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Draft Remedial Investigation/ Feasibility Study Work Plan for the 200-BP-1 Operable Unit Hanford Site, Richland, Washington

United States
Department of Energy
Richland, Washington

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Environmental Engineering Group

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3-1 Location of 200 East Area Monitoring Wells

6-1 Anticipated Schedule for the Remedial Investigation/Feasibility Study for the 200-BP-1 Operable Unit

LIST OF ACRONYMS

ACI	Acceptable Chronic Intake
ACL	Alternate Concentration Limits
ADI	Acceptable Daily Intake
ALARA	As Low as Reasonably Achievable
ARAR	Applicable or Relevant and Appropriate Requirement
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act, as amended
CLP	Contract Laboratory Program
DCG	Derived Concentration Guides
DQO	Data Quality Objective
DWS	Drinking Water Standards
EDMI	Electronic Distance Measuring Instrument
EII	Environmental Investigations Instructions
EIS	Environmental Impact Statement
EQAPP	Environmental Quality Assurance Program Plan
FS	Feasibility Study
HRS	Hazard Ranking System
IC	Ion Chromotography
IRIS	Integrated Risk Information System
ITS	In-Tank Solidification
MCL	Maximum Contaminant Level
MRAL	Mobile Radionuclide Analysis Laboratory
MSL	Mean Sea Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NPL	National Priorities List
OVA	Organic Vapor Analyzer
PNL	Pacific Northwest Laboratory
PUREX	Plutonium-Uranium Extraction
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAS	Routine Analytical Services
RCRA	Resource Conservation and Recovery Act
Redox	Oxidation-Reduction
RFD	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Stiudy
ROD	Record of Decision
RPT	Radiation Protection Technologist
RSR	Radionuclide Shipment Record
S&A Plan	Sampling and Analysis Plan
SAS	Special Analytical Services
TBP	Tributyl Phosphate
TCL	Target Compound List
TFS	Tank Farm Services
TOC	Total Organic Carbon
TSD	Treatment Storage or Disposal

LIST OF ACRONYMS (continued)

U.S. DOE	U.S. Department of Energy
U.S. DOE-RL	U.S. Department of Energy - Richland Operations Office
U.S. EPA	U.S. Environmental Protection Agency
UN	Unit (Unplanned Release not to existing disposal facility)
UPR	Unplanned Release
WHC	Westinghouse Hanford Company
WHO	World Health Organization

REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN FOR THE 200-BP-1 OPERABLE UNIT

1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) on June 24, 1988 proposed the 200 Area at the Hanford Site for inclusion on the National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). This action is being incorporated into the continuing environmental restoration efforts at the Hanford Site. These efforts are being addressed through the Tri-Party Agreement that is currently being negotiated between the U.S. Department of Energy (DOE), the EPA and the Washington Department of Ecology (Ecology).

Over 1,400 waste sites have been identified on the Hanford Site. These include active treatment, storage, and disposal (TSD) facilities, subject to permit application and/or closure under the Resource Conservation and Recovery Act of 1976 (RCRA) and the Dangerous Waste Regulations, Washington Administrative Code, (WAC) 173-303 (Ecology, 1987), as well as inactive waste sites subject to corrective action under RCRA or remedial action under CERCLA. Most of these sites are located within geographic areas on the Hanford Site that are referred to as the 100, 200, 300, 400, and 1100 Areas. Figure 1-1 shows the location of these areas. The 600 Area includes the remainder of the Hanford site that is outside the above designated areas. All sites have been grouped into four aggregate areas (100, 200, 300, and 1100) which have been proposed for listing on the NPL under CERCLA. The four aggregate areas are subdivided into 21 waste area groups on the basis of facility and type of operation. Each waste area group is further subdivided into operable units on the basis of waste disposal practices, geology, hydrogeology, and other pertinent site characteristics. A total of 74 source operable units and 4 specific groundwater operable units have been identified to date. This identification process is continuing, and the total number of operable units, as well as the individual sites within each operable unit, are subject to change.

The 200-BP-1 Operable Unit is located within the 200 East Area of the Hanford Site.

1.1 PURPOSE AND OBJECTIVE

The purpose of the work plan is to guide DOE and Westinghouse Hanford Company in the implementation of all remedial investigation/feasibility study (RI/FS) activities conducted at this operable unit. This work plan was developed in accordance with the statutory requirements of CERCLA, the National Environmental Policy Act of 1970 (NEPA), the regulatory requirements of the National Oil and Hazardous Substances Pollution Contingency Plan, the Council on Environmental Quality (CEQ, 1978), and relevant EPA guidance documents.

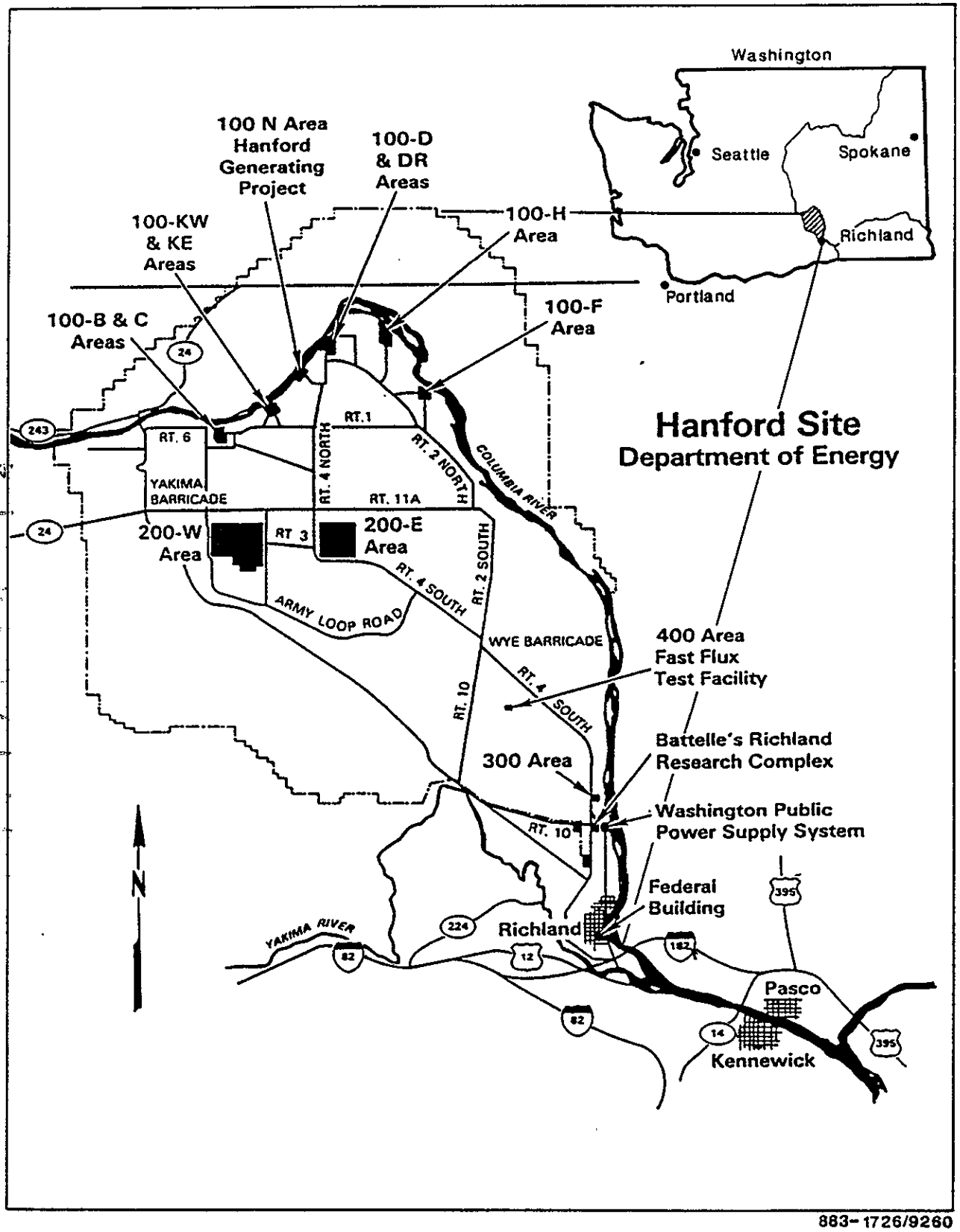


Figure 1-1. Hanford Site Map

1.2 OVERVIEW OF THE RI/FS PROCESS

An agreement between the EPA, the DOE and Ecology is currently under negotiation. This work plan discusses how the investigation and remediation of the 200-BP-1 Operable Unit will be conducted under CERCLA through the Tri-Party Agreement.

The ultimate goal of CERCLA activities at the Hanford Site is to select and implement a cost-effective remedial alternative that mitigates threats to, and provides protection of, public health, welfare and the environment, consistent with regulatory requirements and guidelines established by EPA and Ecology.

After a waste site has been identified through a Preliminary Assessment/Site Inspection (PA/SI) and listed on the NPL, an RI/FS is carried out to determine the nature and extent of the threat posed by hazardous substances, to screen proposed remedial technologies, and to evaluate appropriate remedial alternatives on the basis of effectiveness, ability to implement, and cost. After public review and comment, EPA, with input from Ecology, will select an appropriate remedy and document this choice in the record of decision (ROD). This will be followed by design and implementation of the selected alternative. Figure 1-2 indicates the overall RI/FS process.

Primary objectives of the RI are to collect data on site and waste characteristics, contaminant pathways, and transport mechanisms, and to conduct treatability testing as necessary to support the evaluation of proposed remedies. The FS identifies, screens, and evaluates potential remedial alternatives. Data are collected during the RI to support the development of remedial alternatives in the FS, which in turn affects the data needs and scope of additional investigations. Both the RI and the FS are conducted concurrently, in several phases. Data collected in the initial phase of the RI are used to develop a comprehensive understanding of the site, to improve upon the existing data, and to conduct a baseline risk assessment. The initial phase of the FS identifies potential remedial actions and determines the threat to public health and the level of risk associated with no action. Subsequent phases of the RI will satisfy specific data needs identified in the FS. Later phases of the FS will include screening of remedial alternatives and feasibility-level design and cost estimates for appropriate remedial alternatives.

The initial phase of the RI/FS will be oriented toward determining the nature and extent of any contamination present in the vicinity of the 200-BP-1 Operable Unit.

Particularly where groundwater is involved, contamination observed in the vicinity of the 200-BP-1 Operable Unit may or may not be a result of waste disposal activities associated with the individual waste sites identified as part of the operable unit. Other potential sources of groundwater contamination are known to exist in the vicinity of the operable unit. The RI/FS is not intended to investigate these sources specifically. However, the extent to which they contribute contaminants to the groundwater in the 200-BP-1 area will be investigated as necessary.

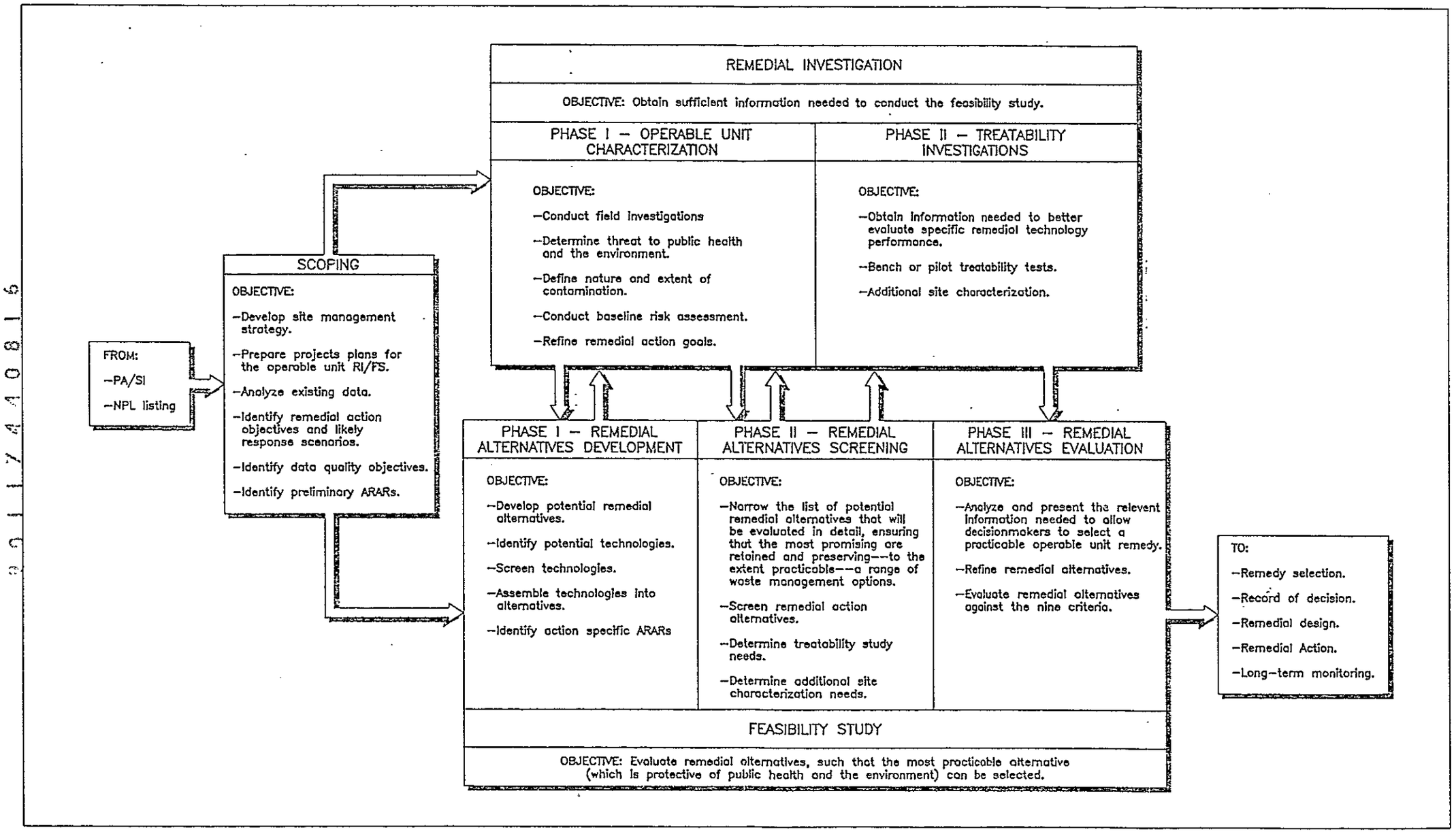


Figure 1-2. RI/FS Process

1.3 ORGANIZATION OF RI/FS WORK PLAN

This RI/FS work plan for the 200-BP-1 Operable Unit conforms with current draft guidance for CERCLA activities (EPA, 1988a). It has been completed with current knowledge of site conditions and may require modifications, primarily for later phases of the RI/FS process, when additional information is obtained.

The work plan also conforms, in part, with the CEQ requirements promulgated under NEPA (CEQ, 1978). This work plan, the results of work performed pursuant to it, and subsequent remedial action decisions, will be circulated for public, federal and state agency review to satisfy CEQ procedural requirements. This work plan is based on the assumption that complete conformance with CEQ requirements will be achieved through the development of a supplemental, programmatic environmental impact statement (EIS). The programmatic EIS, which will encompass all CERCLA activities on the Hanford Site, will address those environmental factors that are not normally relevant to an RI/FS. Such factors include assessing impacts on energy and natural resources, transportation, public services and utilities, and cumulative effects for the Hanford region. The programmatic EIS is currently proposed to be completed by August 1995.

In addition to the programmatic EIS, the NEPA process will be applied for each individual operable unit before the initiation of RI work to ensure that potential impacts to workers, the public, and the environment are mitigated while gathering data. Similarly, based on the data gathered during RI, a NEPA review will be completed for the proposed remedial action identified in the Phase III FS.

This work plan consists of seven sections and accompanying attachments. Section 1 is the introduction to this document. Section 2 presents the history and current knowledge on 200-BP-1 disposal systems. Information and descriptions of the physical environment are also provided that are relevant for CERCLA investigations. Demographics and environmental resources of the Hanford Site and surrounding lands are summarized.

Section 3 provides a conceptual model of contaminant pathways and receptors. Waste sources, quantities and characteristics are defined for disposal systems in 200-BP-1. The current knowledge of impacts to media from waste disposed in 200-BP-1 is identified. Preliminary identification of applicable or relevant and appropriate requirements (ARARs) is presented as well as preliminary remedial responses.

Section 4 provides the rationale and objectives for RI/FS activities. Data needs and required data quality are defined to attain these objectives. Existing data are compared with data needs and required data quality for obtaining these objectives. From this comparison, data gaps and required quality are identified and form the basis for RI activities.

Section 5 presents activities necessary to conduct Phases I and II RI and Phases I, II and III FS. Later phases of both the RI and FS are somewhat generic and will depend on information and data gathered primarily through Phase I RI.

Section 6 provides an anticipated schedule for conducting and completing the RI/FS. Again, modifications to the schedule may need to be made as more information is obtained.

Section 7 is the bibliography of information used in developing this work plan.

Attachments to this work plan include support project plans that are necessary to manage, conduct and control the RI/FS Project. The project plans include:

- Attachment 1: Sampling and Analysis Plan
  - Field Sampling Plan
  - Quality Assurance Project Plan
- Attachment 2: Health and Safety Plan
- Attachment 3: Community Relations Plan
- Attachment 4: Data Management Plan
- Attachment 5: Project Management Plan

Each plan is developed to be used in conjunction with the work plan and other plans, hence, minimizing duplication of information and description.

1.4 QUALITY ASSURANCE

The basic objective of the Work Plan and its appended project plans is to ensure that the data and results or findings obtained are sufficiently accurate and reliable to support decisions associated with site evaluation, risk assessment, and evaluation and selection of remedial alternatives. In addition, all work on the Hanford Site is subject to the requirements of DOE-RL Order 5700.1A, Quality Assurance (DOE-RL, 1983), which establishes broadly applicable quality assurance (QA) program requirements in compliance with ANSI/ASME NQA-1 guidelines (ANSI/ASME, 1986); the QA program requirements so defined apply to all types of project activities conducted on the Hanford Site.

To ensure that the objectives of the RI/FS are met in a manner consistent with DOE-RL Order 5700.1A (1983), all work will be performed in compliance with Westinghouse Hanford's existing quality assurance and a QA program plan specific to CERCLA RI/FS activities. This QA program describes the various plans, procedures, and instructions that will be used by Westinghouse Hanford to implement the requirements of DOE-RL Order 5700.1A (DOE, 1983). The plan discusses areas such as the following:

- Management policies
- Organization charts and charters
- Management requirements and procedures
- Document clearance and information release
- Records management
- Quality audits and surveillances

- Operational health physics and radiological protection
- Emergency preparedness
- Standard engineering practices
- Radioactive and mixed solid waste packaging, storage, and disposal requirements
- Publication style
- Procurement

Current EPA guidance for structure and content (EPA, 1988a) will be followed in the preparation of the RI/FS work plan and the supporting project plans. These plans will be prepared within the overall DOE-mandated QA program structure and will be supported and implemented through the use of standard operating procedures drawn from the overall program.

2.0 SITE BACKGROUND AND PHYSICAL SETTING

2.1 200-BP-1 OPERABLE UNIT DESCRIPTION

2.1.1 Location

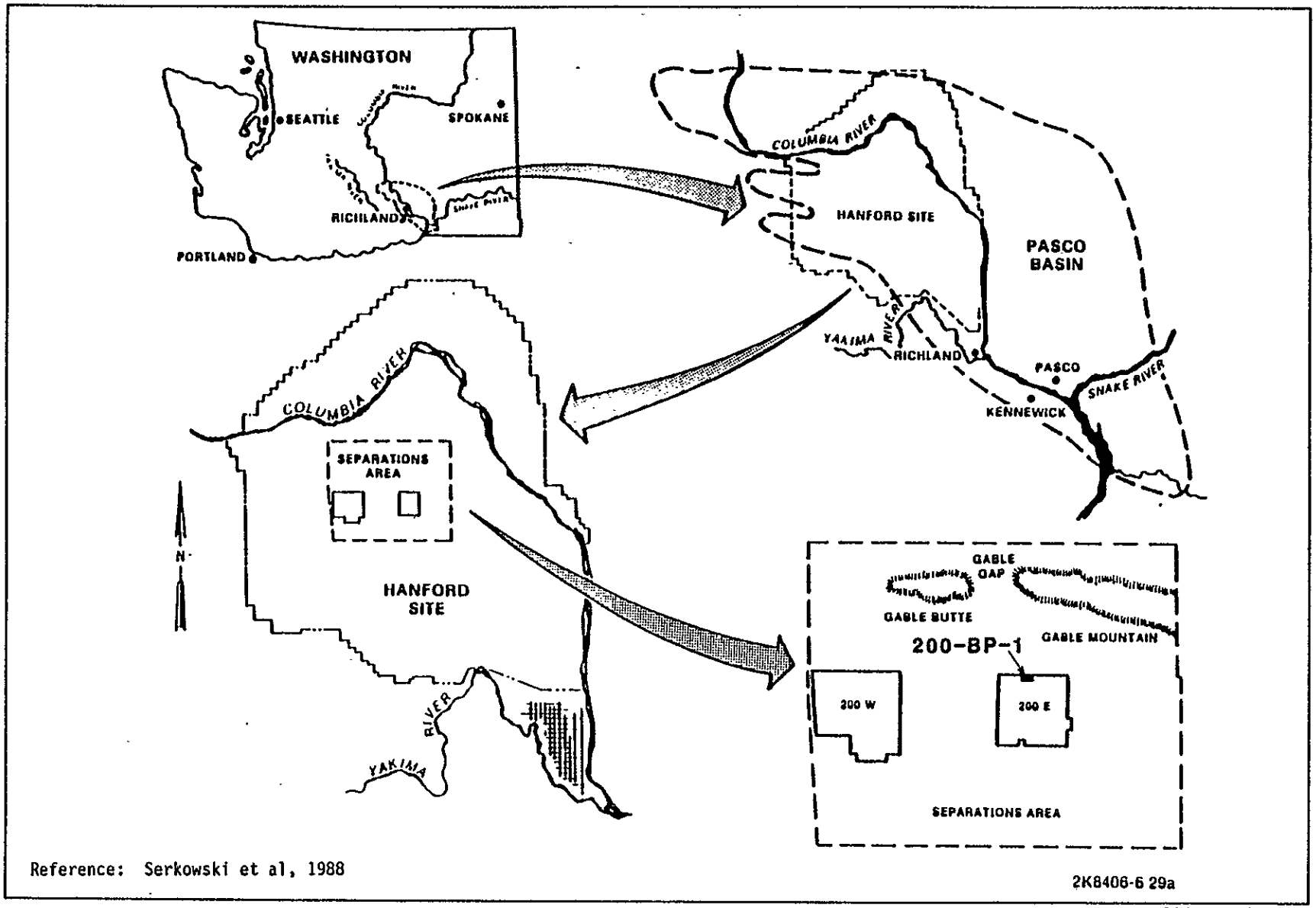
The Hanford Site is located in south-central Washington State, approximately 270 kilometers (170 miles) southeast of Seattle and 200 kilometers (125 miles) southwest of Spokane (Figure 2-1).

The 200-BP-1 Operable Unit is located in the approximate center of the Hanford Site, along the north boundary of the 200 East Area. The 200 East Area is located within the Separations Area which encompasses both the 200 East Area and the 200 West Area. The 200 East Area has been subdivided into operable units as illustrated in Plate 2-1. The 200-BP-1 Operable Unit is located within the southeast quadrant of Section 34 of T.13N. and R26E. Operable Unit 200-BP-1 is bounded within the north/south coordinates N46000 and N47000 and east/west coordinates W53000 and W55000.

2.1.2 History of Operations

The Hanford Site has been in operation since 1943 and is used, in part, for nuclear reactor operation, reprocessing of spent fuel, and management of radioactive waste. The 200 Area is divided into the East and West Area and is collectively called the Separations Areas. The primary function of the 200 Area facilities is to reprocess irradiated fuel for separation and recovery of desirable isotopes such as plutonium and uranium. Since 1944, radioactive wastes from the processing of irradiated uranium have been stored as alkaline slurries in underground tanks. A total of 149 single-shell tanks were constructed for this use ranging in capacity from 55,000 to 1 million gallons. These tanks are grouped in 12 tank farms located in the 200 East and 200 West Areas. Tanks were used for storage, transfer, and solidification/precipitation of wastes.

The 200-BP-1 Operable Unit includes nine inactive cribs, as well as three unplanned releases designated as waste units (UN) which were the result of tank farm operations (Figure 2-2). The cribs received low level liquid waste from U-Plant uranium reclamation operations and waste storage tank condensate from the adjacent 241-BY Tank Farm. A tenth crib designated 216-B-61 was constructed but was never used or received wastes. All but two of the cribs have been inactive since the mid-1950's. The remaining two were operated into the early 1970's. Eight of the sites within this operable unit individually received Hazard Ranking System (HRS) scores greater than 28.5. This operable unit encompasses a total area of 10 hectares (25 acres), although the majority of the sites are concentrated in a 1.6-hectare (4-acre) region at the eastern end of the 200-BP-1. Table 2-1 identifies the cribs and UNs contained in 200-BP-1 and summarizes their periods of operation (or dates of occurrence for UNs) and waste sources. Appendix A provides additional information on the cribs and UNs associated with Operable Unit 200-BP-1.



Reference: Serkowski et al, 1988

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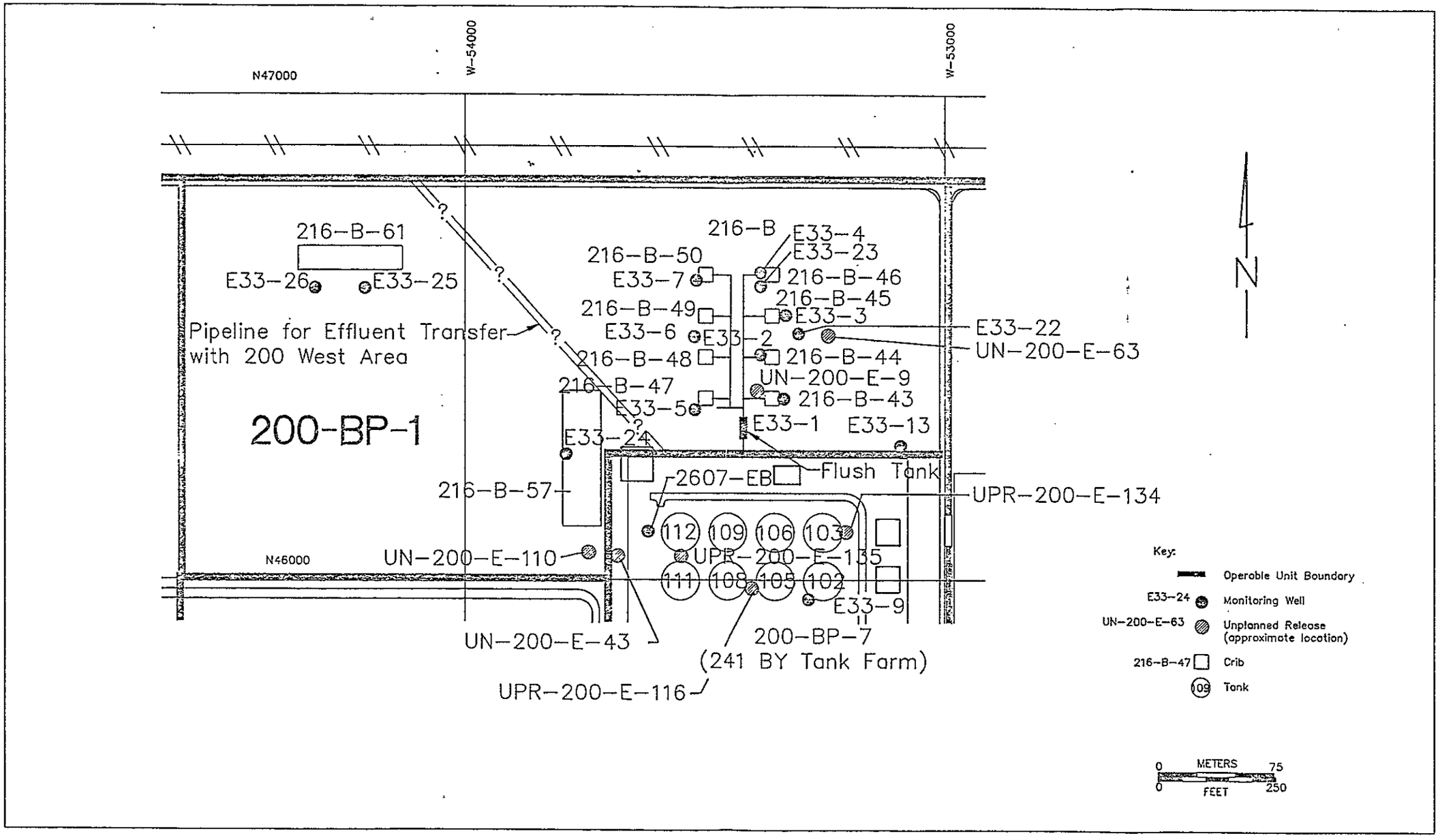
Figure 2-1. Separations Area Location Map



6831726\7827

Figure 2-2. Site Map of the 200-BP-1 Operable Unit

9 0 1 1 7 4 0 8 2 2

Table 2-1. Sites Included in Operable Unit 200-BP-1

CRIBS	Periods of Use	Waste Source
216-B-43	11/54 to 11/54	TBP[a] Supernatant From 221-U Building
216-B-44	11/54 to 3/55	TBP Supernatant From 221-U Building
261-B-45	4/55 to 6/55	TBP Supernatant From 221-U Building
216-B-46	9/55 to 12/55	TBP Supernatant From 221-U Building
216-B-47	9/55 to 9/55	TBP Supernatant From 221-U Building
216-B-48	11/55 to 7/57	TBP Supernatant From 221-U Building
216-B-49	11/55 to 12/55	TBP Supernatant From 221-U Building
216-B-50	3/65 to 1/74	ITS[b] #1 Tank Condensate
216-B-57	2/68 to 6/73	ITS #2 Tank Condensate
216-B-61	Not Applicable	Never used or received wastes

Unplanned Release	Date
UN-200-E-9	September 15, 1955
UN-200-E-110	August 7, 1955
UN-200-E-63	No information available

[a]Tributyle phosphate

[b]In-tank solidification unit

2.1.3 Processes Generating Waste

Waste sent to 216-B-43 through 49 cribs was generated in the tributylphosphate (TBP) process in the 221-U Building. The TBP process was used for recovery of uranium metal from wastes generated by the bismuth phosphate (B_iPO_4) process in the B plant. Prior to implementing the TBP process, this waste had been stored in the 241-BY Tank Farm.

From 1952 to 1958, stored waste within the 241-BY Tanks was transferred to the U Plant for uranium recovery. The sludge was dissolved in nitric acid, and then the uranium was extracted using TBP in a normal paraffin diluent. The TBP process wastes contained the fission products, sulfate, and phosphate ions in the aqueous nitric acid solution. The acid solution was made alkaline for transfer and storage in 241-BY Tank Farm. The TBP process wastes in the 241-BY Tanks were treated with potassium ferrocyanide ($K_4Fe[CN]_6$) as a cesium scavenger. The supernatant was decanted to the 216-B-43 through 216-B-49 cribs (Anderson and Mudd, 1979).

Waste sent to cribs 216-B-50 and 216-B-57 was storage tank condensate from the In-Tank Solidification (ITS) #1 and #2 units, respectively. In-tank solidification was accomplished by in-tank heating and the units were designated ITS 1 and ITS 2. Both were located in the 241-BY Tank Farm in 200 East Area. The ITS 1 unit startup was March 19, 1965, and the ITS 2 unit started up on February 17, 1968. On August 24, 1971, the ITS 1 unit was converted from an evaporator to a cooler for ITS 2. Evaporates were collected and condensed. Condensate was discharged to either the 216-B-50 or the 216-B-57 cribs. The 216-B-61 crib was constructed, but never received any process wastes.

2.1.4 Facilities

2.1.4.1 Cribs and Pipelines. Plate 2-2 is a plan view of the construction details of 216-B-43 through 216-B-50 cribs and distribution pipelines. In addition to the cribs and associated pipelines, a pipeline for effluent transfer between the 200 West Area and the 241-BY Tank Farm crosses the operable unit (see Figure 2-2). The disposal cribs were designed to receive, disperse and infiltrate liquid waste effluents completely underground. Liquid waste effluents were diverted to the cribs via the flush tank and underground pipe and discharged through pipe perforations and sumps into a gravel bed. The gravel bed and perforated pipe or sump was about 2 meters (6 to 7 feet) below land surface. A soil cover was placed over the gravel bed. Plate 2-3 presents the construction details for 216-B-43 through 216-B-50 cribs and Plate 2-4 provides construction information for the 216-B-57 crib.

The original design concept for the cribs was based upon limiting the total volume of liquid effluent discharged to a crib to less than the specific retention capacity of the soils beneath the crib. The assumption apparently was made that the specific retention was nearly uniform and that infiltration was uniformly distributed along a "wetting front." These concepts are not commonly held today. This design was intended to prevent liquid waste effluents from reaching the water table during infiltration. The estimated quantity of waste discharges to the 200-BP-1 cribs is presented in Appendix A. However, the accuracy of these estimates is currently unknown.

Groundwater below the cribs appears to be impacted with contaminants that are indicative of waste effluents discharged to the 200-BP-1 cribs. The infiltrating effluents may have exceeded the soil's specific moisture retention along preferential infiltration pathways and thus, did not contact the entire soil column. As a result, the specific retention capacity would have been much less than originally calculated allowing effluents to reach the water table.

In addition, the presence of calcium carbonate cemented horizons, and thin beds of silt (which are common in the slackwater deposits of the Hanford Formation), and clastic dikes (which are known to occur) invalidate some of the assumptions in calculating the rate of infiltration relative to the rate of decay of short-lived radionuclides.

2.1.4.2 Unplanned Releases. Three unplanned releases have been identified (see Figure 2-2) to have occurred or impacted soils within the 200-BP-1 Operable Unit. These unplanned releases have been designed as waste units as follows:

UN-200-E-9
UN-200-E-63
UN-200-E-110

Little information is available regarding details of these UNs (see Appendix A). No information was obtained for UN-200-E-63. Waste unit UN-200-E-9 involved about 41,000 liters (about 11,000 gallons) of supernatant waste from the 221-U Building in an area directly north of the 216-B crib flush tank. Most of the wastes were removed and the release area was covered with 3 meters (10 feet) of clean soil.

Waste unit UN-200-E-110 involved first cycle waste from the 112-BY tank in the 241-BY Tank Farm and impacted approximately a-2,300-meter^2 (25,000-foot^2) area around the 112-BY pit. No information was obtained on the quantity of the release or whether remedial action was taken (WHC, 1988).

From the information available, the releases resulting in UN-200-E-9 and UN-200-E-110 apparently occurred in the 241-BY Tank Farm which is not in the 200-BP-1 Operable Unit. It is possible, although currently unknown, whether the releases flowed into the 200-BP-1 Operable Unit. Uncertainty exists on the location, quantity and source of UN-200-E-63.

2.1.5 Interactions With Other Operable Units

As illustrated in Plate 2-1, 200-BP-1 Operable Unit is bordered by Operable Units 200-BP-4 to the east, 200-BP-7 and 200-BP-3 to the south, and 200-BP-10 to the west. The 600 Area (the 600 Area includes all areas at the Hanford Site not located in the other designated areas [i.e., 100, 200, 300, 400, and 1100 Areas]) borders the operable unit to the north.

Operable units adjacent to 200-BP-1 contain waste storage, waste burial or waste infiltration systems. Operable units 200-BP-4 and 200-BP-3 contains cribs. Operable unit 200-BP-7 contains the 241-BY, 241-BX and 241-B Tank Farms. Operable Unit 200-BP-10 contains burial grounds for solid waste

disposal. The 600 Area immediately to the north of 200-BP-1 does not contain process facilities or waste disposal systems.

The waste disposal cribs and waste storage tanks in adjacent operable units received or contain many of the same constituents as the cribs in 200-BP-1. Cribs in adjacent operable units were designed for underground infiltration of waste water effluents. Leaks have occurred from single-shell storage tanks in Operable Unit 200-BP-7, resulting in release of wastes containing higher concentrations of radionuclides than were normally disposed in the cribs (WHC, 1988). Most of these operable units are hydraulically upgradient of the 200-BP-1 Operable Unit and may be contributing to groundwater contamination in the area.

2.2 PHYSICAL SETTING

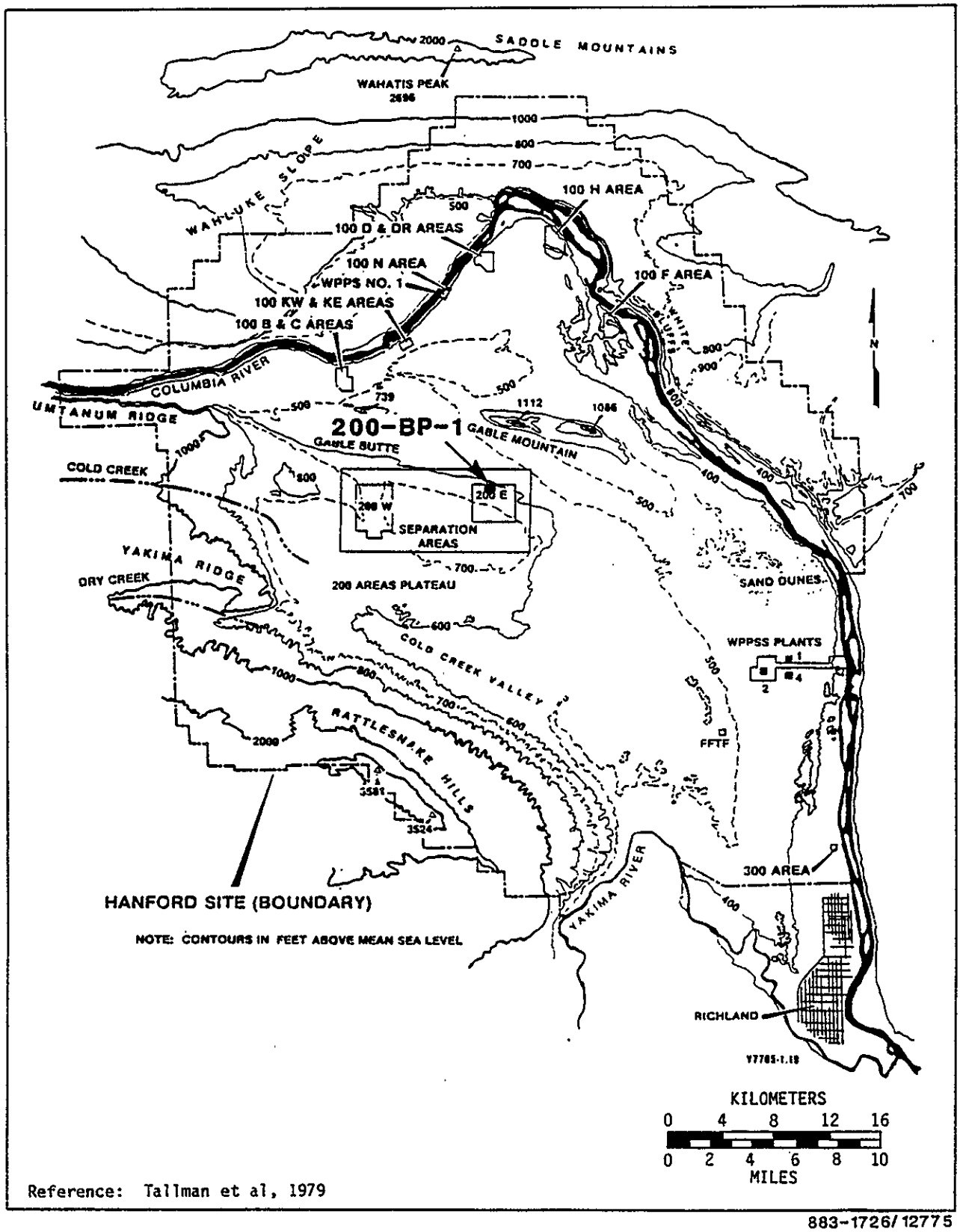
2.2.1 Topography

Central Washington lies within the Columbia Plateau Physiographic Province. In south-central Washington State, deformation of the lava flows of Columbia River basalt has formed a broad structural and topographic basin, the Pasco Basin, in which the Hanford Site is located. The Pasco Basin is bounded on the north by the Saddle Mountains, on the west by Umtanum Ridge, Yakima Ridge, and the Rattlesnake Hills, on the south by the Rattlesnake Hills, and on the east (6 kilometers [3.1 miles] east of the Columbia River) by a broad monocline (see Figure 2-3).

The 200 East Area lies on a terrace called the 200 Area plateau in the approximate center of the Hanford Site. The 200-BP-1 Operable Unit is at an approximate elevation of 200 meters (650 feet) above mean sea level. The terrace decreases in elevation to the north, northwest and east toward the Columbia River. Decreases in elevation to the north and northeast of the 200-BP-1 Operable Unit occurs primarily along the edges of the terrace. The terrace escarpments are steep with elevation changes between 15 and 30 meters (50 and 100 feet).

2.2.2 Geology

The stratigraphy beneath the 200-BP-1 Operable Unit consists of Miocene basalts of the Columbia River Basalt Group overlain by Pliocene and Pleistocene sediments (Figure 2-4). The uppermost basalts of the Yakima Subgroup are, in ascending order, the Grande Ronde, Wanapum, and Saddle Mountains formations. The Ringold Formation overlies the Saddle Mountains Basalt and generally conforms to the basalt surface. Overlying the Ringold are the glaciofluvial sediments, informally named the Hanford Formation. Two important nonformational units, the early "Palouse" soil and surface loess deposits are also found in the Separation Area although not below the 200-BP-1 Operable Unit. Stratigraphic cross sections are given in Figures 2-5 through 2-7 for unconsolidated deposits above basalts. Stratigraphic cross sections emphasizing the structure of basalts are illustrated in Figures 2-8 through 2-11.



Reference: Tallman et al, 1979

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Figure 2-3 Location and Topography of the Hanford Site

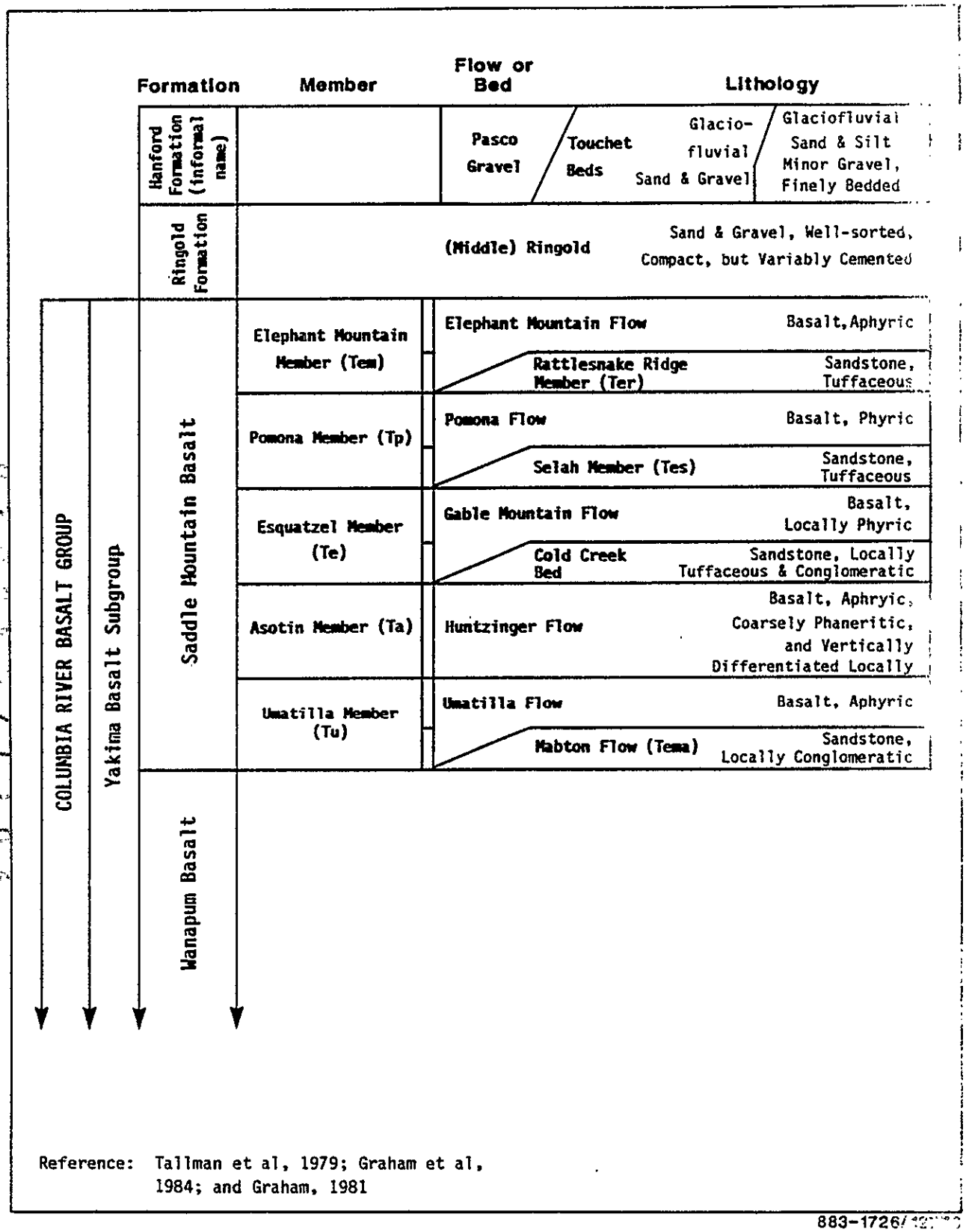
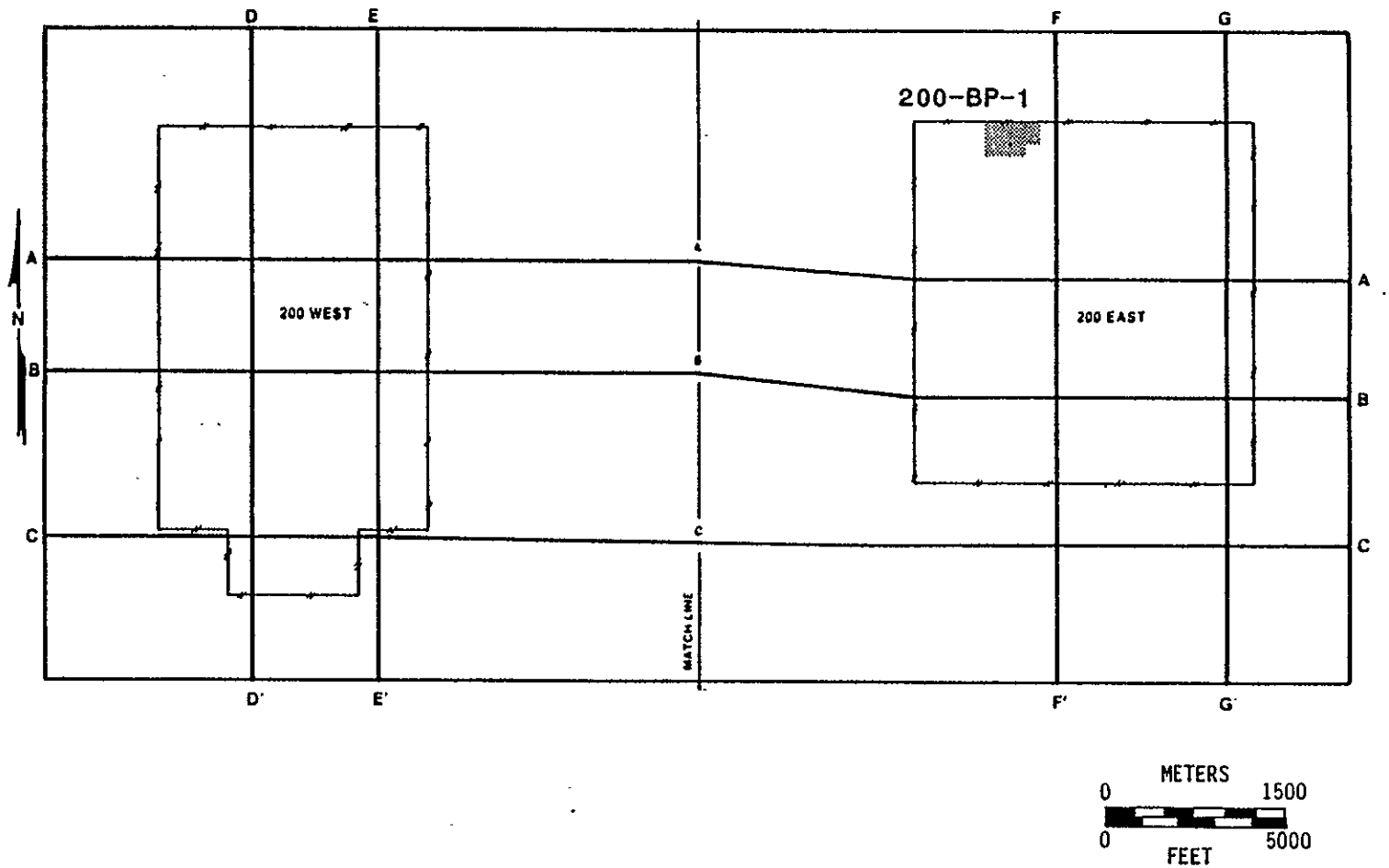


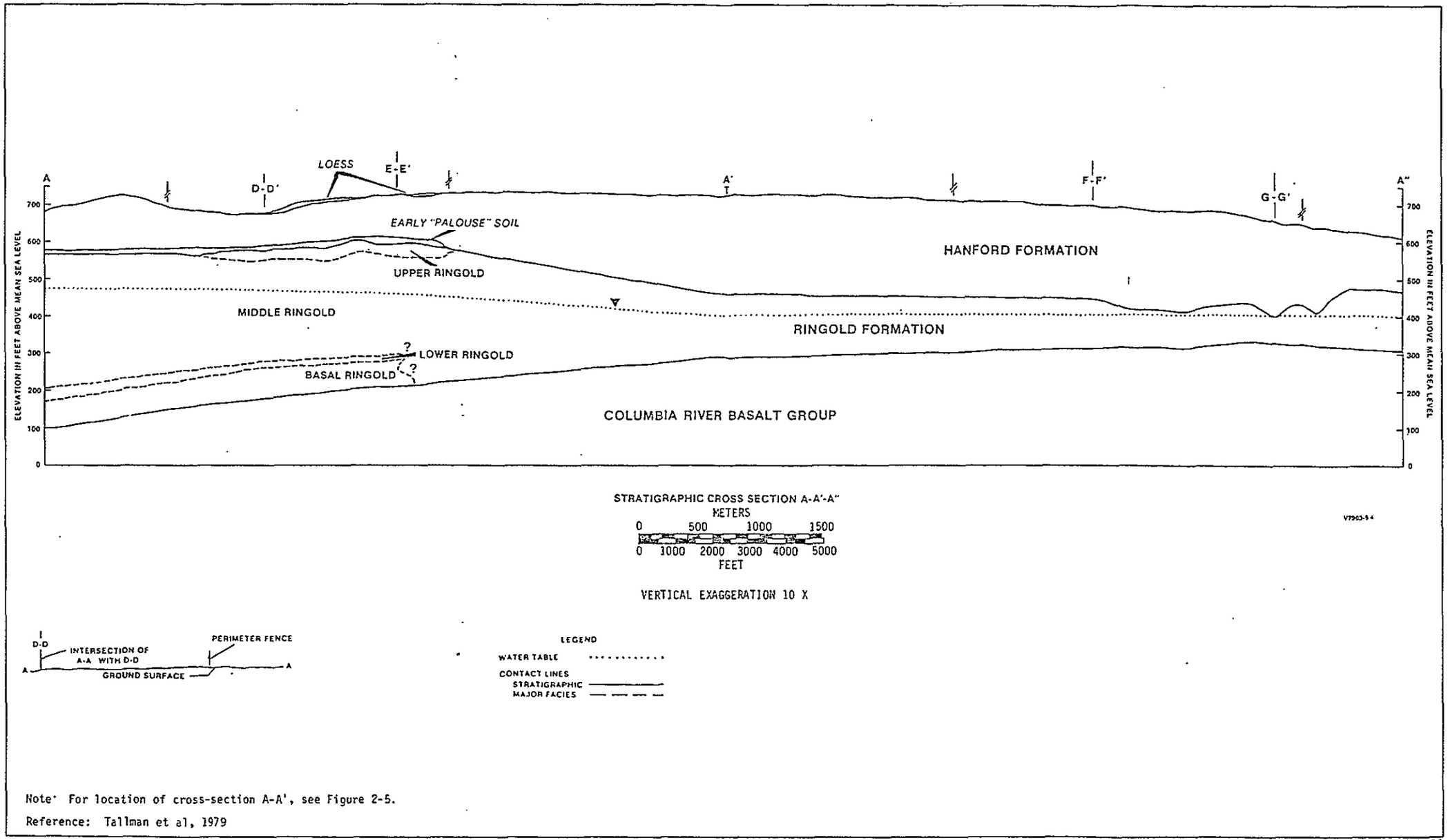
Figure 2-4. Geologic Stratigraphy Beneath the 200-BP-1 Operable Unit



Reference: Tallman et al, 1979

883-1726/12777

Figure 2-5. Separation Areas Stratigraphic Cross-Section Location Map and Legend



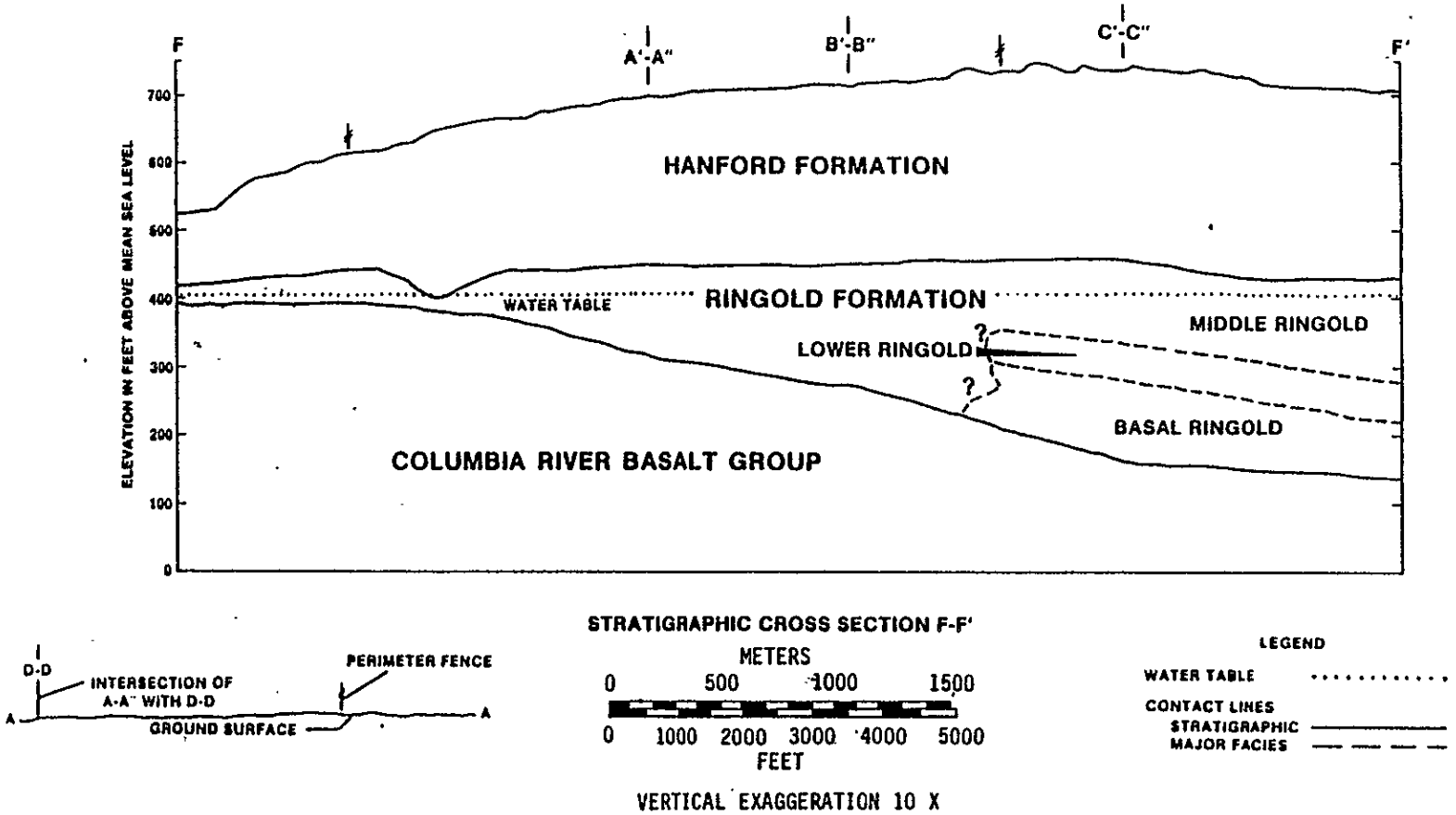
Note: For location of cross-section A-A', see Figure 2-5.

Reference: Tallman et al, 1979

883-1726/12888

Figure 2-6. Separation Areas Stratigraphic Cross-Section A-A'-A"

9 0 1 1 7 4 4 0 8 3 0



Note: For location of cross-section F-F', see Figure 2-5.

Reference: Tallman et al, 1979

883-1726/12878

Figure 2-7. Separation Areas Stratigraphic Cross-Section F-F'

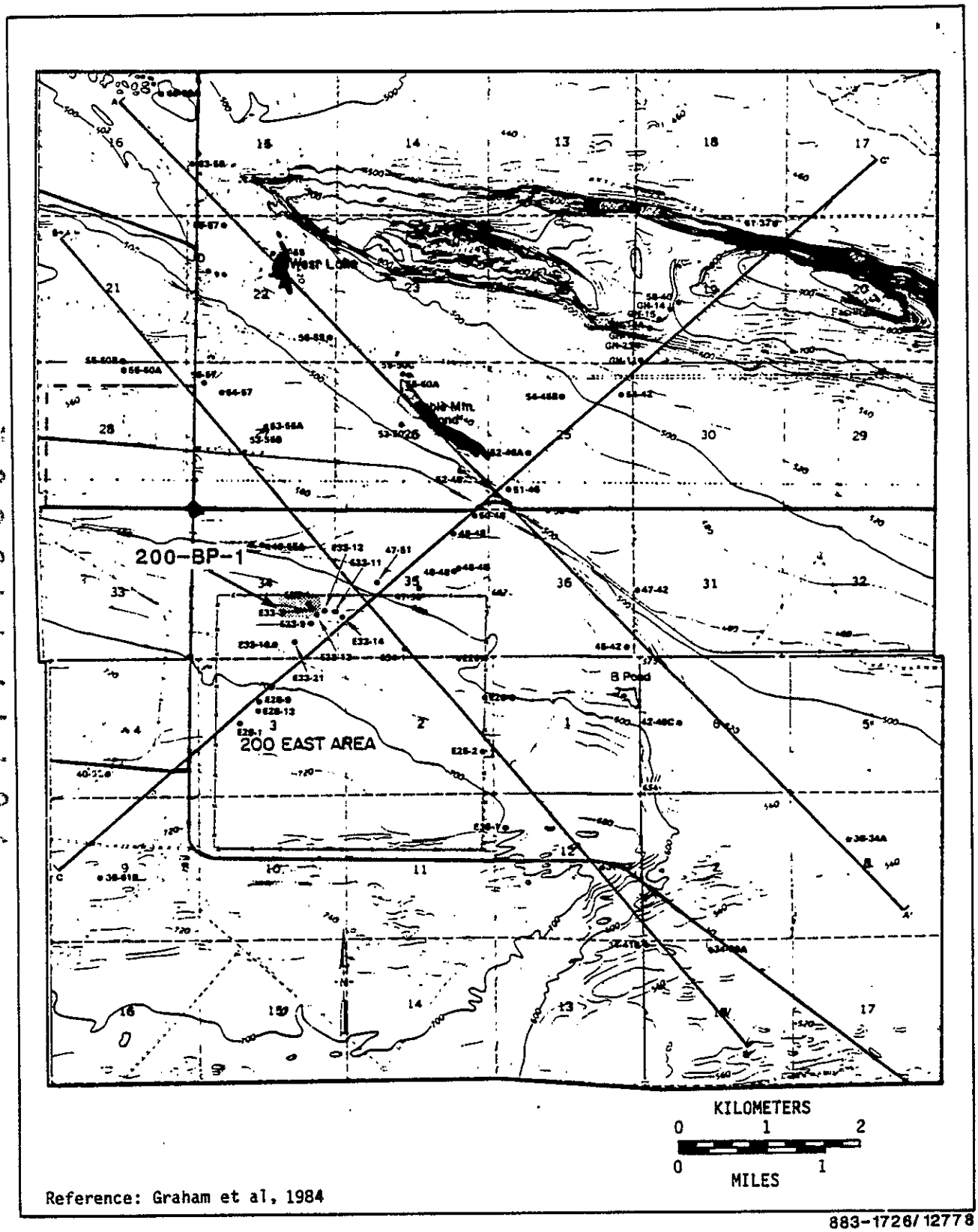
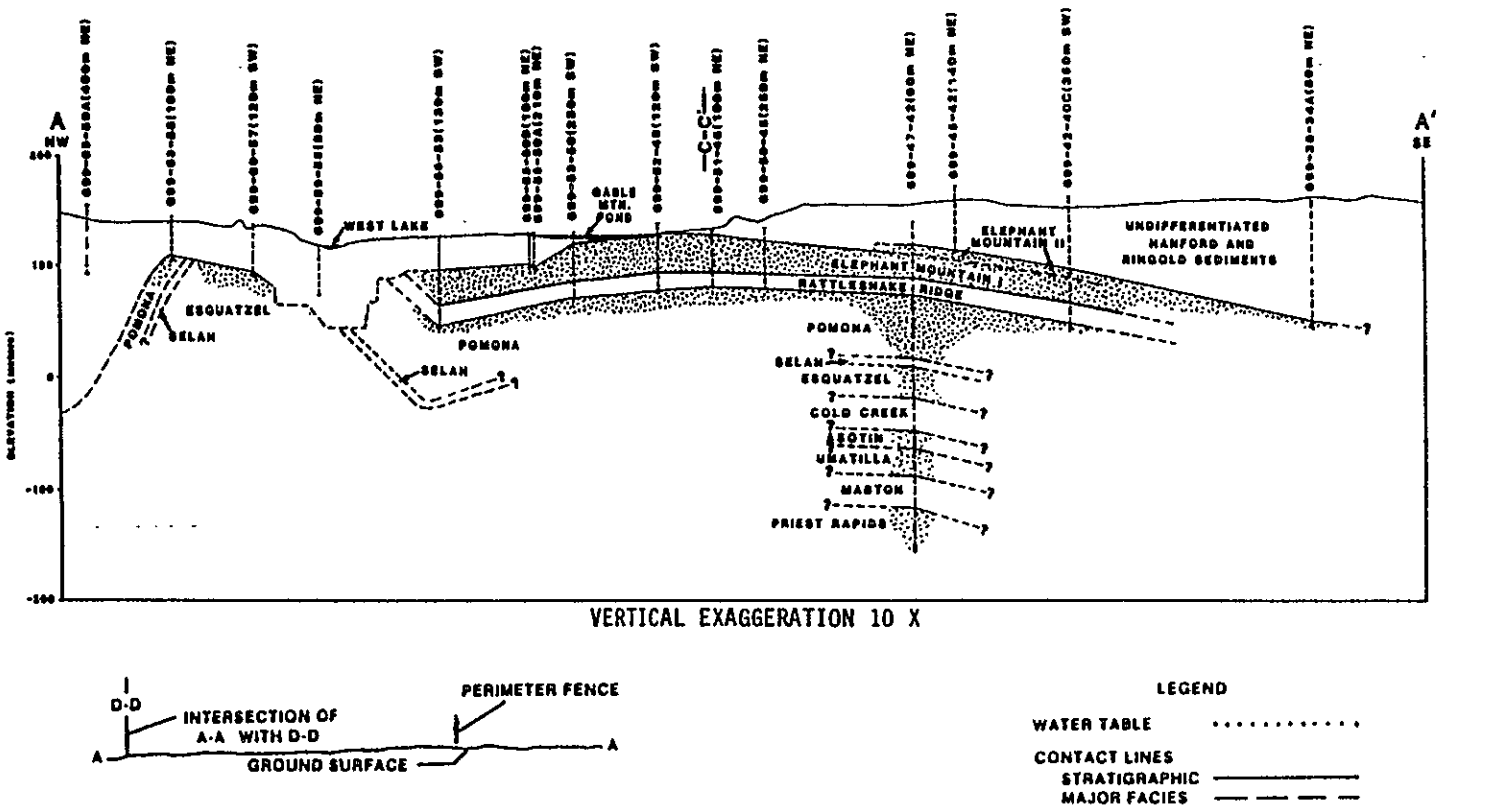


Figure 2-8. Cross-Section Location Map



LEGEND

WATER TABLE

CONTACT LINES
STRATIGRAPHIC
MAJOR FACIES

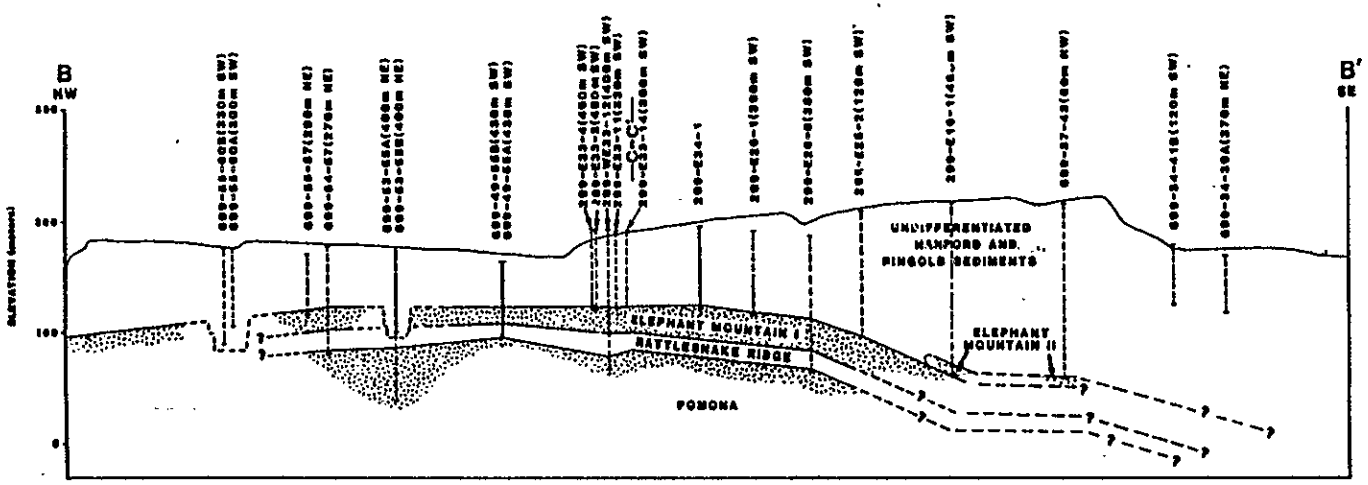
METERS
0 500 1000 1500
0 1000 2000 3000 4000 5000
FEET

Note: A-A' location presented in Figure 2-8.

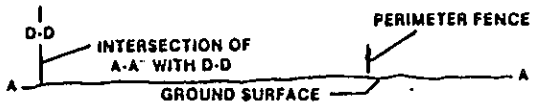
Reference: Graham et al, 1984

883-1726/12880

Figure 2-9. Cross-Section A-A'



VERTICAL EXAGGERATION 10 X



LEGEND

WATER TABLE

CONTACT LINES
STRATIGRAPHIC
MAJOR FACIES

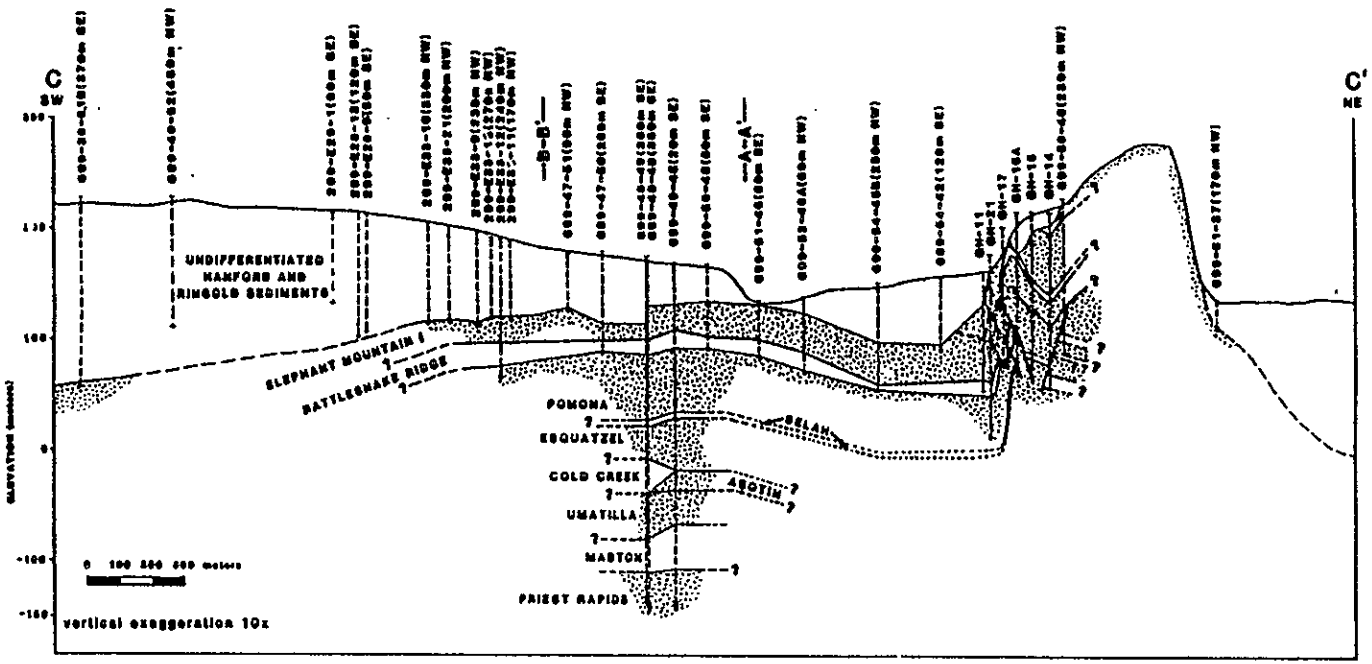
METERS
0 500 1000 1500
0 1000 2000 3000 4000 5000
FEET

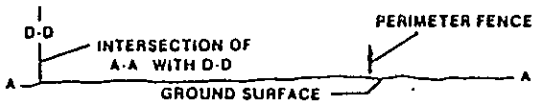
Note: B-B' location presented in Figure 2-8.

Reference: Graham et al, 1984

883-1726/12881

Figure 2-10. Cross-Section B-B'





LEGEND

WATER TABLE

CONTACT LINES
STRATIGRAPHIC
MAJOR FACIES

METERS
0 500 1000 1500
0 1000 2000 3000 4000 5000
FEET

Note: C-C' location presented in Figure 2-8

Reference: Graham et al, 1984

883-1726/12908

Figure 2-11. Cross-Section C-C'

2.2.2.1 Columbia River Basalt Group. The Columbia River Basalt Group underlying the Separation Areas consists of a thick sequence of basalt flows which constitute the Yakima Basalt Subgroup and includes the Grande Ronde Basalt, the Wanapum Basalt, and the Saddle Mountains Basalt. For purposes of this report, the Saddle Mountains Basalt has been subdivided into members, whereas, the Wanapum and Grande Ronde basalts remain undifferentiated (Tallman et al., 1979).

The Saddle Mountains Basalt within the study area consists of five members which are, from oldest to youngest: the Umatilla, Asotin, Esquatzel, Pomona, and Elephant Mountain. Interfingered with many of the Saddle Mountains Basalt flows are sedimentary beds. The major interbedded sediments are the Mabton, Cold Creek, Selah, and Rattlesnake Ridge.

2.2.2.2 Ringold Formation. Deformation during the later stages of Columbia River Basalt volcanism resulted in the emergence of the Yakima fold system in the western plateau. Growth of these folds created a system of structural ridges and basins, which include: the Ellensburg Basin, Quincy Basin, Yakima Basin, Pasco Basin, and Umatilla Basin. Thick sequences of sediments transported from the surrounding highlands accumulated in these basins (Tallman et al., 1979).

In the Pasco Basin, the Miocene/Pliocene Ringold Formation was deposited in response to a flattening of the gradient of the Columbia and Snake River systems. The Ringold Formation in the Pasco Basin accumulated to a thickness of up to 360 meters (1,200 feet).

The Ringold Formation can generally be divided into four units on the basis of texture: sand and gravel of the basal Ringold unit; clay, silt and fine sand with lenses of gravel of the lower Ringold unit; occasionally cemented sand and gravel of the middle Ringold unit; and silt and fine sand of the upper Ringold unit. In the 200-BP-1 area, only the middle Ringold unit has been identified. North of 200-BP-1, the Ringold Formation is eroded and absent (Figure 2-12).

2.2.2.3 Hanford Formation. During the Pleistocene glaciation, multiple floods occurred as ice-dammed lakes in northern Washington, Idaho, and Montana released catastrophic torrents of water and ice when the ice dams were breached. The floods scoured the land surface, leaving a network of buried channels crossing the Pasco Basin. As a result, the Ringold Formation, together with the upper basalts and sedimentary interbeds, were locally eroded and truncated (Tallman et al., 1979).

The glaciofluvial sediments in the Pasco Basin, informally named the Hanford Formation, were deposited on the Columbia River Basalt Group and Ringold Formation. North of 200-BP-1, the Ringold Formation is absent and the Hanford Formation lies directly on the basalts (see Figure 2-12). These sediments can be divided into the coarser sand and gravel which are referred to as the Pasco Gravels, and the finer sand and silts units called the Touchet Beds.

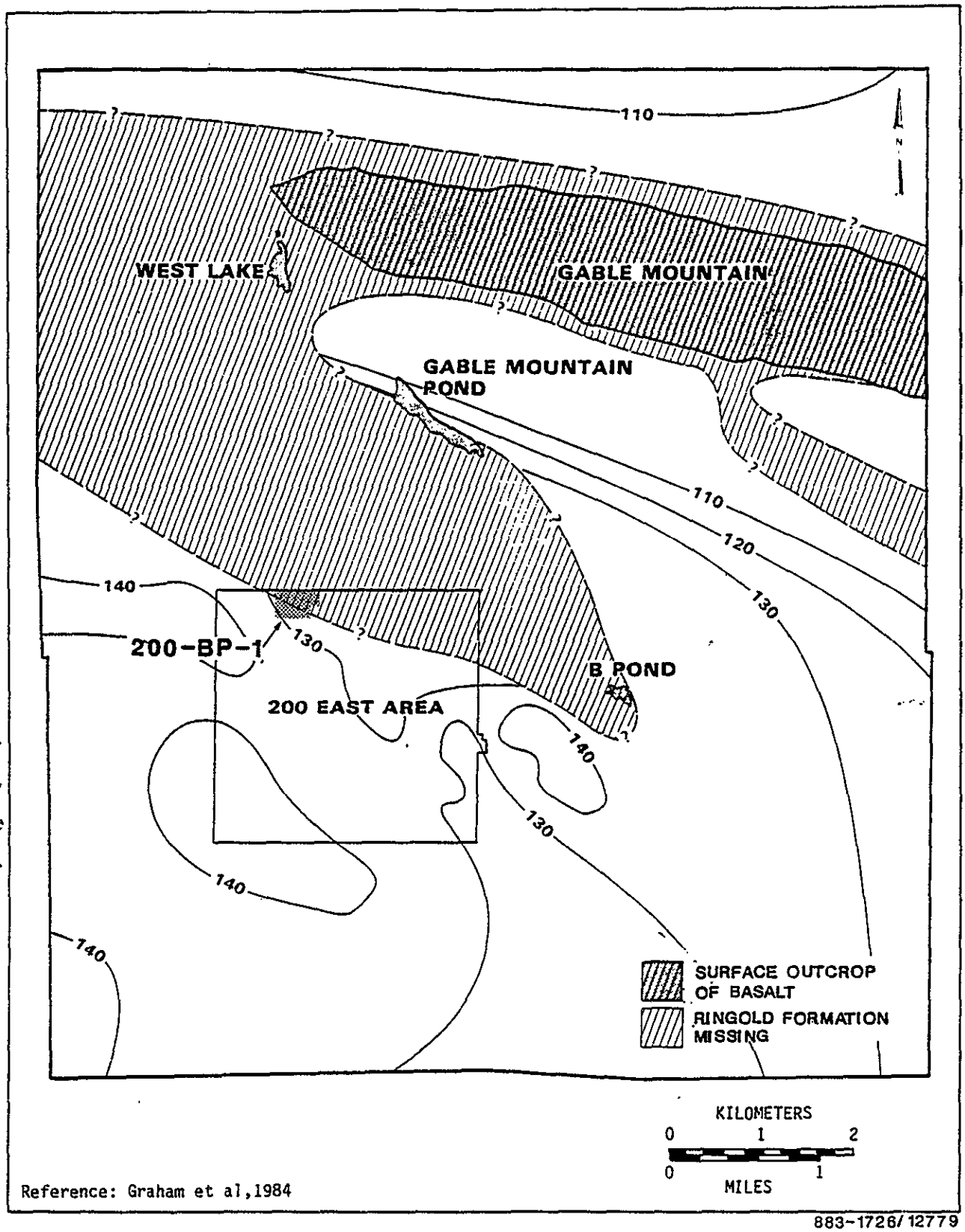


Figure 2-12. Map of the Surface of the Ringold Formation

The Touchet Beds represent low-energy (slackwater) sediments deposited when flood waters were backed up behind the Wallula Gap constriction. The Pasco Gravels represent high energy deposition in areas of more rapid water flow. In general, the Touchet Beds are found on the margins of the basin and the Pasco Gravels in and near the center of the basin. The characteristic variability of sediment size and degree of sorting within the "gravel" unit can be attributed to changes in water velocity and water level which occurred during the flooding process. The thickness of the Hanford Formation varies significantly within the basin, with the thickest occurrence in the region of buried paleo stream channels.

2.2.2.4 Site Geologic Setting. The Separations Area lies in the Pasco Basin near the eastern limit of the Yakima fold system. The site is situated on the south flank of the Umtanum-Gable Mountain Structure. The basalt bedrock dips to the southwest and sediments increase in thickness to the south where they reach a maximum in the Cold Creek Syncline. The deepest part of the Pasco Basin is a few miles to the southeast of the Separations Area where the basalt surface is about 45 meters (150 feet) below sea level (Tallman et al., 1979).

All four units of the Ringold Formation are present in the subsurface within the Separations Area and show varying degrees of erosion and incision by both normal fluvial processes and catastrophic Pleistocene floods. The Separations Area lies on a broad bar formed when Pleistocene floodwaters spread out beyond the Umtanum-Gable Mountain Structure depositing the sand and gravel of the Hanford Formation. The flood bar, roughly defined by the 200-meter (650-foot) contour line, is commonly referred to as the "200 Area Plateau."

The buried surface of the upper basalt flows have been eroded to various degrees (Figure 2-13). North of 200-BP-1 in the West Lake Area, the Elephant Mountain and Pomona basalt flows have been totally eroded, exposing the Rattlesnake Ridge and possibly the Selah interbeds to the unconsolidated deposits of the Ringold and Hanford formations (see Figure 2-9). Other areas in which the Elephant Mountain basalt flows have been or are suspected of being totally eroded are in an area 2 kilometers (1.2 miles) north of 200-BP-1 and an area in the northeast corner of 200 East Area.

2.2.3 Hydrogeology

In the vicinity of the 200-BP-1 Operable Unit, an unconfined aquifer formed by unconsolidated sediments is underlain by a number of confined aquifers consisting of sedimentary interbeds and/or interflow zones between dense basalt flows. This section describes the recharge, movement, discharge, hydraulic properties and general water quality of the unconfined and confined aquifers located in the vicinity of 200-BP-1.

2.2.3.1 Unconfined Aquifer. The unconfined aquifer lies within the boundaries of the Pasco Basin, contained within Hanford Formation sands and gravels and the Ringold Formation sands, silts, and gravels. The aquifer in the immediate vicinity of 200-BP-1 is dominated by the middle member of the Ringold Formation, consisting of sorted sands and gravels of varying induration. North of 200-BP-1, the Ringold Formation is absent and the unconsolidated/unconfined aquifer consists of Hanford Formation sands and gravels. The base of the aquifer is the basalt surface. The aquifer is over 70 meters (230 feet) thick in areas to the south of 200-BP-1, and thins to zero thickness along the flanks of the bordering anticlinal structures to the north. Some local basalt highs within the basin extend above the water table, the most notable of which are Gable Mountain and Gable Butte on the Hanford Site (Figure 2-14) (Graham, 1981). Based on review of borehole logs, the unconfined aquifer beneath and downgradient of 200-BP-1 is about 1 to 6 meters (13 to 18 feet).

2.2.3.1.1 Recharge. Sources of natural recharge to the unconfined aquifer are rainfall and runoff from the bordering higher elevations, water infiltrating from small ephemeral streams, and river water along influent reaches of the Yakima and Columbia rivers. The principal source of recharge occurs around the periphery of the basin where precipitation and runoff infiltrate to the water table. Small ephemeral streams draining the western slopes, such as Cold Creek and Dry Creek, lose water to the ground as they spread out on the valley plain. The Yakima River recharges the unconfined aquifer along its reach from Horn Rapids to Richland. During high stages of the Columbia River, river water is transferred to bank storage as groundwater. Within the basin, upward leakage from the lower basalt aquifers may enter the unconfined aquifer. Little, if any, recharge to the groundwater occurs from percolating rainfall on the broad areas of the desert terrain due to a high rate of evapotranspiration. Studies have estimated that deep percolation on the Hanford Site from precipitation is between 0 and 8 centimeters/year (0 and 2.8 inches/year) (Isaacson et al., 1974; Jones, 1978; Gee and Heller, 1985; Gee, 1987).

Artificial recharge to the groundwater occurs in the basin from two sources, agricultural irrigation and waste disposal operations at the Hanford Site. Agricultural irrigation in Cold Creek Valley to the west of the Hanford Site causes an undetermined amount of recharge to the system. Possibly as much as 40 percent of this irrigation water reaches the water table (U.S. Bureau of Reclamation, 1971). Recharge from Hanford waste disposal practices occurs within the Separations Area principally from ponds but also potentially from cribs, dry wells, and trenches. Artificial recharge has a major influence on groundwater flow within the Hanford Site. Flow patterns in the unconfined aquifer have been altered by changes in effluent discharge practices at the Hanford Site (WHC, 1988a; and PNL, 1988a).

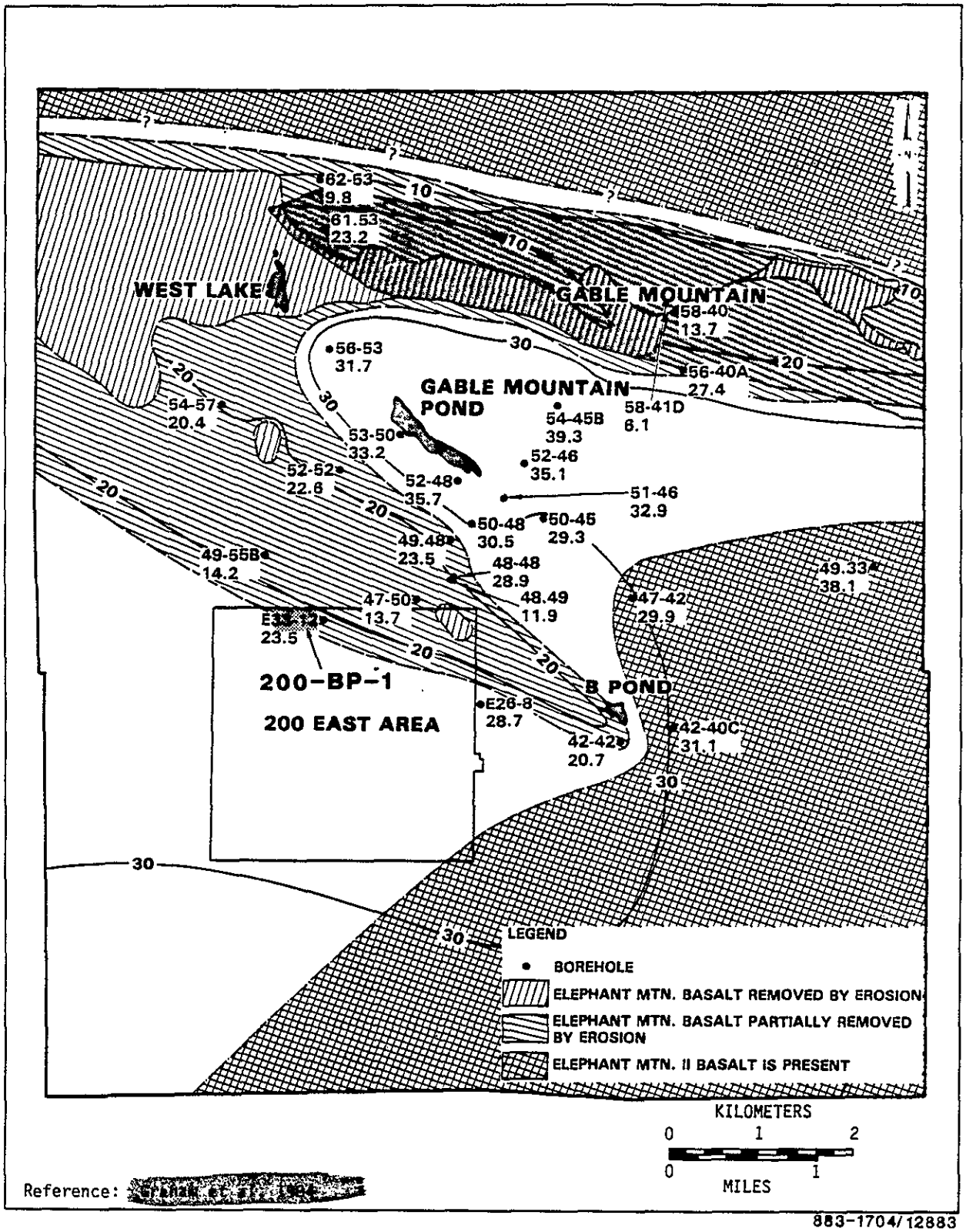


Figure 2-13. Isopach Map of the Elephant Mountain Member

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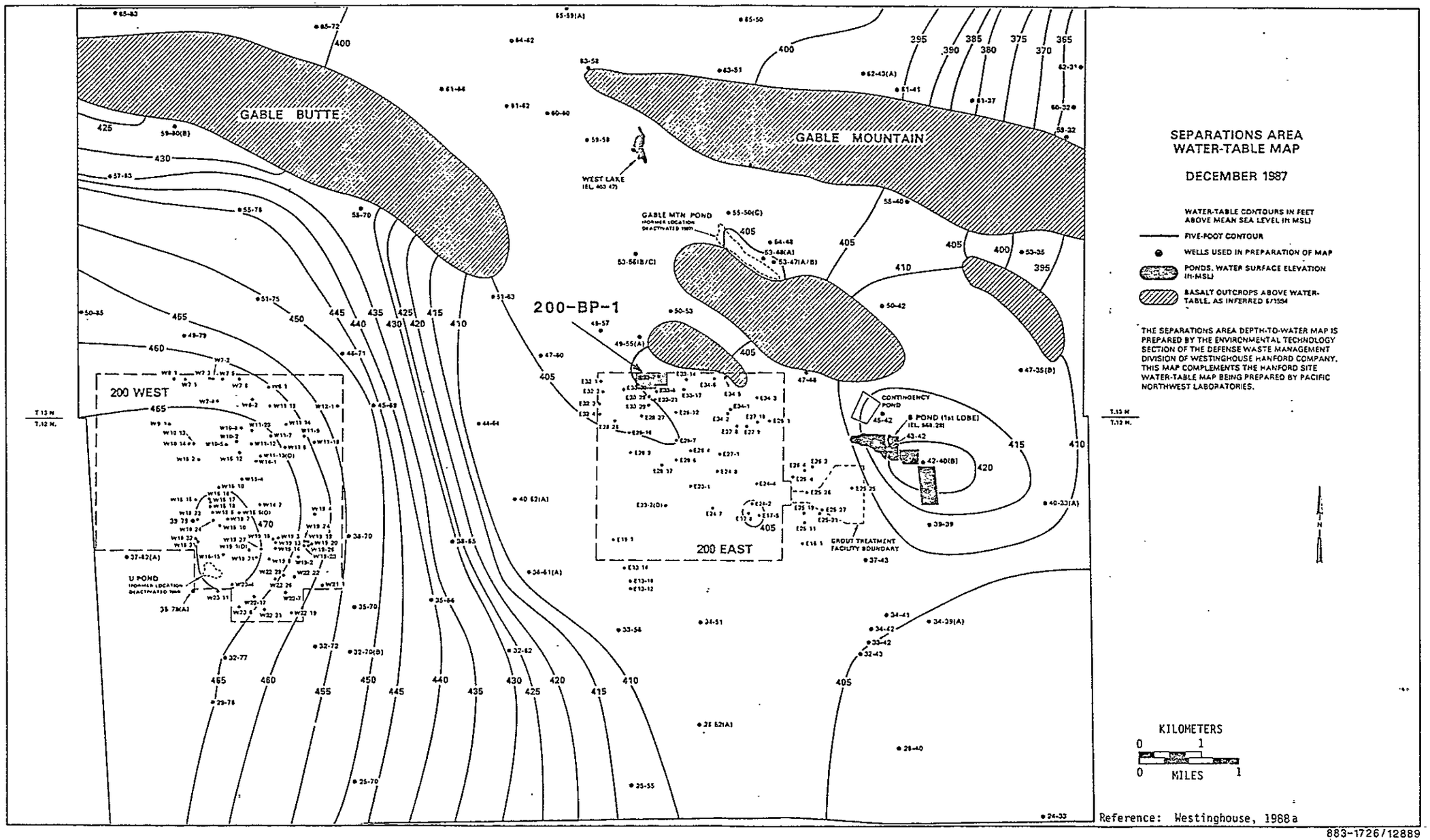

883-1726/12889

Figure 2-14. Separation Area Water Table Map

9 0 1 1 7 4 1 0 8 4 2

2.2.3.1.2 Groundwater Movement. From the recharge areas, the groundwater flows downgradient to the discharge areas, primarily the Columbia River. This general flow pattern is interrupted locally by groundwater mounds in the Separations Areas caused by artificial recharge from waste effluent disposal ponds. Groundwater mounds are evident below the B Pond and U Pond (deactivated in 1984) and were to a lesser degree below Gable Mountain Pond when it was active. The effects on the groundwater flow system from these mounds have been widespread. When the Gable Mountain Pond was active, a stagnation zone appears to have developed in the unconfined aquifer in the vicinity of the 200-BP-1 Operable Unit. Figures 2-15 and Figure 2-14 illustrate potentiometric surface of the unconfined aquifer during and after operation of the Gable Mountain Pond, respectively. Recent changes in waste management practices, primarily increased liquid disposal to B Pond because of the restart of the plutonium-uranium extraction (PUREX) operation and the reduction and elimination (fall, 1987) of discharges to Gable Mountain Pond, has caused increased northward hydraulic gradients below 200-BP-1 (see Figure 2-14) (Westinghouse, 1988a; and PNL, 1988a).

2.2.3.1.3 Discharge. Groundwater discharge from the unconfined aquifer flowing under Hanford is almost exclusively to the Columbia River north of Richland, Washington. Downward leakage to lower confined aquifers may be occurring under the eastern groundwater mound beneath B Pond. The rise in the water table above the potentiometric surface of the confined aquifer provides the potential for this leakage (Figure 2-16).

West Lake is hydraulically connected to the unconfined aquifer and represents a topographic depression that intersects the water table. Because of high surface water evaporation rates and low surface overland flow even during storms, the lake is expected to result in a net loss of groundwater, and thus be a local discharge zone.

2.2.3.1.4 Hydraulic Properties. The geologic and hydraulic properties of the Pasco Basin sediments are highly variable. The range of hydraulic conductivities can be several orders of magnitude. There have been numerous aquifer tests performed in the Pasco Basin, the majority of which were done on the Hanford Site. Results are presented in Gephart et al, 1979 from more than 100 tests on the Pasco Basin. These results are summarized in Table 2-2 (Graham, 1981 modified from Gephart et al., 1979).

2.2.3.1.5 Water Quality. Water quality data of the unconfined aquifer in the Pasco Basin were obtained from the U.S. Geological Survey (USGS). These data are from samples collected from wells outside the Hanford Site. Chemical analyses are available for well samples collected at Hanford between the years 1974 and 1987 by the USGS and Pacific Northwest Laboratory (PNL). These analytical results are reported annually by PNL. The means, standard deviations, and ranges for the various constituents of the two data sets are given in Table 2-3 (Graham, 1981).

The waters are principally a calcium-bicarbonate type, although a considerable variability in chemical composition exists between individual samples. This is primarily attributed to natural variability of water chemistry within the aquifer. The chemical character of the groundwater is influenced by its proximity to recharge areas, its rate of movement, and the chemical and physical nature of the sediments through which it flows.

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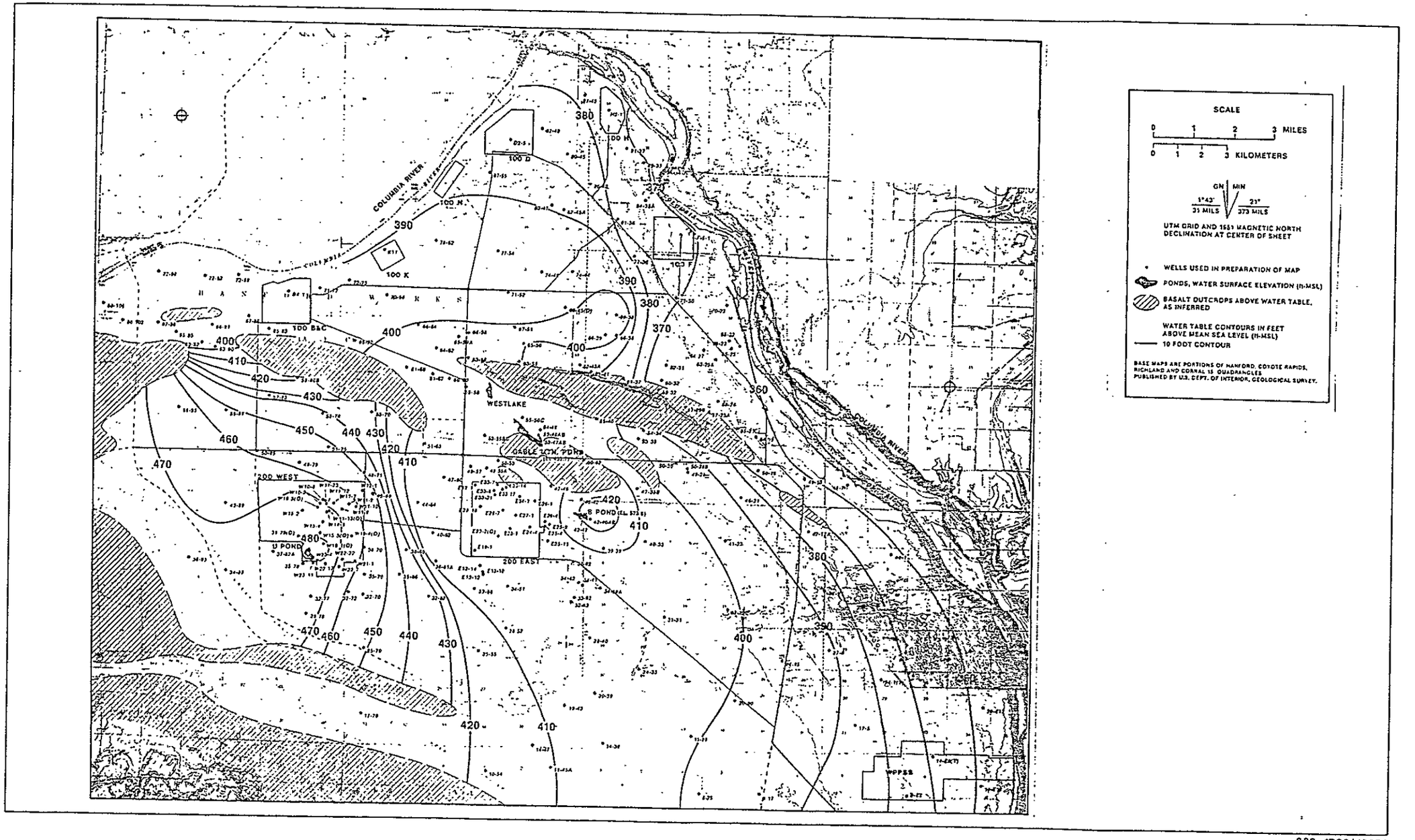

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Figure 2-15. Water Table Map of the Hanford Site

9 0 0 1 1 7 4 4 0 8 4 4

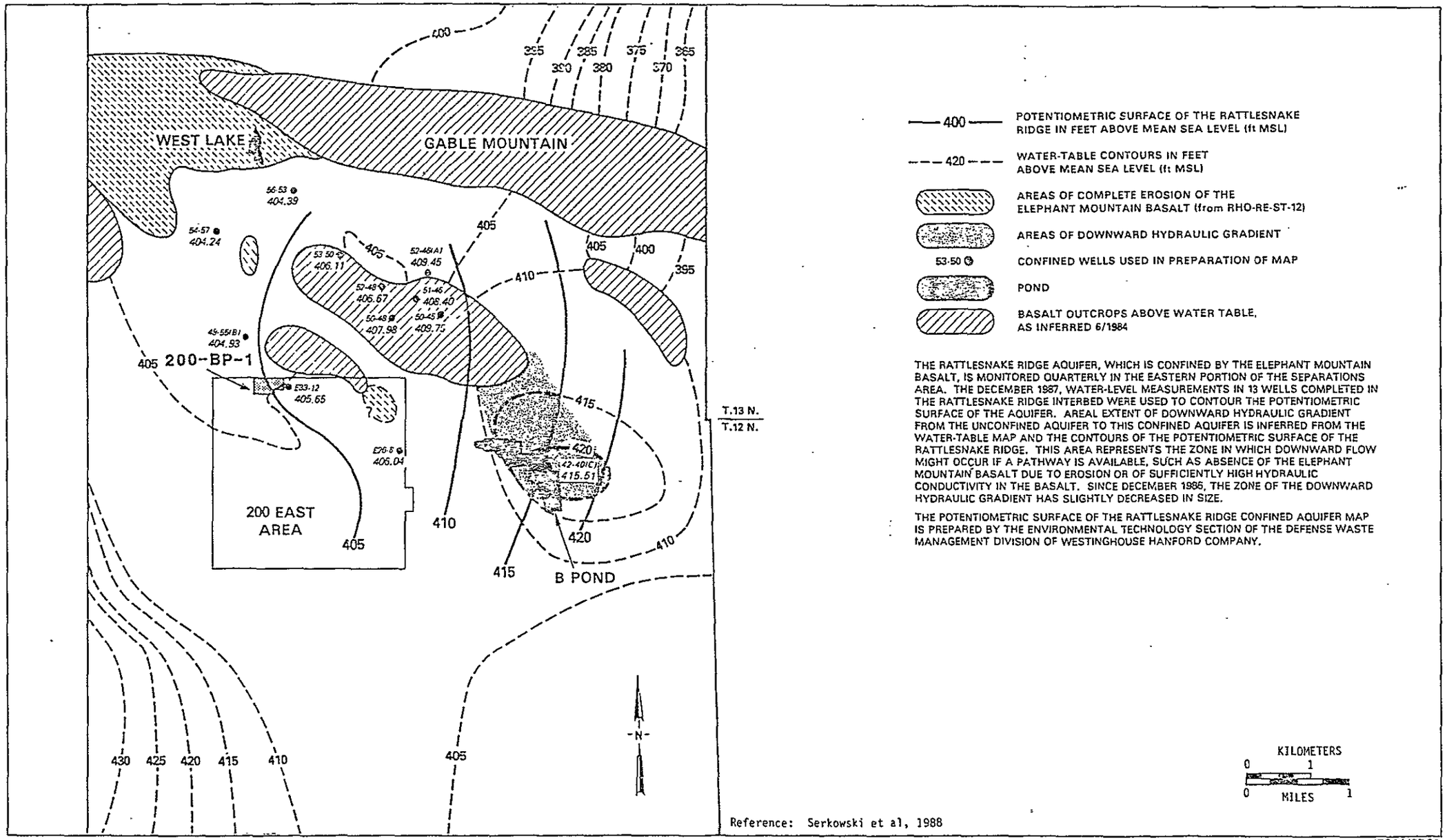

Figure 2-16. Comparison of Potentiometric Surface of the Rattlesnake Ridge Confined Aquifer with the Water Table of the Unconfined Aquifer, December, 1987

Table 2-2. Representative Hydraulic Properties of the Unconfined Aquifer

Stratigraphic Interval	Hydraulic Conductivity (m/d)	Hydraulic Conductivity (ft/d)
Hanford Formation (informal name)	150 - 6,100	500 - 20,300
Undifferentiated Hanford and Middle Ringold Unit	30 - 2,100	100 - 7,000
Middle Ringold Unit	6 - 180	20 - 600
Lower Ringold Unit	0.03 - 3.0	0.1 - 10.0

Graham, 1981 (modified from Gephart et al., 1979).

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Table 2-3. Water Quality of the Unconfined Aquifer for the Pasco Basin and the Hanford Site

Constituent	Location	Samples	Mean	Standard Deviation	Range
Temp. °C	Pasco Basin	193	13.5	2.6	3.1-21.2
	Hanford	89	19.2	3.2	14.5-39.1
Spec. Cond., μmhos/cm	Pasco Basin	184	323	162	125-1,250
	Hanford	99	409	117	194-927
pH	Pasco Basin	3	7.6	0.5	7.2-8.1
	Hanford	104	7.9	0.3	7.0-9.4
Ca^{++}, mg/L	Pasco Basin	15	31.5	9.2	20.0-54.0
	Hanford	101	41.4	12.5	12.0-92.0
Mg^{++}, mg/L	Pasco Basin	15	11.6	4.0	6.9-23.0
	Hanford	101	11.1	3.7	3.1-29.0
Na^{+}, mg/L	Pasco Basin	17	15.8	9.6	5.9-43.0
	Hanford	101	22.6	10.4	2.9-64.0
K^{+}, mg/L	Pasco Basin	16	3.1	1.0	1.4-4.9
	Hanford	101	6.2	1.9	1.9-13.0
HCO_3^{-}, mg/L	Pasco Basin	16	166	44	82-244
	Hanford	101	146	38	53-314
Cl^{-}, mg/L	Pasco Basin	16	4.7	4.1	2.6-19.0
	Hanford	101	11.1	6.6	2.5-32.0
$SO_4^{=}$, mg/L	Pasco Basin	16	10.9	9.2	5.1-43.0
	Hanford	100	47.2	33.5	2.7-190.0
NO_3 as NO_3, mg/L	Pasco Basin	(not available)			
	Hanford	101	26.0	39.0	0.05-270.0

Modified after Graham, 1981

Some of the variation between the Hanford Site groundwater samples and the Pasco Basin groundwater samples is attributed to liquid waste disposal at Hanford. Thermal pollution is evident from the significantly higher mean temperature of the Hanford aquifer water compared to the mean temperature of the Pasco Basin aquifer water. The nitrate concentrations in the Hanford waters are also the result of liquid waste disposal practices.

2.2.3.2 Confined Aquifers. The confined aquifers consist of sedimentary interbeds and/or interflow zones which occur between dense basalt flows in the Columbia River basalt group. The main water-bearing portion of the interflow zone occurs within a network of interconnecting vesicles and fractures of the flow tops or flow bottoms. The confining layers are dense basalt flow interiors. Vertical cooling joints and fractures within the confining layers can permit localized leakage. This appears to be more prevalent in near-surface basalt flows (Graham, 1981).

Confined aquifers are known to underlie the Separations Area to a depth of 1,700 meters (5,660 feet) as evidenced from borehole ARH-DC-1. Additional aquifers may exist at greater depths. The confined aquifers are continuous throughout most of the Pasco Basin except where the aquifers have been eroded or stratigraphically pinch out. The thicknesses of the aquifers vary from over 52 meters (170 feet) within the Mabton interbed, to a few centimeters in some basalt flow contacts. The Rattlesnake Ridge interbed has a thickness of 15-21 meters (50-70 feet).

2.2.3.2.1 Recharge. Recharge to the Saddle Mountains basalt occurs primarily where the basalt formations are at or near ground levels, as water infiltrates from precipitation and stream runoff. These recharge areas are the Rattlesnake Hills, Yakima Ridge, Umtanum Ridge, and the Saddle Mountains. Artificial recharge could be occurring from the unconfined aquifer in the area of B Pond. Present day water levels show that the water table lies above the potentiometric surface of the Rattlesnake Ridge under major disposal ponds, creating the potential for aquifer leakage from the unconfined to the confined aquifers in these areas (Graham, 1981).

2.2.3.2.2 Movement. The potentiometric surface is influenced by the areas of recharge and discharge for the confined aquifer. The gradient indicating the groundwater flow direction of the uppermost confined aquifer (the Rattlesnake Ridge) is shown in Figure 2-17. In the southern portion of the Hanford Site, this movement is assumed to generally conform closely with the regional dip of the basalts along the axis of the Cold Creek Syncline (southeast trending). However, in the northern portion of the Hanford Site, flow is toward the Gable Mountain-Gable Butte area. Groundwater flow in the Rattlesnake Ridge aquifer is toward the north in the vicinity of 200-BP-1 (Graham, 1981).

2.2.3.2.3 Discharge. The major discharge area for the southern portion of the Saddle Mountains basalt aquifers is presently assumed to be the Columbia River near Richland, Washington (Gephart et al., 1979). In this area, the potentiometric surface lies above the mean stage of the river.

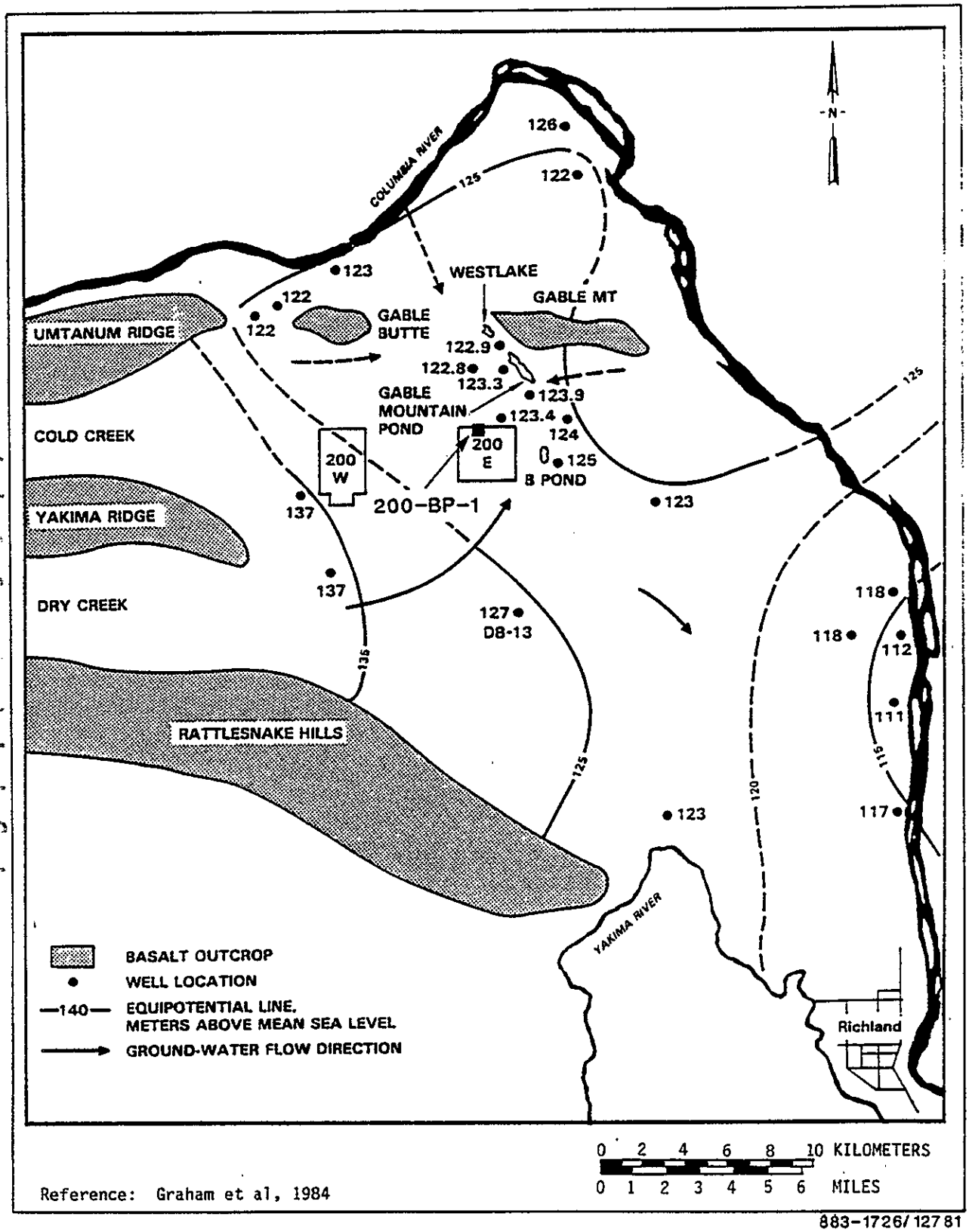


Figure 2-17. Potentiometric Surface Map of the Rattlesnake Ridge Aquifer Within the Hanford Site

Between Gable Mountain and Gable Butte, the Elephant Mountain basalts are completely eroded. The Rattlesnake Ridge aquifer is exposed to the overlying unconsolidated sediments. Discharge of the Rattlesnake Ridge aquifer in this area is believed to be to the unconfined aquifer (see Figure 2-17).

2.2.3.2.4 Hydraulic Properties. Hydraulic conductivity values for the Saddle Mountains basalt aquifers were obtained primarily by pump tests conducted at wells within the Hanford Site (Graham, 1981). The ranges of hydraulic properties for the confined aquifers in these wells are presented in Table 2-4 (Gephart et al., 1979).

2.2.3.2.5 Water Quality. Table 2-5 lists the mean and range of major chemical constituent concentrations for the groundwater in the Mabton interbed. The Mabton interbed is used to represent the confined aquifer system of the Saddle Mountains basalt since it is extensive throughout the Pasco Basin and contains the most reported chemical analyses (Gephart et al., 1979). On the average, the confined system contains much lower total dissolved solids than the unconfined aquifer and is of a sodium-bicarbonate chemical type. The confined aquifer is also characteristically low in nitrate because of its isolation from surface contaminants. However, in the B Pond/Gable Mountain Pond area, intermixing of groundwater from the unconfined aquifer has occurred, as indicated from elevated nitrate and tritium concentrations in the uppermost (Rattlesnake Ridge) confined aquifer (Graham, 1981).

2.2.4 Drainage and Surface Water

There are no perennial or ephemeral streams in the 200 East area or adjacent land. Ephemeral surface runoff following rain storms will follow general drainage patterns. Surface drainage from the 200-BP-1 Operable Unit is primarily toward the north. A topographic depression exists 0.7 kilometer (0.43 mile) north of the 200-BP-1 Operable Unit. If runoff from rain storms occurs, it would apparently flow in to this depression. Surface drainage onto the 200-BP-1 Operable Unit is from the BY-Tank Farm immediately south of 200-BP-1 and from areas southwest of 200-BP-1. The BY-Tank Farm exists on a constructed flat bench higher in elevation and slopes towards 200-BP-1.

West Lake, the nearest surface water, is approximately 6.5 kilometers (4 miles) north of the 200-BP-1 Operable Unit along the southwestern corner of Gable Mountain and is about 4 hectares (10 acres) in area. West Lake is perennial and represents a topographic depression that intersects the surface of the groundwater table.

2-31

Table 2-4. Ranges of Hydraulic Properties of the Confined Aquifer From Wells DB-13, DB-14, DB-15, and ARH-DC-1.

Aquifer	Transmissivity		Thickness		Hydraulic Conductivity	
	m^2/d	ft^2/d	m	ft	m/d	ft/d
Elephant Mtn. interflow[a]	569	6120	0.9	3	622	2040
Rattlesnake Ridge interbed	0.8-28.5	8-307	15-25	50-82	0.03-1.8	0.10-6
Selah interbed	0.8-43	9-462	6-11	20-36	0.1-7	0.4-23
Cold Creek interbed	13-774	141-8326	14-29	46-94	0.5-55	1.50-181
Umatilla interflow[b]	116	1253	1.8	6	55	179
Mabton interbed	13-177	136-1900	26-34	86-111	0.5-6	1.6-20

(a) from Well DB-13
(b) from Well DB-15

Graham, 1981

Table 2-5. Mean and Range of Major Chemical Constituent Concentrations Within Ground Water of the Mabton Interbed

Constituent	Concentration Range, mg/L	Concentration Mean, mg/L
Anions		
HCO_3^-	169-267	217
Cl^-	4.3-63	20
$SO_4^=$	0.3-18	4.0
NO_3^-	<0.5	<0.5
F^-	0.1-8	2.2
Cations		
Na^+	36-122	83
K^+	7.7-14	11
Ca^{++}	0.5-22	4.7
Mg^{++}	0.1-12	1.8

Graham, 1981 (modified from Gephart et al., 1979)

The Columbia River, approximately 8 kilometers (5 miles) to the northwest of the 200-BP-1 Operable Unit, flows through the northern part of the Hanford Site and forms part of the eastern boundary of the Hanford Site. The discharge of the Columbia River in this region is regulated primarily by Priest Rapids Dam. Hanford reach flows fluctuate significantly because of the relatively small storage capacity and operational practices of the nearby upstream dams. A minimum flow rate of 1,000 m^3/s has been established at Priest Rapids. Typical daily flows range from 1,000 to 7,000 m^3/s with peak spring runoff flows of up to 12,600 m^3/s (450,000 cfs) being recorded. Typical annual average flows at Priest Rapids Dam are 3,100 m^3/s to 3,400 m^3/s. Monthly mean flow typically peak from April through June and are at the lowest levels from September through October (PNL, 1978).

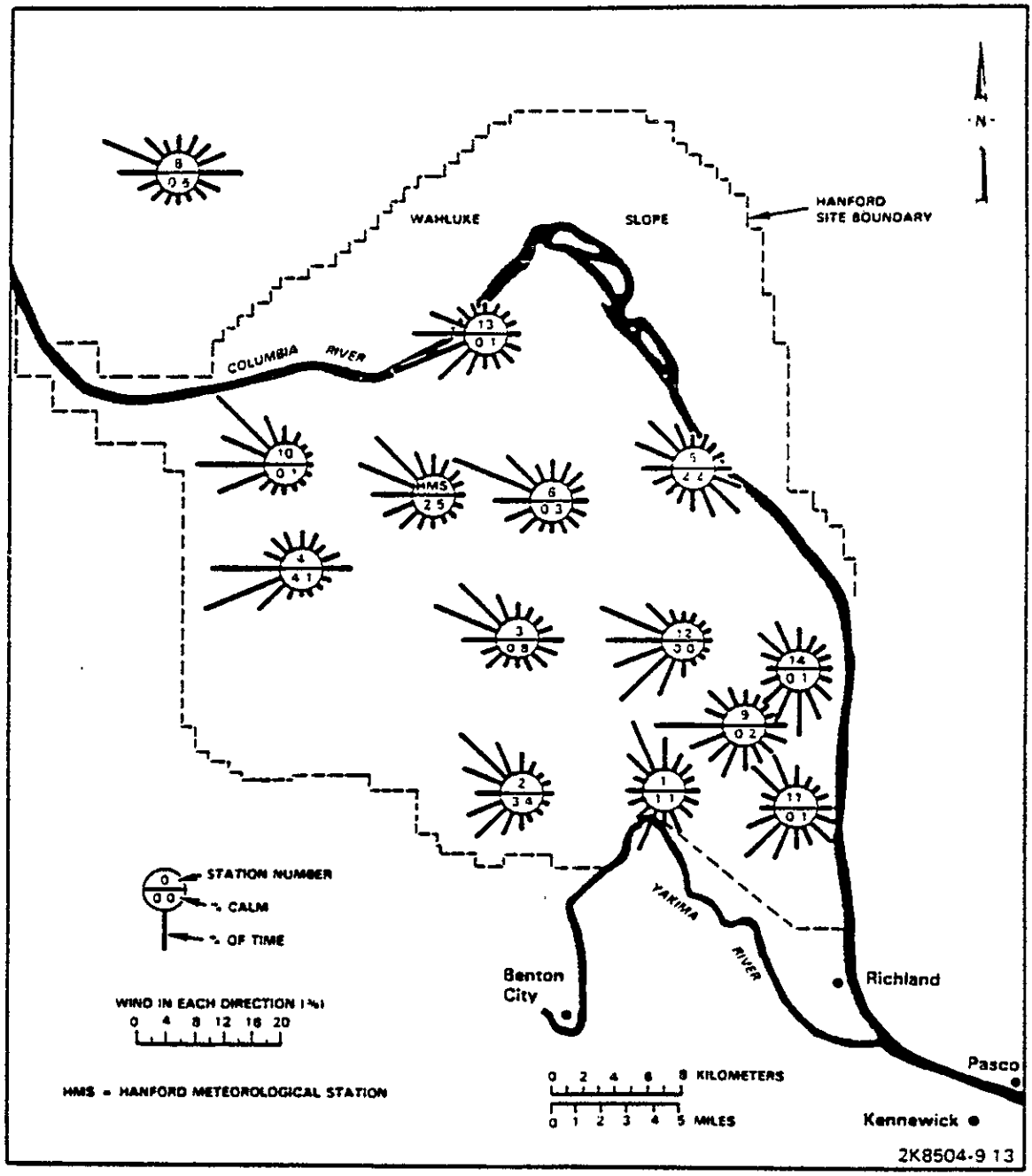
2.2.5 Meteorological Conditions

Climatological data are available from the Hanford Meteorological Station, which is located between the 200 East and West areas (DOE, 1987b). Data have been collected at the Hanford Meteorological Station since 1945, and temperature and precipitation data from nearby locations are also available for the period 1912 through 1943. A summary of these data, through 1980, has been published by Stone et al. (1983). Data from the Hanford Meteorological Station are assumed to be representative of the general climatic conditions for the region.

2.2.5.1 Wind. Wind data are collected routinely at the Hanford Meteorological Station. In addition to surface wind data (2.1-meter [7-foot] level), wind data are collected at the 15.2- (50-foot), 30.5- (100-foot), 61.0- (200-foot), 91.4- (300-foot), and 121.9-meter (400-foot) levels of a 125-meter (410-foot) tower at the station. More than 20 telemetry stations distributed on and around the Hanford Site provide supplementary surface (9.1-meter [30-foot] level) wind data for defining wind patterns (DOE, 1987b).

Prevailing wind directions are from the northwest in all months. Secondary maxima are indicated for southwesterly winds. The wind direction summaries indicate that winds from the northwest quadrant occur most often during the winter (i.e., December, January, February) and summer (i.e., June, July, August). During the spring and fall, the frequency of southwesterly winds increases with a corresponding decrease in northwest flow. Winds blowing from other directions (e.g., northeast) display minimal variation from month to month.

Monthly and annual joint frequency distributions of wind direction versus wind speed are given in Stone et al. (1983). Monthly average wind speeds are lowest during the winter months, averaging 10 to 11 kilometers/hour, and highest during the summer, averaging 14 to 16 kilometers/hour on a monthly basis. Wind speeds that are well above average are usually associated with southwesterly winds. In the summer, high-speed winds from the southwest are responsible for most of the dust storms experienced in the region. Figure 2-18 is a wind rose for the Hanford Site.



Reference: US DOE, 1987b

883-1726/12782

Figure 2-18. Wind Rose for the Hanford Telemetry Network

2.2.5.2 Temperature and Humidity. Diurnal and monthly averages and extremes of temperature, dewpoint, and humidity are contained in Stone et al. (1983). For the period 1912 through 1980, the average monthly temperatures range from a low of -1.5°C in January to a high of 24.7°C in July. During the winter, the highest monthly average temperature at the Hanford Meteorological Station was 6.9°C, and the record lowest was -5.9°C; both occurred during February. During the summer, the record maximum monthly average temperature was 27.7°C in July and the record lowest was 17.2°C in June. The annual average relative humidity at the Hanford Meteorological Station is 54 percent, with maxima during the winter months (averaging about 75 percent) and minimum average relative humidity during the summer (about 35 percent) (DOE, 1987b).

2.2.5.3 Precipitation. Average annual precipitation at the Hanford Meteorological Station is 16 centimeters (6.3 inches). The total annual precipitation ranges (98 percentile) from 8 centimeters (3.15 inches) to 28 centimeters (11 inches). Most of the precipitation takes place during the winter with nearly half of the annual amount occurring in the months of November through February. Days with greater than 1.3 centimeters (0.5 inch) precipitation occur less than 1 percent of the year. Rainfall intensities of 1.3 centimeters/hour (0.5 inch/hour) persisting for 1 hour are expected once every 10 years. Rainfall intensities of 2.5 centimeters/hour (1 inch/hour) for 1 hour are expected only once every 500 years. Winter monthly average snowfall ranges from 0.8 centimeter (0.3 inch) in March to 13.5 centimeters (5.3 inches) in January. The record snowfall of 62 centimeters (24.4 inches) occurred in February 1916, but the second highest snowfall is less than half this amount (DOE, 1987b).

2.2.6 Environmental Resources

2.2.6.1 Flora. The semiarid terrain, on which the 200-BP-1 Operable Unit lies, has been subjected to various landscape manipulations as a result of 200 East Area construction and operation activities. Natural vegetation, however, consists mostly of a sparse covering of desert shrubs and drought-resistant grasses. Dominant shrubs are big sagebrush, bitterbrush, rabbitbrush, and spiny hopsage. Grasses dominate the understory, especially cheatgrass (an alien species introduced from Eurasia in the late 1800s) and Sandberg bluegrass. The presence of cheatgrass is attributable to the effects of past livestock grazing. The predominant vegetation type in the 200 East Area is the sagebrush/grass type. Table 2-6 includes federal- and state-designated endangered and threatened flora which could occur in or near the Hanford Site (PNL, 1988d; DOE, 1987b).

2.2.6.2 Fauna. Predominant fauna of the sagebrush/grass community that could potentially reside near the operable unit are the cottontail, jackrabbit, Great Basin pocket mouse, horned lark, and the western meadowlark. Various species of raptors, mule deer, and coyotes forage in this habitat type, and grasshoppers are the most conspicuous insects in the community (DOE, 1987b).

Table 2-6. Endangered and Threatened Species Potentially Associated with the Hanford Site (Sheet 1 of 2)

Species	Notes
Endangered Species	
American white pelican *Pelecanus erythrorhyncus*	Forages on the Hanford reach of the Columbia River in fall and winter.
Peregrine falcon *Falco peregrinus*	An erratic visitor.
Proposed Endangered Species	
Columbia River tiger beetle *Cincindela columbica*	Believed to inhabit the sandy shores of the Hanford reach of the Columbia River.
Persistent sepal yellowcress *Rorippa columbiae*	Inhabits the wetted shoreline of the Hanford reach of the Columbia River.
Threatened Species	
Pygmy rabbit *Sylvilagus idahoensis*	Only known, on the Hanford Reservation, to inhabit areas near springs in the Snively Basin, west of the 200 Area plateau.
Townsend's big-eared bat *Plecotus townsendii*	Potential inhabitant of caves or abandoned buildings.
Bald eagle *Haliaeetus leucocephalus*	A regular winter visitor to the Hanford reach of the Columbia River.
Ferruginous hawk *Buteo regalis*	An occasional forager in sagebrush/grassland habitats on the Hanford Reservation.
Thompson's sandwort *Arenaria franklinii thompsonii*	Exists as *A. franklinii* on stabilized sand dunes on the Hanford Site; taxonomic status of the Hanford form is under evaluation.

Table 2-6. Endangered and Threatened Species Potentially Associated with the Hanford Site (Sheet 2 of 2)

Proposed Threatened Species	
Hoover's desert parsley *Lomativum tuberosum*	A regional endemic.
Columbia milk-vetch *Astragalus columbianus*	A regional endemic.

DOE, 1987

The Columbia River provides a habitat for a wide diversity of fish. Important game species are chinook salmon, steelhead, coho salmon, sockeye salmon, smallmouth bass, largemouth bass, sturgeon, walleye, yellow perch, and channel catfish. The Hanford reach of the Columbia River sustains a spawning population of fall chinook salmon. Increases in this population over the years are responsible for attracting numerous bald eagles to the area in the fall and winter to feed on spawned-out salmon (DOE, 1987b).

2.2.6.3 Sensitive Environments and Critical Habitats. No 2-hectare (5-acre) or larger wetlands or other sensitive environments exist near 200-BP-1. The Columbia River, however, could be regarded as an important environment with respect to this operable unit. The importance of the river as a source of drinking and irrigation water in the region, as well as being a productive habitat for waterfowl, economically important fish species, and transitory endangered white pelicans and threatened bald eagles, could merit special concern for this environment during the remedial response.

Information as to whether the proposed-endangered Columbia River tiger beetle and the persistent sepal yellowcress actually reside on the banks of the river, along and immediately downstream of potential discharge zones for contaminated groundwater plumes from 200-BP-1 is lacking. If one of these species does exist here, the shoreline along that portion of the Columbia River would be regarded as a critical habitat for that species.

2.2.7 Population And Land Use

2.2.7.1 Demography. Based on 1980 census data, only 110 people live within 16 kilometers (10 miles) of the 200 Areas (DOE 1987b). No one resides within a 1.6-kilometer (1-mile) radius of the 200-BP-1 Operable Unit. The city of Richland corporate boundary is approximately 29 kilometers (18 miles) to the south. The working population for all shifts in the 200 Areas is approximately 2,400 (EPA, 1987c).

2.2.7.2 Land Use. For reasons of national security, as well as to ensure public health and safety, access to the entire Hanford Site has been controlled since 1943 and is expected to remain controlled for the foreseeable future. Access to the 200 Areas is restricted even further (DOE, 1987b).

Prior to the Hanford Site being formed, portions of the land had been used for agriculture, and much of the land was subjected to grazing by domestic livestock.

Since 1944, most of the land has not been grazed by livestock, all land cultivation and irrigation have ceased, and there has been no resident human population. Currently, most of the land on the site is undeveloped, and the widely spaced industrial facilities are located in scattered clusters (DOE, 1987b).

Land use in the area surrounding the site consists primarily of irrigated and dry-land farming, livestock grazing, and urban and industrial development. Principal agricultural crops include hay, wheat, potatoes, corn, apples, grapes, hops, and other fruits and vegetables. Most industrial activities in the area are associated with agriculture and energy production (DOE, 1987b).

2.2.7.3 Water Use.

2.2.7.3.1 Surface Water. The Hanford reach of the Columbia River is used for multiple purposes: drinking water, industrial process water, irrigation, fish hatchery operation, fishing, hunting, boating, and swimming (PNL, 1988d) (EPA, 1987c). River water intakes, downstream from 200-BP-1, include the Ringold Fish Hatchery intake, the Ringold Flats irrigation intakes, the Taylor Flat irrigation intakes, the 300 Area process and drinking water intake, the Battelle Farm Operations irrigation intake, the Tri-Cities University Center irrigation intake, and the city of Richland drinking water intake (EPA, 1987c).

2.2.7.3.2 Groundwater. Downgradient groundwater in the immediate vicinity of 200-BP-1 is not utilized for either drinking or irrigation. The nearest drinking water supply wells are those that serve the 400 Area. They are located about 13 kilometers (8 miles) to the southeast of the operable unit (PNL, 1988d; EPA, 1987b). These wells however, are hydraulically upgradient from 200-BP-1.

9 0 1 1 7 1 0 6 5 9

3.0 INITIAL EVALUATION

3.1 KNOWN AND SUSPECTED CONTAMINATION

This section summarizes, by media, the known extent of contaminants that may be associated with the 200-BP-1 Operable Unit. Table 3-1 summarizes analytes that were detected in the media in the vicinity of 200-BP-1. A discussion of the concentrations and trends of these analytes in the various media follows.

3.1.1 Sources

To date, there are no data on the concentrations and quantities of radionuclides or other contaminants of concern remaining within the cribs in 200-BP-1. As presented in Section 2.1.4, the quantity of waste constituents disposed in the 200-BP-1 cribs are calculated estimates. There is uncertainty associated with these estimates, as well as, the identification of all constituents that were disposed in 200-BP-1.

Appendix A contains summary reports for cribs and unplanned releases in the 200-BP-1 Operable Unit. These reports provide information on estimated waste inventories, volume of effluents, dimensions, and service history for each crib and UN. Table 3-2 summarizes estimated contaminant discharges and effluent volume that were disposed within cribs located in 200-BP-1 Operable Unit. There is uncertainty whether the UNs designated for 200-BP-1 actually occurred within the 200-BP-1 Operable Unit boundary, although the possibility exists that the releases may have flowed into the 200-BP-1 since the 241-BY Tank Farm is elevated and adjacent to 200-BP-1 (WHC, 1988b).

3.1.2 Soil

3.1.2.1 Surface Soil Monitoring Data. The radionuclide content of soil is routinely measured by Westinghouse Hanford (Elder et al., 1988) to evaluate long-term trends in environmental accumulation of radioactivity in the 200 East Area. Soil samples are collected from a network of 36 grid sampling sites and 17 fenceline sampling plots. The sampling sites are 10 by 10 meters (33 by 33 feet) and are arranged in a grid pattern in the 200 East Area. These sites are intended to monitor the overall 200 Area environment without being specific to any potential source. Locations of the grid sampling sites are illustrated in Figure B-1 in Appendix B. The 17 fenceline plots are each 1 by 5 meters (3.3 by 16.4 feet) and were established in 1984 to monitor areas both upwind and downwind of potential sources where contamination, if present, might be expected to accumulate. Locations of the fenceline plots are illustrated in Figure B-2 in Appendix B. Grid site 2E-2 and 2E-3 are located along the north boundary of the 200-BP-1 Operable Unit. Fenceline plot 2E-N is closest to 200-BP-1 and is located about 30 meters (98 feet) northeast of the BY cribs in 200-BP-1.

Table 3-1. Summary of Detected Analytes by Media

Source[a]	Surface Soils	Vadose Zone	Groundwater		West Lake	Atmospheric	Vegetation
sodium	^{54}Mn	gamma-emitting radionuclides	sodium	^{3}H	total beta	^{90}Sr	^{137}Cs
nitrate	^{90}Sr		nitrate	^{90}Sr	total alpha	^{137}Cs	
sulfate	^{134}Cs		sulfate	^{137}Cs	^{90}Sr	^{239}Pu	
ferrocyanide	^{137}Cs		total cyanide	^{60}Co	^{137}Cs	uranium	
ammonium nitrate	^{238}Pu		ammonium	^{239}Pu	^{239}Pu		
^{3}H	uranium		chloride	^{240}Pu	uranium		
^{90}Sr	^{152}Eu		fluoride	^{238}U			
^{137}Cs	^{154}Eu		potassium	^{106}Ru			
^{60}Co			magnesium	total beta			
^{239}Pu			barium	total alpha			
^{240}Pu			lead	^{99}Tc			
^{238}U			vanadium	uranium			
^{106}Ru			selenium	plutonium			
beta			arsenic	radium			
alpha			zinc	total organic carbon			
^{99}Tc			copper	methylene chloride			
tributylphosphate			mercury				
paraffin hydrocarbons			chromium				

[a] This list includes known and suspected constituents.

Table 3-2. Estimated Waste Quantities Discharged to Cribs in the 200-BP-1 Operable Unit

Total Liquid Effluent Discharged	1.7304×10^8 L
Chemical Disposed	**Quantity (kg)**
sodium	2,650,500
nitrate	6,501,500
sulfate	469,000
phosphate	332,000
ferrocyanide	18,900
ammonium nitrate	10,000
ammonium carbonate	21,000
Radionuclide Inventory (April 1, 1986)	**Quantity (Ci)**
^{3}H	2499
^{90}Sr	6054
^{137}Cs	2092
^{60}Co	0.4490
^{239}Pu	4.0457
^{240}Pu	1.0918
^{238}U	0.1806
^{106}Ru	0.00009
total beta	16,179.2
total alpha	<0.000005
Other Suspected Waste Constituents	
^{99}Tc	Unknown
tributyl phosphate	Trace
paraffin hydrocarbons	Trace

Stenner et al., 1988

Early in the summer of each year, soil samples are collected and submitted for radionuclide analyses. Each soil sample represents a composite of five plugs of soil 2.5 centimeters (1 inch) in depth by 10 centimeters (4 inches) in diameter collected from within each sampling site. The analyses include those radionuclides expected in the Separations Area (i.e., gamma-emitting radionuclides, strontium isotopes, uranium, and plutonium isotopes). The results are compared to regional background levels that are derived from PNL offsite monitoring data to determine the difference between contributions from 200 Area operations and contributions due solely to natural causes and worldwide fallout. The results are also compared to soil contamination standards (Appendix B) developed for use in the 200 Areas (Boothe, 1987). These soil standards are based on radiation protection guides in DOE Order 5480.1A and were derived using soil particle resuspension model estimates. These soil standards represent permissible radionuclide concentrations in the soil above which radiological controls (e.g., cleanup, posting) are required. The soil standards are intended for use only in the 200 Areas.

Of the 36 grid sampling sites, 20 were sampled in 1987. At three sites replicate samples were taken for quality assurance (QA) purposes. Radionuclide concentrations in surface soils are presented in Appendix B in Figures B-3 through B-10 (Elder et al., 1988).

Surface soil samples from 2E-2 have fluctuated slightly above and below background concentrations for ^{90}Sr, ^{239}Pu and ^{137}Cs since 1978 to 1987 (PNL, 1988d). Analytical results for surface soil samples from 2E-3 have all been above determined background levels by PNL for ^{90}Sr, ^{239}Pu and ^{137}Cs for the same time period. Analytical results for surface soils sample from fenceline site 2E-N have all been greater than background levels for ^{90}Sr and ^{137}Cs from 1984 to 1987, but was only slightly above background levels for ^{239}Pu in 1984 and have been below background during 1985 through 1987.

3.1.2.2 Vadose Zone Soil. Subsurface vadose zone soils under the BY cribs are assumed to be currently contaminated because of the nature of disposal at the 200-BP-1 Operable Unit. The possibility exists that perched water tables were created during active disposal of effluents to the cribs in the 200-BP-1 Operable Unit. The lateral extent of contamination in the vadose zone could have increased due to spreading from perched conditions.

Chemical analysis has not been conducted on vadose zone soils from wells located in the 200-BP-1 Operable Unit. However, the wells have been logged for gross gamma by downhole scintillation probes (Additon et al., 1978). Wells E33-1 through E33-7 are located adjacent to cribs 216-B-43 through 216-B-50 (Figure 2-2). Well E33-24 is adjacent to crib 216-B-57, while wells E33-25 and E33-26 are adjacent to crib 216-B-61 which never received wastes effluents. Well E33-13 is located in the southeast corner of 200-BP-1 Operable Unit about 75 meters (250 feet) from the nearest crib. The results of the borehole gamma logging are provided in Appendix C (Additon et al., 1978).

Background gamma radiation was determined to be in the range of $2x10^{-3}$ to $7x10^{-3}$ counts per minute (Additon et al., 1978). Scintillation logs indicate that radionuclides are present in vadose zone soils to the water table which is approximately at 65 to 70 meters (210 to 230 feet) in wells E33-1, E33-2, E33-3, E33-4 and E33-7. Radioactivity above anticipated background was not apparent below 40 meters (131 feet) in well E33-5, 47 meters (154 feet) in well E33-6, and 25 meters (82 feet) in well E33-24. Radioactivity above background was not apparent in wells E33-25 and E33-26 until groundwater was encountered. The gross gamma borehole profile from well E33-13 had elevated gamma radiation at two distinct depth intervals (~27 meters [88 feet] and between 40 and 50 meters[131 and 164 feet]). These elevated levels could be indicative of lateral migration of radionuclides by perching of infiltrating effluents on less permeable geologic strata during operation of the cribs or leaks from the adjacent BY-Tank Farm.

3.1.3 Groundwater

Westinghouse Hanford and PNL conduct the 200 Area groundwater monitoring program to determine compliance status of 200 Area facilities and operations with Westinghouse Hanford administrative controls pertaining to groundwater quality. These administrative controls include derived concentration guides (DCGs) and administrative control limits. The monitoring well network for the Separations Area include 149 wells in the unconfined aquifer and 13 wells in the confined aquifers. Wells are monitored routinely for total alpha, total beta, strontium-90, cesium-137, cobalt-60, ruthenium-106, tritium, total uranium, and nitrate. Other analyses are selected for parameters of concern for particular waste disposal units. Table 3-3 presents total depths and monitoring interval for each well in the vicinity of 200-BP-1. Plate 3-1 was prepared by PNL from the Hanford Groundwater Database to show the location of monitoring wells in the 200 East area. Monitoring wells within the 200-BP-1 Operable Unit, that are monitoring the unconfined aquifer include the following:

- 299-E33-1A (unconfined)
- 299-E33-2 (unconfined)
- 299-E33-3 (unconfined)
- 299-E33-4 (unconfined)
- 299-E33-5 (unconfined)
- 299-E33-6 (unconfined)
- 299-E33-7 (unconfined)
- 299-E33-13 (unconfined)
- 299-E33-22 (unconfined)
- 299-E33-23 (unconfined)
- 299-E33-24 (unconfined)
- 299-E33-25 (unconfined)
- 299-E33-26 (unconfined)

Groundwater in both the unconfined and confined (Rattlesnake Ridge Interbed) aquifers flows northward. Downgradient wells, shown on Figure 3-1, include the following, with information on the aquifer that is monitored:

- 699-47-50 (confined)
- 699-49-55A (unconfined)
- 699-49-55B (confined)
- 699-49-57 (unconfined)
- 699-50-53 (unconfined)
- 699-55-57 (unconfined)
- 699-54-57 (confined)

Table 3-3. Monitoring Well Depths and Monitoring Intervals

Well No.	Location EW	Location NS	Well Depth (ft)	Screened Interval Min. Depth (ft)	Screened Interval Max. Depth (ft)	Total Drilled Depth (ft)
2-E32-1	-56684	46488	274	241	271	283
2-E33-1A	-53335	46375	235	215	235	235
2-E33-2	-53384	46466	231	220	233	243
2-E33-3	-53331	46547	234	219	231	236
2-E33-4	-53384	46635	228	215	231	231
2-E33-5	-53523	46352	237	218	235	238
2-E33-6	-53524	46503	236	214	229	238
2-E33-7	-53520	46619	224	215	230	233
2-E33-8	-53850	45840	256	230	257	257
2-E33-9	-53285	45960	261	252	262	275
2-E33-10	-54566	45216	290	259	285	290
2-E33-11	-52452	46444	229	---	---	230
2-E33-12	-52850	46436	414	305	385	415
2-E33-13	-53093	46278	229	210	235	235
2-E33-14	-52177	46223	230	212	227	230
2-E33-15	-52751	46066	251	222	237	251
2-E33-16	-52815	45887	258	231	246	258
2-E33-17	-52529	45894	244	220	244	244
2-E33-18	-52825	45624	263	240	260	278
2-E33-19	-52629	45744	245	217	248	252
2-E33-20	-52629	45664	250	225	251	254
2-E33-21	-53856	45321	280	235	275	282
2-E33-22	-53300	46450	230	212	232	232
2-E33-23	-53350	46600	227	218	230	230
2-E33-24	-53790	46260	253	219	241	256
2-E33-25	-54210	46600	238	199	233	240
6-47-50	-49508	47266	---	260	295	295
6-49-55A	-54926	48805	145	125	135	149
6-49-55B	-54951	48803	226	170	226	226
6-49-57	-56913	48960	164	144	161	168
6-50-53	-53267	49840	159	142	159	185
6-53-55A	-55014	53006	270	165	280	455
6-53-55AO	-55014	53006	200	160	180	200
6-53-55AP	-55014	53006	335	330	335	335
6-53-55AQ	-55014	53006	388	375	395	395
6-53-55AR	-55014	53006	315	315	335	335
6-53-55AS	-55014	53006	275	255	275	275
6-53-55B	-55030	52979	252	232	232	252
6-53-55C	-55015	52976	220	187	220	220
6-54-57	-56639	54311	321	236	321	321
6-55-57	-57208	54608	180	139	169	180

Modified after Stenner et al., 1988.

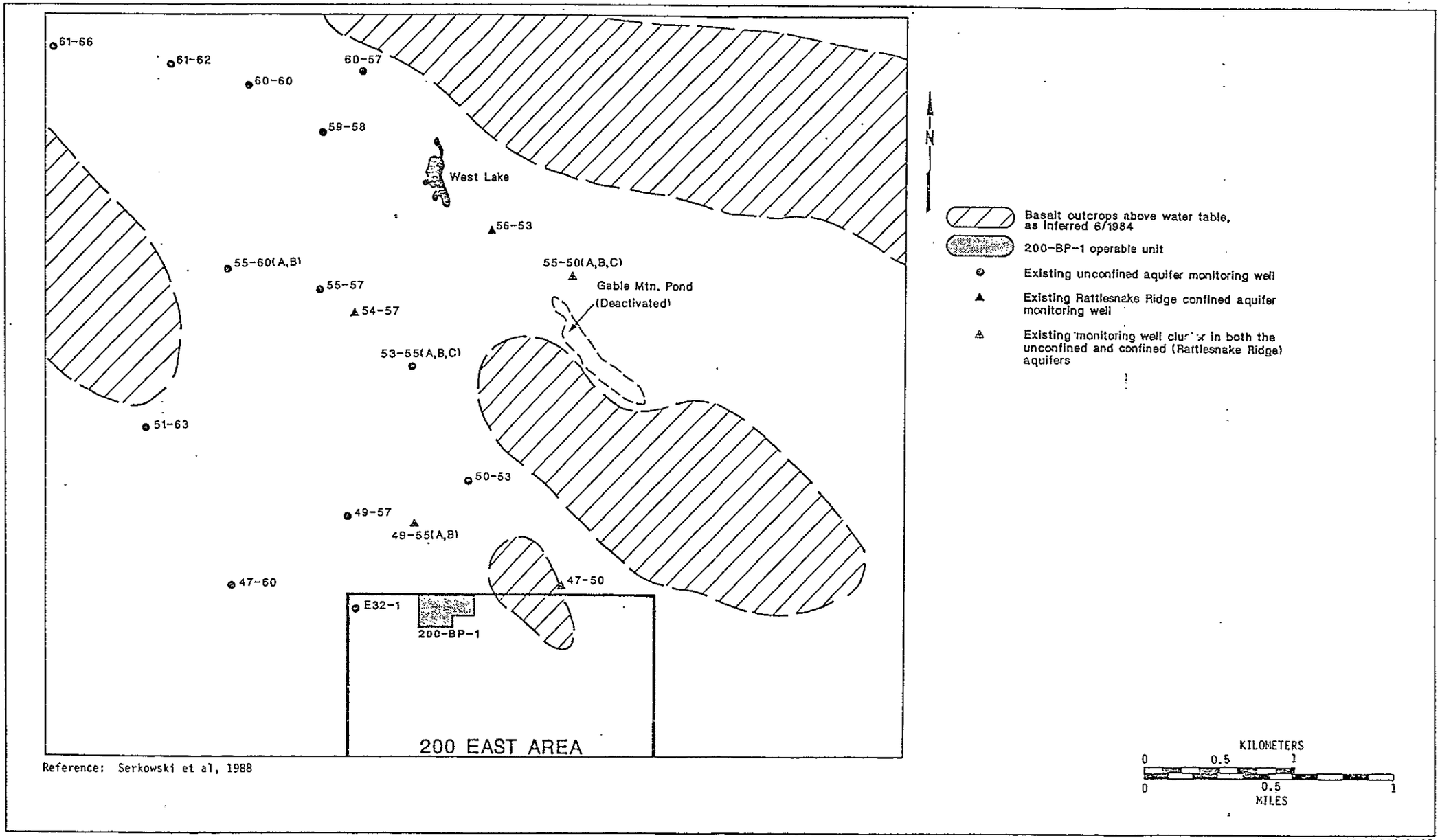
Monitoring wells located in adjacent operable units that will be useful for understanding contaminant contribution to groundwater from adjacent sources are shown on Plate 3-1 and include the following:

- 299-E32-1 (unconfined)
- 299-E33-8 (unconfined)
- 299-E33-9 (unconfined)
- 299-E33-11 (unconfined)
- 299-E33-12 (confined)
- 299-E33-14 (unconfined)
- 299-E33-15 (unconfined)
- 299-E33-16 (unconfined)
- 299-E33-17 (unconfined)
- 299-E33-18 (unconfined)
- 299-E33-19 (unconfined)
- 299-E33-20 (unconfined)
- 299-E33-21 (unconfined)

Analytical results for the above-listed monitoring wells during the years 1985 to June 1988 are presented in Appendix D for the major analytes. The data presented in Appendix D are a subset of a larger computerized data base containing Hanford groundwater monitoring results (Stenner et al., 1988). Additional analytes were tested in groundwater from the wells in the vicinity of 200-BP-1. Appendix E presents, for selected wells, the complete lists of analytes tested since 1985, with the maximum concentration analyzed. Data presented in both Appendix D and E contain detection limits for comparison of results. As indicated in Appendix E, most of the numerous compounds analyzed were below detection limits. The detection limit represents the highest normally achievable detection limit by the analytical procedures (contract detection limit). Many times, especially for radionuclides, actual detection limits are lower for specific analysis and groundwater matrices. Negative values for radionuclides indicate that the analyzed value based on scintillation counting is lower than equipment or laboratory background (which is subtracted from the analyzed value) and, therefore, represent zero or below detectable concentrations. Pertinent results are summarized later in this section. The analytes included in Appendix D are:

- total alpha
- total beta
- tritium (^3H)
- strontium-90
- cesium-137
- cobalt-60
- technetium-99
- total uranium (U)
- plutonium-238
- plutonium-239/240
- ruthenium-106
- nitrate (NO_3)
- cyanide
- total organic carbon (TOC)
- ammonium ion (NH_4)
- chloride (Cl)
- sulfate (SO_4)
- phosphate (PO_4)
- hydrogen ion activity (pH)
- specific electrical conductance
- fluoride (F)
- chromium (Cr)
- sodium (Na)
- kerosene
- tributylphosphate (TBP)

Groundwater contamination observed in and around the 200 East Area has been attributed in part to the BY cribs. Contaminants observed include cyanide, strontium-90, technetium-99, cobalt-60, nitrate, and undesignated beta activity. Other potential hazardous substances known to have been disposed of to these facilities include tritium, cesium-137, plutonium-239 and plutonium-240. Cyanide is currently of greatest concern, with a maximum level of 1,690 p/b observed in a groundwater monitoring well immediately north of the cribs. The cyanide contamination plume is estimated to cover an area of 259 hectares (640 acres), underlying the operable unit and significant areas spreading out to the north and west.



Reference: Serkowski et al, 1988

883-1726/12783

Figure 3-1. Location of Groundwater Monitoring Wells North of the 200-BP-1 Operable Unit

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It is anticipated that local groundwater mounding in the unconfined aquifer may have occurred beneath the BY cribs during active operations. Thus, contaminants reaching the water table could have spread radially within the aquifer. The degree of mounding that may have occurred is not known.

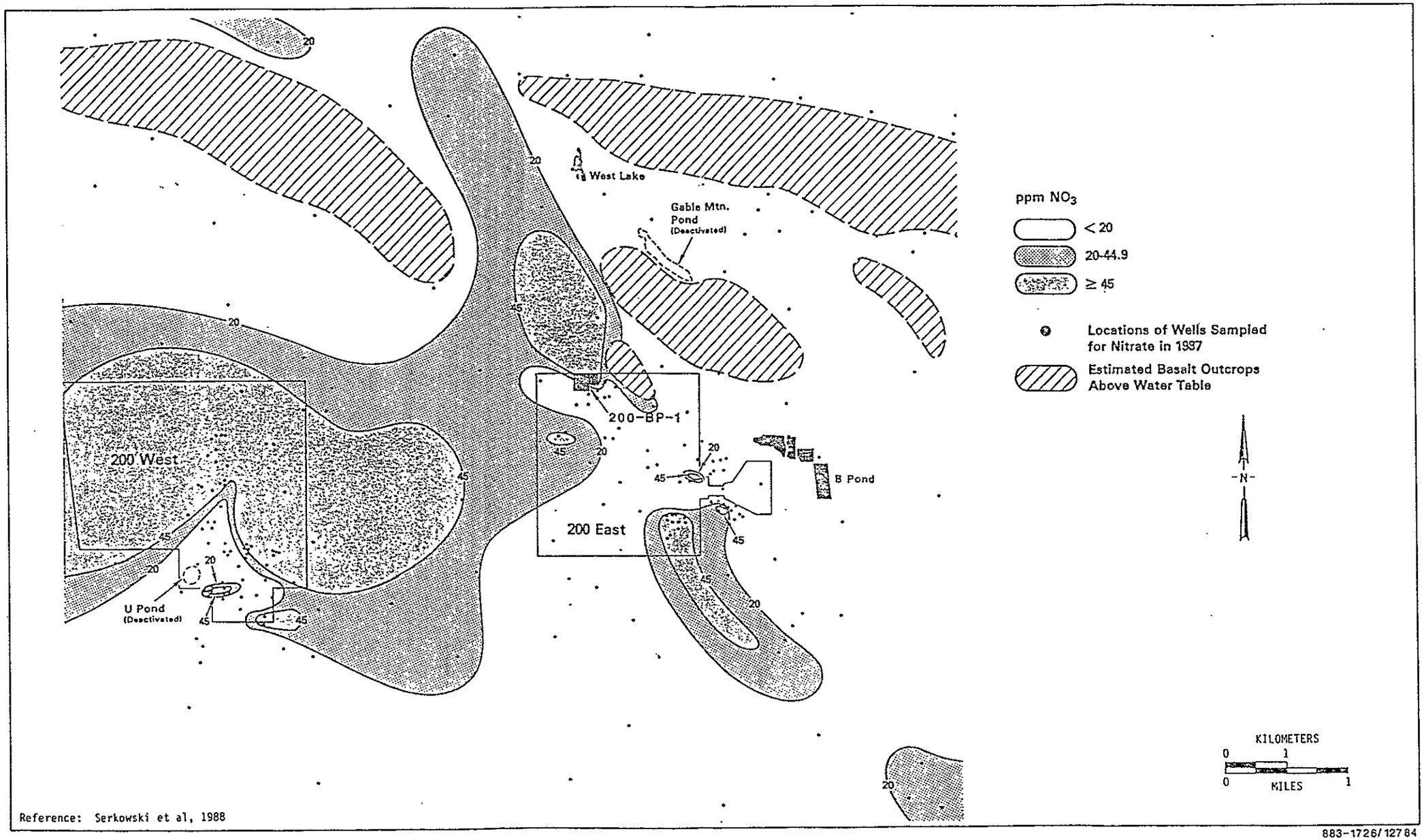
3.1.3.1 Nitrate. The current known extent of nitrate contamination in the unconfined aquifer is illustrated in Figure 3-2. A potential plume emanating from the 200-BP-1 exists and extends to the gap between Gable Mountain and Gable Butte. Nitrate concentrations above the maximum contaminant level (MCL) of 45 mg/L have been recorded in groundwater samples from wells E33-1A, E33-3, 49-55A, 49-57, and 50-53. The highest concentration observed since 1985 was 560 mg/L from well 50-53 during June 1988. Concentration from well 50-53 appear to be increasing over the last couple of years. Concentrations appear to be declining recently in wells E33-1A, E33-5 and 49-55A.

3.1.3.2 Tritium. The current known extent of tritium contamination in the unconfined aquifer is illustrated in Figure 3-3. Tritium is relatively ubiquitous in the 200 East Area and results from numerous sources. The highest tritium concentrations in groundwater samples are from wells E33-24 and 49-55A at 17,600 and 17,800 pCi/L, respectively. Tritium concentration appears to be increasing in wells E33-1A, E33-5, E33-8, E33-9, E33-20 and 50-53. Tritium concentration may be declining in well 49-55A.

Tritium has been detected near the 200-BP-1 Operable Unit in wells E33-12 (333 pCi/L), 47-50 (310 pCi/L), and 49-55B (0.7 pCi/L). These wells receive groundwater from the Rattlesnake Ridge confined aquifer (Graham et al., 1984). The source of tritium in the Rattlesnake Ridge aquifer is suspected to be from B-pond where downward vertical gradients exist because of groundwater mounding in the unconfined aquifer.

3.1.3.3 Total Beta. The known extent of total beta plumes in the unconfined aquifer is illustrated in Figure 3-4. The concentration of total beta is strongly associated with the 200-BP-1 Operable Unit. The highest concentrations in the 200-BP-1 Operable Unit were from wells E33-3 (1,200 pCi/L) and E33-7 (1000 pCi/L), although concentrations appear to be declining in these wells. Groundwater from well 50-53 had the high total beta at about 3000 pCi/L and appears to be steady over the last couple of years. Well 49-55A also had high total beta at about 1300 pCi/L and has been steady since 1987. The furthest potential downgradient well, 53-55A has low concentrations of beta at about 10 pCi/L.

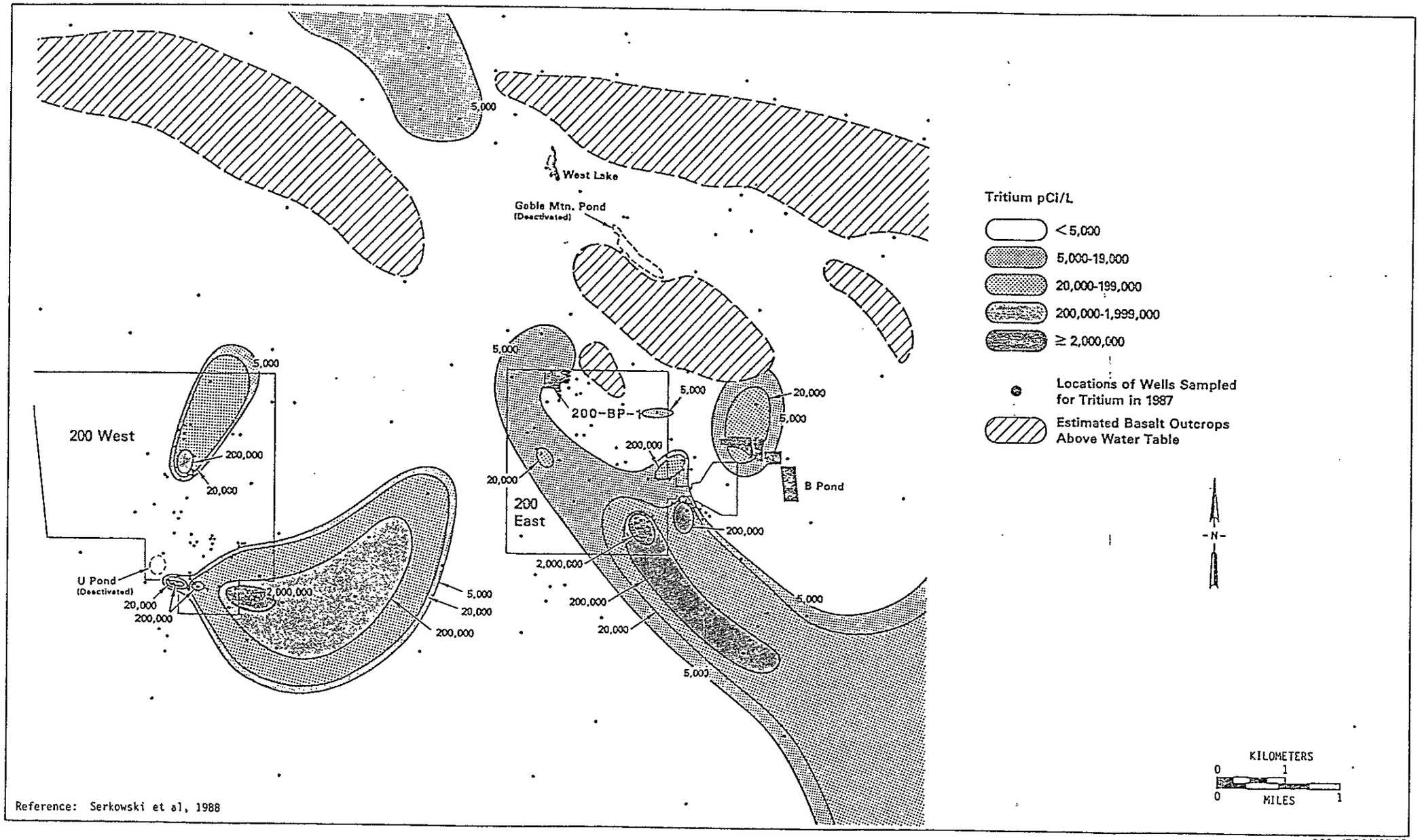
3.1.3.4 Cyanide. Sampling for chemicals in March 1987 included several 600-Area wells directly north of the 200 East Area. Cyanide was detected in two wells, 49-57 and 50-53. More extensive sampling during April to June 1988 confirmed those preliminary results. Figure 3-5 illustrates the estimated extent of the current cyanide plume. In addition, a field test taken during sampling by DOE has indicated the presence of free cyanide in well 50-53, just north of the 200 East area. The presence of cyanide was accompanied by corresponding increases in cobalt-60 and gross beta activity. Although cobalt-60 is normally relatively immobile in the Hanford subsurface environment, it appears to be chemically complexed and mobilized by cyanide. The extent of the contamination is currently limited to about 2.5 kilometers^2 (1 mile^2); however, the exact extent of the plume is difficult to determine



Reference: Serkowski et al, 1988

883-1726/12784

Figure 3-2. Nitrate Plumes Within the Separations Area, 1987 Data



883-1726/12785

Figure 3-3. Tritium Plumes Within the Separations Area, 1987 Data

9 0 1 1 7 4 1 0 9 7 0

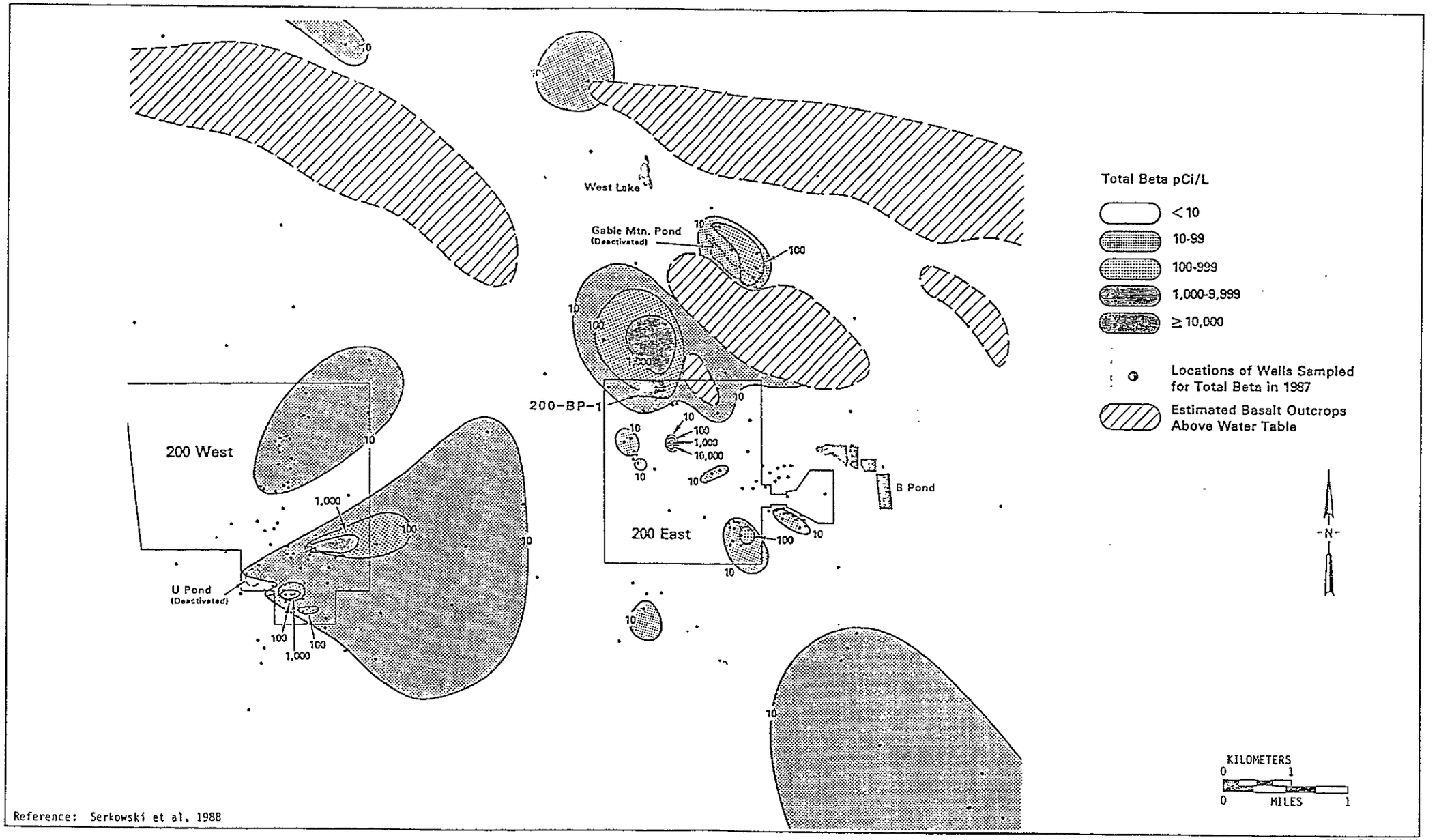


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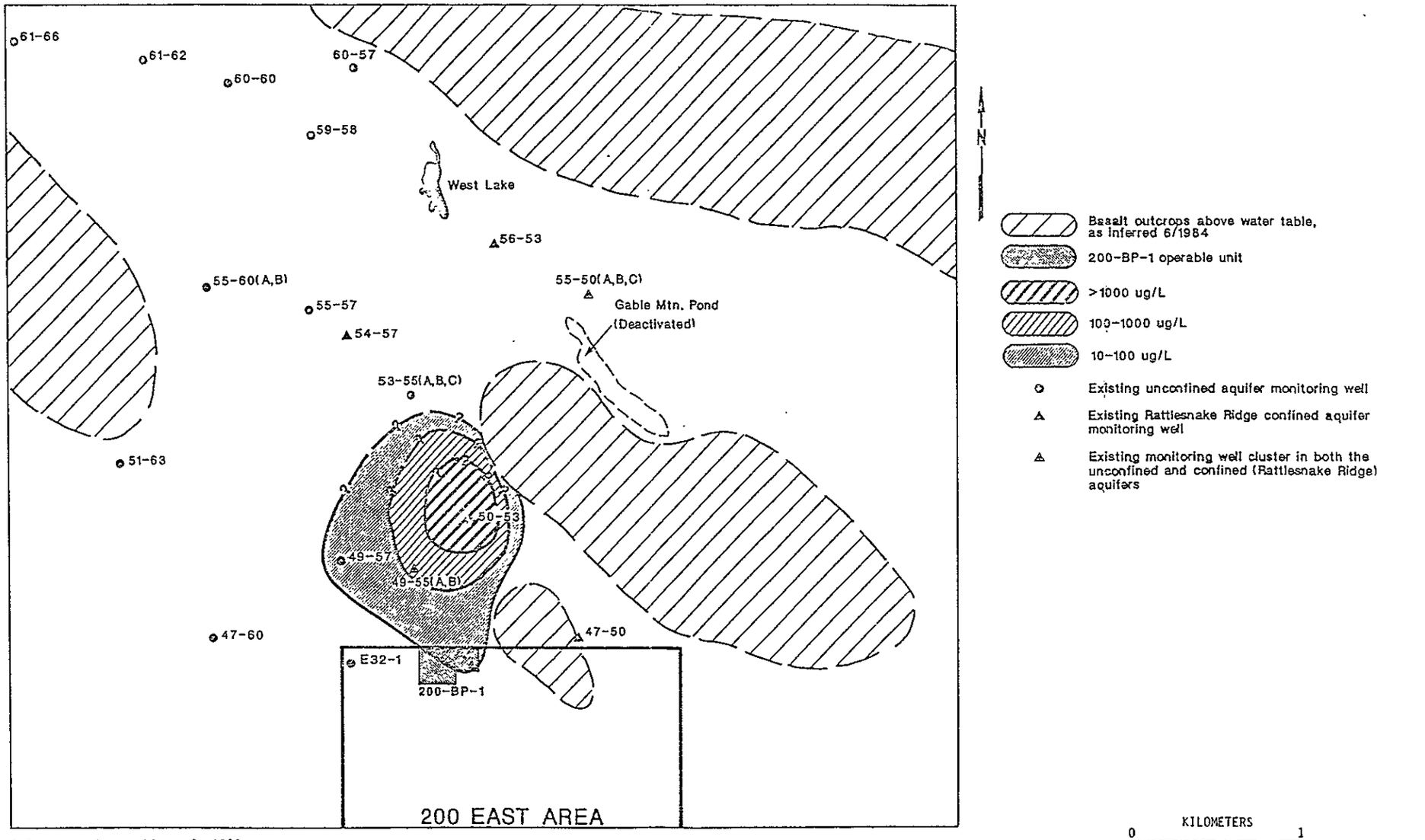
Figure 3-4. Total Beta Plumes Within the Separations Area, 1987 Data



Reference: Serkowski et al, 1988

883-1726/12787

Figure 3-5. Estimated Cyanide Plume in the Unconfined Aquifer North of the 200-BP-1 Operable Units in 1988

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because there are few wells in the area. The cyanide distribution indicates a plume with a probable source being the BY cribs. Cyanide is a waste product of the cesium precipitation processes that took place during uranium reclamation operations in the mid-1950s (PNL, 1988a).

Other wells containing detectable cyanide in groundwater include wells located in 200-BP-1 (E33-3 at 39 µg/L, E33-1A at 16 µg/L, and E33-5 at 26 µg/L) and located directly north of 200-BP-1 (49-55A at about 200 to 300 µg/L). In June 1988, sampling of 49-55A included analysis on triplicate samples with poor reproducibility. Values reported were 104, 77, and less than 10 µg/L on the triplicate samples. Cyanide concentrations appear to be decreasing in groundwater samples from wells in 200-BP-1 and in wells 49-55A and 49-57, although an increasing trend in cyanide concentrations are apparent in well 50-53 which had the highest concentration of cyanide in June 1988 at 1,690 µg/L.

Unambiguous identification of free cyanide has not yet been made by analysis. The chemical analysis method employed has been reported to be unresponsive to iron complexes of cyanide (EPA, 1982); however, a series of ferrocyanide and ferricyanide standards recently analyzed showed quantitative recovery of the added complexed cyanide. The field test method was found to respond to ferricyanide, but not to ferrocyanide (PNL, 1988d).

3.1.3.5 Technetium-99. Improved analytical procedures which resulted in a lower cost for technetium-99 allowed some additional waste sites to be investigated for technetium-99. The groundwater beneath the 216-B-48, -49, -50 Crib area was found to have technetium-99 in excess of the MCL (900 pCi/L). The highest concentration analyzed (in pCi/L) are as follows for wells tested:

E33-1A	964	pCi/L	August 4, 1987
E33-3	2710	pCi/L	August 8, 1986
E33-5	1980	pCi/L	August 10, 1987
E33-7	4700	pCi/L	August 4, 1987
E33-8	287	pCi/L	February 28, 1988
E33-9	592	pCi/L	September 2, 1987
E33-12	132	pCi/L	February 28, 1988
E33-18	32	pCi/L	March 1, 1988
E33-20	30	pCi/L	March 1, 1988
E33-24	1580	pCi/L	August 6, 1987
E33-26	1420	pCi/L	September 1, 1987
49-55A	12500	pCi/L	February 12, 1988
49-55B	0.5	pCi/L	February 19, 1988
49-57	1330	pCi/L	February 9, 1988
50-53	29100	pCi/L	December 7, 1987

Technetium-99 is suspected to be a major contributor to total beta concentration in groundwater in 200-BP-1 and hydraulically downgradient of 200-BP-1. It has not been tested long enough to determine, with confidence, if concentrations are increasing or decreasing.

3.1.3.6 Total Uranium. Low concentrations of uranium have been detected in groundwater in the vicinity of 200-BP-1 with no obvious trends. The highest concentrations detected are from groundwater from wells E33-3 (4.6 pCi/L) on August 6, 1987 and 49-55A (3.83 pCi/L) on February 12, 1988.

3.1.3.7 Strontium-90. Several 200 East Area wells contained strontium-90 in concentrations greater than the MCL (8 pCi/L). The highest concentrations were found northeast of the B Plant (south and upgradient of 200-BP-1) in wells E28-7 (85.7 pCi/L), E28-23 (6,910 pCi/L), E28-24 (186 pCi/L), and E28-25 (3,490 pCi/L). The concentrations in these wells can be attributed to wastes discharged to the 216-B-5 reverse well during 1945 to 1947. The concentration in well E28-23 was similar to those measured in 1986 (about 7,000 pCi/L); the other wells were first sampled in March 1987 (PNL, 1988a).

Concentrations of ^{90}Sr in groundwater from wells in 200-BP-1 has been 1 pCi/L or less except for a single anomalous analysis of 40.3 pCi/L in E33-7 on August 4, 1987 that was never repeated. Wells located downgradient of 200-BP-1 Operable Unit have had concentrations less than 2 pCi/L since 1985.

3.1.3.8 Cobalt-60. All cobalt-60 results were near or below the contract detection limit (200 pCi/L), except in an isolated portion of the 200 East Area and the adjacent 600 Area. The concentration of cobalt-60 in well E33-7, located in the northern portion of the 200 East Area, is currently about 70 pCi/L but has been as high as 117 pCi/L. Wells 49-55A and 50-53, which are immediately north of well E33-7, continue to contain cobalt-60 in concentrations much above the MCL (100 pCi/L), around 200 and 470 pCi/L, respectively. The transport of cobalt-60 to these wells is probably attributable to complexing with cyanide, which was discussed earlier (PNL, 1988a).

3.1.3.9 Cesium-137. Concentrations of cesium-137 were below the detection limit (22.5 pCi/L) in all wells except E28-23. That well continued to contain cesium-137 in concentrations averaging 2,490 pCi/L, which is well above the MCL (200 pCi/L). E28-23 is 900 meters (2,953 feet) south of 200-BP-1 and adjacent to the 216-B-5 reverse well which is believed to be the source of cesium-137. This well is hydraulically upgradient 900 meters (2,953 feet) to the 200-BP-1 Operable Unit and may eventually impact groundwater in the vicinity of the 200-BP-1 area (PNL, 1988a).

3.1.3.10 Ruthenium-106. Ruthenium-106 has been detected in groundwater samples throughout the vicinity of 200-BP-1. Results have been sporadic and difficult to associate with the 200-BP-1 Operable Unit. The laboratory contract detection limit which is achievable is 172 pCi/L. Ruthenium-106 has not been detected in 200-BP-1 vicinity groundwater samples above this detection limit which is higher than the drinking water MCL (30 pCi/L). Because concentration of ruthenium-106 in groundwater samples are stressing the limits of utilized analytical procedures there is a low level of confidence in quality control and interpretation of results.

3.1.3.11 Total Alpha. Total alpha has been detected in groundwaters from wells in the vicinity of 200-BP-1. The concentrations are typically less than 5 pCi/L. The highest single analysis was 8 pCi/L from well 50-53. No obvious trends were observed in total alpha concentrations with time.

3.1.3.12 Ammonium Ion. Ammonium ion concentrations in groundwater in the vicinity of 200-BP-1 are near or slightly above detection limits of 50 μg/L. An exception is groundwater from 49-55A which appears to have increasing concentrations with time. Ammonium ion was detected in recent analysis on February 12, 1988 at about 1,450 mg/L from this well.

3.1.3.13 Phosphate. All analyses of phosphate in groundwater from wells in the vicinity of 200-BP-1 have been below detection limit of 1 mg/L.

3.1.3.14 Chloride. Chloride concentrations vary within groundwater samples. The highest concentrations were 113 mg/L from well 50-53 during one sampling period.

3.1.3.15 Sulfate. Higher sulfate concentrations in groundwater appear to be associated with 200-BP-1. The highest concentrations are from well 50-53 at about 470 mg/L. In addition, sulfate was relatively high from well 49-55A at about 140 mg/L. Concentrations in groundwater from these wells appear to be stabilized.

3.1.3.16 Total Organic Carbon. Many organic compounds were tested in groundwater from wells in the vicinity of 200-BP-1 (Appendix E). Only total organic carbon (TOC) was detectable in low concentrations in groundwater. One groundwater sample obtained from well 50-53 was reported to contain 22,300 µg/L of methylene chloride. This is believed to be an erroneous value because groundwater from well 50-53 analyzed previous to and subsequent to this result were below detection of 10 µg/L. All other groundwater samples in the vicinity of 200-BP-1 tested for methylene chloride had concentration below detectable limits.

Groundwater samples from wells near the 200-BP-1 Operable Unit normally had concentrations of TOC less than 1,000 µg/L except from well 50-53 which had concentrations consistently above 1,000 µg/L (maximum was 2,000 µg/L). Concentrations of TOC appear to be declining within the last year.

3.1.3.17 Other Detectable Analytes. Many analytes have been detected in groundwater samples from wells in the vicinity of 200-BP-1. Major cations that are common to all groundwater include sodium, calcium, magnesium, and potassium which are present in groundwater around 200-BP-1. All major cations were highest in groundwater from well 50-53 and next highest from well 49-55A. Sodium has been identified as a significant waste constituent but the maximum value in 200-BP-1 vicinity well water is 66 mg/L from well 50-53.

Other detectable metals and anions include:

- iron
- manganese
- barium
- lead
- vanadium
- selenium
- arsenic
- zinc
- copper
- mercury
- chromium
- fluoride

All of the above analytes, except iron and selenium are below primary or secondary drinking water standards (40 CFR 141 and 40 CFR 143). Iron and selenium were above secondary drinking water and primary drinking water standards, respectively, in groundwater from only one well, 50-53. Vanadium and barium were present in all groundwaters tested since 1985 at relatively constant concentrations in the range of 10 to 80 µg/L and probably represents background concentrations in the unconsolidated aquifer. Fluoride, iron, and zinc were detectable in most groundwater samples while the remainder of the analytes were detectable only in a few groundwater samples.

Groundwater from well 50-53 has consistently contained the highest concentrations of most contaminants. Three possible explanations or combinations for this may be:

1. The plume emanating from disposal units in 200-BP-1 is migrating as a slug which originated during active disposal periods, with a reduced flux of contaminants to the unconsolidated aquifer in recent times.

2. Groundwater in the area of well 50-53 is receiving contaminants from sources other than 200-BP-1 such as B Pond, the 216-B-2 trench and/or the 216-B-51 crib. Selenium concentration from well 50-53 has recently been increasing to 27 µg/L, and has been below detection (5 µg/L) in all other groundwater samples associated with 200-BP-1. This indicates possible contributions from other sources.

3. Paleo stream channels (higher energy deposits) with high hydraulic conductivities may exist within the unconfined aquifer which are controlling and channeling contaminant plumes.

3.1.4 Surface Water

Water, vegetation, and sediment samples are being collected and analyzed from active ponds and ditches and from West Lake. These data are available in annual reports by Westinghouse Hanford and PNL. Active ponds and ditches represent waste management units outside 200-BP-1; data associated with active ponds and ditches are not relevant to this work plan.

West Lake is a perennial surface water body that is in hydraulic communication with the unconfined aquifer and is located hydraulically downgradient of 200-BP-1. Groundwater monitoring data (Section 3.1.3) suggest that plumes associated with 200-BP-1 are not currently discharging to West Lake or the Columbia River. Analyses of surface water, lake sediment and lake vegetation are presented in Appendix F. Any current contamination existing in West Lake is expected to have been primarily caused by disposal practices associated with the operation of Gable Mountain Pond. If groundwater plumes associated with 200-BP-1 are discovered to be discharging to West Lake, these monitoring data may be useful (Elder et al., 1988).

3.1.5 Air

Ambient air sampling is conducted by Westinghouse Hanford to determine baseline concentrations of radionuclides in the 200 Areas and to assess the impact of operations on the local environment. These measurements also provide an indication of the 200 Areas facility performance and are used to demonstrate compliance with environmental protection criteria. The Westinghouse Hanford air sampling program in the 200 East Area, as illustrated in Figure G-1 in Appendix G, takes into consideration prevailing and high wind directions, as well as potential source terms. Meteorological conditions are continuously monitored by PNL's meteorological stations positioned around the Hanford Site (Elder et al., 1988).

The network of 46 air samplers operates on a continuous basis in and around the 200 Areas. Three of the 46 samples are distant from the 200 Areas to provide background data: one each at the Yakima and Wye Barricades and one at the Hanford townsite. Two air monitoring stations, particularly relevant to the 200-BP-1 Operable Unit, are designated N167 and N967. These stations are located immediately south and northeast, respectively of the BY cribs. Air monitoring Station N973 is located about 600 meters (2,000 feet) southeast of the BY cribs. All sample filters are exchanged weekly, held 1 week (to allow for decay of the short-lived natural radioactivity), and then sent to the 222-S Laboratory for initial analysis of gross alpha and gross beta activity. These initial analyses serve as an indicator of potential environmental problems. After the initial analysis, the filters are stored until the end of the calendar quarter, at which time they are composited by sample location (or as considered appropriate) and sent to the U.S. Testing laboratory for specific radionuclide analysis. Of the analyses performed, four are routinely reported: cesium-137, strontium-90, plutonium-239, and total uranium. The compositing of the air filters by sample location provides a larger sample size and, thus, a more accurate measurement of the concentration of airborne radionuclides resulting from operations in the 200 Areas. To help assess the impact of operations, the results obtained must be compared to background data. Because of the sensitivity of air monitoring to the sampling techniques, direct comparisons to background data from PNL cannot be made (e.g., PNL collects a larger sample per filter and composites multiple sites). Therefore, Westinghouse Hanford set up the three distant stations to obtain background data using sampling techniques identical to the rest of the program.

The 1987 air sampling results are summarized in Table G-1 in Appendix G. Annual average radionuclide concentration since 1979 are illustrated in Figures G-1 through G-3 in Appendix G. All sites were below the applicable DOE guidelines in 1987. Activities in the 200 Areas contributed to average radionuclide concentrations in air only slightly above background. Trends over the past 8 years have generally been downward for both 200 East and 200 West Area, and all radionuclide concentrations were below the DCGs in 1987. With the exception of strontium-90 in air at N962 (located in 200 West Area), all individual stations for all measured radionuclides have been showing a generally downward trend as well (Elder et al., 1988).

3.1.6 Biota

When soil samples are collected from the grid sites, terrestrial vegetation samples (e.g., cuttings from growing plants) are also collected to determine accumulation of radioactivity in plants. Analyses are performed for gamma-emitting radionuclides and at selected sites for strontium-90 and plutonium isotopes. Comparisons are made with regional background (PNL, 1988d) data for determining impact due to 200 Area operations (Elder et al., 1988).

The location of sampling grid sites in the 200 East Area are shown on Figure H-1 in Appendix H. Radionuclide concentrations are listed by grid site for 1987 in Figure H-2 in Appendix H. Concentration of cesium-137 for the years 1978 through 1987 in vegetation by grid site is presented in Figure H-3 in Appendix H.

Vegetation samples obtained at grid site 2E-3, which is located on the northeast corner of 200-BP-1 boundary had concentrations above background PNL, 1988 of cesium-137 in all samples obtained from 1978 through 1987. Vegetation samples obtained at grid site 2E-2, which is located close to the northwest corner of 200-BP-1 boundary, also had concentrations of cesium-137 above background during all years tested from 1978 through 1987.

3.1.7 Investigative Sampling

Special investigative sampling is conducted in the operations area to augment the routine-sampling program, to support construction projects, and to verify near-field waste containment. Special sampling is often undertaken to help explain questions that result from analyses of the routine samples; however, it may also be the result of concerns about radioactive waste as it affects or is affected by matters such as employee safety, biotic intrusion, and maintenance of containment systems. Special samples may be collected from the following (Elder et al., 1988).

- A broader area when analytical results from one of the routine sample sites show elevated radionuclide content.
- An area where scheduled construction activities in the vicinity of a waste site make it desirable to demonstrate the radiological condition of the area.
- A site where biotic intrusion, such as animal burrows or deep-rooted vegetation growth has created the potential for the spread of radionuclides.
- Sites where the integrity to radioactive waste maintenance systems is questioned.

These are examples, but certainly not an all-inclusive list, of instances when special investigative samples are needed to ensure employee safety at near-field operations as well as compliance with applicable guidelines and regulations.

During calendar year 1987, there was no investigative sampling associated with or near the 200-BP-1 Operable Unit.

3.2 PRELIMINARY IDENTIFICATION OF POTENTIAL FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

3.2.1 Identification

Section 121(d) of CERCLA requires that remedial actions at NPL sites comply with federal and state laws and regulations that are applicable or relevant and appropriate (ARAR) under the circumstances presented by the release or threatened release of hazardous substances, pollutants or contaminants at the site. These ARARs can be grouped into three types; chemical-specific, location-specific, and action-specific (EPA, 1988c).

Included in Table 3-4 is a preliminary list and assessment of potential federal ARARs for the 200-BP-1 Operable Unit. Potential Washington State ARARs are included in Table 3-5. Normally, only chemical and location-specific ARARs are identified during scoping of the work plan. Potential action-specific ARARs are included in these tables to illustrate those that may be evaluated during remedial alternative screening in the feasibility study.

Also included in these tables is a preliminary assessment of whether the ARAR is applicable, potentially relevant and appropriate, or to be considered. Applicable requirements are defined as those that would be legally applicable to a remedial action if that action were not taken pursuant to CERCLA. Relevant and appropriate requirements are those that apply to similar circumstances to those encountered at CERCLA sites, where their application would be appropriate, although not legally required. Other criteria, advisories, and guidance which are not legally enforceable are to be considered in evaluating alternatives.

Tables 3-6 and 3-7 include a comparison of 200-BP-1 site contaminant levels for the known chemicals of concern with potential chemical-specific ARARs (and guidance) for non radiological contaminants and radionuclides, respectively.

Groundwater monitoring data obtained from 1985 through June 1988 (PNL, 1988e) indicate several chemicals have been detected at levels exceeding ARARs or guidance. Nitrate, selenium, gross beta, cobalt-60, ruthenium-106, strontium-90, and technetium-99 have all been detected at levels exceeding National Interim Primary Drinking Water Standards (EPA, 1976). Sulfate concentrations have exceeded secondary drinking water standards. Cyanide has been detected at levels exceeding EPA drinking water health advisories.

3.2.2 Point of Applicability

A significant factor for evaluation of remedial alternatives at the Hanford Site will be determining the point of applicability for compliance with the ARARs. The points of applicability are the boundaries that will be used to assess the effectiveness of remedial alternatives. Determining the point of applicability of ARARs concerning groundwater quality is especially significant for the contaminants and primary exposure pathways currently identified at the 200-BP-1 Operable Unit.

For water that is or may be used for drinking, the MCLs set under the Safe Drinking Water Act of 1974 are generally the applicable or relevant and appropriate standard. The EPA's interim guidance on compliance with ARARs states, "MCLs are applicable at the tap where the water will be provided directly to 25 or more people or will be supplied to 15 or more service connections. Otherwise, where surface water or groundwater is or may be used for drinking, MCLs are generally relevant and appropriate as cleanup standards for the surface water or the groundwater" (52 FR 32496, August 27, 1987). Groundwater affected by the site is not currently used for drinking water at the Hanford Site and there is no evidence of off site groundwater being

Table 3-4. Preliminary Identification of Federal Applicable or Relevant and Appropriate Requirements (ARARs) at 200-BP-1 Operable Unit (Sheet 1 of 3)

Requirements	Applicable	Potentially Relevant and Appropriate	To Be Considered	Rationale
1. Chemical Specific				
1.1 Safe Drinking Water Act of 1974				Groundwater is not used for drinking and institutional controls can prevent future use. However, there is potential for discharge of contaminated groundwater to the Columbia River which is used for drinking water.
- Maximum Contaminant Levels (MCLs)		X		
- Maximum Contaminant Level Goals (MCLGs)		X		
1.2 Health Advisories, EPA Office of Drinking Water			X	Chemicals identified for which health advisories are listed.
1.3 Clean Water Act of 1977				Potential for contaminated groundwater to discharge to surface water.
- Federal Water Quality Criteria (FWQC)		X		
1.4 RCRA Groundwater Protection Standards (40 CFR 264, Subpart F)				ACLs may be relevant and appropriate in accordance with CERCLA 121 (d)(2)(B)(ii).
- Alternate Concentration Limits (ACLs)		X		
1.5 Health Effects Assessment			X	Public health risk assessment will be conducted in the RI/FS for chemicals of concern by all routes of exposure.

Table 3-4. Preliminary Identification of Federal Applicable or Relevant and Appropriate Requirements (ARARs) at 200-BP-1 Operable Unit (Sheet 2 of 3)

Requirements	Applicable	Potentially Relevant and Appropriate	To Be Considered	Rationale
1.6 Clean Air Act of 1977				
- Standards for Protection Against Radiation (10 CFR 20 and 61)	X			Remedial alternatives may result in air emissions.
- National Emission Standard for Hazardous Air Pollutants for Radionuclides (40 CFR 61)	X			
1.7 Environmental Radiation Protection Standards (DOE Order 5400.3 and 40 CFR 191, Subpart F)	X			Radiation standards for protection of the public in the vicinity of DOE facilities.
2. Location-Specific				
2.1 National Historic Preservation Act of 1966				Applicability will be determined during RI and in evaluation of remedial alternatives.
- Protection of Archeological Resources	X			
2.2 Endangered species Act of 1973		X or	X	Considered in the public health and environmental assessment.
2.3 Fish and Wildlife Coordination Act of 1934	X			Remedial alternatives may affect wetlands and protected habitats, although this is not anticipated.

Table 3-4. Preliminary Identification of Federal Applicable or Relevant and Appropriate Requirements (ARARs) at 200-BP-1 Operable Unit (Sheet 3 of 3)

Requirements	Applicable	Potentially Relevant and Appropriate	To Be Considered	Rationale
2.4 Fish and Wildlife Improvement Act of 1978	X			"
2.5 Fish and Wildlife Conservation Act of 1980	X			"
3. Action-Specific				
3.1 Hazardous Waste Requirements (40 CFR 261-268)	X	or X		May be applicable for generation transport, treating, storing, and off-site disposal alternatives (including the Land Ban requirements). May be relevant or appropriate for containment alternatives (i.e., cover design).
3.2 Clean Water Act of 1977				
- National Pollutant Discharge Elimination System permit	X			Remedial actions may include discharge to surface water.
- Underground Injection Control Regulations (40 CFR Parts 144-147)	X			Remedial actions may include injection of treated groundwater.
3.3 Occupational Safety and Health Act of 1970 (29 USC 651)				Health and safety requirements.
- OSHA Standards (29 CFR Part 1910)	X			

Table 3-5. Preliminary Identification of State Applicable or Relevant and Appropriate Requirements (ARARs) at 200-BP-1 Operable Unit (Sheet 1 of 4)

Requirements	Applicable		Potentially Relevant and Appropriate	To Be Considered	Rationale
1. Chemical-Specific					
1.1 Water Pollution Laws and Regulations					
- Water Pollution Control Act (Ch. 90.46 RCW)	X	or	X		Do not contain numeric standards. Require surface and groundwaters of the state to be protected to maximize beneficial uses. Require all known, available, and reasonable treatment for discharges.
- Regulation of Public Groundwaters (Ch. 90.44 RCW)			X		
- Water Resources Act of 1971 (Ch. 90.54 RCW)			X		
- Water Quality Standards for Waters of the State of Washington (Ch. 173-201 WAC)	X				Contain water quality standards for the Hanford reach of the Columbia River.
- Public Water Supplies (Ch. 248-54 WAC)			X		Washington Department of Social and Health Services standards for public drinking water.
1.2 Solid & Hazardous Waste Laws and Regulations					
- Hazardous Waste Cleanup Act (Ch. 70.105B RCW)			X		Require remedial actions attain a degree of cleanup that is protective of human health and the environment. Ecology to prepare guidance on cleanup levels.

Table 3-5. Preliminary Identification of State Applicable or Relevant and Appropriate Requirements (ARARs) at 200-BP-1 Operable Unit (Sheet 2 of 4)

Requirements	Applicable	Potentially Relevant and Appropriate	To Be Considered	Rationale
- Department of Ecology Final Cleanup Policy - Technical (July 10, 1984)			X	Nonpromulgated policy to be considered.
- Dangerous Waste Regulations (Ch. 173-303 WAC)		X		Contain requirements equivalent to RCRA for groundwater protection standards.
1.3 State Radiation Standards (Ch. 70.98 RCW and WAC Title 402)		X		Contain state radiation standards.
2. Location-Specific				
No state ARARs identified at this time.				
3. Action-Specific				
3.1 Washington Clean Air Act (Ch. 70.94 RCW and Ch. 173 - 480 WAC)	X or	X		Remedial alternatives may include air emissions to the extent Federal laws are applicable. May be relevant and appropriate to the extent they are more stringent than Federal law.

Table 3-5. Preliminary Identification of State Applicable or Relevant and Appropriate Requirements (ARARs) at 200-BP-1 Operable Unit (Sheet 3 of 4)

Requirements	Applicable		Potentially Relevant and Appropriate	To Be Considered	Rationale
3.2 Hazardous Waste Management Act (Ch. 70.105 RCW) and Dangerous Waste Regulations (Ch. 173-303 WAC)	X	or	X		Establish priorities for hazardous waste management. May be applicable to alternatives that include generation, treatment, storage, or disposal of waste. May be relevant and appropriate for containment alternatives (i.e., cover design).
3.3 Solid Waste Management, Recovery and Recycling Act (Ch. 70.95 RCW) and Minimum Functional Standards for Solid Waste Handling (Ch. 173-304 WAC)	X	or	X		May be applicable for alternatives requiring management of solid waste. To extent they are more stringent than Federal law, may be relevant and appropriate.
3.4 Washington State Water Code (Ch. 90.03 RCW)			X		Water rights law. May be relevant and appropriate for alternatives which include extraction and treatment of groundwater.
3.5 Minimum Standards for Construction and Maintenance of Water Wells (Ch. 173-160 WAC)			X		May be relevant and appropriate for monitoring wells during RI and alternatives which include extraction wells.
3.6 State Waste Discharge Program (Ch. 173-216 WAC)			X		May be relevant and appropriate to alternatives which include discharges to ground.

Table 3-5. Preliminary Identification of State Applicable or Relevant and Appropriate Requirements (ARARs) at 200-BP-1 Operable Unit (Sheet 4 of 4)

Requirements	Applicable		Potentially Relevant and Appropriate	To Be Considered	Rationale
3.7 Underground Injection Control Program (Ch. 173-218 WAC)	X	or	X		May be applicable to alternatives which include underground injection to the extent Federal laws are applicable. May be relevant and appropriate to the extent they are more stringent than Federal law.
3.8 National Pollution Discharge Elimination System Permit Program (Ch. 173-220 WAC)	X	or	X		May be applicable to alternatives which include discharges to the Columbia River to the extent Federal laws are applicable. May be relevant and appropriate to the extent they are more stringent than Federal law.

Table 3-6. Potential Applicable or Relevant and Appropriate Requirements and Guidance for Nonradiological Contaminants at 200-BP-1 Operable Unit (µg/L)

Chemical	Federal Drinking Water Standards: MCL (a)	MCLG (b)	Proposed MCLG(c)	Concentration at 10^{-6} Risk Level (d,e)	Concentration at Reference dose Level (d,e)	Water Quality Criteria for Protection of Aquatic Organisms & Human Health (f): Ingestion of Drinking Water Only: Threshold Toxicity Protection	10^{-6} Cancer Risk	Ingestion of Drink-Water and Aquatic Organisms: Threshold Toxicity Protection	10^{-6} Cancer Risk	Ingestion of Aquatic Organisms Only: Threshold Toxicity Protection	10^{-6} Cancer Risk	Aquatic Organisms: Acute	Chronic	EPA Office of Drinking Water Health Advisory(g) Lifetime 70 kg Adult	Site (h) Contaminant Levels in Groundwater
ammonia	-	-	-	-	-	-	-	-	-	-	-	(i)	(i)	-	1,490
barium, total	1,000	-	1,500	-	1,750	-	-	-	-	-	-	-	-	1,500	77
chromium total	50	-	120	-	-	-	-	-	-	-	-	(j)	(j)	120	13
cyanide	-	-	-	-	1,015	200	-	200	-	-	-	22	5.2	154	1,690
fluoride	2,000	-	-	-	-	-	-	-	-	-	-	-	-	-	1,670
iron, total	300	-	-	-	-	-	-	-	-	-	-	-	1,000	-	318
nitrate	45,000	45,000	-	-	-	-	-	-	-	-	-	-	-	45,000	558,000
phosphate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1,000
selenium, total	10	-	45	-	105	10	-	10	-	-	-	260	35	-	27
sodium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	65,000
sulfate	250,000	-	-	-	-	-	-	-	-	-	-	-	-	-	474,000
vanadium	-	-	-	-	700	-	-	-	-	-	-	-	-	-	38

(a) 40 CFR 141 and 143. Includes Primary and Secondary Standards.
(b) 40 CFR 141.50.
(c) 50 FR 46936; November 13, 1985.
(d) EPA Integrated Risk Information System database (U.S. EPA, 1989). This information needs to be verified because of frequent updates to data base.
(e) Assuming drinking water ingestion of 2 L/day and body weight of 70 kg.
(f) 45 FR 79318-79379; November 28, 1980.
(g) U.S. EPA, Health Advisories, March 1987.
(h) Maximum site contaminant levels for metals are on filtered samples. Values are maximum levels reported from 1985 through June 1988 for wells in the vicinity of Operable Unit 200-BP-1 (Stenner et al., 1988).
(i) Criteria for ammonium are pH and temperature dependant.
(j) Criteria promulgated for chromium III and chromium VI only

Table 3-7. Potential Applicable or Relevant and Appropriate Requirements and Guidance for Radionuclides at 200-BP-1 Operable Unit

Contaminant	Site Contaminant Levels in Groundwater (pCi/L)(a)	Federal and State Drinking Water Standards (MCLs) (pCi/L)	10 CFR 20[b] Emission Limits: Federal Air Quality Standards	Air (pCi/m³) Soluble	Air (pCi/m³) Insoluble	Water (pCi/m³) Soluble	Water (pCi/m³) Insoluble	Environmental Radiation Protection[c] Standards for Radioactive Waste Disposal (all pathways) (curies/unit of waste): 40 CFR 191	40 CFR 193	Derived Concentration Guides: Water (pCi/L)	Air (pCi/m³)
gross alpha	8.05	15[d]	--	--	--	--	--	--	--	--	--
gross beta and gross gamma	3,020	50[e] 4 mrem/yr[e]	--	--	--	--	--	--	--	--	--
cesium-137	24	200[e]	--	2,000	500	20,000	40,000	1,000	--	3,000	400
cobalt-60	487	100[e]	--	10,000	300	50,000	30,000	--	--	5,000	80
plutonium-239 and	1.2	--	--	0.06	1.0	5,000	30,000	100	--	300	0.02
plutonium-240		--	--	0.06	1.0	5,000	30,000	100	--	300	0.02
ruthenium-106	111	30[e]	--	3,000	200	10,000	10,000	--	--	6,000	30
strontium-90	40.3	8[e]	--	30	200	300	40,000	1,000	--	1,000	9
technitium-99	29,100	900[e]	--	70,000	2,000	300,000	200,000	10,000	--	100,000	--
tritium	17,800	20,000[e]	--	200,000	200,000	3,000,000	3,000,000	--	--	2,000,000	200,000
uranium	2.43	--	--	3.0	5.0	40,000	40,000	100	--	600	0.1
all sources		Whole Body: 25 mrem/yr Critical Organ: 75 mrem/yr Alternate Standards Continuous Exposure: 100 mrem/yr Noncontinuous Exposure: 500 mrem/yr						Whole Body: 25 mrem/yr 25 mrem/yr Critical Organ: 75 mrem/yr Alternate Standards Continuous Exposure: 100 mrem/yr Noncontinuous Exposure: 500 mrem/yr		100 mrem/yr	100 mrem/yr

(a) Values are maximum levels reported from 1985 through June 1988, groundwater monitoring program for wells in the vicinity of operable unit.
(b) NRC radiation protection standards at boundary of restricted area.
(c) 40 CFR 191 has been invalidated by the Courts and remanded back to EPA on groundwater protection issues. Release limits for radionuclides may be deleted from these regulations.
(d) 40 CFR 141.15 - 141.16 excludes radon and uranium; WAC 248-54-175(8) excludes uranium only.
(e) Annual average concentrations shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 mrem/yr. For known mixtures of radionuclides, the sum of the ratios of the observed concentrations of each radionuclide and its corresponding MCL must not exceed 1.0.

affected by this operable unit. The MCLs would not be applicable, but may be relevant and appropriate cleanup standards for the 200-BP-1 Operable Unit.

The groundwater protection standards for the RCRA program promulgated under 40 CFR 264 and 265 Subpart F provide EPA with the option of establishing alternate concentration limits (ACLs) at hazardous waste facilities. Section 121 (d)(2)(B)(ii) of CERCLA states that ACLs may only be used to establish standards for cleanup of groundwater under the following conditions:

- there are known and projected points of entry of such groundwater into surface water; and
- on the basis of measurements or projections, there is or will be no statistically significant increase of such constituents from such groundwater in such surface water at the point of entry or at any point where there is reason to believe accumulation of constituents may occur downstream; and
- the remedial action includes enforceable measures that will preclude human exposure to the contaminated groundwater at any point between the facility boundary and all known and projected points of entry of such groundwater into surface water.

If these conditions are met, then the assumed point of human exposure (point of applicability) may be at such known or projected points of entry. Based on these criteria, ACLs may be particularly relevant for evaluation of groundwater remedial alternatives for the 200-BP-1 Operable Unit.

The EPA has also published draft guidance on remedial actions for contaminated groundwater at CERCLA sites that is useful in determining cleanup standards and points of applicability (EPA, 1988c). The guidelines discuss EPA's groundwater protective strategy and procedure for classifying groundwater within a prescribed area around a facility or activity based on the value, use, and vulnerability of the groundwater. The groundwater protection strategy establishes three classifications of groundwater, requiring different levels of protection. These include:

Class I - Special groundwaters (i.e., sole source aquifers)

Class IIa - Current and potential sources of drinking water and water having other beneficial uses

Class IIb - Not currently used but potential source of drinking water and water having other potential beneficial uses

Class III - Groundwater that is not a potential source of drinking water and of limited potential use due to salinity or widespread contamination

Drinking water standards are applicable or relevant and appropriate cleanup standards for Class I and Class II groundwater. Drinking water standards are not applicable or relevant and appropriate for Class III type water.

Groundwater in the 200-BP-1 Operable Unit would probably be considered Class IIb. However, establishment of ACLs may be appropriate depending on whether institutional controls over groundwater use in the area will continue.

In summary, the point of applicability of ARARs will be a significant factor in evaluating appropriate remedial alternatives for groundwater in the 200-BP-1 RI/FS. Applicability of ARARs at the operable unit boundary versus potential points of entry to surface water will have to be determined.

3.2.3 Evaluation

Evaluation of ARARs is an iterative process that will be conducted at multiple points throughout the RI/FS, namely:

- During Phase I of the RI (site characterization), when the public health evaluation is conducted to assess risks at the 200-BP-1 Operable Unit, the chemical-specific ARARs and advisories and location-specific ARARs will be identified more comprehensively and used to help determine the cleanup goals.

- During development of remedial alternatives in Phase I and II of the FS, action-specific ARARs will be identified for each of the proposed alternatives and considered along with other ARARs and advisories.

- During detailed analysis of alternatives in the Phase III FS, all the ARARs and advisories for each alternative will be examined as a package to determine what is needed to comply with other laws and be protective of public health and the environment.

Following completion of the RI/FS, the remedial alternative selected must be able to attain all ARARs unless one of the six statutory waivers provided in Section 121 (d)(4)(A) through (f) of CERCLA is invoked. This will be documented in the ROD. Finally, during remedial design, the technical specifications of construction must ensure attainment of ARARs. The six reasons ARARs can be waived are:

- The remedial action is an interim measure where the final remedy will attain ARARs upon completion.

- Compliance will result in greater risk to human health and the environment than other options.

- Compliance is technically impracticable.

- An alternative remedial action will attain the equivalent performance as the ARAR.

- For state ARARs, the state has not consistently applied (or demonstrated the intention to consistently apply) the requirements in similar circumstances.

- For CERCLA-financed actions under section 104, compliance with the ARAR will not provide a balance between the need for protecting public health, welfare, and the environment at the facility, and the need for fund money to respond to other sites (this waiver is not applicable at the Hanford Site).

3.3 PRELIMINARY ASSESSMENT OF POTENTIAL IMPACTS TO PUBLIC HEALTH AND THE ENVIRONMENT

3.3.1 Objectives

In this section, the potential impacts associated with releases from the 200-BP-1 Operable Unit will be examined with the following objectives.

- Identify target compounds for RI baseline risk assessment.
- Identify imminent and substantial threats to public health and the environment.
- Identify potentially operable exposure pathways and qualitatively assess existing or potential risks to the extent necessary to identify risk assessment "data gaps."
- Identify appropriate ARARs and/or target concentrations of contaminants, at least to the extent necessary to establish data quality objectives (DQOs) for the baseline risk assessment.

As indicated in more detail in the following sections, the evaluation of existing data indicates there currently is no imminent or substantial threat to human health or the environment beyond the site boundary. However, the extent of surface, near-surface, vadose zone, and groundwater contamination must be determined to conduct the baseline risk assessment and evaluate the potential for future impact from the operable unit. The preliminary target substances identified for the baseline risk assessment at this operable unit are radionuclides, cyanide, and nitrate.

3.3.2 Potential Substances for Baseline Risk Assessment

This preliminary assessment of potential public health impacts is based on extensive existing environmental sampling and analytical data described in Section 3.1.

Table 3-8 presents a list of radioactive and chemical substances which, based on the estimated quantities released and/or levels detected in one or more environmental media, represent potential substances for the baseline risk assessment.

Table 3-8. Potential Substances in the 200-BP-1 Operable Unit

Ra	In Co
^{137}Cs	ammonium ion
^{60}Co	chloride iron
^{3}H	cyanide
^{239}Pu	nitrate ion
^{240}Pu	phosphate
^{106}Ru	selenium
^{90}Sr	sodium ion
^{99}Tc	sulfate ion
^{238}U	vanadium

The substances discharged to the BY cribs in the greatest quantities include ammonium ion, sodium, phosphate, sulfate, nitrate, ferrocyanides, and radionuclides. Clearly however, there is a wide disparity between the potential toxicity of sodium, for example, and ferrocyanide complexes with the potential to release cyanide. The following discussion offers a preliminary screening of substances which might be considered in a baseline risk assessment based on evaluating the carcinogenicity, toxicity, and mobility.

3.3.2.1 Radionuclides. All of the radionuclides in Table 3-8 have been detected at levels in excess of background in one or more environmental media near the 200-BP-1 Operable Unit and, with the exception of technitium-99, are known to have been released to one or more of the BY cribs. The dose response functions used by EPA to estimate radiation risks (linear and linear quadratic) presume that any exposure carries with it some associated excess cancer risks. Consequently, the presence of any nuclide or nuclides at greater than background concentrations may be presumed to introduce some excess cancer risk which must be evaluated. In light of the additive effects of the various radionuclides, all of the isotopes listed in Table 3-8 must be considered in a baseline assessment of cancer risk.

3.3.2.2 Chemical Contaminants. Sodium has been detected in groundwater near to the 200-BP-1 Operable Unit in concentrations as high as 66 mg/L in well 50-53. Although no drinking water standards exists for sodium, discussion in the National Interim Primary Drinking Water Standards (EPA, 1976) indicates that persons on "strict" sodium restricted diets should limit the concentration of sodium in drinking water to 20 mg/L. Sodium concentrations as high as 210 mg/L are compatible with a "moderately" sodium-restricted diet. Thus, consideration as a chemical for the purpose of risk assessment does not appear to be warranted.

Phosphate is not associated with any specific toxicity and has not been detected in groundwater in wells in the vicinity of 200-BP-1.

Chloride has been detected fairly consistently in groundwater samples the highest measured concentration being 113 mg/L from well 50-53. At high concentrations, chloride has distinct physiological effects, particularly on the body's acid-base equilibrium. The secondary drinking water standard of 250 mg/L is based primarily on aesthetic qualities (taste). Acclimated persons can tolerate chloride concentrations that are much higher. The levels observed in 200-BP-1 groundwater do not pose a risk to public health or the environment.

Sulfate in drinking water can result in pronounced cathartic effects, especially if associated with sodium and magnesium cations, but otherwise exhibits no demonstrable human toxicity. Concentrations as low as 200 mg/L may affect unacclimated individuals and concentrations of 600 to 1,000 mg/L of sulfate will result in a laxative effect on most users. A secondary drinking water standard for sulfate of 250 mg/L has been established based on the aesthetic (taste) effects. The highest concentration of sulfate observed in 200-BP-1 area wells has been 474 mg/L. Sulfate concentrations will not be evaluated for the baseline risk assessment.

As discussed in Section 3.1.3, barium and vanadium were more or less ubiquitous in 200-BP-1 groundwater, in concentrations ranging from 10 to 80 µg/L. The drinking water MCL for barium is 1,000 µg/L. The reference dose (RFD) of vanadium as stated in the Integrated Risk Information System (IRIS) is 1.4 g/d for a 70-kg "standard man" assuming ingestion of 2 L/day of water, the corresponding concentration in water will be 700 µg/L, which is an order of magnitude higher than typical concentrations in 200-BP-1 area wells. The levels observed in the 200-BP-1 groundwater are not considered to pose a threat to public health or the environment.

Iron has been detected in one well (318 µg/L in well 50-53) at levels approximately equal to the secondary drinking water standard of 300 µg/L. Concentrations observed in other wells are below the secondary standards. Background levels in groundwater frequently exceed the secondary standard which is based primarily on aesthetics as oppose to physiologic effects. Higher concentrations can result in brown stains on laundry and plumbing fixtures but do not pose a risk to human health. At this time, iron will not be considered in the risk assessment.

The remaining chemical contaminants include ammonium, cyanide, nitrate, and selenium.

Ammonium concentrations in groundwater in the vicinity of 200-BP-1 were consistently less than 100 µg/L with the exception of well 49-55A which has yielded concentrations as high as approximately 1.6 mg/L. The dose response relationship of ammonia via the inhalation route is well documented. However, there is no primary or secondary drinking water standard for ammonia nor are oral toxicity data available in the EPA Superfund Public Health Assessment Manual (EPA, 1986) or EPA'S IRIS data base. This is consistent with the discussion of ammonia toxicity via exposure through water and food in the environmental health criteria document, Environmental Health Criterion 54, Ammonia, World Health Organization (WHO), Geneva, 1986:

> ...because of the different kinetic patterns between oral and inhalation exposure to ammonia, as well as the highly irritant effects of ammonia on the lung, the estimation of an acceptable daily intake (ADI) for ingestion is difficult. However, it would be possible to define a clearly undesirable level of oral exposure to total ammonia (NH_3 and NH_4+) as well as a level that is clearly tolerable. The range between these two levels would exceed the range within which an ADI could be established.
>
> The amount of excess ammonia (i.e., over and above the amount normally produced in the body) that can be safely ingested and assimilates is difficult to define. In short-term (28 to 90 days) studies carried out on rats and pigs, no adverse effects were reported at higher levels of ammonia intake (75 to 545 mg NH_3/kg body weight per day) in the form of sulfamate, phosphate, citrate, or chloride.

Average concentrations of total ammonia in surface waters are generally less than 0.18 mg/L and around 0.5 mg/L in the vicinity of large metropolitan areas. Given the relatively low concentrations of ammonia observed in groundwater and the low mobility of ammonia in soil, it would appear that the presence of ammonia at the 200-BP-1 Operable Unit does not pose a significant threat to human health or the environment at this time. Thus, inclusion for consideration in the baseline risk assessment is not warranted.

Selenium has been detected above the MCL in well 50-53 which is outside the boundaries of the operable unit. Given that selenium is not ordinarily associated with wastes released directly to the BY cribs nor with groundwater from 200-BP-1 wells, this well may be intercepting a contaminant plume originating from a source other than the 200-BP-1 Operable Unit. The source, extent, and future migration of the selenium plume indicated in well 50-53 requires further investigation.

Existing groundwater monitoring data indicate a cyanide plume north of the 200-BP-1 Operable Unit, with the BY cribs as a likely source. Total cyanide has been detected in well 50-53 at concentrations as high as 1,690 µg/L. Field tests have indicated the presence of free cyanide although no definitive data are available regarding cyanide speciation.

The RFD for free cyanide is 0.02 mg/kg/day or approximately 1.5 mg/day for an adult male. Assuming 2 liters/day of drinking water and that drinking water is the only source of free cyanide, this corresponds to a concentration of 750 µg/L in water. It is doubtful that the 1,690 µg/L cyanide concentration in well 50-53 consists entirely of free cyanide, but this has not been determined conclusively.

Given the large quantities of ferrocyanides discharged to the BY cribs, the apparent plume to the north, the toxicity of free cyanide, and the fact that the interactions between ionizing radiation and cyanide complexes are unknown, cyanide must be considered in the RI baseline risk assessment.

It is estimated that in excess of 6 million kg of nitrate was released to the BY cribs over the life of the facility. Nitrate has been detected at concentrations greater than 10 times the primary drinking water standard of 45 mg/L. It is ubiquitous in groundwater in the vicinity of the BY cribs and will clearly impact future use of the groundwater resource. Thus, nitrate must also be considered in the RI baseline risk assessment.

3.3.3 Imminent Or Substantial Threat To Public Health And The Environment

Access to the site is strictly controlled and will remain so for the foreseeable future; thus, the following discussion of risk to public health is limited to exposure of individuals outside of the Hanford Site boundaries for the purposes of evaluating current risks. Potential contaminant pathways and receptors are shown in Figure 3-6. All past releases to the 200-BP-1 Operable Unit have been to the soil. Consequently, all subsequent releases to other environmental media will originate in the soil as indicated in Figure 3-6.

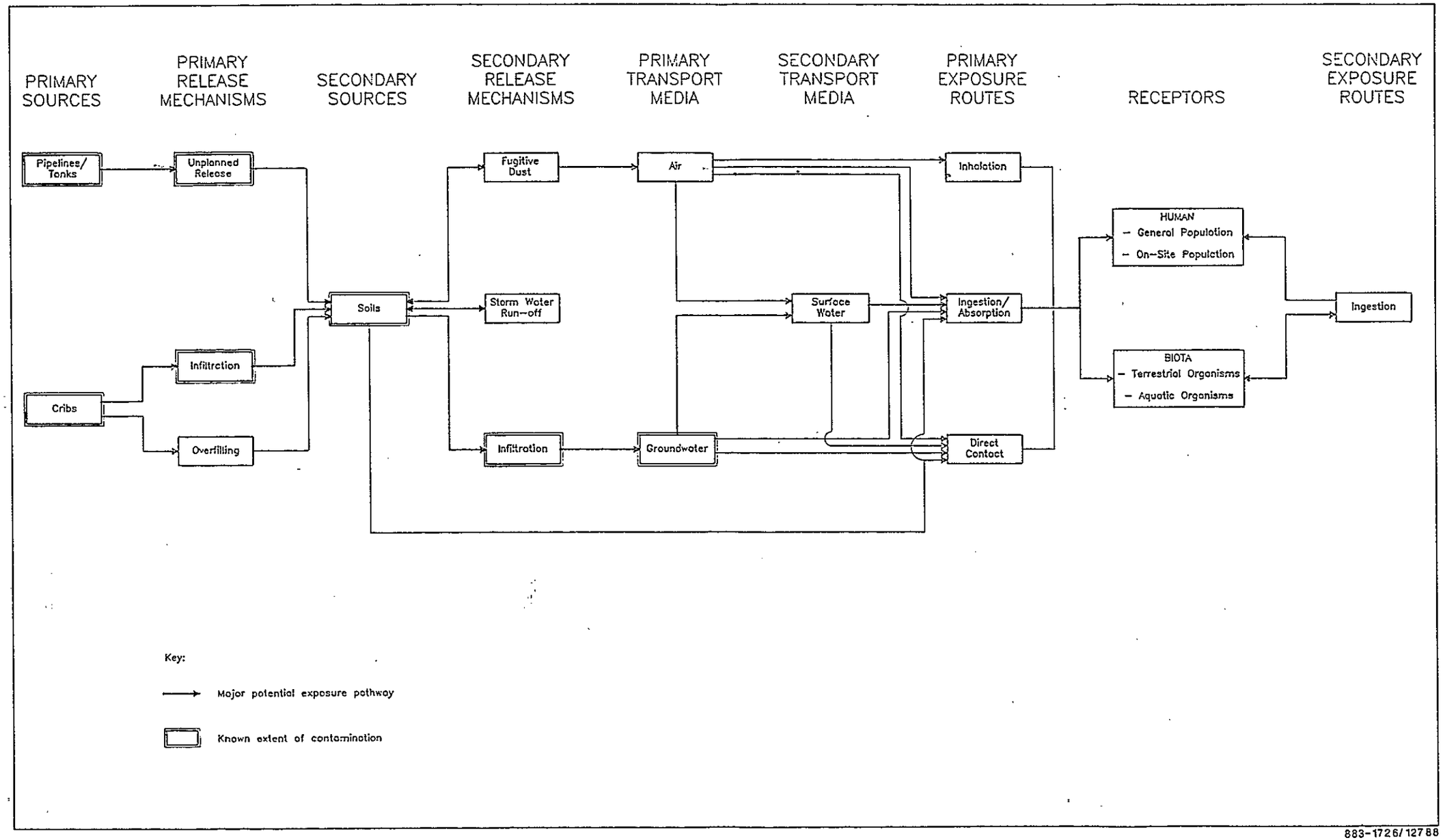

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Figure 3-6. Contaminant Pathway and Receptor Identification for the 200-BP-1 Operable Unit

9 0 1 1 7 1 1 0 8 9 6

3.3.3.1 Surface Runoff. There are no perennial or ephemeral streams in the 200 East or adjacent areas. The nature and extent of the surface and near-surface contaminants within the operable unit is not well characterized. While the impact of rain water run off offsite is expected to be negligible, it cannot be definitively characterized at this time. Potentially contaminated surface runoff may contaminate adjacent surface soils resulting in a subsequent fugitive dust (air) or surface soil (direct contact) problem. Given the limited rainfall and high evapotranspiration rate, contamination of groundwater as a result of surface runoff is considered unlikely.

3.3.3.2 Direct Contact. As mentioned above, access to the 200 Area is strictly controlled and deliberate or inadvertent intrusion by the general public onto or in the vicinity of the operable unit is extremely unlikely. Direct contact of contaminated soil is not considered as a potential pathway.

3.3.3.3 Groundwater. There are no wells used as a source of water for drinking or bathing located down gradient from the 200-BP-1 Operable Unit. Ingestion and direct contact with contaminated well water is not currently a significant exposure route.

3.3.3.4 Surface Water. As discussed in Section 3.2, extensive groundwater and surface water monitoring data indicate that contaminated groundwater plumes from 200-BP-1 are not impacting West Lake, and are unlikely at present, to be discharging to the Columbia River approximately 13 kilometers (8 miles) to the northeast. None of the surface-water-related pathways, such as direct ingestion, recreation, consumption of fish, etc., appear to be current routes of exposure.

3.3.3.5 Air. All remaining pathways are either directly or indirectly associated with air. To date, environmental sampling results have failed to reveal the presence of any volatile organic contaminants in 200-BP-1 groundwater, which is consistent with existing knowledge of BY crib wastes. In the absence of volatile constituents, potential air pathways are limited to reentrainment of surface contaminated soil (fugitive dust) and exposure via direct inhalation, and ingestion of vegetables, meat, milk, etc., contaminated by wet and/or dry deposition of airborne particulate.

Air monitoring data are not available for nitrates, cyanides, ammonia, sulfates, etc. Since these substances were released entirely underground in the same manner as the radionuclides, and since the observed dose due to radionuclides are orders of magnitude less than potential levels of concern for the above chemical contaminants, it is reasonable to assume that offsite chemical exposure via the air pathways is not significant.

3.3.3.6 Cancer Risk Associated with Hanford Operations

Table 3-9 presents the calculated committed and effective doses to hypothetical maximally exposed individuals based on 1987 environmental monitoring data (PNL, 1988d). As stated in the 1988 PNL report, the maximally exposed individual was postulated to be an individual who:

- was a resident in an area approximately 13 kilometers (8 miles) south-southeast of the 300 Area,

Table 3-9. Calculated Committed Doses and the Effective Dose to the Hypothetical Maximally Exposed Individual From 1987 Hanford Operations

Pathway		50-Year Committed Dose (mrem)					
		Red Marrow	Bone Surfaces	Lung	GI[a]	Thyroid	Effective Dose[b]
Air	- Direct[c]	0.003	0.009	0.004	0.001	0.008	0.002
	- Food[d]	0.001	0.001	0.001	0.001	0.8	0.03
Water[e]	- Foods[f]	0.04	0.07	0.003	0.01	0.007	0.01
	- Drinking Water	0.005	0.007	0.003	0.004	0.003	0.003
	- River Recreation[g]	0.02	0.05	0.004	0.01	0.005	0.009
Total		0.07	0.1	0.02	0.03	0.8	0.05

(a) Gastrointestinal tract (lower large intestine).
(b) Effective dose is compiled from the product of each organ's dose and its weighting factor and includes some organs not listed here.
(c) Includes inhalation, submersion, and direct exposure to ground deposition.
(d) Includes consumption of all foodstuffs contaminated via dry deposition.
(e) Includes dose from ground water seepage (^{3}H and ^{129}I) to the river.
(f) Includes consumption of all foodstuffs contaminated via irrigation water.
(g) Includes consumption of fish taken from the Columbia River.

PNL, 1988d.

- consumed foodstuffs grown in the northwestern part of the Riverview district using Columbia River water for irrigation,
- ingested drinking water obtained from the Pasco sanitary water system,
- used the Columbia River extensively for boating, swimming, and fishing, and consumed the fish that were caught.

As indicated in Table 3-9, the effective (whole body) dose via the air pathway is 0.032 mrem/yr and the total effective dose via all pathways is 0.05 mrem/yr.

Table 3-10 and Figure 3-7 illustrate the comparison of 1987 results to the corresponding environmental data for 1985 and 1986. The 1987 data coincides with the shut down of the N Reactor and the limited operation of the PUREX plant. This would suggest that observed levels of offsite radioactivity are largely due to ongoing activities as opposed to past operation and releases.

Table 3-11 presents dose rates to nearby individuals and the regional population from airborne radionuclide emissions from the Hanford Site in 1981, as estimated by the EPA in the 1984 NESHAPS (National Emission Standards for Hazardous Air Pollutants) Background Information Document for Radionuclides (EPA, 1984). Both direct inhalation and air-to-foodchain pathways are included in this table.

The calculated cancer risks corresponding to the above dose estimates are shown in Table 3-12 (EPA, 1984). The total risk to "nearby individuals" from all Hanford areas is approximately $7x10^{-5}$ based on 1981 emission rates (EPA, 1984). The stated calculated risk specifically associated with activities in the 200 Area is $2x10^{-7}$. Presumably this risk would be considerably less based on 1987 data (PNL, 1988d).

3.3.4 Potential Impacts to Public Health and the Environment From 200-BP-1 Operable Unit

The previous section addressed risks posed to the public at or beyond the site boundaries. Potential impacts to human health and the environment at the boundaries of the 200-BP-1 Operable Unit are discussed in this section.

3.3.4.1 Surface Runoff and Direct Contact from Surface Soil. As discussed in 3.3.3.2 above, the most significant result of surface runoff is likely to be the spread of radiological contamination to surface soil beyond the boundaries of the operable unit, with the subsequent possibility of direct human contact with contaminated surface soils. The extent of surface and near-surface soil contamination within the operable unit is not well characterized and will be addressed in the RI. Existing surface soil monitoring data for the sampling points closest to 200-BP-1 were discussed in Section 3.1.2, and the results are presented in Appendix B.

Table 3-10. Calculated Committed Organ Doses and Effective Dose to the Hypothetical Maximally Exposed Individual From Hanford Operations, 1985 Through 1987

Organ[a]	Committed Dose, mrem 1985	1986	1987
Red Marrow	0.3	0.3	0.07
Bone Surfaces	0.7	0.6	0.1
Lung	0.07	0.03	0.02
GI[b]	0.09	0.04	0.03
Thyroid	1.0	0.9	0.9
Effective Dose[c]	0.1	0.09	0.05

(a) Total 50-year committed dose to each organ from exposure to all available pathways.
(b) Gastrointestinal tract (lower large intestine).
(c) Effective dose compiled from the product of each organ's dose and its weighting factor, and includes some organs not listed here.

PNL, 1988d.

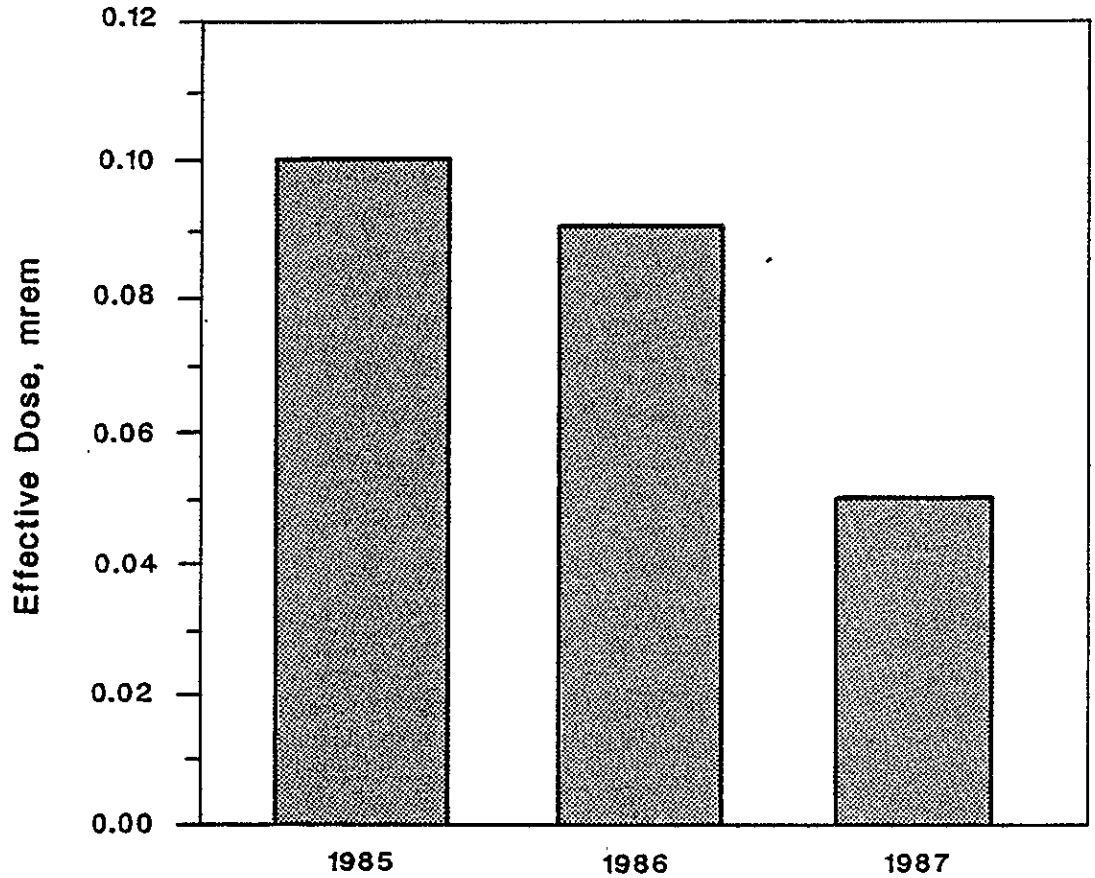

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Figure 3-7. Calculated Effective Doses to the Maximally Exposed Individual for 1985, 1986, and 1987

TABLE 3-11. Radiation Dose Rates From Radionuclide Airborne Emissions From the Hanford Site, 1981

Organ	Dose to Nearby individuals (mrem/y)		
400 Area	100	200	300-400
Red marrow	2.2	2.0E-2	1.2
Endosteum	2.4	8.4E-2	1.5
Pulmonary	2.2	2.1E-2	1.4
Pancreas	2.1	9.2E-3	1.4
Breast	2.2	1.1E-2	1.3

EPA, 1984.

Table 3-12. Fatal Cancer Risks Due to Radionuclide Emission From the Hanford Site

Source	Lifetime risk to nearby individuals	Regional population (Fatal cancers/y of operation)
100 Area	4E-5	2E-3
200 Area	2E-7	6E-5
300-400 Area	3E-5	1E-3

EPA, 1984.

The likely exposure pathways associated with contaminated soil will be direct contact, external radiation, and ingestion or inhalation of radionuclides. Cyanide (as ferrocyanide) and nitrate are not considered significant in surface contamination relative to radiological contamination.

Inhalation will be considered subsequently in the air discussion. Of the remaining pathways, ingestion is believed to be the primary route of exposure of contaminated soil.

Of the potential exposure pathways associated with surface soil, ingestion of soil by children will generally be the most restrictive consideration in determining acceptable contamination levels for clean up standards. As stated in the EPA Superfund Public Health Evaluation Manual (EPA, 1986), soil ingestion rates in children vary from 0.1 to 5 g/d, the former being associated with inadvertent hand-to-mouth contamination, and the latter being indicative of pica behavior. "Pica" is an abnormal craving for unnatural foods (especially common in small children) such as soil, clay, chalk, crayons, etc, and is generally limited to ages 2 through 6.

Table 3-13 identifies concentrations of radionuclides in soil which will result in a maximum dose of 4 mrem/yr by ingestion of 0.1 and 5 g/d of soil. This table is included as an indicator of relative risks, and for comparison with background and observed concentrations of radionuclides adjacent to the 200-BP-1 Operable Unit.

The amount of each radionuclide (in picocuries) which will result in a dose of 4 mrem/yr by ingestion is derived from the concentrations in drinking water given in the National Interim Primary Drinking Water Standards, Table IV-2A (EPA, 1976) divided by 2 for application to a child. This value is then divided by 10 in the next column to account for the multiple nuclides present and comply with the unity rule. The last two columns in Table 3-13 give the concentrations in soil in picocuries per gram that will result in a maximum dose of 4 mrem or ingestion of 7.5 pCi/d of alpha based on ingestion of 0.1 and 5 g/d of soil, respectively.

Since uranium is specifically excluded from the drinking water standards, the value included in Table 3-13 for uranium is based on the DOE DCG for drinking water. The DCG is divided by 10 since it is based on an annual effective dose of 100 mrem and considers only the particular radionuclide by only one exposure pathway.

The resulting maximum soil concentrations based on ingestion of 5 g/d of soil represent a worst case exposure scenario and, hence, a practicable lower limit for maximum allowable radionuclide concentrations in soil. They are not offered as target concentrations, but rather, for comparison with background and measured radionuclide concentrations. Table 3-14 compares the 5 g/d soil concentrations to background levels found elsewhere in the 600 Area, to concentrations actually measured in the vicinity of the 200-BP-1 Operable Unit, and to soil standards developed by Boothe (1987).

Table 3-13. Concentration in Soil Resulting in Maximum Dose of 4 mrem/yr by Ingestion

Radionuclide	ADI(a) (pCi)	ADI / 10 (pCi)	Concentration In Soil (Assuming ingestion of 0.1g/d soil) (pCi/g)	Concentration In Soil (Assuming ingestion of 5g/d soil) (pCi/g)
^{3}H	(b)			
^{60}Co	100	10	100	2.0
^{90}Sr	8	0.8	8	0.16
^{99}Tc	900	90	900	18.0
^{106}Ru	30	3	30	0.6
^{137}Cs	200	20	200	4.0
^{238}U	(c)	6	60	1.2
^{238}Pu	15	1.5	15	0.3
^{230}Pu	15	1.5	15	0.3
^{240}Pu	15	1.5	15	0.3

(a) Allowable daily intake of radioactivity by ingestion based on drinking water standards. 4 mrem/year or 15 pCi/L assuming an intake of 1 L/day (child).
(b) Not considered in soil.
(c) Derived concentration guide/10

Table 3-14. Comparison of Background Soil Concentrations Measured Soil Concentrations, and Maximum Allowable Soil Concentrations Based on Ingestion of 5 gram/day

RADIONUCLIDES	BACKGROUND LEVEL (pCi/g)	MEASURED SOIL CONCENTRATIONS (1987[a]) pCi/g				MAXIMUM ALLOWABLE CONCENTRATIONS (Based on ingestion of 5 g/d) pCi/g	SOIL STANDARDS (BOOTH 1987) (pCi/g)
		2E-N	2E-NE	2E-2	2E-3		
^{60}Co		1.6E-2		<7.6E-3	<3.0E-3	2.00	3.0E+2
^{90}Sr	1.5E-1	1.9E+0			7.8E-1	0.16	4.0E+2
^{99}Tc						18.00	2.0E+3
^{106}Ru		<7.9E-2			<1.5E-1	0.60	
^{137}Cs	6.0E-1	9.1E+0			1.3E+1	4.00	4.0E+2
^{238}U	3.7E-1	2.8E-1				1.20	
^{238}Pu		<2.0E-4			8.0E-4	.3	60
^{239}Pu	9.0E-3	6.0E-3	5.1E-3		2.3E-2	.3	60
^{240}Pu						.3	

(a) Data from Elder, et. al., 1988. Locations (2E-N etc.) refer to sampling locations (See Appendix B. Figure B-2.)

3.3.4.2 Vadose Zone Soils. Available borehole scintillation probe data (see Appendix C) indicate the presence of radioactive contamination in vadose zone soils in the vicinity of the BY cribs at depths which could be subject to intrusion by burrowing animals and deep rooted vegetation.

Vadose zone contamination in and around the cribs must be characterized in sufficient detail to evaluate the potential impacts to indigenous flora and fauna, and identify appropriate remedial action, if required.

3.3.4.3 Groundwater. The maximum concentrations of nonradiological and radiological contaminants detected in groundwater were presented in Section 3.2 (see Tables 3-6 and 3-7, respectively) and are compared to corresponding ARARs. The primary drinking water standards for nitrate, gross beta, selenium, cobalt-60, ruthenium-106, strontium-90, and technetium-99 are exceeded. It is important to note that for mixtures of radionuclides, the sum of the ratios of the observed concentration of each radionuclide to the corresponding drinking water MCL must not exceed 1.0 (referred to as the unity rule). The MCLs for the beta/gamma emitters (tritium-3, cobalt-60, strontium-90, technetium-99, ruthenium-106, and cesium-137) must be adjusted accordingly so as not to exceed the unity rule. The 45 mg/L MCL for nitrate is an appropriate target concentration and the minimum required detection limits can be established accordingly.

Cyanide has been detected immediately downgradient from the 200-BP-1 Operable Unit at concentrations nearly an order of magnitude greater than the EPA ambient water quality standard and nearly two orders of magnitude above the EPA reference dose of 0.2 mg/L for free cyanide ion.

3.3.4.4 Surface Water. As discussed in the previous sections, it does not appear that the 200-BP-1 Operable Unit is impacting the nearest surface water body (West Lake) or the Columbia River. An important objective of the RI must be the evaluation of potential future migration and subsequent impacts to surface water.

3.3.4.5 Ambient Air. Ambient air monitoring procedures are discussed in Section 3.1.5 and the results are presented in Appendix G.

The most restrictive ARAR in this case appears to be the EPA NESHAPS standard limiting the total annual dose via radionuclides in ambient air resulting from emissions from DOE facilities, to 25 mrem/yr.

Table 3-15 shows the DCG for air for each of the radionuclides known to be associated with the BY cribs. These DCG values represent the airborne concentrations of each radionuclide which will result in an effective dose equivalent of 100 mrem (year). In the next column, the DCG value is divided by 40 (4x10) to bring the given airborne concentration down to a resultant annual dose equivalent of 25 mrem (DCG/4) and to further allow for the contribution of multiple nuclides and observance of the "unity rule" (DCG/10).

Table 3-15. Comparison of Measured Ambient Air Concentrations To Estimated Concentration Resulting In Maximum Dose of 25 mrem/year

RADIONUCLIDE	DOE DCG-AIR pCi/m^3	DCG/40 pCi/m^3	AVERAGE ANNUAL AMBIENT AIR CONCENTRATION pCi/m^3		
			N157 STATION	N967 STATION	N973 STATION
^{3}H(a)		(b)			
^{60}Co(a)					
^{90}Sr	90.0E-00	2.25E-01	1.35E-04	2.14E-05	1.37E-04
^{99}Tc(a)					
^{106}Ru(a)					
^{137}Cs	4.0E-02	1.0E-01	3.61E-03	5.34E-04	9.92E-04
^{238}U	1.0E-01	5.0E-04	1.75E-05(c)	1.74E-05(c)	1.0E-01(c)
$^{239/240}Pu$	2.0E-02	2.5E-03	7.72E-06	4.55E-06	4.81E-06
^{238}Pu(a)					

(a) Not analyzed.

(b) Concentration in air estimated to result in a maximum dose of 25 mrem/yr from all nuclides by all air associated pathways.

(c) Total uranium

The last three columns in Table 3-15 show the annual average ambient air concentrations for the reported radionuclides at each monitoring station (N157, N967, and N973). It is apparent that the observed concentration in ambient air are two to four orders of magnitude less than the adjusted DCG values. This would suggest that the impact to ambient air in the immediate vicinity of the 200-BP-1 Operable Unit is minimal and that the given levels of detection are adequate to evaluate the reported radionuclides.

Based on the estimated inventories of radionuclides released to the BY cribs, ambient air concentrations of technetium-99, cobalt-60, or ruthenium-106 should not be disproportionately higher than the nuclides reported. It may be necessary to include these additional radionuclides in subsequent analysis.

Chemical contaminants have not been monitored in air, but are not expected to be above safe limits in ambient air in the vicinity of the operable unit. On site air monitoring will be required as discussed in the RI Health and Safety Plan (Attachment 2) and will provide additional insight in this regard.

3.3.5 Conclusions

Substances which must be scrutinized in the RI risk assessment include all of the BY crib radionuclides, nitrate, and cyanide. Cyanide is expected to be present predominantly as ferrocyanide, but the species and the extent of cyanide contamination must be definitively characterized.

The 200-BP-1 Operable Unit does not appear to pose any imminent or substantial threat to the public beyond the site boundaries, nor does there appear to be an imminent or substantial endangerment to the environment at the boundaries of the operable unit which require emergency removal action.

While there does not appear to be an immediate threat, the extent of surface, near-surface, and vadose zone contamination must be sufficiently characterized to evaluate the likelihood of migration beyond the operable unit boundaries and potential future impacts to ground and surface water. Ambient background levels must be established for cobalt-60, ruthenium-106, and plutonium-238.

Ambient air concentrations of radionuclides in the vicinity of the operable unit appear to be within the NESHAPs limits for DOE facilities, although, not all of the potential contaminants are reported.

3.4 PRELIMINARY REMEDIAL ACTION OBJECTIVES AND ALTERNATIVES

Preliminary alternatives for the 200-BP-1 Operable Unit have been developed to address contamination associated with the use of nine cribs and various pipelines and tanks in the 200 East Area. Information regarding historical treatment and disposal activities and groundwater monitoring data in the operable unit has been used to determine possible waste constituents in the soils and groundwater. The data developed to date regarding the concentrations of contaminants and the volume of wastes are limited. Additional data will be developed during the RI that may impact the

technologies and alternatives that are considered for the operable unit. Media-specific remedial action objectives have been developed based on the preliminary data regarding the contaminants present, the potential exposure pathways, and remediation goals. General response actions have been developed for each medium that will be evaluated and implemented to satisfy the remedial action objectives. Technologies applicable to each general response action have been considered for preliminary screening based on available data. These technologies have been assembled into alternatives for soil, sediment, and groundwater remediation in the 200 East Area.

3.4.1 Preliminary Remedial Action Objectives

The contaminants determined to be present and of concern in the operable unit include radionuclides, metal complexed cyanide, selenium, nitrates, sulfates, phosphates, and sodium. Additional soil and groundwater data developed as part of the RI may expand the list of contaminants.

Media-specific remedial action objectives and general response actions developed for screening are presented in Table 3-16. The general response actions are developed to provide for human health and environmental protection. The current media known to be impacted by the operable unit include soil in the cribs (or potentially in the UNs) and groundwater. Potential media of concern include surface water, sediments, and biota in West Lake and the Columbia River from discharge of contaminated groundwater. Air and terrestrial biota are not currently media of concern, based on on going Hanford Site monitoring data.

3.4.2 Preliminary Remedial Technologies

General remedial technologies included for preliminary screening for the 200-BP-1 Operable Unit are presented in Table 3-17. These technologies address the waste constituents potentially present in soils and chemicals that have been detected in groundwater. Applicable technologies will be better defined as additional RI data are obtained.

Although remedial action objectives were developed for surface water, air and biota, no specific remedial technologies and subsequent remedial alternatives have been identified for these media. If any of these media are determined to be impacted during the RI, the source of this impact would be either the soil or groundwater. Therefore, remediation of the soil and groundwater would achieve the response objectives for the other media.

Table 3-16. Media Specific Remedial Action Objectives and General Response Actions (Sheet 1 of 3)

Environmental Media	Remedial Action Objectives	General Response Actions
Soil	For human health: Prevent ingestion, inhalation, or direct contact with soil containing radionuclides, cyanide compounds, and other waste constituents present at concentrations considered to be a human health risk. For environmental protection: Prevent migration of radionuclides, cyanide compounds, and other waste constituents that would result in groundwater or surface water contamination with constituents at concentrations exceeding ARARs.	No action: No action with institutional actions such as deed restriction for land use. Additional site access restrictions. Long-term monitoring. Containment actions: Capping with institutional controls. Capping with long-term monitoring. Excavation/treatment/disposal actions: In situ treatment. Excavation/landfill disposal. Excavation/treatment. Excavation/incineration/ash landfill disposal.

Table 3-16. Media Specific Remedial Action Objectives and General Response Actions (Sheet 2 of 3)

Environmental Media	Remedial Action Objectives	General Response Actions
Groundwater	For human health:	No action:
	Prevent ingestion of water containing radionuclides, cyanide, and other waste constituents in concentrations considered to be a human health risk.	No action with institutional actions such as deed restrictions.
		Collection/treatment actions:
	For environmental protection:	In situ treatment.
	Prevent adverse environmental impacts resulting form migration of contaminants in groundwater (groundwater discharge believed to be the Columbia River and West Lake)	Pumping (collection)/ treatment/reinjection.
		Pumping (collection)/ treatment/discharge.
Biota	For human health:	No action:
	No current risk identified.	No action with monitoring.
		Containment action:
		Capping of contaminated soil/sediment areas to prevent biota exposure to wastes.
	For environmental protection:	Containment of contaminated groundwater to prevent migration to surface water and subsequent biota exposure to contaminated water and/or sediments.
	Prevent adverse environmental impacts on local biota.	

Table 3-16. Media Specific Remedial Action Objectives and General Response Actions (Sheet 3 of 3)

Environmental Media	Remedial Action Objectives	General Response Actions
Surface water	For human health: Prevent discharge of contaminated groundwater to surface water. Prevent ingestion of and dermal exposure to water containing radionuclides, cyanide, and other waste constituents in concentrations considered to be a human health risk. The Columbia River is of primary concern as it serves as a public drinking water source and recreation area.	No action: No action with monitoring. Containment action: Groundwater containment via lateral or horizontal barriers to prevent migration to the Columbia River and West Lake.
	For environmental protection: Ensure that site water discharges do not cause exceedance of ambient water quality standards in the Columbia River.	Pump/treat/reinject/discharge groundwater to prevent migration to the Columbia River and West Lake.

Table 3-17. General Remedial Technologies (Sheet 1 of 3)

Environmental Media	Technology	Description
Air	For human health:	No action:
	No current risk identified. Prevent inhalation of airborne particulates and/or organic emissions from soils/sediments containing radionuclides and cyanide.	No action with monitoring.
		Containment actions:
		Cap or cover soils and/or sediments to prevent airborne migration and volatilization of constituent
Soils	Excavation	Physical removal of waste materials for treatment or disposal.
	Capping	Barrier placed on top of waste materials.
	Chemical Stabilization/solidification	Process to mix chemical wastes with materials (e.g., cement, lime kiln dust, cement kiln dust, fly ash, or proprietary agents) to fix the waste solubility and leachability in a dry aggregate or solid material.
	Landfill	Waste materials are disposed of in an area designed to receive the wastes. Materials may be drummed or disposed of in bulk form.
	Flushing	Use of water and/or surfactants/lixiviants to enhance elutriation of organic or inorganic contaminants from soil. Used in conjunction with other treatment steps.

Table 3-17. General Remedial Technologies (Sheet 2 of 3)

Environmental Media	Technology	Description
Soils (cont.)	Vitrification	Incorporation of waste materials into a glass matrix by the introduction of electric currents.
Groundwater	Extraction wells	Groundwater collection wells suitable for deep systems or in shallow groundwater where trenches are not cost effective.
	Subsurface barrier	Underground barriers used to physically divert groundwater flow from an area or to contain a plume.
	Physical/chemical treatment	Represents various oxidation, reduction, or pH adjustment methods to effect the removal of soluble metals from water through precipitation.
		Chemical precipitation of cyanide with lime, alum, ferrochloride, ferrosulfate.
		Chemical oxidation of cyanide waste: Alkaline chlorination Ozonation Ketone process Photozone oxidation Microbial decomposition
		Polysulfide treatment for cyanide converts metal complexed cyanide to thiocyanate.

Table 3-17. General Remedial Technologies (Sheet 3 of 3)

Environmental Media	Technology	Description
Groundwater (cont.)	Ultraviolet radiation	Represents treatment by oxidation of metal complexed constituents with ozone and other oxidation radicals.
	Electrocoagulation	Represents treatment with electrical currents causing suspended and dissolved solids to precipitate.
	Alkaline hydrolysis	Use of elevated heat (180°C) and pressure (140 psig) at high pH to reduce cyanide to ammonia and formate.
	Ion exchange	Process to replace inorganics in waste with innocuous inorganics.
	Reverse osmosis	Concentrates inorganic salts and some organics by forcing the solvent through a semipermeable membrane which acts as a filter to remove total dissolved solids.
	Evaporation	Concentration of nonvolatile components in a solution or dilute slurry by vaporization of the solvent (water).

3.4.3 Preliminary Remedial Alternatives

The preliminary identification of remedial alternatives for soils and groundwater are presented in Table 3-18. They include no action, containment, removal/treatment, removal/disposal, and in situ treatment alternatives for soils and no action, containment, collection/treatment, and disposal alternatives for groundwater. Several technologies will be considered for each remedial alternative and combinations of alternatives may be assembled (i.e., in situ treatment and containment). Onsite and offsite treatment and disposal options will be considered for each media as appropriate. Treated water reuse will also be addressed as an option or in conjunction with discharge to the Columbia River.

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Table 3-18. Preliminary Alternatives for Soil and Groundwater (Sheet 1 of 3)

Environmental Media	Alternatives for Screening	Technologies for Screening
Soils	No action	Deed restrictions for future land use
		Long-term monitoring
		Additional site access restrictions
	Containment	Capping -- clay cap, RCRA cap
		Vertical barrier -- slurry wall
		Horizontal barrier -- synthetic liners, grout injection
	Removal/treatment	Excavation, stabilization
		Excavation, physical treatment (leaching, etc.)
		Excavation, biological treatment
	Removal/disposal	Excavation, incineration (onsite or offsite)
		Excavation, stabilization/fixation, landfill disposal (onsite or offsite)
		Excavation, landfill disposal (onsite or offsite)
	In situ treatment	Solidification
		Flushing

Table 3-18. Preliminary Alternatives for Soil and Groundwater (Sheet 2 of 3)

Environmental Media	Alternatives for Screening	Technologies for Screening
Groundwater	No action	Long-term monitoring in conjunction with site groundwater containment
		Water use restrictions
		Alternate water supply
	Collection	Extraction wells
		Extraction/injection wells
	Treatment	Physical/chemical:
		Chemical precipitation
		Chemical oxidation cyanide waste:
		Alkaline chlorination Ozonation Ketone process Photozone oxidation
		Polysulfide treatment for cyanide complexes Microbial decomposition for cyanide
		Ultraviolet radiation
		Electrocoagulation
		Alkaline hydrolysis
		Ion exchange
		Reverse osmosis
	Disposal	Onsite -- reuse, cooling water
		Offsite -- discharge into Columbia River
		Water reinjection

Table 3-18. Preliminary Alternatives for Soil and Groundwater (Sheet 3 of 3)

Environmental Media	Alternatives for Screening	Technologies for Screening
	Containment	Cap -- clay and soil, asphalt, concrete, multimedia
		Vertical barriers -- slurry wall, grout curtain
		Horizontal barrier -- grout injection

9 0 1 1 7 4 1 0 9 2 0

4.0 WORK PLAN RATIONALE

This section presents an evaluation and identification of the data needs for completing the RI/FS. Initially, this section defines data needs and data quality objectives necessary for each media; for site characterization, risk assessment, evaluation of alternatives and engineering design. Finally, an overview of the methodology for obtaining and evaluating data needs are provided which focuses the RI and provides a general preview of tasks which will be conducted in the RI.

4.1 DATA NEEDS AND DATA QUALITY OBJECTIVES

As discussed in Section 3.0, existing data relevant to the remedial objectives at the 200-BP-1 Operable Unit are limited for some environmental media. This section describes the additional data needed for the various media to characterize the site, define the risks to public health and the environment, screen and evaluate potential remedial alternatives, and for remedial design. Table 4-1 summarizes the data needs and uses of the data to complete the RI/FS. Analytical levels listed in the table are described in Data Quality Objectives for Remedial Response Activities, Volume I, "Development Process" (EPA, 1987a). Analytical levels that may be required for the RI/FS at the site are summarized below.

Level I - Field Screening. This level is characterized by the use of portable instruments, such as an organic vapor analyzer (OVA) or scintillation detector, that can provide real-time data to assist in the optimization of samples for laboratory analysis and for health and safety monitoring. Qualitative data can be generated regarding the presence or absence of certain types of contaminants (e.g., radionuclides and volatile organics) at sampling locations. However, results are generally not chemical specific and are not quantitative.

Level II - Field Analysis. This level uses more sophisticated portable analytical instruments either onsite or in a mobile laboratory. Qualitative and quantitative data can be generated for certain compounds depending on the type of contaminant, sample matrix analytical procedures, and skills of the personnel. Field analysis is not anticipated for this RI/FS based on the types of compounds currently known to have been disposed.

Level III - Laboratory Analysis. This level refers to analysis conducted by standard, documented (non-contract laboratory program [CLP]) laboratory procedures in a laboratory. This level of analysis will be used for analysis of radionuclides during the remedial investigation and for all other analyses except when Level IV or V is required.

Level IV - Contract Laboratory Program Routine Analytical Services. This level refers to analysis conducted by a CLP laboratory (or a non-CLP laboratory using CLP procedures) following stringent quality assurance/quality control (QA/QC) protocols and documentation. Level IV procedures will be utilized for analysis of non-radiological constituents conducted for source characterization.

Table 4-1. Summary of Data Needs for RI/FS at 200-BP-1 Operable Unit (Sheet 1 of 2)

MEDIA	DATA NEEDS	PRIORITIZED DATA USE	APPROPRIATE ANALYTICAL LEVELS	CHEMICALS FOR ANALYSES	RATIONALE
SOURCE	Complete chemical and radionuclides characterization of soils immediately beneath cribs	Site Characterizations Risk Assessment Evaluate Alternatives	I III IV V III IV V III IV V	Target Compound List and Radionuclides	Information on contamination in source area needed. Complete analyses needed due to uncertainty regarding chemcials possibly disposed in cribs
SURFACE AND NEAR SURFACE SOILS	Determine nature and extent of contamination above cribs or as a result of UNs	Site Characterizations Risk Assessment Evaluate Alternatives	I III V III V III V	Radionuclides and additional chemicals identified in source characterizations	Information needed to characterize nature and extent of contamination. Determine whether exposure pathway exists and evaluate remedial alternatives
VADOSE ZONE SOILS	Determine nature and extent of contamination beneath cribs	Site Characterizations Risk Assessment Evaluate Alternatives	I III V III V I III V	Radionuclides and additional chemicals identified in source characterizations	Information needed on nature and extent of contamination to determine potential migration to groundwater for risk assessment and evaluation of alternatives
GROUND WATER	Determine nature and extent of contamination, model plume migration. Determine influence from other operable units.	Site Characterizations Risk Assessment Evaluate Alternatives	I III V III V III V	Cyanide (Form) Selenium Nitrate Sulfate Radionuclides	Information needed downgradient of well 50-53 to determine nature and extent of contamination and to predict plume migration toward Columbia River. Influence of other operable units on contaminant plume needed.

Table 4-1. Summary of Data Needs for RI/FS at 200-BP-1 Operable Unit (Sheet 2 of 2)

MEDIA	DATA NEEDS	PRIORITIZED DATA USE	APPROPRIATE ANALYTICAL LEVELS	CHEMICALS FOR ANALYSES	RATIONALE
VADOSE ZONE SOIL CHARACTER-IZATION	Flux rate of contaminants from vadose zone to groundwater. Physical properties	Risk Assessment Evaluate Alternatives Site Characterizations	III V I III V I III V	Radionuclides Cyanide Nitrate Sulfate Additional chemicals identified in source	Information needed to estimate future impacts to groundwater. Physical properties to evaluate remedial alternatives.
HYDRO-GEOLOGY	Determine the hydraulic parameters of aquifers, groundwater, velocity.	Site Characterization Evaluate Alternatives Risk Assessment	N/A N/A N/A	N/A	Information needed to assess potential migration of compounds. Evaluate hydraulic barrier systems.
SOLUTE RETARDA-TION	Sorption and precipitation of solutes.	Risk Assessment Evaluate Alternatives Site Characterization	III V I III V I III V	Sorption/desorption and saturation indices for radionuclides and cyanide, sulfate, selenium and nitrate	Information needed to evaluate migration and attenuation of contaminants in the aquifer flow system.
HYDRO-GEOLOGIC STRUCTURE	Surface contour of the Elephant Mountain basalt flow.	Site Characterization Risk Assessment Evaluate Alternatives	N/A N/A N/A	N/A	Information needed to understand hydrogeologic structure that will influence plume migration and cause intercommunication of aquifers.

Level V - Nonstandard Methods or Contract Laboratory Program Special Analytical Services. This level refers to analysis where method modification or development is required for specific compounds or to achieve lower detection limits than standard methods produce. Special analytical services (SAS) methods will be used to determine the forms of cyanide which has been detected and to achieve adequate detection limits for ruthenium-106.

Cribs and underlying vadose zone soils may contain radioactive materials with emissions in excess of 5 mrem/hr, which must be analyzed in a laboratory on the Hanford Site. However, currently there is no onsite laboratory capable of conducting analyses for the entire CERCLA-target compound list (TCL). The onsite laboratory is expected to expand its analytical capabilities during CY 1989. Sampling activities which require TCL analyses and that are expected to generate samples with radioactivity in excess of 5 mrem/hr will have to be delayed until adequate laboratory capability exists. Adequate onsite laboratory capabilities are expected to be available by January 1990. Samples that have radioactivity less than 5 mrem/hr can be analyzed by qualified offsite laboratories capable of conducting TCL analyses.

The parameters of interest for the 200-BP-1 Operable Unit are based on existing information and monitoring data (see Section 3) and are presented in Table 4-2. Table 4-2 also identifies acceptable detection limits for site characterization and risk assessments for water and soil media. Detection limits for radionuclides in water represents the lower value of either the normal Westinghouse Hanford contract detection limits or 0.1 times the MCL equivalent concentration for drinking water (accounting for the "unity rule" during risk assessments). Acceptable radionuclide detection limits in soils represent either background surface soil concentrations (PNL, 1988d) for strontium-90, cesium-137, plutonium-239/240, and total uranium or the achievable detection limit in soils by a qualified laboratory for isotopes in which background concentrations have not been defined. The achievable detection limit that has been realized by from qualified laboratories for technetium-99, cobalt-60, plutonium-238, and ruthenium-106 in soils should be low enough for site characterization and risk assessments. Method modification (i.e., Level V-SAS) may be required to achieve adequate detection limits, particularly for ruthenium-106 in water, and to determine speciation of cyanide in waste for completing the baseline risk assessment.

Tables 4-3 and 4-4 are the CERCLA-TCL for organic compounds and inorganic compounds, respectively. The CERCLA-TCL will be analyzed using Level IV-routine analytical services (RAS) analytical methods, normal detection limits and analytical quality.

The DQOs related to precision, accuracy, representativeness, completeness, and comparability (PARCC) must be met to ensure the data are of acceptable quality for the intended data uses. In general, precision and accuracy specified in the analytical methods or historically obtained in the CLP (as indicated on Table 4-2) will provide acceptable levels of these parameters for all intended data uses. Acceptable precision and accuracy is most critical if concentrations of contaminants detected are close to the level of concern defined by ARAR's (see Tables 3-6 and 3-7) or necessary for the baseline risk assessment. However, if analytical results are far above or below the level of concern, the data may be useful even when the precision and accuracy are outside the normally acceptable range.

Table 4-2. Parameters of Interest, Analytical Methods and Acceptable Detection Limits and Analytical Quality for the 200-BP-1 Operable Unit Remedial Investigation

ANALYTE	SOIL METHOD	SOIL DETECTION	SOIL ACCURACY	SOIL PRECISION	WATER METHOD	WATER DETECTION	WATER ACCURACY	WATER PRECISION
RADIONUCLIDES								
total alpha	9310(1)	6 pCi/g	(1)	(1)	9310(1)	4 pCi/L	(a)	(1)
total beta	9310(1)	3 pCi/g	(1)	(1)	9310(1)	8 pCi/L	(1)	(1)
tritium	-	-	-	-	(2)	500 pCi/L	(b)	(2)
technetium-99	(2)	0.5 pCi/g	(2)	(2)	(2)	15 pCi/L	(2)	(2)
strontium-90	(2)	0.15 pCi/g	(2)	(2)	(2)	0.8 pCi/L	(2)	(2)
cesium-137	(2)	0.6 pCi/g	(2)	(2)	(2)	20 pCi/L	(2)	(2)
cobalt-60	(2)	0.02 pCi/g	(2)	(2)	(2)	10 pCi/L	(2)	(2)
plutonium-238	(2)	0.0001 pCi/g	(2)	(2)	(2)	0.75 pCi/L	(2)	(2)
plutonium-239/240	(2)	0.009 pCi/g	(2)	(2)	(2)	0.75 pCi/L	(2)	(2)
total uranium	(2)	0.3 pCi/g	(2)	(2)	(2)	0.5 pCi/L	(2)	(2)
ruthenium-106	(2)	0.2 pCi/g	(2)	(2)	(3)	3 pCi/L	(c)	(3)
Non-Radionuclides								
nitrate	300(1)	1 ug/g	(1)	(1)	300(1)	500 µg/L	(1)	(1)
total cyanide	9010(1)	0.5 ug/g	(1)	(1)	9010(1)	10 µg/L	(1)	(1)
sulfate	300(1)	1 ug/g	(1)	(1)	300(1)	500 µg/L	(1)	(1)
selenium	7740(1) or 7741(1)	0.5 ug/g	(1)	(1)	7740(1) or 7741(1)	5 µg/L	(1)	(1)
ferrocyanide	(4)	0.5 ug/g	(4)	(4)	(4)	10 µg/L	(d)	(4)
free cyanide	(4)	1.0 ug/g	(4)	(4)	(4)	10 µg/L	(4)	(4)

(a) EPA, 1986. Accuracy and precision for each analytical method provided in referenced document.
(b) U.S. Testing Company, Inc. analytical methods, accuracy and precision for radionuclides.
(c) Modified development necessary. Accuracy and precision needs to be defined.
(d) Ion chromatography with amperometric detection. Accuracy and precision will need to be defined.

Table 4-3. Target Compound List Organics Analyses (Sheet 1 of 4)

Volatile Compounds	Required Detection Limits[a] Low Concentration Water[b] (µg/L)	Low Concentration Soil/Sediment[c] (µg/kg)
chloromethane	10	10
bromomethane	10	10
vinyl chloride	10	10
chloroethane	10	10
methylene chloride	5	5
acetone	10	10
carbon disulfide	5	5
1,1-dichloroethane	5	5
1,1-dichloroethene	5	5
trans-1.2-dicholoethene	5	5
chloroform	5	5
1.2-dichloroethane	5	5
2-butanone	10	10
1,1,1-trichloroethane	5	5
carbon tetrachloride	5	5
vinyl acetate	10	10
bromodichloroethane	5	5
1,1,2,2-tetrachloroethane	5	5
1,2-dichloropropane	5	5
trans-1,3-dichloropropene	5	5
trichloroethane	5	5
dibromochloromethane	5	5
1,1,2-trichloroethane	5	5
benzene	5	5
cis-1,3-dichloropropene	5	5
2-chloroethyl vinyl ether	10	10
bromoform	5	5
2-hexanone	10	10
2-methyl-2-pentanone	10	10
tetrachloroethene	5	5
toluene	5	5
chlorobenzene	5	5
ethyl benzene	5	5
styrene	5	5
total xylenes	5	5

Table 4-3. Target Compound List Organics Analyses (Sheet 2 of 4)

Extractable Organic Compounds	Required Detection Limits[a] Low Concentration Water[b] (µg/L)	Low Concentration Soil/Sediment[c] (µg/kg)
n-nitrosodimethylamine	10	330
phenol	10	330
aniline	10	330
bis(2-chloroethyl) ether	10	330
2-chlorophenol	10	330
1,3-dichlorobenzene	10	330
1,4-dichlorobenzene	10	330
benzyl alcohol	10	330
1,2-dichlorobenzene	10	330
2-methylphenol	10	330
bis(2-chloroisopropyl) ether	10	330
4-methylphenol	10	330
N-nitroso-dipropylamine	10	330
hexachloroethane	10	330
nitrobenzene	10	330
isophorone	10	330
2-nitrophenol	10	330
2,4-dimethylphenol	10	330
benzoic acid	50	330
bis(2-chloroethoxy)methane	10	1,600
2,4-dichlorophenol	10	330
1,2,4-trichlorobenzene	10	330
naphthalene	10	330
4-chloroanaline	10	330
hexachlorobutadiene	10	330
4-chloro-3-methylphenol (para-chloro-meta-cresol)	10	330
2-methylnaphthalene	10	330
hexachlorocyclopentadiene	10	330
2,4,6-trichlorophenol	10	330
2,4,5-trichlorophenol	50	1,600
2-chloronaphthalene	10	330
2-nitroanaline	50	1,600
dimethyl phthalate	10	330
acenaphthylene	10	330
3-nitroaniline	50	1,600

Table 4-3. Target Compound List Organics Analyses (Sheet 3 of 4)

Extractable Organic Compounds	Required Detection Limits[a] Low Concentration Water[d] (µg/L)	Low Concentration Soil/Sediment[e] (µg/kg)
acenaphthene	10	330
2,4-dinitrophenol	50	1,600
4-nitrophenol	50	1,600
dibenzofuran	10	330
2,4-dinitrotoluene	10	330
2,6-dinitrotoluene	10	330
diethylphthalate	10	330
4-chlorophenyl phenyl ether	10	330
fluorene	10	330
4-nitroaniline	50	1,600
4,6-dinitro-2-methylphenol	50	1,600
N-nitrodiphenylamine	10	330
4-bromophenyl phenyl ether	10	330
hexachlorobenzene	10	330
pentachlorophenol	50	1,600
phenathrene	10	330
anthracene	10	330
di-n-butylphthalate	10	330
fluoranthene	10	330
benzidine	50	1,600
pyrene	10	330
butyl benzyl phthalate	10	330
3,3'-dichlorobenzidine	20	660
benzo(a)anthracene	10	330
bis(2-ethylhexyl)phthalate	10	330
chrysene	10	330
di-n-octyl phthalate	10	330
benzo(b)fluoranthene	10	330
benzo(k)fluoranthene	10	330
benzo(a)pyrene	10	330
indeno(1,2,3-cd)pyrene	10	330
dibenz(a,h)anthracene	10	330
benzo(g,h,i)perylene	10	330

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Table 4-3. Target Compound List Organics Analyses (Sheet 4 of 4)

Pesticide Compounds	Required Detection Limits[a] Low Concentration Water[f] (µg/L)	Low Concentration Soil/Sediment[g] (µg/kg)
alpha-BHC	.05	2
beta-BHC	.05	2
delta-BHC	.05	2
gamma-BHC	.05	2
heptachlor	.05	2
aldrin	.05	2
heptchlor epoxide	.05	2
endosulfan I	.05	2
dieldrin	.1	4
4,4'-DDE	.1	4
endrin	.1	4
endosulfan II	.1	4
4,4'-DDD	.1	4
endrin aldehyde	.1	4
endosulfan sulfate	.1	4
4,4'-DDT	.1	4
endrin ketone	.1	4
methoxychlor	.5	20
chlordane	.5	20
toxaphene	1.0	40
arochlor 1016	.5	20
arochlor 1221	.5	20
arochlor 1232	.5	20
arochlor 1242	.5	20
arichlor 1248	.5	20
arochlor 1254	1.0	40
arochlor 1260	1.0	40

(a) Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

(b) Medium water contract required detection limits (CRDL) for volatile compounds are 100 times the individual low water CRDL.

(c) Medium Soil/Sediment CRDL for volatile compounds are 100 times the individual low soil/sediment CRDL.

(d) Medium water CRDL for semi-volatile compounds are 100 times the individual low water CRDL.

(e) Medium soil/sediment CRDL for semi-volatile compounds are 100 times the individual low soil/sediment CRDL.

(f) Medium water CRDL for pesticide compounds are 100 times the individual low water CRDL.

(g) Medium soil/sediment CRDL for pesticide compounds are 60 times the individual low soil/sediment CRDL.

Table 4-4. Target Compound List Inorganic Analyses

Element	Required Detection Limits (a) Low Concentration Water (µg/L)
aluminum	200
antimony	60
arsenic	10
barium	200
beryllium	5
cadmium	5
calcium	5,000
chromium	10
cobalt	50
copper	25
iron	100
lead	5
magnesium	5,000
manganese	15
mercury	0.2
nickel	40
potassium	5,000
selenium	5
silver	10
sodium	5,000
thallium	10
tin	40
vanadium	50
zinc	20
cyanide	10

(a) Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

Completeness of data for Level III, IV, and V analysis will be considered acceptable if it is at least 80 percent complete. Completeness for Level I analysis is not critical however, it will be essentially 100 percent because of the ease of repeating analysis if needed. No Level II analysis is proposed for this investigation.

In order to be considered representative, the sampling program (locations, sampling intervals, and sampling procedures) must be designed to ensure the sample data accurately and precisely represent the site conditions. The objectives for comparability of data must be met by using standardized protocols and techniques to collect and analyze representative samples and in reporting analytical results. Section 4.2 provides a summary of methods for obtaining data to meet these objectives. Additional details are provided in Section 5.0 and the Sampling and Analysis Plan (Attachment 1).

4.1.1 Source

As discussed in Section 3.1.1, the existing data on the waste sources in the operable unit is limited to the list of compounds and quantities known and suspected to have been disposed in the BY cribs (Appendix A). A complete chemical analysis for substances on the TCL and radiological characterization of the soils immediately beneath the cribs is needed, due to uncertainty regarding actual compounds which may have been disposed and their concentrations in the source area. Tables 4-3 and 4-4 contain the substances included on the TCL with the detection limits for water and soil.

The use of this data is primarily for site characterization. However, secondary uses include risk assessment, and evaluation of alternatives, Analytical Level I screening for radiation and health and safety monitoring will be conducted in the field, Level III will be used for radionuclides, and Level IV procedures will be used for the TCL analyses. Level V analyses will be conducted to identify the form of cyanide present.

4.1.2 Soil

4.1.2.1 Surface and Near-Surface Soil. Information on the nature and extent of contamination of surface and near surface soils in the operable unit is needed. The crib area is currently roped off with warning signs indicating radiation is present in the area. However, it is not known whether this contamination is due to unplanned releases or overfilling of the cribs resulting in contamination of surface or near surface soils, or due to radiation penetrating the soils above the cribs. No information is available for non-radiological contaminants and the concentrations and identity of specific radionuclides are not known. This information is needed for the following uses:

- site characterization,
- risk assessment via direct contact, inhalation, and ingestion routes of exposure,
- evaluation of remedial alternatives, and

- engineering design.

Level I screening will be conducted to optimize samples for analysis and for health and safety monitoring. Level III analyses will be required for the parameters of interest on the samples for site characterization, risk assessment and remedial alternative evaluations. Level V analyses will be conducted for cyanide speciation.

4.1.2.2 Vadose Zone Soil. Due to the nature of the waste disposal practices at this operable unit, the vadose zone soils can be assumed to contain contaminants below the cribs. However, the only existing data on the nature and vertical extent of this contamination are based on radiation logging in wells adjacent to the BY cribs using gross gamma probes for gamma radiation. Radiation was detected above background to the water table in most of these wells.

The concentrations of specific contaminants and the vertical extent of soil contamination beneath the cribs must be determined. In addition, the horizontal extent of contamination must be determined. Lateral spreading may have occurred due to perched conditions while the cribs were in use. This information is important for site characterization to assess the potential future migration of contaminants from the vadose zone to groundwater and evaluate the effectiveness of remedial alternatives and for engineering design.

Level I screening with radiation detectors will be used to select samples for full analysis. Appropriate Levels (III and V) for laboratory analysis will be selected based on the results of the source characterization. If compounds are identified in the source area that require Level V analysis to achieve required detection limits or compound identification, this level of analysis will be conducted.

4.1.3 Groundwater

As described in Section 3.1.3, a variety of radionuclides have been detected in groundwater from monitoring wells near the 200-BP-1 Operable Unit. Cyanide, selenium, and nitrate have also been detected in concentrations exceeding health advisories and drinking water standards. Additional data are required to determine the nature and extent of the groundwater contamination resulting from disposal practices at this operable unit and to be able to predict future plume migration. In addition, any groundwater contamination entering the study area from other operable units located upgradient and adjacent to 200-BP-1 must be defined. Additional geologic and hydraulic information is required to understand the groundwater flow system. These data needs are described in Section 4.1.7.2.

Two aquifers of importance to 200-BP-1, the unconfined (Ringold and Hanford Formation) and the confined (Rattlesnake Ridge) basalt flow interflow zone. A number of confined aquifers (basalt flow interbeds) exist at greater depths but are not believed to require study unless the 200-BP-1 unit is impacting the Rattlesnake Ridge aquifer.

4.1.3.1 Unconfined Aquifer. Plumes of contaminants north of 200-BP-1 in the unconfined aquifer appear to be associated with this operable unit. The only compound that is elevated in a downgradient well but has not been identified as a waste constituent nor has been detectable in groundwater from onsite wells is selenium. The possibility exists that plumes in the unconfined aquifer could have contributions from other operable units.

Uncertainty exists in plume delineation within the unconfined aquifer. The highest uncertainty is the northward extent of the plume and whether the plume is discharging to West Lake or bypassing it to the west. The possibility exist that high hydraulic conductivity paleo stream/flood channels exist in the unconfined aquifer and will channel and control solute transport processes.

4.1.3.2 Rattlesnake Ridge Confined Aquifer. Low but elevated tritium concentrations have been identified in the Rattlesnake Ridge aquifer in the vicinity of 200-BP-1. Groundwater from wells E33-12 and 47-50 contained over 300 pCi/L of tritium compared to average values of less than 1 pCi/L. The tritium is suspected to be entering the Rattlesnake Ridge aquifer in the area of B-Pond where tritium exists in the unconfined aquifer and a downward vertical hydraulic gradient exists. There is also the possibility that contaminants from 200-BP-1 have entered the Rattlesnake Ridge aquifer, or that a mound in the unconfined aquifer could have existed during operation of the BY cribs and created downward hydraulic gradients.

The horizontal hydraulic gradients within the Rattlesnake Ridge aquifer around 200-BP-1 need to be better defined. This will permit a higher confidence on the source of tritium in E33-12, the migration of contaminants in the Rattlesnake Ridge, and whether it is impacted from 200-BP-1 waste management practices.

The communication of the Rattlesnake Ridge aquifer with the overlying unconfined aquifer is not completely understood in the area of 200-BP-1. Hydraulic heads are about equal in 49-55(A) and 49-55(B) (Graham et al., 1984). The confining Elephant Mountain basalt flow is apparently missing in the area of well 53-55 (A, B, C), but exists in well 54-57. Further north the Elephant Mountain basalt flow is completely missing in all wells. The direct communication of these aquifers will influence the migration and concentration of contaminants.

The above data will be used for site characterization, risk assessment, evaluation of alternatives, and engineering design. Appropriate analytical levels are Level I for field parameters (i.e., pH, temperature, etc.) and Levels III and V for initial site characterization, risk assessment and evaluation of remedial alternatives. Additional geologic and hydrogeologic information is also required to characterize the site. These data needs are identified in Section 4.1.7.

4.1.4 Surface Water

As discussed in Section 3.1.4, there is no information to indicate a release to surface water is occurring from this operable unit. Data obtained to model the fate and transport of contaminants in groundwater will provide sufficient information anticipated to evaluate potential impacts to surface

water. Extensive sampling of West Lake, which is the nearest potential surface water discharge point for groundwater that is impacted by this operable unit, is currently being conducted. No additional sampling of West Lake is needed at this time, with the possible exception of sampling for tritium, which has not been conducted.

4.1.5 Air

Based on the discussion in Section 3.1.5, the air pathway of exposure does not appear to be significant at this operable unit. Extensive air monitoring is already being conducted for the Hanford Site with three air monitoring stations located around the operable unit. However, airborne emissions may have to be considered for specific remedial alternatives.

4.1.6 Biota

As discussed in Section 3.1.6, vegetation and animal feces sampling has been conducted in the Separations Area to determine the impacts of waste management activities on the biota. This sampling has included locations at the north boundary of this operable unit. Samples have not been collected from within the operable unit. A biotic reconnaissance is needed to evaluate evidence of uptake of toxic substances by plants or animals. In addition, a survey for threatened or endangered species is needed. Possible contamination of surface and near-surface soils are the most likely routes of exposure to biota. Uptake of vegetation, and ingestion or direct contact by burrowing animals are the most likely receptors via this route of exposure. However, no route of exposure from biota to the human food chain is likely from the site. In addition, no critical habitats appear present within the operable unit for threatened or endangered species (see Section 2.2.6.4). Level III analysis for parameters of interest will be adequate for any biota samples collected.

4.1.7 Other Data Needed

A variety of additional data are or may be needed to complete the RI/FS. The physical conditions of the site that affect the risk assessment, evaluation of alternatives, and remedial design must be understood. These data needs include characterization of soil properties, predicting the fate and transport of contaminants from vadose zone soils to the groundwater, and characterization of the aquifer properties. These data are needed to complete the risk assessment, evaluate remedial alternatives, and for engineering design.

4.1.7.1 Soil Characteristics. The flux rate of contaminants from the vadose zone may be needed to predict the impact on groundwater. A variety of factors influence the fate of contaminants in the vadose zone soils and transport to the groundwater. These include the chemical state of the compounds, degradation and transformation of the chemicals in the soil, sorptive capacity of the soil for the chemicals of concern, and the rate of infiltration of meteoric water.

Some of this information may be difficult to obtain directly. However, it may be possible to empirically determine the potential flux rate from the vadose zone soils for different rates of infiltration. This could be predicted through bench-scale leach tests of samples collected during site characterization activities. Representative vadose zone soils from beneath the cribs would be required and leach tests conducted simulating infiltration at the Hanford Site. Analytical levels required for testing the leachate will be Levels I, III, and V.

Additional physical properties of the soils will be needed to evaluate remedial alternatives and for remedial design. These properties include grain size distribution, moisture content, density, hydraulic conductivity, and thermal conductivity, and moisture content-capillary pressure relations.

Selected samples from surface soils and vadose zone borings will be tested for physical properties or archived for later testing as needed for evaluation of remedial alternatives.

4.1.7.2 Aquifer Characterizations. Numerous pump tests have been conducted in wells that receive groundwater from either the unconfined aquifer or Rattlesnake Ridge Aquifer (Graham, 1981, and Graham et al., 1984). The results indicate that significant variability exists in both aquifers. Within the unconfined aquifer the Hanford gravels have hydraulic conductivities that are approximately two orders-of-magnitude higher than the Middle Ringold Sands (Graham, 1981). Variability in hydraulic conductivity of the Ringold Sands is almost one and a half orders-of-magnitude. Similar variations exists in hydraulic conductivity of the Rattlesnake Ridge aquifer (Graham et al., 1984). The hydraulic properties of the unconfined aquifer will need to be defined in the area of the 200-BP-1 contaminant plumes to provide better estimates of plume migration rates.

4.1.7.3 Solute Retardation. The migration and fate of contaminants in aquifers needs to be adequately understood to predict future risks to the public and environment and evaluate the effectiveness of remedial alternatives. Data pertaining to persistance, retardation, and attenuation (with flow rates of groundwater in aquifers) will be required to evaluate the migration and fate of contaminants. Level I, III, and V analysis will be conducted on samples obtained to determine solute retardation.

4.1.7.4 Surface Contours of the Uppermost Basalt. Defining the surface contours of the uppermost basalt (Elephant Mountain) is important to evaluate the possibility of channeling of groundwater and solutes in the unconfined aquifer. This information is also needed to locate areas in which the basalts are eroded and the Rattlesnake Ridge aquifer is in direct contact with the overlying unconfined aquifer.

4.2 METHODOLOGY FOR OBTAINING AND EVALUATING DATA

This section summarizes the methodology and provides general preview of tasks which will be conducted in the RI/FS to obtain and evaluate the data needs identified in Section 4.1. Specific details are included in the RI/FS task descriptions (Section 5.0) and in the Sampling and Analysis Plan (Attachment 1). Tasks in the RI/FS will be conducted in a logical, integrated and sequenced approach to optimize drilling, sampling, and analysis efforts.

4.2.1 Source Characterization

The initial field sampling and analysis efforts will be within the source area to fully characterize the wastes present in the disposal areas and identify additional target compounds for analysis in subsequent tasks. Data needs described in Section 4.1.1 will be obtained by drilling and sampling at the 10 cribs in the operable unit. Three borings will be drilled to approximately 6 to 7.5 meters (20 to 25 feet) in each of the cribs. Samples will be obtained at the surface (1.5 meters [5 feet]), at depths of about 5 meters (15 feet), and about 7 meters (23 feet). A complete analysis will be conducted on selected composited samples for TCL constituents and radionuclides. These borings will be temporarily capped, pending results of analysis and the deep boring program described in Section 4.2.2.2 below.

The boring to be drilled in the 216-B-61 crib is to confirm that no wastes were disposed. Analysis for TCL constituents will be conducted on the sample obtained immediately below the infiltration gravels. The other samples will be screened in the field with a scintillation counter, and will only be analyzed in a laboratory if there is an indication that contaminants were disposed within this crib.

4.2.2 Soil Characterization

4.2.2.1 Surface and Near Surface Soils. Contamination of surface and near surface soils above the cribs will be characterized during sampling conducted in the boring program described above. In addition, contamination of surface soils in areas outside the cribs within the operable unit will be characterized using soil probes to locate contaminated zones, with confirmation sampling from test pits. The distribution of soil probes should provide a high degree of confidence that sources near the surface are detected and characterized. Emphasis should be placed on locating UNs and potential leaks from distribution lines. Samples will be obtained for analysis and will be screened in the field with a scintillation counter for presence of radionuclides (Level I) and an OVA for presence of volatile organic compounds. Selected samples will be collected for analysis of target compounds and physical properties.

4.2.2.2 Vadose Zone Soils. Contamination of vadose zone soils will be characterized after results of the source characterization analysis are completed. Three deep borings to approximately 70 meters (220 feet) will be drilled, one in each of the three cribs selected after source characterization. These deep borings will be drilled through the shallow borings drilled for source characterization that contain the highest concentrations of contaminants in each of the cribs. The selection of cribs and boring will be based on representing cribs that received in-tank solidification condensate and cribs that received TBP supernatant effluents. Locations will be selected to ensure that boreholes are also spatially separate so that subsurface conditions are investigated over a representative area.

Samples will be obtained continuously from the first boring and at 0.75-meter (2.5-foot) intervals from the remaining borings. Analysis of the currently identified compounds of interest and any additional chemicals identified during the source characterization will be conducted on selected samples. Selected samples will also be tested for physical properties, as required (see Section 4.2.7.1).

Boreholes will be geophysically logged with gamma, gamma-gamma, and neutron probes to assist in determination of moisture content and density, as well as interpretation of stratigraphy and general level of contamination.

All boreholes (including the shallow boreholes described above) will be properly abandoned upon completion of this task in accordance with the requirements of Chapter 173-160 WAC.

Additional vadose zone borings outside the crib boundaries may be required during later phases of investigation. These will be needed if evidence is obtained of perched conditions which resulted in lateral spreading of contaminants in the vadose zone.

4.2.3 Groundwater Characterization

4.2.3.1 Sampling of Existing Wells. The initial task for characterization of groundwater will be to sample existing wells in both the unconfined and confined aquifers. This information is needed to fill the data gaps identified in Section 4.1.3 and to better define locations for any additional wells.

The initial sampling and analysis task will define current water quality in regularly monitored existing wells and wells farther down gradient (north) of well 53-55 location for contaminants of concern. If characterization of source materials indicates additional contaminants are of concern, these additional contaminants will also be included for analysis. In addition, Level V-SAS analytical methods and procedures will be tested for cyanide speciation and for lower detection limits for ruthenium-106 in actual groundwater matrices.

4.2.3.2 Unconfined Aquifer. Three monitoring wells in the unconfined aquifer are needed to determine contributions from other operable units to the contaminant plumes north of 200-BP-1. These wells will be installed in areas north, east, and south of the cribs in the 200-BP-1 Operable Unit as described below.

- A well will be installed to the east of the operable unit near an existing well (E33-12), which is installed in the Rattlesnake Ridge aquifer, and downgradient of crib 216-B-51.
- A well will be installed in the operable unit to the south of the cribs and downgradient of the BY-Tank Farm between existing wells E33-13 and E33-24.

- A well will be installed southeast of existing well 50-53 in the gap between basalt strata outcropping above the water table to monitor contaminant contributions from the eastern portion of 200 East Area and B-Pond.

In addition to these wells, three wells will be installed to define the plume boundaries downgradient (north) of the operable unit. Based on the review of existing data, it is anticipated that these will be installed downgradient of existing well 50-53. However, the exact locations of these wells will be determined based on results of the initial sampling program of existing wells and of the seismic refraction survey.

Wells will be sampled and analysis conducted for chemicals of interest and any additional chemicals identified from initial sampling of existing wells and source materials.

After analysis of sampling results from these wells, it is possible that additional wells will be required in subsequent stages of the investigation to adequately define the plume boundaries. It is assumed that two additional wells will be adequate.

4.2.3.3 Rattlesnake Ridge Confined Aquifer. Additional wells will be installed to determine whether contamination has impacted or may impact the upper confined (Rattlesnake Ridge) aquifer. A well will be installed in the Rattlesnake Ridge aquifer within the operable unit between cribs 216-B-46 and 216-B-50. In addition, a well will be installed in this aquifer adjacent to well 699-50-53. The network of monitoring wells in the Rattlesnake Ridge aquifer will better define the potential interaquifer communication and local horizontal hydraulic gradients to delineate and predict contaminant impacts from 200-BP-1.

If contamination is detected that may be attributable to this operable unit, additional wells will be required to characterize the extent of contamination and to determine the source of contamination. This may require additional upgradient wells in the area south and southwest of the operable unit installed in the Rattlesnake Ridge aquifer as well as downgradient wells to define the plume boundaries.

4.2.4 Surface Water

As indicated in Section 4.1.4, the only additional data required for surface water impacts and characterization beyond that which is currently available will be to include tritium analysis during ongoing West Lake monitoring efforts of the lake's surface waters. Thus, no tasks are currently anticipated for inclusion to the RI/FS.

4.2.5 Air

As indicated in Section 4.1.5, air monitoring is currently being conducted around the 200-BP-1 Operable Unit. No additional tasks are planned for the RI/FS to evaluate the airborne pathway. The airborne pathway is not expected to be an important route of exposure for this operable unit.

4.2.6 Biota

As indicated in Section 4.1.6, a biotic reconnaissance will be conducted to evaluate uptake of toxic substances by plants or animals. In addition, a survey will be conducted for threatened or endangered species.

4.2.7 Other Tasks

4.2.7.1 Soil Characteristics. To determine the flux rate of contaminants to groundwater, laboratory leach tests are proposed as an optional activity. If these tests are conducted, representative depth samples of vadose zone material will be leached in series in the laboratory with simulated rainwater for empirical determination of soluble contaminants. The potential flux of contaminants migrating to the water table will be estimated for the range of recharging meteoric water anticipated from previous studies to be occurring in the 200 Areas. Meteoric water recharge to aquifers is believed to be between 0 and 8 cm/yr (0 and 3.15 in/yr) (Isaacson et al., 1974; Jones; 1978, and Gee and Heller, 1985). Meteoric water infiltration is very complex, requires long-term test sites, and will be necessary for all sites at Hanford. This information, therefore, is best obtained through Hanford-wide representative studies for application to specific sites. The laboratory leaching tests need to be conducted on specific-site, contaminated soils for empirically determining the concentration solubilized and, thus, contaminant flux to the water table for potential rates of infiltrating and recharging meteoric water.

The remedial technologies that may be appropriate (see Section 3.5) require site-specific data on physical properties of soils for evaluation. The required physical properties include:

- grain-size distribution
- moisture content
- density
- hydraulic conductivity
- thermal conductivity
- moisture content - capillary pressure relationship.

These physical properties will be tested using standard methods on selected soil samples obtained during source sampling, surface soil sampling, and vadose zone soil sampling tasks. Parameters that are not stable such as moisture content will be tested immediately from sealed samples and estimated from neutron-epithermal-neutron borehole logging. Density estimates will be obtained by drive tube penetration testing of soils and gamma-gamma and neutron-epithermal-neutron borehole logging techniques.

4.2.7.2 Aquifer Hydraulic Pump Tests. Hydraulic aquifer pump tests may be necessary during the RI. The number of hydraulic tests and the wells chosen for testing will be based on plume delineation information needed to evaluate remedial alternatives. The unconfined aquifer in the Hanford Formation may have hydraulic conductivities too high for effective slug testing. Therefore, drawdown and recovery testing methods are preferred. Since purged contaminated groundwater requires capture and treatment, the pump tests may be best conducted from wells just downgradient of the plume. In addition, determination of migration rates to surface water requires aquifer hydraulic data representing the aquifer between the existing plume and discharge zone to

the surface water body. If remedial alternatives that include extraction of contaminated groundwater need to be evaluated, a combined pumping and groundwater treatability test may be conducted.

4.2.7.3 Solute Retardation. An optional activity is proposed to determine the retardation by chemical absorption. This will be estimated through laboratory testing and analysis. Representative samples of aquifer matrix will be obtained during drilling and installation of monitoring wells. Representative samples of the aquifer and vadose zone soils will be analyzed for total organic carbon content, in case organic solvents are discovered to be a contaminant of concern. Representative samples will also be subjected to sorption tests with representative contaminant/solute solutions. The resulting partitioning between solution and solid for each analyte of interest will be used to estimate retardation.

Saturation indices provide information on whether specific solutes are precipitating from the groundwater. To determine saturation indices for solute concentrations in groundwater, one important parameter for solute speciation and saturation index determinations for radionuclides is the redox condition (reducing/oxidizing) of the groundwater. This parameter is difficult to obtain with confidence, but attempts will be made to measure groundwater redox conditions during sampling. Another limiting factor for solute speciation and saturation index determinations may be completeness of the thermodynamic data base for equilibrium constants of radionuclides, solute speciation, and minerals containing radionuclides. Thermodynamic data bases and equilibrium constants are established through research efforts and are not appropriate for RI/FS.

4.2.7.4 Surface Geophysics. The Hanford Formation (Pasco gravels) are in contact with the Elephant Mountain basalt in much of the area to the north of 200-BP-1. Flow in the unconfined aquifer will be controlled by basalts outcropping above the water table and by channels eroded in the surface of the basalt by catastrophic flooding and deposition of Hanford gravels. Erosional window or possibly channels that interconnect the Rattlesnake Ridge and unconfined aquifer exists as evident at the well 53-55 location. Determinations of the surface contours of the basalt will permit a more focused and relevant placement of additional monitoring wells.

Some seismic studies have been conducted previously in the area north of 200-BP-1. These studies will be reviewed to determine whether the surface contour of the uppermost basalt has been adequately defined. If additional information is needed, the geophysical technique proposed to determine the surface contour of the uppermost basalt is seismic refraction. The seismic refraction study will be carefully designed to not compromise the integrity of the single-shell tanks in the 241 BY-Tank Farm while achieving the objectives.

5.0 DESCRIPTION OF REMEDIAL INVESTIGATION/FEASIBILITY STUDY TASKS

5.1 PHASE I REMEDIAL INVESTIGATION

This section organizes and describes tasks to be performed during Phase I RI of the 200-BP-1 Operable Unit. The tasks are designed to provide information to fill data gaps identified in Section 4.0. The purpose of conducting Phase I is to gather data primarily for characterizing site conditions, conducting the baseline risk assessment, and evaluating remedial alternatives.

The tasks identified and described for Phase I RI are as follows:

- Task 1 - Project Management
- Task 2 - Source Sampling and Analysis
- Task 3 - Surface and Near-Surface Soil Sampling and Analysis
- Task 4 - Vadose Zone Soil Sampling and Analysis
- Task 5 - Seismic Refraction Survey
- Task 6 - Installation of Monitoring Wells
- Task 7 - Groundwater Sampling and Analysis
- Task 8 - Site Topographic Map
- Task 9 - Biota Evaluation
- Task 10 - Column Leach Tests
- Task 11 - Hydraulic Pump Tests
- Task 12 - Sorption Tests
- Task 13 - Baseline Risk Assessment
- Task 14 - Data Evaluation and Phase I RI Report

Table 5-1 provides a summary of the Phase I RI activities.

Prior to commencing any onsite activities, a Radiation Work Permit is required. Work authorization for a subcontractor (if utilized) and the analytical laboratories also must be acquired. Scheduling of activities must be coordinated with the BY-Tank Farm and Crib Operations Manager, any subcontractors, Westinghouse Tank Farm Services, Office of Sample Management, Mobile Radionuclide Analysis Laboratory Services, and the 222-S Radiation Protection Services Laboratory. In addition, procurement of general equipment and supplies for anticipated activities will be necessary. All activities will be conducted in accordance with the 200-BP-1 Sampling and Analysis Plan (Attachment 1), the Health and Safety Plan (Attachment 2), and with the Radiation Work Permit (to be obtained). During activities within 200-BP-1, a radiation protection technologist (RPT) and a Health and Safety Officer will be present. Locations of underground pipelines and utilities will be confirmed using metal detectors/pipe locators prior to underground investigations. A survey of cultural resources will be conducted prior to any work in the 600 Area.

Table 5-1. Summary of Phase I RI Activities (Sheet 1 of 2)

Task No. and Description	Boreholes/ Depth	Wells	Samples[a]	Analyses	Radiological Survey	Soil Probes	Boreholes Geophysics
Task 2 - Source Sampling & Analysis	24/8 meters 4/6 meters 3/5 meters	N/A	124 21 21 41 124	TCL-Volatile organic analysis TCL-semi-volatile Metals Parameters of interest (excluding cyanide) cyanide	N/A	N/A	X
Task 3 - Surface and Near-Surface Soil Sampling Analyses	N/A	N/A	TBD	Alpha, beta/gamma, parameters of interest	X	150 Approx.	N/A
Task 4 - Vadose Zone Soil Sampling Analysis	3/Approx. 70 meters	N/A	35 Minimum (More may be analyzed based on changes in stratigraphy)	Parameters of interest (additional parameters identified in Task 2)	N/A	N/A	X
Task 5 - Seismic Refraction Survey	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Task 6 - Installation of Monitoring Wells	N/A	Stage 1-8 Stage 2-3 (anticipated)	45 (Soil) TBD	Parameters of interest Total organic carbon	N/A	N/A	X

Table 5-1. Summary of Phase I RI Activities (Sheet 2 of 2)

Task No. and Description	Boreholes/ Depth	Wells	Samples[a]	Analyses	Radiological Survey	Soil Probes	Boreholes Geophysics
Task 7 - Groundwater Sampling & Analysis	N/A	35	35-38 (semi-annualy for 4 to 5 years 35-38 (quarterly for 1 year)	Parameters of interest major cations-anions	N/A	N/A	N/A
Task 8 - Site Topographic Map	X	X	N/A	N/A	N/A	X	N/A
Task 9 - Biota Evaluation	N/A	N/A	TBD	Parameters of interest	N/A	N/A	N/A
Task 10 - Column Leach Test	N/A	N/A	36	Parameters of interest	N/A	N/A	N/A
Task 11 - Aquifer Tests	N/A	19	N/A	N/A	N/A	N/A	N/A
Task 12 - Sorption Tests	N/A	N/A	7/Soil 18/Water	Parameters of interest	N/A	N/A	N/A

(a) - Includes quality control Samples

Tank Farm Services will provide operator control for waste and sample handling activities at the site and will provide for the transportation of any radiologically contaminated sampling equipment, dual wall samples, soil and groundwater samples to the 2706-T or T Plant decontamination facilities. Samples with activity greater than 2,000 rads will be transported in lead pigs. All radioactive and potentially mixed waste (drill cutting or waste water) transported from the site will be accompanied by the Radionuclide Shipment Record assigned to the Tank Farm Services waste truck assigned to support the activity. All mixed waste will be accompanied by a uniform hazardous waste manifest form as well.

All samples obtained within the 200-BP-1 Operable Unit will be scanned for radiation in an onsite laboratory. Samples exceeding 5 mrem/hr will remain in the laboratory for chemical analysis. Samples less than 5 mrem/hour may be transferred to a qualified offsite laboratory for chemical analysis. Samples obtained within the 600 Area will be field scanned for radiation by the RPT prior to and after extraction. The RPT will make arrangements for handling and transport of samples exceeding 5 mrem/hr to the laboratory, whereas samples less than 5 mrem/hr can be handled in the field and transported directly to an onsite or an offsite laboratory for analysis or for archiving.

5.1.1 Task 1 - Project Management

The Project Management Plan (Attachment 5) defines the administrative and institutional tasks necessary to support RI/FS activities.

The purpose of this task is to provide general project management necessary to stay within cost and on schedule, direct and document the activities and to secure the generated data with acceptable technical performance. Periodic budget and schedule assessments will be provided throughout the RI/FS of the 200-BP-1 Operable Unit. Initially, individuals will be assigned to the management structure presented in the Project Management Plan. These individuals will be responsible for their assigned roles for the 200-BP-1 Operable Unit.

5.1.1.1 Budget and Schedule Tracking. Costs and scheduled milestones associated with the project will be regularly tracked. Labor, other direct costs, and subcontractor expenses will be tracked on a weekly basis. The budget tracking activity will be computerized and will be the basis for invoice preparation and review. Milestones for reports and schedules for completion of tasks will be tracked weekly.

5.1.1.2 Monthly Progress Reports. Monthly progress reports will be prepared and entered into the project file. These reports will summarize the work completed and data generated during the previous month. They will also discuss any anticipated problems, recommended solutions, upcoming activities and events, key personnel changes, deliverables submitted, and budget and schedule information.

5.1.1.3 File Keeping. File keeping includes activities necessary to keep all records pertaining to this project organized and secured, yet accessible. This task requires daily effort to maintain files for field reports, boring logs, QA documents, correspondence, generated data, memoranda, and

subcontractor reports. All correspondence and data will be logged when it is sent or received and entered into a file to which access is limited.

5.1.1.4 Coordination With Personnel and Subcontractors. Coordination efforts include obtaining work authorizations, radiation work permits, and meetings with field personnel, BY-Tank Farm Operations Manager, radiation protection department, and subcontractor representatives before starting field or laboratory work, to ensure the performed work and data are satisfactory. It includes daily communications between office and field personnel, and periodic communication with subcontractors to assess progress and transmit data.

5.1.1.5 Meetings. As required throughout the RI/FS for 200-BP-1 Operable Unit, meetings will be held with regulatory agencies; DOE, and the public, to present and explain the process of the RI/FS and to present data and conclusions provided in submitted reports.

5.1.2 Task 2 - Source Sampling and Analysis

The purpose for sampling source materials is to verify the identification and remaining concentration of waste constituents within the cribs. Analyses will be undertaken for all CERCLA-TCL and major radioisotopes (including total alpha and beta) to determine whether other constituents need to be included or considered as parameters of interest for the 200-BP-1 investigation. In addition, data from previous investigations at the Hanford Site will be evaluated to determine whether samples should be obtained for microbial activity. Analysis of source materials for the CERCLA-TCL chemicals and radionuclides together with the existing analytical results for groundwater from wells in 200-BP-1 should eliminate the uncertainty of estimates of past disposal effluent constituents. In addition, the analytical results will be useful for evaluating the variability among source materials in cribs that received waste effluent from similar processes. Prior to beginning this activity onsite laboratory capabilities will have to be upgraded to enable analyses for the TCL substances on samples with radioactivity in excess of 5 mrem/hr.

The activities comprising this task include:

1. preparation
2. drilling and soil sampling
3. sample and waste handling, inspection, storage and transfer or disposal
4. chemical analysis
5. geophysical borehole logging
6. geodetic survey
7. borehole abandonment.

Three borings will be drilled through each crib to 3 meters (10 feet) below the gravel infiltration layer, to obtain soil samples for analyses. The three borings within cribs 216-B-43 through 50 will be in a triangular array as shown in Figure 5-1 so as not to disrupt the existing piping and structure. The three borings within crib 216-B-57 will be in a linear array, as shown in Figure 5-2, because of the difference in construction of this crib. One boring will be drilled in crib 216-B-61 at the head end to verify it was never used. Three additional five-meter deep borings will be drilled at a designated zone in the 600 Area at least 100 meters (330 feet) north of crib 216-B-61 (not in a possible surface drainage channel) for determining Area background concentrations.

Because of the design of the cribs, waste constituents are expected to be relatively uniformly distributed. Three borings in each crib should be sufficient to provide representative samples. Samples will be composited (except for volatile organic, cyanide, gross beta, sodium, and sulfates) for selected depths as described below and in Figure 5-3. Discrete samples will be obtained from each boring at the selected intervals and analyzed for TCL volatile organics, cyanide, sulfate, sodium, and total beta and alpha activity. This will provide information on the variability within each crib and whether waste constituents are, in fact, uniformly distributed.

Borings within cribs 216-B-43 through 50 will be to about 8 meters (25 feet) (3 meters [10 feet] below the bottom of the gravel infiltration bed). Depth of borings for the 216-B-57 and 61 cribs are anticipated to be 6 meters (20 feet) to penetrate 3 meters (10 feet) below the infiltration gravels. Drilling will be with dual-wall cable tool techniques primarily for contamination control. The nominal diameter of the outer wall shall be either 25 or 30 centimeters (10 or 12 inches). Samples will be obtained from the inner core barrel of the dual-wall system.

Each boring will be capped and sealed with the outer wall remaining in place for future use in subsequent tasks as necessary. Borings will subsequently be completed to the water table beneath three of the cribs as described in Task 4. Each boring will be geophysically logged and geodetically surveyed for elevation and N-S/E-W coordinates. Eventually, the borings will be properly abandoned in accordance with WAC 173-160 by removing the outer wall and grouting the entire borehole annulus to land surface.

Laboratory soil samples (with the exception of background samples) will be extracted within an appropriate controlled facility, scanned with scintillation detectors, geologically logged, and described according to matrix type. Soil samples for each crib and the three 600 Area background borings will represent the surface soils (uppermost 0.3 meter [1 foot]), soil cover above the gravel infiltration bed (1.5- to 2-meter [5- to 6.5-foot] depth interval), the interface of the bottom of the gravel bed and soils 0.75 meter (2.5 feet) below the gravel bed, and soils from about 2 to 3 meters (7.5 to 10 feet) below the gravel bed as illustrated in Figure 5-3. The samples will be sent to a Westinghouse laboratory for analysis. A portion of each sample will be individually analyzed for volatile organics (EPA 1986, Method 8240), cyanide sulfate, sodium, and total beta and alpha activity. The reminder of the samples will be composited together for each crib and for each material layer as described above (total of four composite samples for each

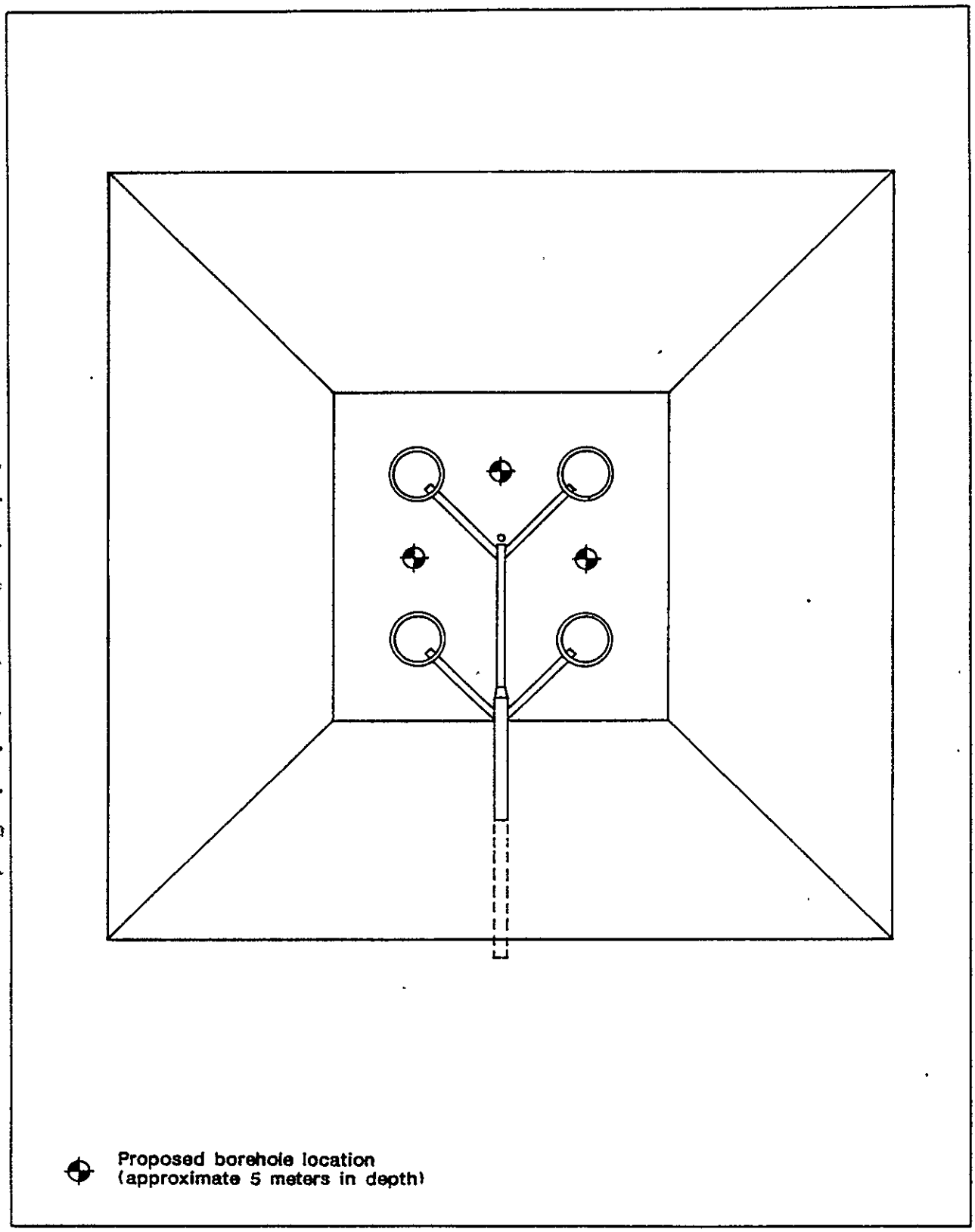

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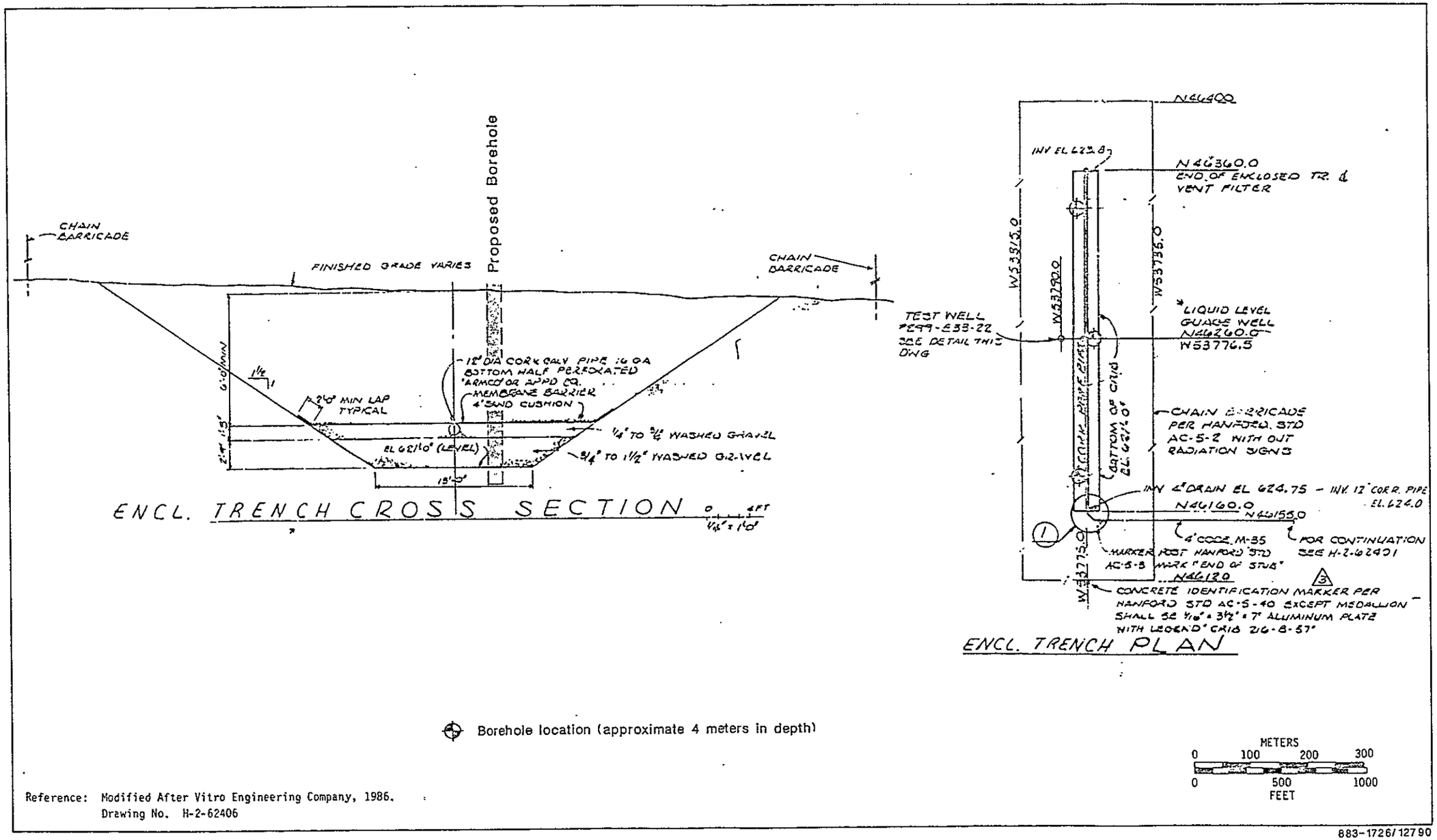
Figure 5-1. Task 2 Borehole Locations for Source Sampling in Cribs 216-B-43 Through 50



Reference: Modified After Vitro Engineering Company, 1986. Drawing No. H-2-62406

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Figure 5-2. Task 2 Borehole Locations for Source Sampling in Cribs 216-B-57

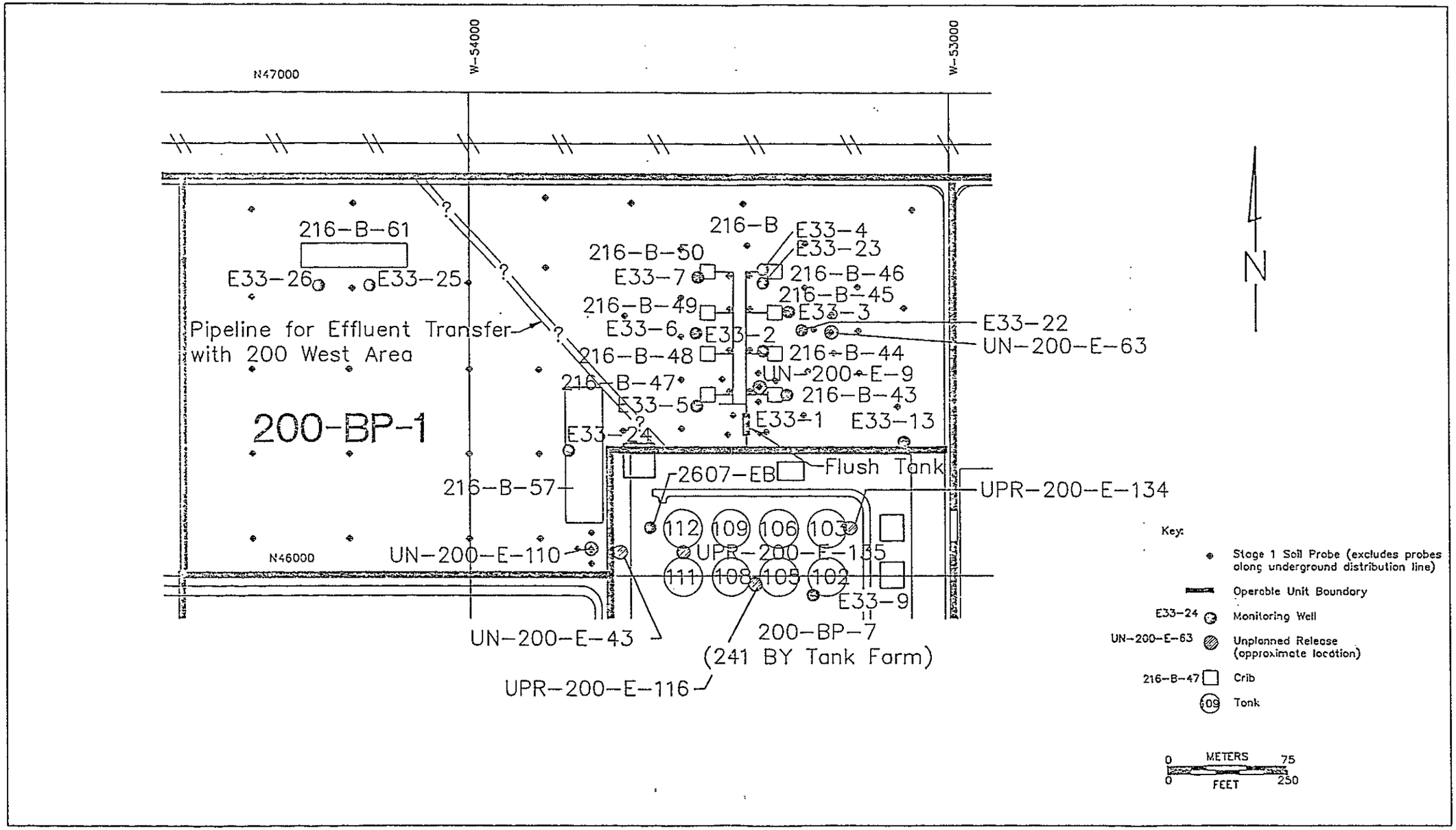

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Figure 5-4. Task 3 Proposed Soil Probe Locations in the 200-BP-1 Operable Unit

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crib). Composited samples representing the interface of the gravel bed and underlying soils from each crib will be analyzed for CERCLA-TCL (except volatile organics) constituents and parameters of interest (see Table 4-2). The other composited samples for each crib will be analyzed for parameters of interest (except cyanide) and other constituents (except TCL volatile organics) discovered during the full CERCLA-TCL analyses. Level IV RAS will be conducted on all sample analysis. If soils from the 216-B-61 crib do not indicate the presence of contamination, the resulting analyses will be evaluated as possible background concentration of soils and crib construction materials. Details on the sampling and handling procedures, sample preservation and storage requirements, analytical methods and quality assurance are provided in the 200-BP-1 Sampling and Analysis Plan (Attachment 1).

The remainder of the samples from each boring will be subdivided to represent depth intervals for: (1) the uppermost meter of material; (2) the soils between (1) above and the gravel infiltration bed; (3) the interface between the soil cover and the gravel infiltration bed; (4) the gravel infiltration bed; and (5) the soils below the gravel infiltration bed. These soils will be archived for subsequent use as described in Tasks 9 and 11, and Phase II RI (Treatibility Tests).

5.1.3 Task 3 - Surface and Near-Surface Soil Sampling and Analysis

The purpose of this task is to investigate contamination of soils at or near the surface. Several unplanned releases (UN-200-E-9, 53, and 110) are associated with 200-BP-1, but the location, extent, and concentration of contaminants are uncertain. In addition, the possibility exists that underground distribution lines could have leaked. This task will attempt to locate and delineate contamination existing in the near-surface soils for site characterization and risk assessment.

This task involves the following activities:

1. preparation
2. scintillation survey of land surface (Level I analyses)
3. evaluation testing and implementation of leak detection techniques for underground distribution lines
4. Subsurface soil survey using soil probes and scintillation detectors (Level I analyses). This task is anticipated to be conducted in stages
5. soil sampling using a hollow-stem auger or backhoe
6. geodetic control and survey
7. laboratory analysis of soils for parameters of interest on soils having elevated scintillation levels (Level III analyses).

5.1.3.1 Scintillation Survey of Land Surface. The ground surface (not including the cribs) will be surveyed using a scintillation detector for beta/gamma and alpha. Area-specific background radiation will be established by surveying land surfaces north of the 200-BP-1 boundary in the designated background zone in the 600 Area used for background evaluations in Task 2. Areas within 200-BP-1 with either alpha or beta/gamma radiation statistically greater (99 percent confidence) than area background will be identified for more detailed inspection.

5.1.3.2 Underground Distribution System Leak Detection. An evaluation of leak detection techniques for underground waste effluent distribution lines will be conducted. Locating leaking areas directly is the most efficient manner of characterizing uncontrolled discharges to subsurface soils. Initially, the piping system construction and installation systems drawings (as builts) will be reviewed. Particular attention will be given to the possibility of isolating (from airtight valves) and pressurizing the system or sections of the system for determinating the possibility of leaks.

Four distribution systems exist in 200-BP-1 and are:

1. effluent transfer lines to cribs 216-b-43 through 216-b-50
2. effluent transfer line to crib 216-b-57
3. effluent transfer line connecting 200 east with 200 west areas
4. effluent transfer line to crib 216-b-61 (location is uncertain).

If the evaluation indicates a distribution system or sections of a system can be isolated and pressurized with existing valves or with retrofited valves, the distribution system will be pressure tested with air for determining the possibility of leaks. Systems or sections of a system that indicate the potential for leaks (pressure reduction with time) will be pressure tested using an appropriate tracer gas to locate leak. An evaluation of appropriate tracer gases needs to be made prior to implementing the tracer gas test. Tracer gases should be relatively inexpensive, inert (stable) to suspected residual effluents in the lines and soil environment, nontoxic, and easily detectable.

Once a suitable tracer gas has been selected, soil gas probes (extending 1.8 to 2.4 meters [6 to 8 feet]) will be installed along the pressurized system lines every 3 meters (10 feet). The system or isolated section of the system will be pressurized with sufficiently high concentrations of the tracer gas. Soil gas samples will be collected and analyzed (preferably onsite) for the presence of the tracer gas. Sampling points where tracer gas is encountered will be noted as being locations where effluent leakage could have occurred. These locations will be targeted for further soil characterization.

5.1.3.3 Subsurface Soil Scintillation Survey. Subsurface soils below areas identified by the land surface scintillation survey as having elevated levels of radionuclides, areas suspected to have unplanned releases, and areas containing underground distribution lines (potential leak areas), will be surveyed using soil probes. The subsurface soil survey will be conducted in stages. Within the remaining areas (excluding cribs), subsurface soils will be investigated through random sampling on a grid pattern using the soil

probes. Figure 5-4 shows the location and the minimum number of subsurface soil probes for Stage 1. During Stage 1, soil probes will be installed and tested along underground distribution lines at a minimum of every 3 meters (10 feet) and in the vicinity of suspected leak areas. The actual number of soil samples will depend on the results of the surface and subsurface surveys. Soil probes will be driven into soils to depths of approximately 1.8 to 2.4 meters (6 to 8 feet). A gamma scintillation detector will be lowered through the probe to measure radiation levels with depth. The Stage 2 subsurface soil survey will more accurately delineate radioactive anomalies identified in the Stage 1 survey. Area-specific background radiation will be determined from subsurface soil probes located in an area designated for background measurements, north of the 216-B-61 crib. Each soil probe will be geodetically surveyed for N-S/E-W coordinates.

Techniques for driving soil probes 1.8 to 2.4 meters (6- to 8-foot depths) will need to be tested. A rotating drive hammer or vibracore used in conjunction with a casing hammer has a good possibility of being able to drive a steel probe to depths of 1.8 to 2.4 meters (6 to 8 feet) in soils expected in 200-BP-1. If driving techniques fail to penetrate to desired depth, soil could be directly sampled and scanned using hollow stem augering methods.

5.1.3.4 Soil Sampling. Soils from areas which have elevated radiation levels will be sampled and analyzed. Surface soils 0.6 meter (2 feet) or less will be sampled using stainless steel trowels/shovels while subsurface soils will be sampled either directly with a vibracore, with hollow-stem auger using split tube samplers, or with backhoes. Details on the sampling and handling procedures, sample preservation and storage requirements, analytical methods and quality control are provided in the 200-BP-1 Sampling and Analysis Plan.

5.1.3.5 Soil Sample Analyses. Soil samples will be screened (Level I) using scintillation detectors. Soil samples containing the highest radiation levels will be sent to a qualified laboratory for analysis of parameters of interest (including additional compounds discovered during Task 2). Level III and V analytical methods and procedures will be used for chemical analysis.

5.1.3.6 Geodetic Control and Survey. Boreholes from augering will be backfilled with grout, while excavated soils from test pits will be backfilled and compacted into the pits from which they were excavated. Each soil probe, boring, or test pit will be staked and flagged for subsequent geodetic surveying for N-S/E-W coordinates.

5.1.4 Task 4 - Vadose Zone Soil Sampling and Analysis

The purposes of sampling vadose zone soils below the cribs are:

1. To obtain detailed geologic stratigraphic information to assess the possibility of infiltrating effluent water becoming perched and migrating laterally.

2. To obtain concentration profiles of parameters of interest to evaluate the vertical migration of each constituent and assess the future impact to the groundwater.

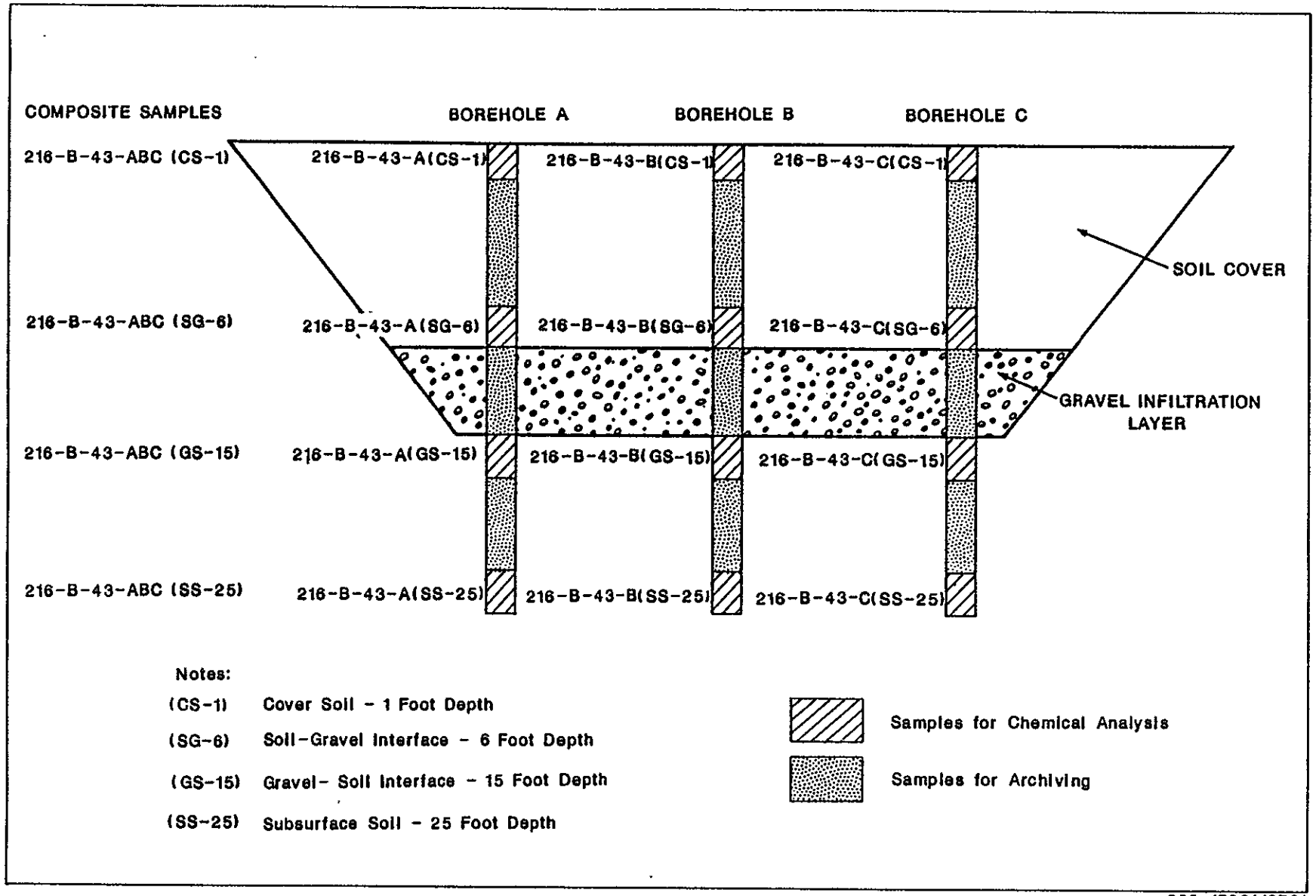

Figure 5-3. Schematic Diagram for Task 2 - Source Sampling and Analysis

3. To obtain representative vadose zone soils for laboratory testing studies such as: (1) leach tests using simulated rainwater for assessing future impacts to the groundwater; (2) physical property tests for evaluation of remedial alternatives; (3) potential bench scale treatment tests (flushing with lixiviants, chemical stabilization, etc.) as may become necessary for evaluation of remedial alternatives.

The activities anticipated for this task include:

1. preparation
2. drilling and soil sampling
3. sample and waste handling, inspection, storage and transfer or disposal
4. borehole geophysics
5. chemical analysis
6. borehole abandonment.

Boreholes will be drilled through cribs 216-B-43, 216-B-49 and 216-B-57 to the water table (~ 70 meters [230 feet]) in accordance with the requirements of (WAC 173-160) Minimum Standards for Construction and Maintenance of Wells. It is anticipated that boring through vadose zone soils below these cribs will be adequate to represent soils below the other cribs that received waste effluents. Crib 216-B-57 received ITS condensate and is assumed representative of crib 216-B-50, while all other cribs received TBP process supernatant effluents. Comparison of vadose zone concentration profiles in the vadose zone below cribs 216-B-43 and 49 should provide information on the validity of this assumption.

Cable-tool drilling techniques are planned for each boring. Prior to implementation of the drilling activities, a reevaluation of drilling techniques will be conducted. If new and tested drilling techniques or modifications appear attractive for attaining the objectives (and health and safety issues) of this task, consideration will be given for their use instead of cable tool methods. Each boring will be drilled through an existing surface casing (nominal 25 to 30 centimeters [10 to 12 inches] in diameter) left in place from Task 2. The dual wall cable tool system will be employed until radiation levels are low enough to use conventional cable tool system, whereupon a nominal 20-centimeter (8-inch) casing will be drilled through the larger diameter casing. If drilling through cribs cannot be continued in a safe manner, drilling and vadose zone soil sampling will be conducted immediately adjacent to the cribs. Samples will either be obtained in the inner wall of the dual wall system as a continuous core or sampled with a 0.6-meter (2-foot) long split-barrel drive tube (at least 6 centimeters ID with internal stainless steel core). Soil samples will be obtained continuously with depth during the first borehole and at 0.75-meter (2.5-foot) depth interval in the subsequent boreholes. Drive tube samples of undisturbed soil below the drive casing will be taken after the drive casing has been bailed clean to drive shoe depth. Records will be kept on the penetration rate of the sampler, force of the hammer and blow counts for evaluating in

situ density. Drill cuttings will be captured in containers and properly disposed.

Background samples will not be collected during this task because they will be obtained from boreholes in the 600 Area during Task 6, Installation of Monitoring Wells.

Within the 2706-T facilities, the dual wall samples will be extracted, scanned by scintillation detector, geologically logged and described according to material type, color, etc. Dual wall samples will be subdivided into 0.75 meter (2.5-foot) depth intervals. Samples will be given a scintillation scan and sent to a qualified laboratory for chemical analysis, while the remainder will be archived for use in subsequent tasks.

Details on the sampling and handling procedures, sample preservation and storage requirements, analytical methods and quality control are provided in the 200-BP-1 Sampling and Analysis Plan (Attachment 1).

Samples obtained at 8-meter (25-foot) depth intervals will be analyzed for the parameters of interest (including any additional analytes identified during Task 2). Analysis of soil samples obtained every 8 meters (25 feet) will provide information on the vertical migration of contaminants in each borehole at discrete and uniform depth horizons for comparison and calibration of scintillation screening and borehole scintillation profiling. In addition, soil samples representing 0.75-meter (2.5-foot) depth interval will be field screened with scintillation detectors. Additional samples will be analyzed for parameters of interest if field screening indicates anomalously high levels relative to other soils. If a stratum which could perch infiltrating effluents is identified, the sample representing soils at the interface of the confining stratum and overlying soils will be sent for analysis for parameters of interest. The remainder of samples will be archived for subsequent analyses (if desired), or for use in subsequent tasks. All chemical analyses for parameters of interest will be Level III or V methods and procedures. Analyses of samples will be at a qualified laboratory.

Following completion of the borings to final depth, each borehole will be geodetically surveyed (elevation and coordinates) and geophysically logged using techniques such as neutron-epithermal-neutron, gross gamma, gamma-gamma, and high resolution spectral gamma probes. Only proven and available techniques, with adequate procedures to control the quality of the data will be used. These logs will help provide data for use in geologic stratigraphic interpretations and density (porosity) estimates of vadose zone soils, and the type and distribution of radionuclides in the vadose zone. The logs will be compared with analytical results obtained from laboratory analysis of parameters of interest and will provide information on the presence of contamination between depths in which sample analysis has not been conducted. If borehole scintillation reveals a horizon in which analytical data are desired, the archived samples representing the horizon could be analyzed. The logs will also be compared with gross gamma data from existing wells in 200-BP-1 to assess the change in gamma radiation with lateral distance away from the cribs.

Upon completion of all activities in this task, each borehole will be properly abandoned in accordance with state regulation WAC 173-160. All steel casing will be removed and the entire borehole annulus grouted to land surface. Steel removed from the borehole will be transferred to an appropriate controlled decontamination facility.

5.1.5 Task 5 - Seismic Refraction Survey

The purpose of the seismic refraction survey is to more accurately define the surface elevations of the upper most basalt stratum. From catastrophic paleo flooding events the surface of the Elephant Mountain basalt has been either completely or partially eroded. Wells at the 53-55 location encountered basalt at an elevation of 76 meters (250 feet) above msl, although borings at well locations 55-57, 54-57, 50-53, 49-57 and 49-55 basalts were encountered at elevations between 117 and 122 meters (380 and 400 feet) above msl. This suggests the possibility of eroded paleo channels in the surface of the basalt which could influence the migration of contaminant plumes emanating from 200-BP-1. In areas where the Elephant Mountain basalt is completely eroded, the Rattlesnake Ridge aquifer is in hydraulic communication with the unconfined aquifer.

The proposed locations for installing monitoring wells (Task 6) will be reevaluated based on the results of the seismic refraction survey. The seismic survey proposed for the RI of the 200-BP-1 Operable Unit will also be useful for RI for other operable units in the northern portion of the 200 East Area.

Some seismic studies have been conducted previously in the area north of 200-BP-1. These studies will be reviewed to determine whether the surface contour of the uppermost basalt has been adequately defined to determine whether this task is necessary.

Figure 5-5 shows the approximate location of the seismic refraction survey lines and the general area of coverage. The area of coverage may be revised based on review of the previous studies. The proposed seismic survey lines will allow maximum use of existing wells for vertical control and calibration during data reduction and interpretation.

Details on the procedures for conducting the seismic survey, instrument calibration, data collection, reduction and interpretation are provided in the 200-BP-1 Sampling and Analysis Plan (Attachment 1). The seismic survey will be carefully designed to not compromise the integrity of the single shell tanks in the 241-BY Tank Farm. A field test will be conducted prior to implementation for evaluating potential impacts to the tank farm. In addition, the capabilities of seismic refraction will be tested to evaluate whether the technique will provide acceptable information in this geologic setting.

5.1.6 Task 6 - Installation of Monitoring Wells

The purpose of installing monitoring wells is to obtain geologic, chemical, and hydraulic data to be used in site characterization. This information will also be used for predictive modeling for the baseline risk

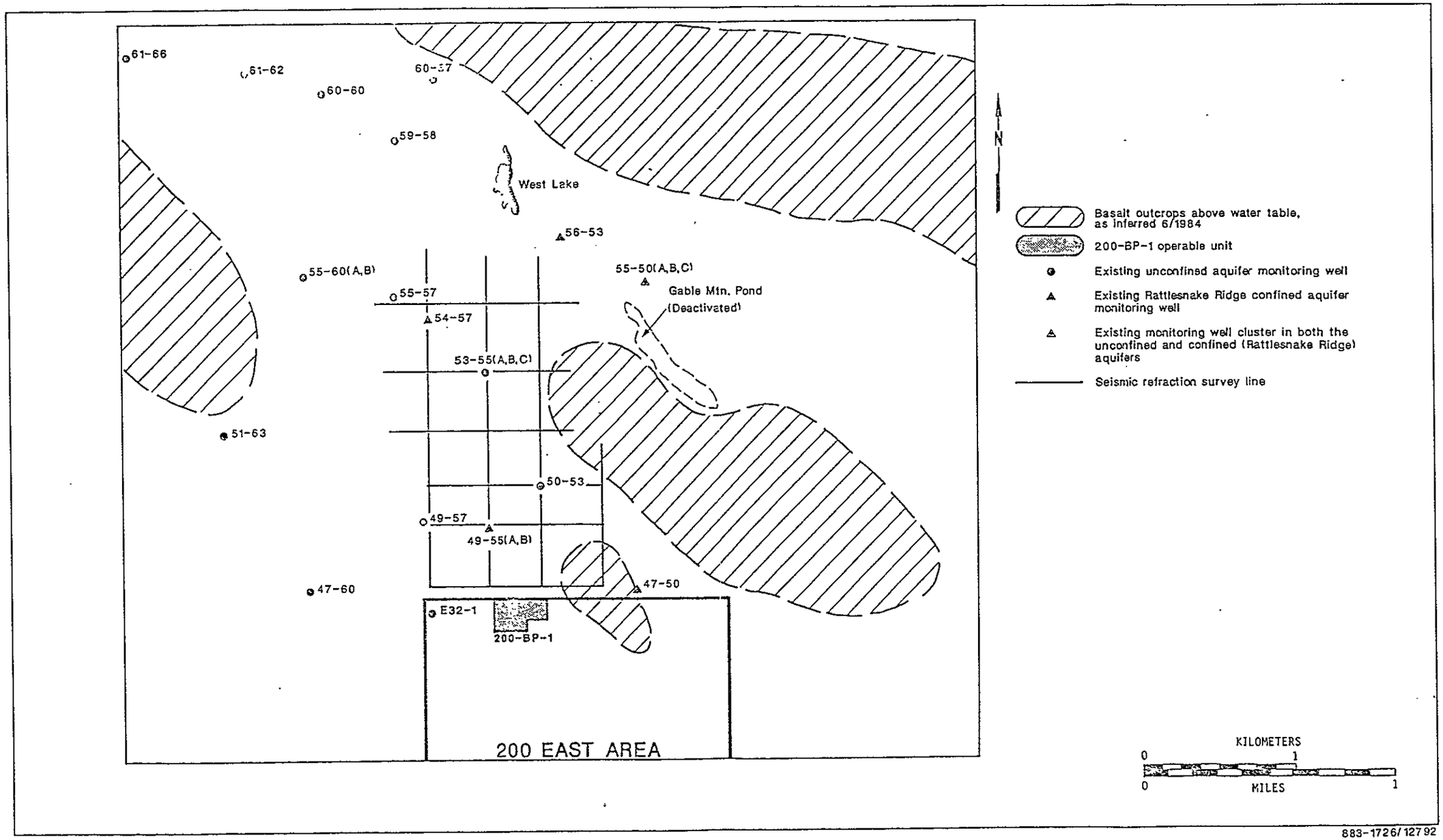

Figure 5-5. Location of Proposed Seismic Refraction Survey Lines

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assessment and evaluating remedial alternatives. The objectives to be met by the proposed wells can be categorized as follows:

1. Delineate contaminant plumes in the unconfined aquifer associated with sources in 200-BP-1 .

2. Determine the potential future direction and extent of plumes emanating from 200-BP-1.

3. Determine the types of chemicals and their concentrations, migrating into the area of interest in the unconfined aquifer.

4. Evaluate the impacts or potential impacts to the Rattlesnake Ridge aquifer due to contaminants released from 200-BP-1.

5. Establish cluster well system (monitor wells in both the unconfined and Rattlesnake Ridge aquifers) to evaluate the hydraulic interconnectivity of the unconfined aquifer and the Rattlesnake Ridge aquifer.

6. Determine the subsurface geologic stratification.

This task will be conducted in stages. In Stage 1, monitoring wells will be installed in an attempt to adequately satisfy the above objectives. However, due to the uncertainty in hydrogeologic investigations, additional field activities may be required under Stage 2, depending on the information collected during Stage 1.

The major activities anticipated for this task include:

1. review and evaluation of data from Task 5 - Seismic Survey, and Task 7 - Groundwater Analysis

2. preparation for field program

3. Stage 1 - drilling and installation of monitoring wells

4. evaluation of data from Task 6 - Stage 1 and Task 7 (2nd sampling period)

5. Stage 2 - drilling and installation of monitoring wells (optional)

6. geophysical logging of boreholes

7. geodetic survey.

Initially, data collected and interpreted from Task 5 - Seismic Refraction Survey, and the latest sampling period for Task 7 - Groundwater Sampling and Analysis, will be evaluated to refine the conceptual model of the hydrogeology presented in Section 3, and to estimate the extent of the current contaminant plumes associated with 200-BP-1. Based upon this, the well locations may be revised from those presently envisioned, and/or additional well locations may be considered necessary.

Conventional cable tool techniques are planned for drilling and installation of monitoring wells in Stage 1. Prior to implementation of drilling activities, new and tested drilling techniques or modifications to conventional techniques will be evaluated for application to this task. Tentative locations of eight new wells to be installed are illustrated in Figures 5-6 and 5-7. The reasons for the selection of these locations, in terms of the functions identified above, are summarized in Table 5-2. It is anticipated that the monitoring wells installed for this investigation will also be useful for RI of other operable units.

A surface casing, 30 centimeters (12 inches) nominal diameter will be installed to 6 meters (20 feet) depth. The remainder of drilled depth will be with 25-centimeter (10-inch) nominal diameter drive casing to the top of the Elephant Mountain basalt. For wells monitoring the Rattlesnake Ridge aquifer, the surface casing will be a minimum 30-centimeter (12-inch) nominal diameter, in which a 25-centimeter (10-inch) nominal diameter drive casing will be extended about 2 meters (6 feet) into the Elephant Mountain basalt. This casing will be sealed from within the basalt to at least 1 meters (3 feet) above the overlying unconfined aquifer. Drilling will continue through the basalt with 20-centimeter (8-inch) nominal borehole. Details on drilling procedure using conventional cable tool techniques are provided in the Sampling and Analysis Plan (Attachment 1).

Soil samples will be obtained at every 1.5-meter (5-foot) depth interval using a split tube drive sampler having a (minimum 6 centimeters [2.4 inches] nominal ID with internal stainless steel core). Drive tube samples of undisturbed unconsolidated soils will be obtained ahead of the drive casing after the drive casing has been bailed clean to the depth of the drive shoe. Records will be kept on the penetration rate, force of the hammer, and blow counts for in situ density estimates. Basalt samples will be obtained from drill cuttings.

Drill cuttings will be captured in appropriate containers and scanned for radioactivity. Drill cuttings that do not indicate radioactivity will be disposed to the ground in adjacent areas. Drill cutting indicating radioactivity will be properly disposed.

Borehole geophysical logging using neutron-epithermal-neutron, gamma-gamma, and gross gamma probes will be conducted in boreholes before well casings are installed. The geophysical logs will provide geologic information and will be compared with other geophysical well logs within 200-BP-1 for evaluation of geologic strata and the lateral migration of contaminants (potentially by perched infiltrating effluents) within the vadose zone.

One monitoring well will be installed in each borehole in accordance with WAC 173-160. The general construction of the monitor wells are provided in Figure 5-8. Each well will be developed by bailing and have a dedicated pump installed that is capable of purging and sampling. All wells will be geodetically surveyed for elevations and N-S/E-W coordinates. Details on well installation procedures and well construction materials are provided in the Sampling and Analysis Plan (Attachment 1). Well screens will extend no more than 6 meters (20 feet) below the surface of the unconfined aquifer or to the top of the basalt, whichever is less, and extend about 1.5 meters [5 feet]

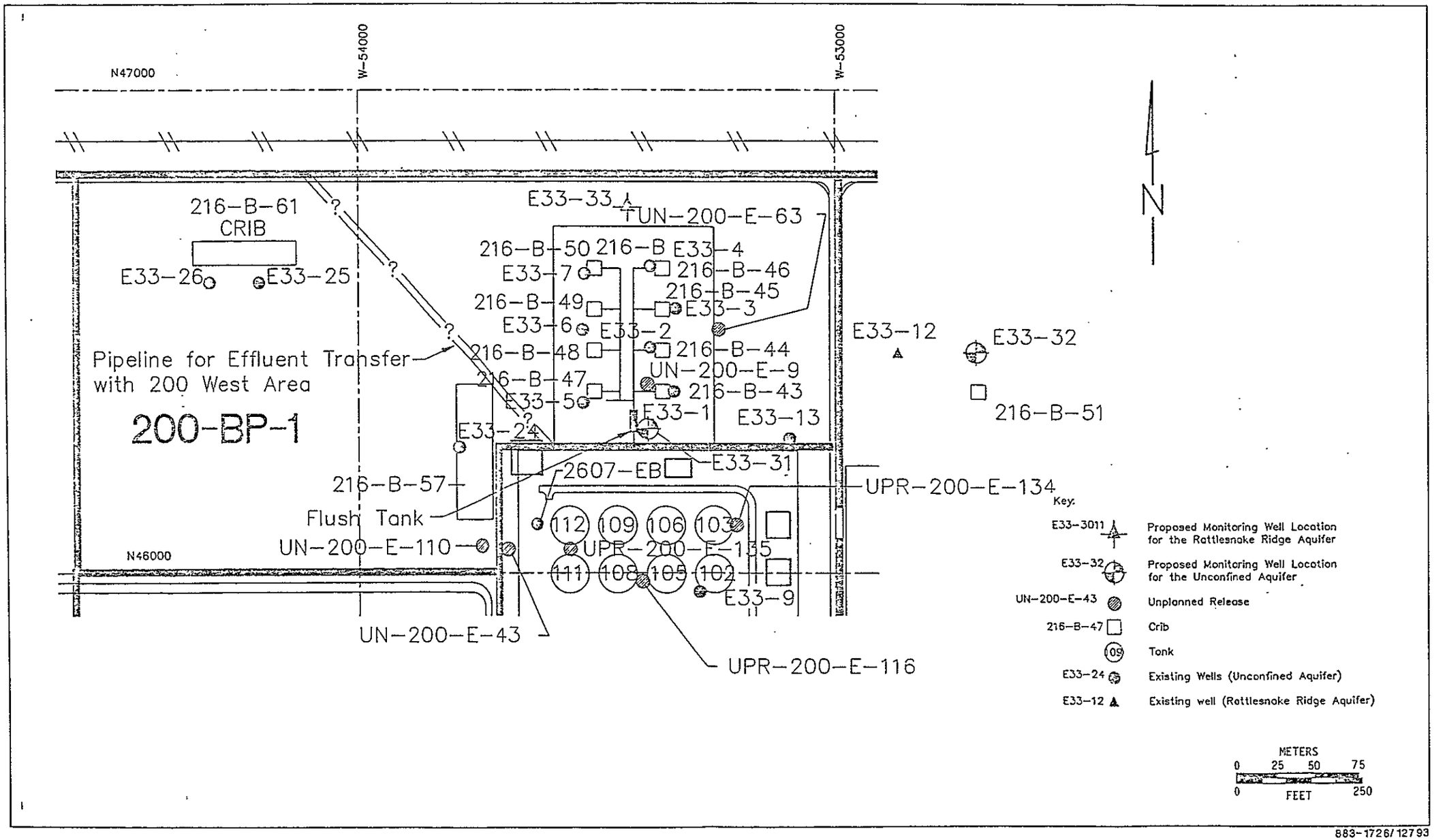

Figure 5-6. Location of Proposed Monitoring Wells Within 200-BP-1

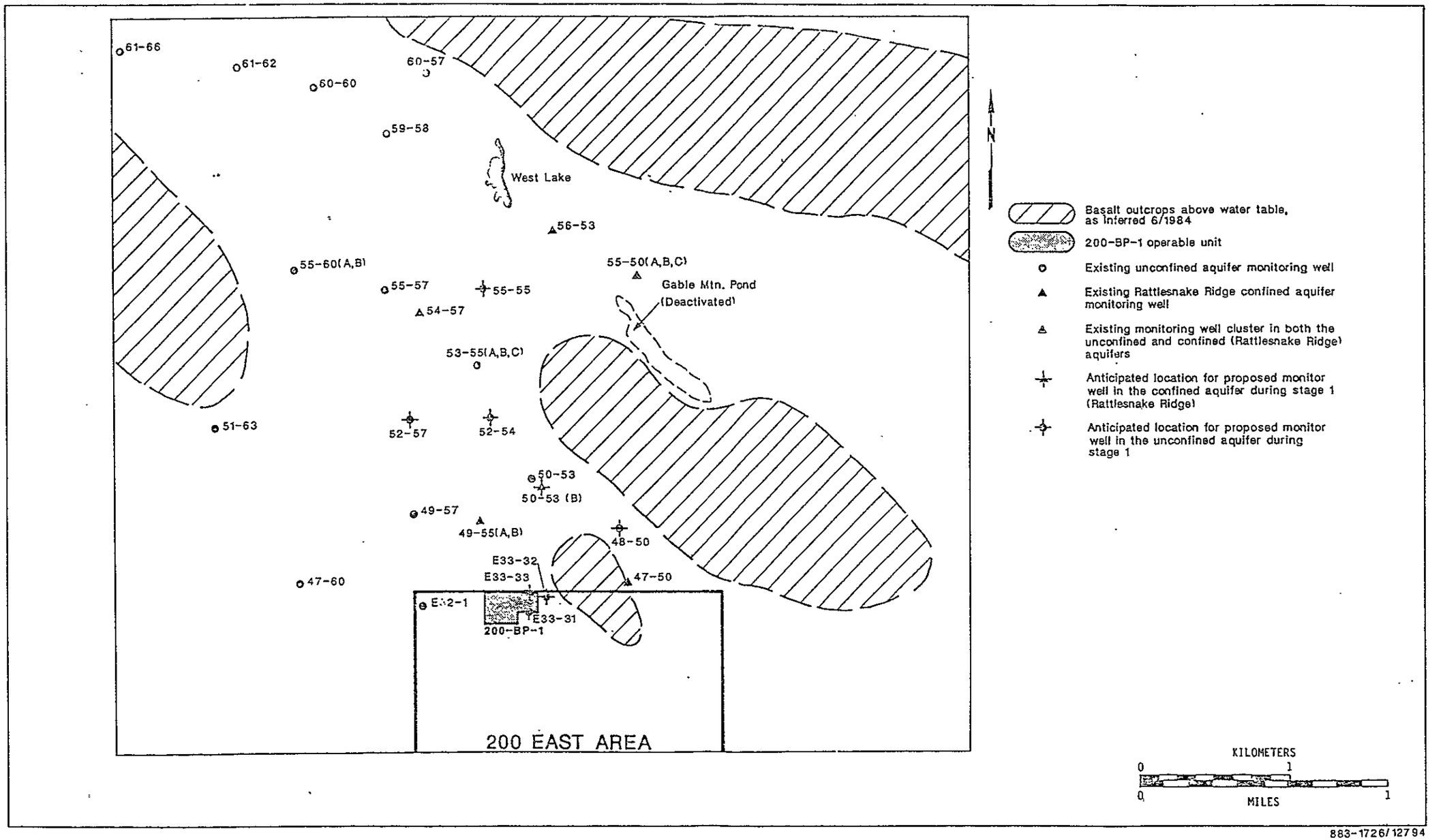

Figure 5-7. Location Map for Proposed Monitoring Wells During Task 6 Stage 1 of Phase 1

9 0 1 1 7 4 0 9 6 1

Table 5-2. Objectives of the Proposed Monitor Well Locations

Proposed Stage 1 Well	Objective Number
E33-31	1,2,3,6
E33-32	1,2,3,5,6
E33-33	2,4,5,6
48-50	3,6
50-53B	2,4,5,6
52-54	1,2,6
52-57	1,2,6
55-55	1,2,6

9 0 1 1 7 3 1 0 9 6 2

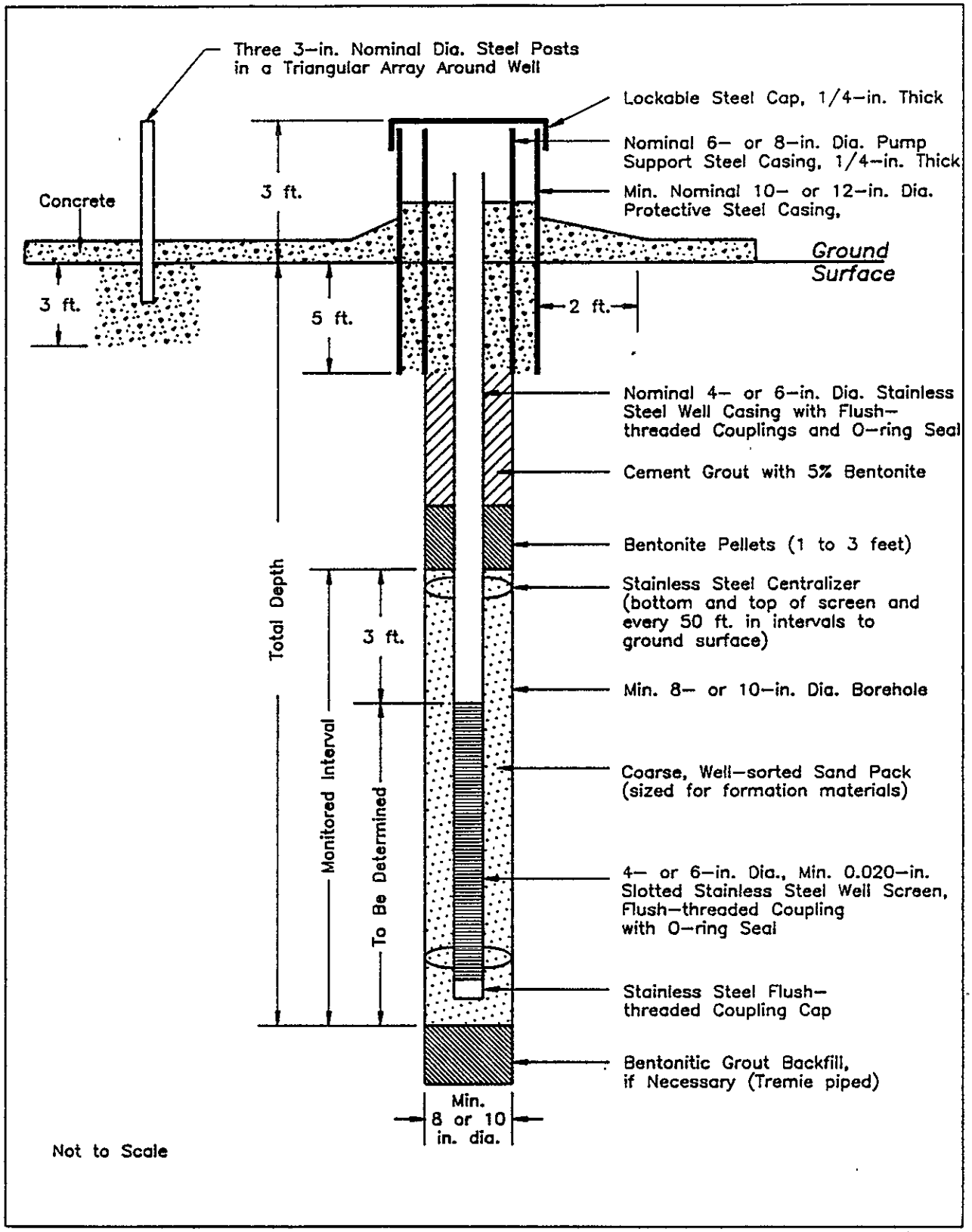

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Figure 5-8. Generalized Schematic Diagram of Completed Single Monitoring Well Construction

above the static water level. Well screens in the Rattlesnake Ridge confined aquifer will be placed approximately 1.5 meters (5 feet) into the overlying basalt and extend into the interbed a maximum of 15 feet depending on the stratigraphy of the interbed.

Results of Task 7 - Groundwater Sampling and Analyses (latest sampling period) will be reviewed and evaluated to assess whether the objectives listed have been adequately satisfied or whether additional monitoring locations are needed in either the unconfined aquifer or Rattlesnake Ridge confined aquifer for implementation of Stage 2. For schedule planning (Section 6.0), it is assumed that three additional monitoring wells in the unconfined aquifer, and one additional monitoring well in the Rattlesnake Ridge aquifer will be necessary.

Soil samples from E33-31 and E33-33 representing the same stratigraphic horizons as soils samples that were analyzed during Task 4 will be sent to a qualified laboratory for chemical analyses of the parameters of interest (Level III methods and procedures). The purpose of analyzing soil samples from E33-31 and E33-33 is to understand the potential lateral migration of effluents from 200-BP-1 cribs. Particular attention will be given to identifying horizon(s) within E33-31 or E33-33 where soil samples indicate previously perched conditions for infiltrating effluents from the cribs.

Soil samples from 52-57 and 55-55 borings at every 8-meter (25-foot) depth interval that correspond to the same sample horizons as obtained during Task 4 will be sent to a qualified laboratory for chemical analysis of the parameters of interest (Level III methods and procedures). The purpose of analyzing soils from 52-57 and 55-55 is to obtain background concentrations of parameters of interest within soils in the vadose zone for comparison with vadose zone samples within 200-BP-1. Two wells are chosen for better representation.

From each borehole in the 600 Area, analyses will be performed for total organic carbon on three soil samples from each aquifer. Three samples from each borehole should provide sufficient data for statistical and spatial evaluation of the TOC content in the aquifer matrix both within a borehole (vertical) and among boreholes (horizontal). Total organic carbon in the aquifer matrix is required for retardation estimates of organic solutes in groundwater flow system. Even if organic compounds are not a contaminant of concern at the 200-BP-1, this information may be useful for contaminants from other operable units.

More details on sample handling procedures, sample preservation and storage requirements, analytical methods and quality control are provided in the 200-BP-1 Sampling and Analysis Plan (Attachment 1).

5.1.7 Task 7 - Groundwater Sampling and Analysis

Groundwater in existing wells and installed wells will be initially sampled quarterly for 1 year then semiannually until the FS is completed. The long-term monitoring will be used for quality determinations, trend evaluations, and plume migration estimates. Wells will be sampled with dedicated pumps capable of purging and sampling. Wells installed during Task 6 - Well Installation, will also be sampled within 1 week after well

development and installation of the dedicated pump of each has been completed. Groundwater has been and will continue to be monitored in many wells in the 200 East Area and 600 Area. Schedules exist for sampling groundwater from an established network of wells for calendar year 1988. Parameters are also identified for analysis from each well. Since this RI/FS is not expected to begin until calendar year 1989, this task was developed independent of anticipated groundwater monitoring efforts being planned for calendar year 1989. However, these should be coordinated to optimize sampling effort. The wells and analyses should be integrated into the schedule for monitoring groundwater quality for the next several years until the FS is completed.

The existing monitoring wells included for 200-BP-1 groundwater sampling and anticipated function are listed in Table 5-3. As new monitoring wells become available during Task 6 - Well Installation, these wells will be included in the regular monitoring periods. The activities included within this task are as follows:

1. Tests conducted for evaluation of analytical methods for cyanide speciation, obtaining representative redox potentials for groundwater, and obtaining lower detection limits for ruthenium-106.

2. Review construction details and/or field verification of existing wells to determine whether the wells are acceptable for continued monitoring for this investigation.

3. Semiannual sampling and analysis of wells included in Table 5-2 and monitoring wells installed during Task 6 - Installation of Monitoring Wells. The length of time monitoring is conducted on these wells will depend when the ROD is established, and any post-ROD followup monitoring that is required.

5.1.7.1 Development of Level IV Special Analytical Services. Initial tests will be conducted to develop methods appropriate for analyses of two parameters of interest (cyanide and ruthenium-106) and an additional analysis (redox potential) that is important for evaluation of groundwater data. The tests will be conducted prior to implementing the regular sampling periods. A summary of tasks are provided below.

The environmental fate and toxicity of cyanide in aqueous systems can vary widely (PHS, 1988). This is in part due to the dependance of cyanide on pH. Furthermore, speciation of cyanide in ground or surface waters will also depend on available cation species which can form simple alkali metal salts or complex metallocyanide compounds. The metals salts which may form are very soluble in water and consequently form cyanide and hydrogen cyanide with their dissociation (Cossinelli, 1986). Metallocyanide complexes can have a wide range of solubilities and variability in water. For example, cyanide complexes of zinc and cadmium are weakly complexed and should easily dissociate. Complexes of nickel and copper are moderately stable and complexes of gold, iron and cobalt exhibiting a fairly inert behavior in water and are expected to remain complexed (Nonomura, 1987).

Table 5-3. List of Monitoring Wells for Semi-annual Groundwater Sampling and Monitoring Function (Sheet 1 of 2)

WELL	AQUIFER MONITORED	MONITORING FUNCTION
Existing Wells		
E32-1	Unconfined	Contribution from other potential sources
E33-1	Unconfined	200-BP-1 source and 200-BP-7 contributions
E33-3	Unconfined	200-BP-1 source contribution
E33-4	Unconfined	200-BP-1 source contribution
E33-5	Unconfined	200-BP-1 source and 200-BP-7 contributions
E33-7	Unconfined	200-BP-1 source contribution
E33-8	Unconfined	200-BP-3 contribution
E33-9	Unconfined	200-BP-7 contribution
E33-11	Unconfined	200-BP-4 and 200-BP-7 contributions
E33-12	Rattlesnake Ridge	Impacts near 200 BP-1
E33-13	Unconfined	200-BP-7 and 200-BP-4 contributions
E33-14	Unconfined	200-BP-4 contribution
E33-15	Unconfined	200-BP-7 contribution
E33-18	Unconfined	200-BP-7 contribution
E33-20	Unconfined	200-BP-7 contribution
E33-24	Unconfined	200-BP-1 source and 200-BP-3 contributions
E33-26	Unconfined	200-BP-10 and 600 Area contributions
E33-28	Unconfined	200-BP-3 contribution
E34-1	Unconfined	200-PD-6 contribution
49-57	Unconfined	200-BP-1 plume delineation
49-55A	Unconfined	200-BP-1 plume delineation
49-55B	Rattlesnake Ridge	Potential impacts from 200-BP-1

Table 5-3. List of Monitoring Wells for Semi-annual Groundwater Sampling and Monitoring Function (Sheet 2 of 2)

WELL	AQUIFER MONITORED	MONITORING FUNCTION
50-53	Unconfined	200-BP-1 plume delineation
53-55B	Unconfined	200-BP-1 plume delineation
53-55C	Unconfined (?)	200-BP-1 plume delineation
54-57	Rattlesnake Ridge	Potential impacts from 200-BP-1
55-57	Unconfined	200-BP-1 plume delineation
Tentatively Proposed Wells		
E33-31	Unconfined	200-BP-7 contribution
E33-32	Unconfined	200-BP-4 and 200-BP-7 contributions
E33-33	Rattlesnake Ridge	Potential impacts from 200-BP-1
48-50	Unconfined	B-pond and 200 PO-6 contributions
50-53B	Rattlesnake Ridge	Potential impacts from 200-BP-1
52-54	Unconfined	200-BP-1 plume delineation
52-57	Unconfined	200-BP-1 plume delineation
55-55	Unconfined	200-BP-1 plume delineation

The relatively insoluble forms of cyanide, such as Fe(CN)6-3 or Co(CN)6-3 will likely sorb onto sediments or soils and could be available for bioaccumulation in aquatic organisms or biological degradation. Biodegradation of cyanide is expected to play a major role in the environmental fate in natural water systems and a number of microorganisms have been observed to break down cyanide at low concentration, under both aerobic and anaerobic conditions (PHS, 1988).

Since inorganic cyanides are present in both simple and complexed forms, several methods have been established to quantitate free, complexed, and total cyanide in water. Determination of free cyanide according to EPA Method 335.2 (1986) will assay soluble metal salts of cyanide, such as sodium hydroxide, or potassium cyanide, as well as cyanide and hydrogen cyanide. Method 9010, determines cyanide susceptible to chemical oxidation through chlorination (EPA, 1986). This method measures all simple cyanides as well as cyanide complexes with the exception of iron cyanide complexes. It should be noted that total cyanide determinations by EPA Method 335.2 (1986), will quantitate all cyanide forms including insoluble complexes.

Established methodologies for cyanide in water rely typically on the determination of cyanide in solution. Although pretreatment may vary, such as chlorination with hypochlorite, these methods employ bulk steam distillation of the sample at a reduced pH, with ultimate collection as hydrogen cyanide in a caustic trap. The trap is then analyzed by either colorimetric, titrimetric, or electrochemical techniques for cyanide ion.

All methods suffer from potential interferences. Some of these method interferences can be reduced with addition of chemical reagents. For a brief summary of analytical methodologies, Table 5-4 lists common techniques used for cyanide determination in water.

In a recent study, method sensitivity and accuracy with the common colorimetric, and electrochemical techniques were evaluated. This study found the colorimetric techniques, specifically the pyridine-barbituric acid method, to be preferred. Both colorimetric techniques were found to have better statistical accuracy than the electrochemical methods. The accuracy of the two common colorimetric methods studies (EPA Method 335.2) were found to be equivalent (U.S. PHS, 1988).

A recently developed technique involving ion chromatography (IC) with amperometric detection has shown promise for the determination of cyanide and cyanide complexes in water. This technique is free of most of interferences associated with distillation techniques or specific electrode electrochemical and colorimetric detection. The IC techniques involve direct injection of the water sample onto the IC with electrochemical detection. Detectable limits of 2 p/b for cyanide were achieved (Nonomura, 1987).

Tests for cyanide on groundwater samples obtained from wells 49-57, 49-55A, and 50-53 are proposed to be conducted. These tests will include duplicates, spikes (of known free cyanide and complexed cyanide including cobalt complexes), and blanks. The method that produces the most accurate, precise and reproducible results will be chosen for use in subsequent analysis during regularly scheduled sampling periods.

Table 5-4. Analtyical Methods for the Determination of Cyanide in Water

METHOD LIMITS	SAMPLE PREPARATION	DETECTION	SPECIES	DETECTION
1	Sample acidified refluxed-disstilled, hydrogen cyanide sorbed onto sodium hydroxide	Spectrophoto (Method 335.2)	Total cyanide	20 p/b
2	Sample chlorinated with hydrochloric acid at pH 11-12 Residual sample acidified as with Method 335.2	Spectrophoto (Method 335.2 Method 9010, cyanide amenable to chlorination)	Simple and some complexes, will not determine iron and cobalt complexes	---
3	Sample acidified and refluxed-distilled as Method 335.2, absorbing solution titrated	Titration (Method 335.2)	Total cyanide	1,000 p/b
4	None	Ion chromatography/ amperometric detection	Free cyanide and some complexes (speciation possible)	2 p/b

EPA 1986 (SW 846).

Ruthenium-106

The normally achievable detection limit obtained from the 222S laboratory and U.S. Testing laboratory is 172 pCi/L for water. Risk assessments may require analytical detections of 3 pCi/L or lower, which is the equivalent of 0.1 times (to account for the "unity rule") MCL for ruthenium-106 in drinking water. Analytical techniques will be tested on groundwater from wells 49-57, 49-55A, and 50-53 including duplicates, spikes and blanks for obtaining consistent detection concentration of 3 pCi/L. The results will be evaluated and assessed whether analytical techniques (capable of 3 pCi/L detection) should be regularly implemented on groundwater samples during the 200-BP-1 RI.

Redox Potential

Aqueous chemical speciation, oxidation state of many transition metals, and actinium and lanthanum series ions, and solubility indices are important for solute transport and fate analysis and are dependent on the oxidation-reduction (redox) potential of the aqueous solution. The redox potential in aqueous systems is highly unstable and may be difficult to characterize. Contact with the atmosphere and metal well screens will also influence the redox potential. An initial test is proposed to evaluate whether the redox potential can be characterized using field analytical methods and to assess the most appropriate method. Normally, if dissolved oxygen is detectable and quantifiable in groundwater, the redox potential can be adequately estimated. Another method for estimating redox is by electrical potential using platinum electrodes. This method requires sufficient concentrations of ionic redox couples (i.e., iron ions, manganese ions) for representation and is subject to "poisoning" of the platinum electrode that results in misrepresentation of actual redox condition. Another method is to measure redox couples directly by ion chromatography. Ion chromographic analysis of redox couples such as iron +2/+3 ion, manganese +2/+4 ions, NO_2^-/NO_3^- ions and $SO_4^=/S^=$ ions, could be used as a validity check for the above more portable field techniques. The above techniques will be tested on purged groundwater from wells 49-57, 49-55A and 50-53. Results will be evaluated and an assessment will be made whether redox should be analyzed regularly in the field and the method to be used.

5.1.7.2 Sampling and Analysis Program. During each sampling period, groundwater samples will be collected according to standard procedures. Temperature, pH, and electrical conductance will be monitored during purging of each well. Wells will be purged a minimum of three well and sand pack storage volumes or until all three parameters have stabilized (temperature $\pm 0.1^{o}C$, pH ± 0.1, and electrical conductance ± 10 percent), whichever criterion is greatest. Purged groundwater will be captured and properly disposed depending on its quality. Samples for inorganic and radionuclide analyses will be immediately filtered through 0.45 μ filter prior to bottling and preservation.

During each sampling period, groundwater from the wells listed in Table 5-3 will be analyzed for the parameters of interest including additional constituents assessed important from the results of Task 2 - Source Sampling.

Groundwater analyses for parameters of interest will be by Level III analytical methods and procedures in a qualified laboratory. During sampling in the field, unstable general water quality parameters will be analyzed (Level I Analytical Methods and Procedures) continuously (in-line) during purging of well water or immediately after sample acquisition. These include pH, temperature, electrical conductance, dissolved oxygen, and redox potential (depending on the result of initial testing of methods for redox). In addition, groundwater from the wells will be analyzed (Level III Analytical Methods and Procedures) for major cation-anion concentrations for remedial alternative evaluations and engineering design and for evaluating the ratio between nitrates and nitrites. The additional cation-anion parameters to be analyzed include the following:

- calcium
- magnesium
- sodium
- potassium
- iron
- manganese
- chloride
- alkalinity
- fluoride
- silicon oxide
- aluminum
- total dissolved solids
- nitrite.

Details on sampling procedures, equipment decontamination, field analyses and calibration, sample handling, preservation and storage, analytical methods, quality assurance and control are provided in the 200-BP-1 Sampling and Analysis Plan (Attachment 1).

5.1.8 Task 8 - Site Topographic Map

A site map of the 200-BP-1 Operable Unit will be established to be used during site characterization, evaluation of remedial alternatives and engineering design. Geodetic surveys for elevation and north-south (N-S) and east-west (E-W) coordinates are necessary for vertical and horizontal control of RI activities and data.

The activities anticipated in this task include:

1. Development of site topographic map for 200-PB-1 Operable Unit.

2. Geodetic survey in Task 2 boring for elevation and N-S/E-W coordinates.

3. Geodetic survey in Task 3 soil probes and test pits for N-S/E-W coordinates.

4. Geodetic survey in Task 4 borings for elevation and N-S/E-W coordinates.

5. Geodetic control in Task 5 seismic refraction survey lines within the N-S/E-W coordinate system.

6. Geodetic survey in Task 6 monitoring wells for elevation and N-S/E-W coordinates.

The site topographic map will show elevation contours at 0.5 meter (or 2 feet) intervals. Site features such as the 200-BP-1 boundary, fence lines, gates, buildings, tanks, restricted areas, and pipelines will be included. The site map will extend 100 meters (330 feet) beyond the boundary of 200-BP-1 and include the designated area-specific background zone. The site map will be prepared so as to be compatible with the N-S/E-W coordinate system used for the existing maps of the 200 East Area. Third-order precision and accuracy will be used for the development of the site map.

Details on the procedures for conducting geodetic surveys, instrument calibration, and data collection, reduction and interpretation are provided in the 200-BP-1 Sampling and Analysis Plan.

5.1.9 Task 9 - Biota Evaluation

A visual reconnaissance effort will be conducted at these sites by qualified personnel to locate and evaluate any evidence of uptake of toxic substances by plants or animals. Any evidence of weakened, necrotic, or chloritic plants will be documented by species. Observations would also be made of evidence of small mammals and bird species, and animal burrowing activities. Where possible, at least two soil samples from burrowing animal mounds will be collected at each site and analyzed for parameters of interest. A threatened or endangered species survey will also be conducted as part of the biotic reconnaissance effort. For comparison purposes, at least one control site (preferably similarly disturbed) located nearby (within approximately 3.2 kilometers [2 miles]) would also be examined in the same way.

5.1.10 Task 10 - Column Leach Tests

The purpose of conducting column leach tests is to investigate the mobility of contaminants in the vadose zone due to infiltrating rain water. This test will determine the solubilization of contaminants with infiltrating water and together with conclusions from rain water infiltration studies conducted at Hanford will be used to evaluate potential future impacts to groundwater from vadose zone contamination. Past studies undertaken at the site indicate the recharge (water flux) to the aquifer could be zero or as high as 8 centimeters/year (3.1 inches/year) (Isaacson et al., 1974, Jones, 1978, Gee and Heller, 1985, and Gee, 1987). Tests to determine recharge fluxes of infiltrating rain water are difficult and time consuming. They should, therefore, be undertaken independently of the RI so that they may be applied to other operable units within the Separations Area. The concentrations obtained through these proposed column leach tests with the estimated recharge flux of infiltrating rain water will be used to estimate contaminant flux to groundwater. The contaminant flux to groundwater together with observed trends in groundwater contaminant concentrations (Task 7) will be used to evaluate the potential for future contaminant impacts. Data from these leach tests will be useful for evaluation and design of capping

technologies, such as partial infiltration instead of zero infiltration covers.

The proposed column leach test is an optional activity that will be conducted on soil samples obtained during Task 2 and Task 4 of Phase I RI. Soil samples will be stacked within a column to represent the field conditions. Simulated rainwater will be allowed to percolate through the column as shown in Figure 5-9. A reservoir equipped with a septum will be installed between sample intervals for degassing (if necessary), or sampling infiltrating water (if possible) between sample intervals through a syringe.

The leach columns will be established for leaching vadose zone soil samples that were obtained from each borehole during Task 4. A total of nine columns will be established. Source samples from Task 2 corresponding to each borehole will also be used. The three leach tests for each borehole samples will be conducted with different infiltration rates to gain information on the dependence leachate concentration with infiltration rate. Effluents collected periodically at the bottom of the leaching column will be analyzed for the parameters of interest using Level III Analytical Methods and Procedures. The rate and amount of water applied and collected will be monitored for each test.

9 0 1 1 7 1 0 9 7 3

5.1.11 Task 11 - Aquifer Tests

The purpose of conducting aquifer tests is to obtain information on the hydraulic properties of the unconfined and Rattlesnake Ridge aquifer. This information will be used for site characterization (contaminant transport, velocities, and fluxes), baseline risk assessment (contaminant concentrations and variations with time at surface water discharge points) and preliminary screening of remedial alternatives (hydraulic barrier systems, flushing).

Slug testing will be conducted on all wells which are to be hydraulically tested. Slug tests are only accurate within an "order-of-magnitude". The anticipated hydraulic conductivity and transmissivity of the aquifers may be too high to conduct adequate slug tests. Drawdown/recovery testing, which is the preferred hydraulic test methods will be performed only on wells where groundwater can be discharged directly to adjacent ground for infiltration, since these tests will produce large quantities of water. At the time of testing, the current groundwater quality will be evaluated and a determination will be made of the type of hydraulic test which is appropriate for the well.

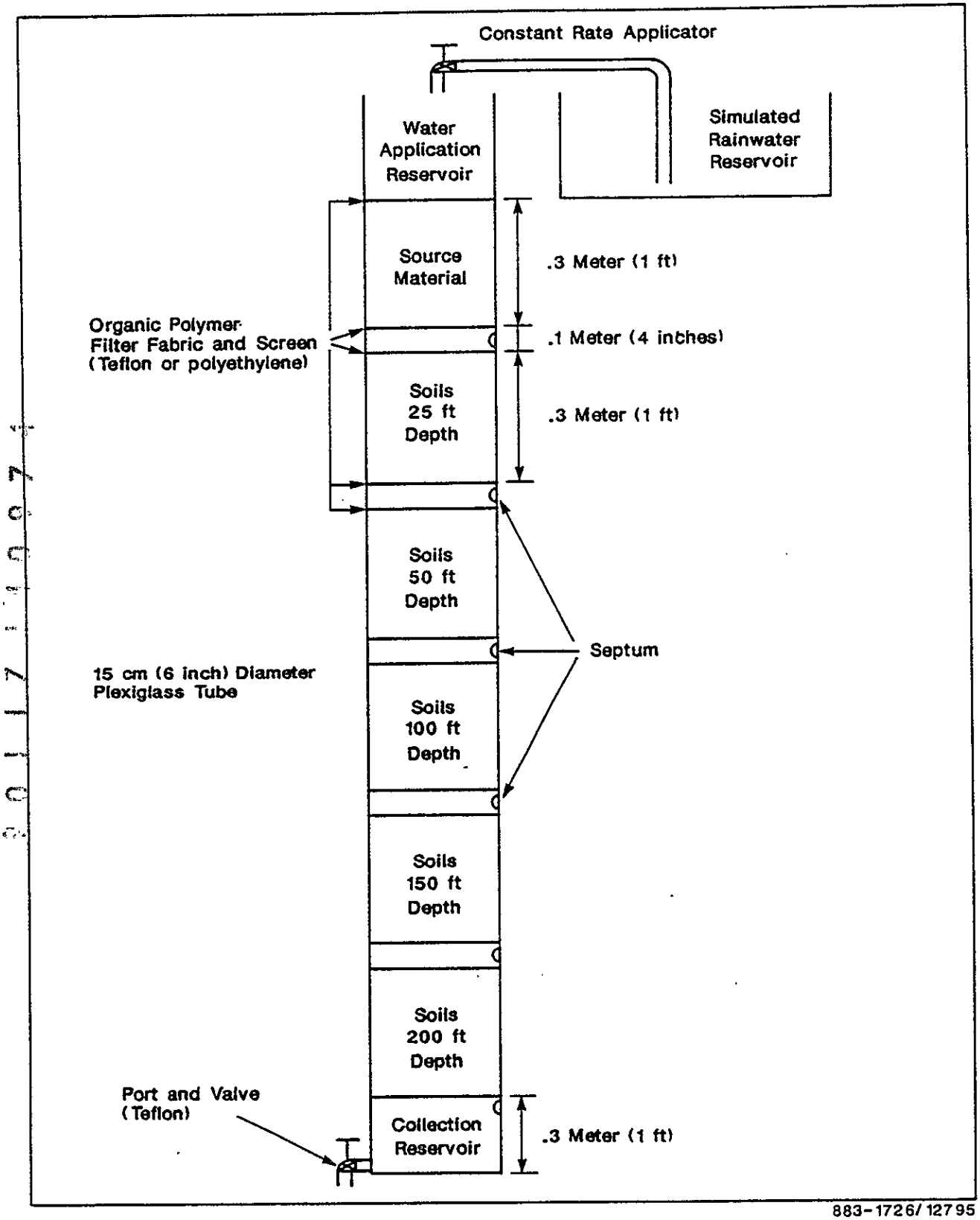

Figure 5-9. Schematic Diagram of Column Leach Test

The only well within the study area that has been hydraulically tested in previous studies (Graham et al., 1984; and Graham, 1981) is E33-12 (Rattlesnake Ridge aquifer). The wells that are proposed for hydraulic testing to develop a spatial representation of the unconfined aquifer properties are:

Existing	Proposed
E33-1	52-57
E33-4	52-54
E33-5	55-55
E33-7	
E33-24	
49-57	
49-55A	
50-53	
53-55B	
53-55C	
55-57	
60-60	

Wells that are proposed for hydraulic testing of the Rattlesnake Ridge aquifer are:

Existing	Proposed
49-55B	E-33-33
54-57	50-53B

Before each slug test, water levels will be monitored and recorded for a minimum of 0.5 hour or until no detectable change is occurring to determine antecedent trends in water levels. Slug tests will be performed by removing an instantaneous slug of water (by displacement) and measuring water level recovery by down hole pressure transducers with a surface automatic data acquisition system. This system will provide water level readings as frequently as will be necessary to accommodate anticipated recovery rates. Each test will be performed in duplicate for comparison of results.

Before performing drawdown/recovery tests, the wells will be tested for well efficiency and antecedent trends in water levels. Well efficiency will be evaluated by using the step drawdown technique which will be conducted at three or four discharge rates. Each discharge rate will be run for between 1 to 4 hours as determined by a hydrogeologist for each well. Estimates of well efficiency and transmissivity will be made and the optimal constant pumping rate for the longer term drawdown/recovery test will be determined. For evaluation of antecedent trends, water levels will be monitored and recorded for a period of about the anticipated pumping and recovery time. In addition, well barometric efficiency will need to be estimated for wells that are connected to the confined aquifer. Barometric efficiency can be determined before or after the pump test.

During the drawdown/recovery test, the well will be pumped at a constant discharge rate for a minimum of 1 day. The total length of the test will be determined by a hydrogeologist and will depend on the observed changes in water level with time. Drawdown will be monitored and recorded with time. The pump discharge rate will be monitored and regulated if the discharge rate changes. After the pump is turned off, the recovery of water levels in the

well will be monitored and recorded with time until water levels reach at least 95 percent static conditions. If other wells exist in the near vicinity (<100 meters [328 feet] for unconfined aquifer pumping or <1,000 meter [3,300 feet] for confined aquifer pumping), their water levels will be monitored during the entire test. For wells receiving water from the confined Rattlesnake Ridge aquifer, barometric pressure will be monitored and recorded throughout the test period.

Details on the testing procedures, equipment and calibration requirements, and data monitoring and recording frequencies, are provided in the 200-BP-1 Sampling and Analysis Plan (Attachment 1).

The baseline risk assessment or preliminary screening of alternatives may necessitate having more accurate hydraulic properties of the aquifer in specific areas. If this is required, drawdown/recovery test will be performed during Phase II RI. Phase II hydraulic aquifer tests could be conducted for an extended time (≈ 1 month or greater) with the use of observation wells for more representative hydraulic parameters and possibly hydraulic boundary analysis. Large quantities of groundwater may require capture and treatment before discharge. Such tests could be performed in conjunction with a treatability test for groundwater remediation.

5.1.12 Task 12 - Sorption Tests

The purpose of conducting sorption tests is to gain information on the partitioning of contaminants between the aquifer matrix and the water phase. This information will be used to estimate the migration velocity of plumes relative to the velocity of groundwater in the flow system, the attenuation of contaminants in the aquifer and the potential impacts to surface waters.

Sorption tests have been conducted on many radionuclides for specific Hanford soils. These data will be reviewed to determine whether additional tests are needed. However, sorption tests have not been conducted on hazardous chemical constituents.

Most sorption coefficients for geological material are obtained experimentally by equilibrating the material with a solute/radionuclide containing aqueous solution for a specified period of time. Sorption of the radionuclide on the geological material is usually determined by measuring the decrease in the solute/radionuclide concentration (i.e., activity in the solution) over this period of time. Corrections for removal of the solutes from solution by processes other than sorption on the geological surface - either by sorption on the walls of the container or by precipitation or colloid formation - may or may not be made, depending on the sophistication of the experimental approach (Vandergraaf, 1982).

Sorption coefficients can be determined during the desorption as well as during the sorption step. In the desorption step, the geological material with the sorbed solute/radionuclide is contacted with a solution containing no solute/radionuclide of interest, and the degree of desorption determined from the increase in the activity of the solution.

The coefficients obtained during the sorption and desorption steps are not necessarily the same. Irreversible processes such as precipitation and incorporation of solute/radionuclides into the crystal lattice of the minerals during the "sorption" step may make new nuclides unavailable for subsequent desorption.

Sorption tests are proposed as an optional activity. They will be conducted on samples of aquifer soils obtained during Task 6 - Installation of Monitoring Wells, if additional data are needed following the literature review. Aquifer soils will be composited into high density polyethylene vials. Constant and known ratio of solution volumes and mass of geologic material will be used during the tests. Test will be run in triplicate for soils (or cuttings) collected from the unconfined aquifer during drilling of proposed monitor wells:

E33-31
E33-33
50-53
52-54
55-55
52-57

Sorption tests will be conducted using actual groundwater collected from the unconfined aquifer. Two types of groundwaters will be used:

1. Groundwater not containing detectable parameters of interest. Groundwater sampling and analysis during Task 7 - Groundwater Sampling and Analysis will define which well should be used for this groundwater type.

2. Groundwater containing relatively high concentrations of parameters of interest (possibly from well 50-53).

Initially, test soils will be flushed with distilled and deionized water. The purpose of soil flushing is to flush existing groundwater and desorp existing contaminants from the aquifer soil matrix. Distilled and deionized water will be flushed through the test soils. The volume of distilled and deionized water shall be 10 times the volume of soils. Samples of flush water will be screened (Level I) regularly for alpha, beta, and gamma radiation using scintillation detectors and nitrate using ion specific electrodes. After flushing, the test soils will be drained then analyzed for the parameters of interest (Level III Analytical Methods and Procedures) to establish baseline/ residual concentration prior to the sorption test.

Sorption tests will next be conducted using the "contaminated" groundwater type. Test soils will be transferred to 1 liter tests vials, which are glass and equipped with airtight septum caps. The ratio of test soil and groundwater will be 1.0 for each test. The test vial will be filled with groundwater and not contain entrained air. The test materials in the vials will be continuously agitated for the duration of each test. Contaminated water will be regularly screened using ion-specific electrodes and scintillation detectors (Level I Analysis) and periodically sampled and analyzed for parameters of interest (Level III Analytical Methods and Procedures). The desorption step will be performed on all test soils after draining the "contaminated" water (distilled water flush should not be

conducted). The desorption step will be conducted in the same manner as the sorption step except "clean" groundwater will be used instead of "contaminated" groundwater. The desorption step will determine whether irreversible processes exist.

Figure 5-10 is an illustration of the test procedure. Between each sorption/desoprtion step, the geological material is transferred and the vial itself is analyzed for radionuclide soprtion on the vial wall and corrections are applied to the calculation of the sorption/desorption coefficient. Nitric acid solution (pH < 2) shall be used to extract absorbed metals and radionuclides from the vial for analysis.

Details on the test procedures, equipment and calibration requirements, analytical methods and quality assurance are provided in the 200-BP-1 Sampling and Analysis Plan (Attachment 1).

The sorption coefficient (K_d) will be estimated from the following:

$$K_d(mL/g) = \frac{\text{activity sorbed/gram material}}{\text{activity in solution/mL solution}}$$

5.1.13 Task 13 - Baseline Risk Assessment

Baseline risk assessments provide an evaluation of the potential threat to human health and the environment in the absence of any remedial action. They provide the basis for determining whether or not remedial action is necessary and the justification for performing remedial actions. The risk assessment will be developed in accordance with the Superfund Public Health Evaluation Manual (EPA, 1986).

The risk assessment will be divided into four activities:

- contaminant identification
- exposure assessment
- toxicity assessment
- risk characterization.

5.1.13.1 Contaminant Identification. The objective of contaminant identification is to screen the information that is available on hazardous substances or wastes present at the site and to identify parameters of interest to focus subsequent efforts in the risk assessment process. Parameters of interest will be selected because of their intrinsic toxicological properties, because they are present in large quantities, or because they are present in potentially critical exposure pathways.

It may be useful to select "indicator chemicals" as part of this process. Indicator chemicals are selected to represent the most toxic and/or mobile substances among those identified and for which the best information is available.

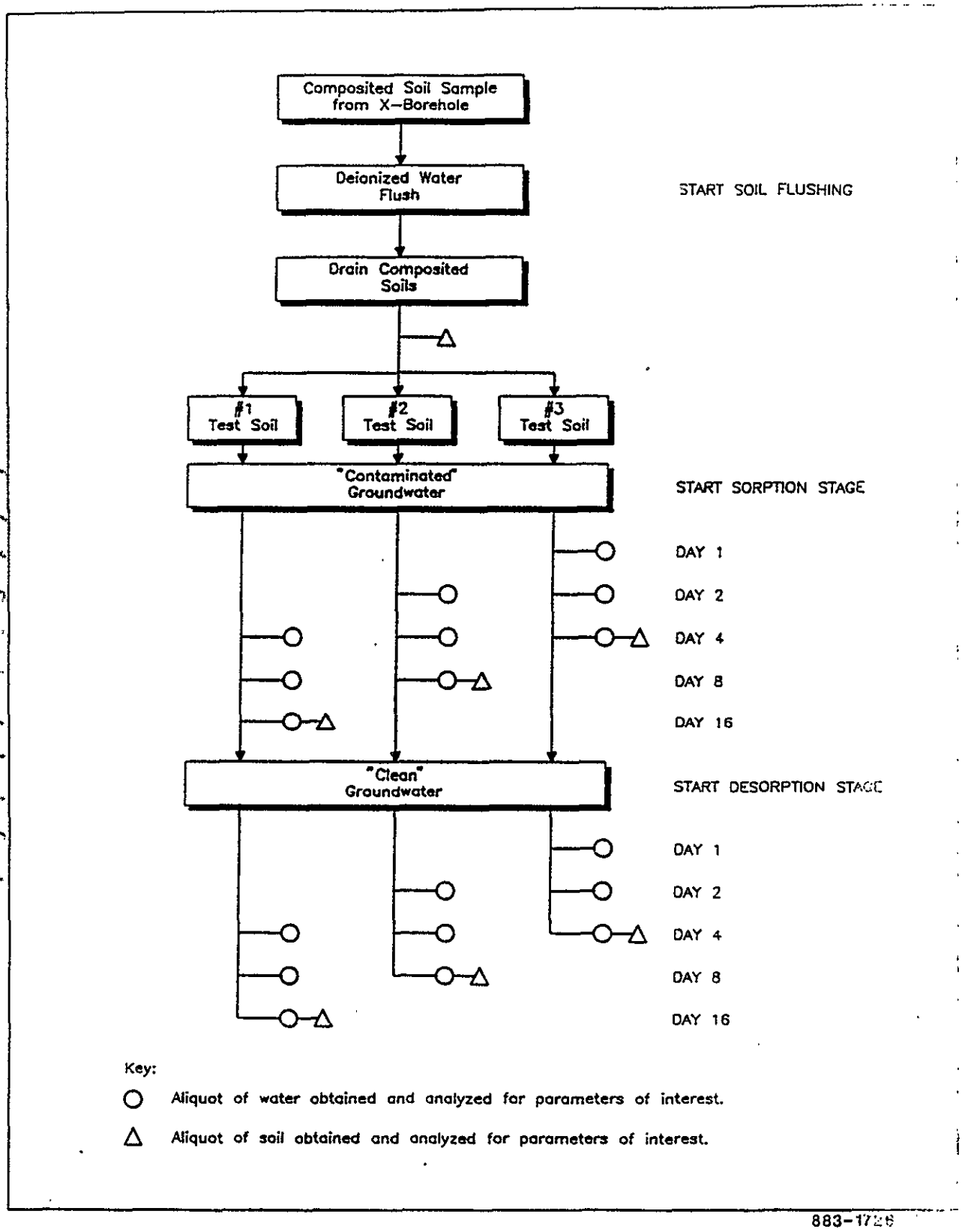

Figure 5-10. Illustration of the Sorption Test Procedure for Aquifer Soils from Bor

5.1.13.2 Exposure Assessment. The objectives of an exposure assessment are to identify actual or potential exposure pathways, to characterize the potentially exposed populations, and to determine the extent of the exposure. The exposure assessment will be developed in accordance with the superfund exposure assessment manual which is being developed by EPA. These objectives are attained by:

- identifying exposure pathways
- analyzing exposed populations
- estimating expected exposure levels.

Identifying potential exposure pathways helps to conceptualize how contaminants may migrate from a source to an existing or potential point of contact. Exposure pathway consists of four elements.

1. A source and mechanism of chemical release to the environment.

2. An environmental transport medium (e.g., air, groundwater) for the released chemical.

3. A point of potential contact with the contaminated medium (referred to as the exposure point).

4. An exposure route (e.g., inhalation, ingestion) at the contact point.

The first element of an exposure pathway analysis is the analysis of the contaminant source and the contaminant release mechanism. This analysis involves determining the parameters of interest at the site and the mean and maximum concentrations of each contaminant released to each environmental medium.

In the second element of exposure pathway analysis, the environmental fate and transport of the contaminants are analyzed. This element considers environmental transport (e.g., groundwater migration, airborne transport); transformation (e.g., biodegradation, hydrolysis, and photolysis), and transfer mechanisms (e.g., sorption, volatilization). The results of these analyses provide information on the potential magnitude and extent of environmental contamination.

The third element identifies potential exposure points for receptors. To estimate the potential worst-case total risk, the location and magnitude of the highest potential exposure concentration for a given release source and transport media combination will be estimated.

The fourth element of exposure pathway analysis is the identification and description of potential exposure routes. Exposure routes describe how a receptor can come into contact with contaminants in a specific environmental medium. Environmental media to be considered include air, groundwater, surface water, soil and sediment, and food. Exposure routes include ingestion, dermal absorption, inhalation, and direct exposure to radioactive sources.

After the exposure pathway analysis is completed, the potential for exposure to populations will be assessed. This will involve gathering information on the frequency, mode, and magnitude of exposure. These data are

then assessed to yield a value that represents the amount of contaminated media contacted per day due to sources in the 200-BP-1 Operable Unit. This analysis will include not only identification of currently exposed populations but also exposures that may occur in the future if no action is taken at the site.

The final step in the exposure assessment is to integrate the information and develop a qualitative or quantitative estimate of the expected exposure level(s) resulting from the actual or potential release of contaminants from the site. A variety of computer models and codes may be used in conducting the exposure assessment. These are described in more detail in Appendix I.

5.1.13.3 Toxicity Assessment. To assess the risks from a site, a comparison of acceptable levels of contamination with actual levels identified during the exposure assessment must be made. Contaminant-specific ARARs, when available, would be used to determine acceptable levels. When ARARs are not available or ARARs represent a risk greater than 10^{-4}, acceptable levels will be based on concentration levels that would yield exposures less than the or equal to (RFDs) for noncarcinogens and specified risk levels based on potency factors (q_1*s) for carcinogens. The preliminary goals for carcinogens will be based on the risk range of 10^{-4} to 10^{-7} excess lifetime cancer risk. Priority will be given to the RFDs and q_1*s in setting these goals, although, other available values may be useful in establishing final chemical-specific cleanup levels.

5.1.13.4 Risk Characterization. The final component of the risk assessment is risk characterizations where the potential for adverse health or environmental effects for each of the exposure scenarios derived in the exposure assessment are estimated. These estimates will be obtained by integrating information developed during the exposure and toxicity assessments to characterize the potential or actual risk including carcinogenic risks, noncarcinogenic risks, and environmental risks. The final assessment will include a summary of the risks associated with a site, including each projected exposure route for parameters of interest and the distribution of risk across various sectors of the population. In addition, such factors as the weight-of-evidence associated with toxicity information, the estimated uncertainty of the component parts, and the assumptions contained within the estimates will be discussed.

Characterization of the environmental risks involves identifying the potential exposures to the surrounding plants and animals and evaluating the potential effects associated with such exposure(s). Important factors include disruptive effects to plant and animal populations and the extent of perturbations to the ecological community.

The results of the baseline risk assessment may indicate that the site poses little or no threat to human health or the environment. In such situations, the FS may be either scaled down as appropriate to that site and its potential hazard, or eliminated altogether. The results of the RI and the baseline risk assessment will therefore serve as the primary means of documenting a no-action decision.

5.1.13.5 Evaluate Data Needs. As data are collected and a better understanding of the site and the risks that it poses are obtained, the preliminary remedial action alternatives identified in Section 3.4 will be reviewed and refined. The available data will be evaluated to determine if they are sufficient to develop remedial alternatives. If they are not, additional necessary data gathering will be identified and incorporated into Phase II RI.

5.1.14 Task 14 - Data Evaluation and Remedial Investigation Report

5.1.14.1 Evaluation of Data. The Data Management Plan (Attachment 4) describes the procedural and electronic system for accessing and tracking the receipt storage, and control of validated data, records, documents, correspondence, and other information. Existing data and data from Phase I of the RI will be compiled and evaluated in this activity. Concentrations of contaminants in the source and surface soils will be summarized. Geologic data will be examined and correlated with borehole geophysical surveys to evaluate vadose zone contaminant migration. Stratigraphic cross sections will be developed. Data generated from groundwater monitoring will be interpreted to establish hydraulic potential gradients and for estimating the flow of groundwater within the unconfined aquifer and the Rattlesnake Ridge aquifer. Contaminant plumes will be delineated and illustrated. Contaminant migration factors (retardation and dispersion) will be estimated from observations of contaminant plume patterns and the physical and chemical characteristics of the aquifer and contaminants. Particular attention will be given to determining the migration mechanism of the particular contaminants at the site.

The potential sources onsite and offsite will be evaluated for their contribution to the contaminants in the groundwater. Correlations will be made between constituents in the groundwater and in the 200-BP-1 sources. Impacts or the potential for impacts to the Rattlesnake Ridge aquifer will be evaluated.

Data evaluation will identify data gaps and evaluate whether sufficient information and understanding of the site conditions has been obtained. Additional site characterization data will be identified for inclusion in the Phase II RI.

5.1.14.2 Phase I Remedial Investigation Report. This activity summarizes and presents the conclusions and evaluations from Phase I of the RI. The information presented will document the present situation that exists at the site and vicinity. This report will include the Phase I Baseline Risk Assessment. The general outline of the Phase I RI report is presented in Table 5-5.

Table 5-5. Outline of Phase I Remedial Investigation Report (Sheet 1 of 2)

Executive Summary

1. Introduction
   - 1.1 Purpose of Report
   - 1.2 Site Background
     - 1.2.1 Site Description
     - 1.2.2 Site History
     - 1.2.3 Previous Investigations
   - 1.3 Report Organization

2. Study Area Investigation
   Includes field activities associated with site characterization. These will include physical and chemical monitoirng of the following:
   - 2.1 Surface Features (topographic mapping, etc.) (natural and manmade features)
   - 2.2 Contaminant Source Investigations
   - 2.3 Geological Investigations
   - 2.4 Soil and Vadose Zone Investigations
   - 2.5 Groundwater Investigations
   - 2.6 Other Investigations

3. Physical Characteristics of the Study Area
   - 3.1 Includes results of field activities to determine physical characteristics. These may include some, but not necessarily all of the following:
     - 3.1.1 Surface Features
     - 3.1.2 Meteorology
     - 3.1.3 Surface-Water Hydrology
     - 3.1.4 Geology
     - 3.1.5 Soils
     - 3.1.6 Hydrogeology
     - 3.1.7 Demography and Land Use
     - 3.1.8 Ecology

4. Nature and Extent of Contamination
   - 4.1 Presents the results of site characterizaiton, both natural chemical components and contaminants in some, but not necessarily all, of the following media:
     - 4.1.1 Sources (lagoons, sludges, tanks, etc.)
     - 4.1.2 Soils and Vadose Zone
     - 4.1.3 Groundwater
     - 4.1.4 Surface Water and Sediments
     - 4.1.5 Air
     - 4.1.6 Biota

Table 5-5. Outline of Phase I Remedial Investigation Report (Sheet 2 of 2)

5. Contaminant Fate and Transport
   - 5.1 Potential Routes of Migrations (i.e., air, groundwater etc.)
   - 5.2 Contaminant Persistence
     - 5.2.1 If they are applicable (i.e., for organic contaminants), describe estimated persistence in the study area environment and physical, chemical, and/or biological factors of importance for the media of interest.
   - 5.3 Contaminant Migration
     - 5.3.1 Discuss factors affecting contaminant migration for the media of importance (e.g., sorption onto soils, solubility in water, movement of groundwater, etc.)
     - 5.3.2 Discuss modeling methods and results, if applicable.

6. Baseline Risk Assessment
   - 6.1 Public Health Evaluation
     - 6.1.1 Exposure Assessment
     - 6.1.2 Toxicity Assessment
     - 6.1.3 Risk Characterization
   - 6.2 Environmental Assessment

7. Summary and Conclusions
   - 7.1 Summary
     - 7.1.1 Nature and Extent of Contamination
     - 7.1.2 Fate and Transport
     - 7.1.3 Risk Assessment
   - 7.2 Conclusions
     - 7.2.1 Data Limitations and Recommendations for Future Work
     - 7.2.2 Recommended Remedial Action Objectives

Appendices

A - Analytical Data and QA/QC Evaluation Results
B - Risk Assessment Methods

5.2 PHASE I FEASIBILITY STUDY - DEVELOPMENT OF ALTERNATIVES

Section 3.4 of this document presented a preliminary identification of remedial action objectives, general response actions, remedial technologies, and a range of remedial alternatives for various media in 200-BP-1 Operable Unit. These items were identified after a review of available data on environmental conditions within the unit. For 200-BP-1, the available data concerned groundwater and the characteristics of the process wastes discharged to the cribs. There were no data available to assess the nature and extent of possible contamination for soils. Ongoing Hanford Site monitoring indicates surface water and air are not contaminated at present from this operable unit.

Because of the general lack of data, the alternatives identified in Section 3.4.3 of the initial evaluation are broad in scope. The purpose of the first phase of the FS process is to further develop and refine the initial evaluation based on the data obtained during the RI. This refinement is accomplished through a series of steps as described in the following sections. Results of the Phase I FS will be incorporated into a combined Phase I and Phase II report as described in Section 5.3.6.

5.2.1 Develop Remedial Action Objectives

Preliminary remedial action objectives for the 200-BP-1 Operable Unit were identified in Section 3.4.1. These objectives were medium specific, and consist of goals for protecting human health and the environment. Media initially considered include soils, surface water, groundwater, air, and biota. Of these media, soils and groundwater are known to be contaminated from operation of the BY cribs for process waste disposal. There have also been unplanned releases from various pipelines and tanks in the area. It is currently unknown whether other pathways are present.

The RI and baseline risk assessment described in Section 5.1 will quantify the magnitude of potential risk to human health and biota associated with each of the media. Based on the identified risk, the preliminary remedial action objectives will be refined. This refinement will involve the identification of specific parameters of interest, exposure routes and receptors, and acceptable contaminant levels or range of levels for each exposure route.

5.2.2 Develop General Response Actions

Preliminary general response actions for the 200-BP-1 Operable Unit were identified in Section 3.4.1. These response actions are medium specific and describe the general activities that satisfy each of the remedial action objectives. Since the response actions relate directly to the remedial objectives, any substantial changes in the objectives as discussed in the previous section will require that the response actions be refined.

5.2.3 Identify Volumes or Areas of Media

For Operable Unit 200-BP-1, volumes of contaminated soils and the areal extent of ground water contamination will be defined based on the remedial investigation and baseline risk assessment. Other media, such as air or surface water, will be considered if identified as being a source of unacceptable risk to human health or the environment.

5.2.4 Identify and Screen Remedial Technologies

The first activity to occur during this step of the feasibility study will be to review the list of potentially applicable remedial technology types and process options presented in Section 3.4.2 in light of the results of the RI and baseline risk assessment. Technologies and process options initially not considered may be added to the list based on additional site characterization data.

Once the final list of technology types and process options has been developed, a screening step will take place. During this screening step, process options and entire technology types are eliminated from further consideration on the basis of technical implementability. Technical implementability refers to the ability of the technology or process option to meet the general response action with which it is associated, given specific site conditions. At this point, an analysis will not be performed to assess the ability of the technology or process option to meet cleanup goals. For example, interceptor trenches do not accomplish the desired response action of collection if the depth to groundwater is too great. Another example is that air stripping does not accomplish treatment if volatile organic compounds or ammonia are not present.

5.2.5 Evaluate Process Options

This step of the alternatives development process will consider those process options considered to be technically implementable, and attempt to select one process to represent each technology type. For example, a variety of process options (e.g., coagulation/flocculation, ion exchange, etc.) may be evaluated to select one process that is technically implementable for chemical treatment technologies. This simplifies the subsequent development and evaluation of alternatives without limiting flexibility during remedial design.

During this step, the final list of process options will be evaluated with respect to effectiveness, implementability, and cost. The focus of this evaluation will be effectiveness with less effort directed at implementability or cost. A representative process will be selected for those groups of process options determined to be similar in terms of effectiveness, implementability, and cost. If two or more processes are sufficiently different in their performance or effect that one would not adequately represent the other, they will all be retained for further consideration.

Because of the presence of mixed waste, it is expected that innovative technologies will be especially applicable at Hanford. However, it is likely that detailed data on their effectiveness and cost will not be available.

Therefore, the evaluation of these technologies will be somewhat more liberal than would be normal for a strictly hazardous waste site. Innovative technologies will be retained based primarily on their implementability. Effectiveness and cost will not be the basis for elimination from consideration unless there is clear evidence that one of these factors is limiting.

5.2.5.1 Effectiveness Evaluation. The effectiveness evaluation will focus on: (1) the potential effectiveness of the process options in handling the estimated areas or volumes and meeting the contaminant reduction goals identified in the general response action; (2) the effectiveness of the process options in protecting human health and the environment during the construction and implementation phase; and (3) how proven and reliable the process is with respect to the contaminants and conditions at the site.

It is expected that sufficient information to evaluate the effectiveness of process options for the various media will be collected during the RI. It is also expected that a limited conceptual design of treatment processes will be required, mainly because of the probable consideration of multiple innovative technologies.

5.2.5.2 Evaluate Implementability. Both technical and institutional implementability are considered as part of this evaluation. Since technical implementability has already been established at this point, the emphasis will be on institutional factors. These factors are of particular importance at Hanford because of numerous unresolved issues with respect to control of mixed wastes. It is expected that assumptions regarding some of these issues will be necessary. A basis for the conceptual design of these facilities may also be developed to allow unit disposal costs to be estimated.

5.2.5.3 Cost Evaluation. This will be the least important of the criteria used to evaluate process options. Relative capital and operations and maintenance costs will be developed to the extent possible, and will be largely based on engineering judgement and experience. Processes will be evaluated as to whether costs are high, low, or medium relative to other process options in the same technology type.

5.2.6 Assemble Alternatives

Based on preliminary data, remedial alternatives for the 200-BP-1 Operable Unit were identified in Section 3.4.3. These alternatives were developed by assembling general response actions for each medium under consideration. This step of the FS will involve redefining these general alternatives based on the results of the activities discussed in the previous sections. This will mainly involve specifying the process options which comprise each alternative. For example, the preliminary soil alternative of containment would become containment by capping with long-term monitoring. Another example would be the redefining of groundwater collection, treatment, and disposal as groundwater collection with extraction wells, treatment via chemical precipitation and disposal by discharge to the Columbia River.

It is anticipated that the alternatives will be kept medium-specific at this point. Although the cribs are a likely source of groundwater contamination it is clear that additional sources exist from outside the operable unit. This makes development of operable unit specific alternatives very difficult because of the contribution from other sources to groundwater contamination.

5.3 PHASE II FEASIBILITY STUDY - INITIAL SCREENING OF ALTERNATIVES

The screening of alternatives follows the development of alternatives and precedes the detailed analysis of alternatives. The objective of alternative screening is to reduce the list of potential alternatives that will be evaluated in detail, based on their effectiveness, implementability, and cost. This screening ensures that the most promising alternatives are being considered.

Three distinct steps are conducted during the screening of alternatives. First, the alternatives selected in Phase I are further refined, based on the quantities of media affected, the sizes and capacities of process options, and other pertinent factors obtained from the RI. Second, the refined alternatives are evaluated on a general basis to determine their effectiveness, implementability, and cost. Third, the alternatives best able to meet the remediation objectives of protection of human health and the environment are retained for detailed analysis in Phase III of the FS.

5.3.1 Define Alternatives

Prior to beginning the screening, alternatives must be further defined to identify individual process options, process sizing requirements, and remediation time frames. Results from the RI will be used to determine interactions among media, which may influence remediation activities, and risk assessment information will be used to address site-wide protectiveness.

5.3.1.1 Refine Objectives. Alternatives are developed in Phase I of the FS to meet remedial action objectives for each medium of interest. However, protectiveness of human health or the environment may be dependent on meeting remedial action objectives for multiple media. Exposures may occur through more than one pathway from several media. The assembled alternatives are thus evaluated to ensure that they protect human health and the environment from all potential pathways at the site. If it is found that an alternative is not fully protective, a reduction in exposure levels may need to be made for one or more media, or it may be determined that a specific alternative is unable to meet a target risk level and would, therefore, not be retained. Conversely, it may be determined that certain media do not pose an unacceptable risk, and treatment alternatives could be eliminated from further evaluation. An example of a medium for which remediation may be unnecessary is air.

Information obtained in the RI and baseline risk assessment will be used to refine the objectives to consider media interactions so that alternatives are fully protective of public health and the environment in the event of multiple exposure pathways.

5.3.1.2 Define Media and Process Options. The information collected during the RI will be used to refine the extent or volume of contaminated material and the size of major technology and process options in order to allow differentiation among alternatives with respect to effectiveness, implementability, and cost.

Media interactions will be evaluated to determine if ongoing releases (such as from contaminated soils) significantly affect contaminant levels in other media (such as groundwater). This is necessary because source control actions affect remediation levels and/or time frames for other media. For example, source removal of contaminated soils would reduce the rates and volumes of groundwater extraction needed to achieve the target remediation levels.

After refining the alternatives with respect to volumes of media, the technology process options will be further defined with respect to effectiveness, implementability, and costs to identify differences among alternatives. The following information will be developed for the technology process options used in an alternative:

- size and configuration of onsite extraction and treatment systems
- time frame in which treatment, containment, or removal goals can be achieved
- rates or flows of treatment
- special requirements for construction
- distances for disposal technologies
- required permits and imposed limitations.

5.3.2 Screening Evaluation

In the screening evaluation, information assembled in the further definition of alternatives is used to evaluate the alternatives with regard to the short- and long-term aspects of effectiveness, implementability, and cost. During this screening, comparisons will be made between similar alternatives, with the most promising carried forward for further analysis.

5.3.2.1 Evaluate Effectiveness. Each alternative will be evaluated with respect to the level of protectiveness to human health and the environment it will provide through reductions in toxicity, mobility, or volume. The short-term component, occurring during the construction and operation period, and the long-term component, occurring after remedial action is complete, will be evaluated. Levels obtained in reduction of toxicity, mobility, or volume will be compared to chemical-specific ARARs and/or target risk levels as determined in the baseline risk assessment.

5.3.2.2 Evaluate Implementability. Implementability is a measure of both the technical and institutional feasibility of constructing, operating, and maintaining a remedial action alternative with respect to a specific site. Technical feasibility refers to the ability to construct, operate, and meet technology-specific regulations for process options; institutional feasibility refers to the ability to obtain approvals from Federal, state, and local agencies, and procure required services and equipment.

5.3.2.3 Evaluate Cost. Comparative cost estimates with relative accuracy will be made. Cost estimates will be based on cost curves, generic unit costs, vendor information, conventional cost-estimating guides, and/or prior similar estimates. Both capital and operating and maintenance costs will be considered where appropriate. Present worth analyses will be used to evaluate expenditures that occur over different time periods, so that costs for different remedial action alternatives can be compared on the basis of a single figure for each alternative.

5.3.2.4 Innovative Technologies. Innovative technologies are those technologies which are fully developed but which lack sufficient cost or performance data for routine use at hazardous waste sites. Therefore, it will, most likely, not be possible to evaluate alternatives incorporating innovative technologies on the same basis as available technologies. However, innovative technologies will be carried through the screening phase if there is reason to believe that they offer significant advantages. It is anticipated that innovative technologies may be attractive alternatives at the Hanford Site due to the mixed wastes present in soils and groundwaters.

5.3.3 Alternatives Screening

Alternatives with the most favorable composite evaluation of all factors will be retained for further consideration during the detailed analysis. Alternatives will be selected to preserve the range of treatment and containment technologies initially developed. No more than 10 alternatives will be retained. Unselected alternatives may be reconsidered at a later step in the detailed analysis if information is developed that identifies an additional advantage not previously apparent. However, it is expected that alternatives eliminated during this phase will not be reconsidered for selection.

5.3.4 Identify and Verify Action-Specific ARARs

At the conclusion of screening, sufficient information will exist on the technologies and configurations of greatest interest to perform a more definitive identification of action-specific ARARs. Action-specific ARARs will be developed from the general ARARs identified in Section 3.2.

5.3.5 Identify Treatability Tests and Additional Site Characterization Needs

Once the field of alternatives has been narrowed, the need for treatability tests can be determined. At the Hanford Site, it is anticipated that treatability tests will be required for the technologies shown in Table 5-6. Modifications to this list will be made, and will depend upon the specific process options under consideration and their level of development. This testing will occur during the Phase II RI discussed in the next section.

Additional data needs may also be identified during the screening phase. However, it is expected that the nature and extent of contamination will be well defined by the end of the RI. Therefore, any additional field investigations will focus on better defining the effect of site conditions on the performance of the technology processes of greatest interest.

5.3.6 Phase I and II Feasibility Study Report

The results of the develoment and initial screening of alternatives conducted during Phase I and II of the FS will be incorporated into an interim FS Report and will follow the general outline as presented in Table 5-7. The procedures for evaluating, defining, and screening the alternatives will be well documented. The following types of information will also be included:

- Summary of background information from the RI including the nature and extent of contamination, contaminant fate and transport, and the baseline risk assessment
- Identification of the refined remedial action objectives and general response actions for each medium of concern
- Identification and screening of remedial technology types and process options
- Screening evaluation summaries of each alternative
- Selection of representative processes; and notation of process options that were initially screened out and are being represented by the processes comprising the alternative
- Incorporation of selected processes into a range of alternatives
- Definition of each alternative including extent of remediation, volume of contaminated material, sizes of major treatment processes, process parameters, cleanup time frames, transportation distances, and special considerations.

Table 5-6. Preliminary Identification of Treatability Test Requirements (Sheet 1 of 2)

Remedial Technology	Testing Program
Soil/sediments	Bench:
Capping Chemical stabilization/ solidification Landfill Flushing	Soil density and bearing capacity vs. moisture content curves for proposed capping materials. Physical/chemical/analytical testing of admix and soils to determine admix/soil ratio for stabilization/ solidification. Physical characteristics of soil for landfill construction. Physical characteristics of area soils such as density, permeability, etc., to determine gas/liquid injection and/or withdrawal through soils for insitu treatment technologies.
	Pilot:
	Test fill for cap construction. Percolation test for flushing. Test for liquid injection/withdrawal rates in soil.
Groundwater collection:	Bench:
Extraction/injection wells subsurface barriers	Determine soil characteristics for ground water withdrawal/injection rates.
	Pilot:
	Conduct field tests for ground water withdrawal and injection

Table 5-6. Preliminary Identification of Treatability Test Requirements (Sheet 2 of 2)

Remedial Technology	Testing Program
Groundwater treatment:	Bench:
Physical/chemical treatment Ultraviolet radiation Electrocoagulation Alkaline hydrolysis Activated carbon absorption Ion exchange Reverse osmosis	Chemical and physical treatability studies to define rate constants, minimal-maximal loading rates and retention times, optimal pH and temperature, sludge generation rates and characteristics, oxygen transfer characteristics; chemical type and dose rates; solids flux rate vs. solids concentration in sludge thickening systems. Pilot Studies: Testing of pilot-scale equipment on real or simulated waste to verify laboratory results, to provide scale-up data, to identify special operations and maintenance needs (i.e., scaling problems), to identify anc characterize secondary emissions, and to verify attainability of effluent standards.

Table 5-7. Preliminary Outline of the Phase II Feasibility Report

Executve Summary

1. Introduction
   - 1.1 Purpose and Organization of Report
   - 1.2 Summary of Background Information

2. Identification and Screening of Technologies
   - 2.1 Introduction
   - 2.2 Remedial Action Objectives
   - 2.3 General Response Actions
   - 2.4 Identification and Screening of Technology Types and Process Options
   - 2.5 Identification and Screening of Technologies
   - 2.6 Evaluation and Selection of Representative Processes

3. Alternatives Formulation
   - 3.1 Introduction
   - 3.2 Rationale
   - 3.3 Alternatives Formulation

4. Preliminary Screening of Alternatives
   - 4.1 Introduction
   - 4.2 Description of Alternatives
   - 4.3 Evaluation of Effectiveness
   - 4.4 Evaluation of Implementability
   - 4.5 Cost Evaluation

5. Summary of Prescreening Process

Hydraulic properties of the aquifer may need to be more accurately estimated in the contaminated portions of the aquifer or in the area anticipated for remedial action. Phase II hydraulic aquifer tests could be conducted for extended time ≈ 1 month or greater) with the use of observation wells for more representative hydraulic parameters and possibly hydraulic boundary evaluations. If hydraulic tests are necessary in contaminated zones of the aquifer, large quantities of groundwater will be pumped. These tests could possibly be coordinated with water treatment pilot-scale testing required for detailed evaluation of remedial alternatives.

If data from Phase I RI indicate that significant lateral migration of contaminants has occurred in the vadose zone, additional characterization will be necessary during Phase II RI. Boring with soil sampling and analyses will be necessary to delineate the extent of lateral migration of contaminants and understand the source(s) and fate of the contamination.

Prior to initiating field reconnaissance activities or laboratory testing of soils, a work plan for Phase II tasks will be established which specifies the rationale and objectives for additional site characterization data, the scope of work, testing procedures, and analysis. The Phase II RI work plan will be an amendment to this work plan.

5.4.3 Treatability Testing

Some of the technologies selected for detailed analysis at the Hanford Site may be well developed, proven, and documented such that site-specific information collected during the RI is adequate for evaluation without conducting treatability testing. However, it is expected that some technologies, particularly those dealing with mixed waste, will not have been sufficiently demonstrated to predict treatment performance or to estimate the size and cost of treatment units. Some treatment processes, particularly innovative technologies, are not sufficiently understood for performance to be predicted, even with a complete characterization of the wastes. When treatment performance is difficult to predict, actual testing of the process may be the most cost-effective means of obtaining the necessary data.

Treatability testing to support the remedial alternative evaluation and design process can be performed by using bench-scale or pilot-scale techniques. In general, treatability studies will include the following steps:

- prepare a work plan for the bench or pilot studies
- perform field study and/or bench testing, and/or pilot testing
- evaluate data from field studies, and/or bench testing, and/or pilot testing
- prepare a brief report documenting the results of the testing.

5.4 PHASE II REMEDIAL INVESTIGATION - POST-SCREENING INVESTIGATIONS

As site information is collected during the RI and alternatives are being developed, additional data needs necessary to adequately evaluate alternatives during the detailed analysis may be identified. These additional data needs may involve the collection of site characterization data or treatability studies to better evaluate technology performance.

5.4.1 Data Requirements for Remediation Technologies

Data collected during site characterization may not be adequate for assessing the feasibility of remedial technologies, and the need for detailed data from treatability tests may not become apparent until the initial screening of alternatives (Phase II FS) has been completed. Additional data may also be required for innovative technologies.

A literature survey will be conducted to identify additional data needs. The objectives of the survey are listed below.

- Determine whether the performance of those technologies under consideration have been sufficiently documented on similar wastes considering the scale, e.g., bench, pilot, or full, and the number of times the technologies have been used.
- Gather information on relative costs, applicability, removal efficiencies, operations and maintenance requirements, and implementability of the candidate technologies.
- Determine testing requirements for bench or pilot studies.

5.4.2 Additional Site Characterization

Additional site characterization may become necessary once Phase II of the FS has been completed and remedial alternatives have been screened for detailed analysis. Site characterization during Phase II RI will focus on additional information to support the detailed evaluation of selected remedial alternatives.

Additional site characterization is expected for obtaining information on the physical properties of soils. In situ physical properties such as density and moisture content will be estimated during the Phase I RI. Additional soil properties that may require characterization include:

- grain-size distribution
- intrinsic or hydraulic conductivity
- moisture content-capillary pressure relationships
- thermal conductivity.

If specific remedial alternatives require information on the above properties, where possible, soil samples (or cuttings) that have been archived from Phase I RI will be used for testing. Standard American Society of Testing Materials (ASTM) methods will be utilized where applicable, or procedures will be developed for tests which are not standardized.

5.4.3.1 Bench-Scale Testing. Bench-scale testing will be performed to determine if a process is technically feasible for some alternatives involving treatment or destruction technologies. Prior to initiating bench-scale treatability tests, the following information will be collected:

- prepare and identify test procedures
- prepare a waste sampling plan
- characterize the waste
- develop treatment goals
- develop data requirements for estimating the cost of the technology being evaluated
- identify required test services, equipment, chemicals, and analytical services.

Bench-scale tests can be used to test for a wide variety of operating conditions, and can be used to determine broad operating conditions to allow optimization during additional bench or larger-scale pilot tests. The objectives of bench-scale testing are to determine the following:

- effectiveness of the treatment alternative on the waste
- differences in performance between competing manufacturers
- differences in performance between alternative chemicals
- sizing requirements for pilot-scale studies
- screening of technologies to be pilot-scale tested
- sizing of those treatment units that would affect the cost of the technology sufficiently to affect the FS evaluation process
- compatibility of materials with the waste.

For a technology that is well developed and tested, bench studies are usually sufficient to evaluate performance on new wastes. For innovative technologies, however, pilot tests may be required since information necessary to conduct full-scale tests will be either limited or nonexistent.

5.4.3.2 Pilot-Scale Testing. Pilot units are intended to more accurately simulate the operation of the full-scale process than would bench-scale testing. However, pilot tests require significant time and can be quite costly. Therefore, the need for pilot-scale testing must be determined by comparing the potential for improved performance or savings in time or money during implementation against the additional time and expense for the pilot testing. Innovative technologies will be considered if they offer the potential for more permanent treatment, destruction of the waste, or significant savings in time or money required to complete a remedial action.

5.4.4 Application of Results

The purpose of the treatability evaluation is to provide information needed for the detailed analysis of alternatives and to allow selection of remedial actions to be made with a reasonable certainty of achieving the response objectives. The results of bench- and pilot-scale tests can be used to ensure that conventional and innovative technologies are evaluated during the detailed analysis phase of the FS.

Information collected during treatability studies can also aid in the detailed design of the selected remedial technology. However, the limitations of the bench- or pilot-scale test must be compensated for in a full-scale application. Therefore, an evaluation which includes a sensitivity analysis to identify the key parameters and unknowns that could affect a full-scale system would be conducted. In the case of innovative technologies, full-scale systems may not be in wide use. Therefore, the potential need for process modifications during design or operation must be considered.

5.4.5 Phase II RI Report

The Phase II RI report will provide additional site characterization data and will describe the testing that was performed, the results of the tests, and an interpretation of how the results would affect the evaluation of the remedial alternatives considered for the site. The report will contain a discussion of the effectiveness of the treatment technology for the wastes onsite, and will contain an evaluation of how test results affect treatment costs developed during the detailed analysis of alternatives.

5.5 PHASE III FEASIBILITY STUDY - DETAILED ANALYSIS OF ALTERNATIVES

The detailed analysis of alternatives follows the development and screening of alternatives and precedes the actual selection of a remedy. The results of the detailed analysis provide the basis for identifying a preferred alternative and preparing the proposed plan. The detailed analysis of alternatives consists of the following components:

- further definition of each alternative, if appropriate, with respect to the volumes or areas of contaminated media to be addressed, the technologies to be used, any performance requirements associated with those technologies

- an assessment and a summary of each alternative against nine evaluation criteria

- a comparative analysis among the alternatives to assess the remedial action (The evaluation criteria are listed in Section 5.5.2).

5.5.1 Refine Alternatives

The alternatives that remain after screening may need to be refined more completely prior to the detailed analysis. During the detailed analysis, each alternative will be reviewed to determine if additional definition is required to apply the evaluation criteria consistently and to develop order-of-magnitude cost estimates (+50 to -30 percent). Information developed to further refine alternatives at this stage may include preliminary design calculations, process flow diagrams, sizing of key process components, preliminary site layouts, and a discussion of limitations, assumptions, and uncertainties concerning each alternative. Information collected from treatability studies, if conducted, will also be used to further refine alternatives.

5.5.2 Evaluation Criteria

Nine evaluation criteria will serve as the basis for conducting the detailed analysis and for subsequent selection of an appropriate remedial action. The evaluation criteria are:

- short-term effectiveness
- long-term effectiveness and permanence
- reduction of toxicity, mobility, or volume
- implementability
- cost
- compliance with arars
- overall protection of human health and the environment
- state acceptance
- community acceptance.

These criteria encompass technical, cost, and institutional considerations and compliance with specific statutory requirements.

5.5.2.1 Short-Term Effectiveness. This evaluation criterion addresses the effects of the alternative during the construction and implementation phase until remedial response objectives are met. The following factors relating to effects on human health and the environment will be addressed for each alternative:

- protection of the community during remedial actions
- protection of workers during remedial actions
- environmental impacts
- time until remedial response objectives are achieved.

The evaluation of these factors will include a discussion of increased risk posed by the remedial action being evaluated and an evaluation of the effectiveness and reliability of protective measures that could be taken for worker protection or environmental impact mitigation. This is of particular concern at the Hanford Site because of the inherent problems concerning mixed wastes.

5.5.2.2 Long-Term Effectiveness. The evaluation of alternatives using this criterion will address the results of a remedial action in terms of the risk remaining at the site after response objectives have been met. The following components will be addressed to evaluate the extent and effectiveness of controls that may be required to treat residuals and/or untreated wastes:

- magnitude of remaining risk
- adequacy of controls
- reliability of controls.

The evaluation of these components will include an assessment of residual risk, the adequacy of containment systems and institutional controls, and the potential need to replace components of the remedial action.

5.5.2.3 Reduction in Toxicity, Mobility, and Volume. This evaluation criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of a hazardous substance as their principal element. The following specific factors will be addressed:

- the treatment processes, the remedies they will employ, and the materials they will treat
- the amount of hazardous materials that will be destroyed or treated
- the degree of expected reduction in toxicity, mobility, or volume as a percentage of reduction
- the degree to which treatment will be irreversible
- the type and quantity of treatment residuals that will remain.

Alternatives which treat a site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volumes of contaminated media will satisfy the preference for permanent treatment.

5.5.2.4 Cost. Cost considerations will be an important evaluation criteria at the Hanford Site because funding is distributed by the United States Congress. Costing procedures outlined in the Remedial Action Costing Procedures Manual (EPA, 1985) will be used in the alternatives evaluation. Both capital costs and annual operation and maintenance costs will be considered. Cost will be developed within accuracy of +50 to -30 percent (rough order of magnitude). In addition, a present worth analysis will be conducted so that all alternatives can be compared on the basis of a single

figure in a common base year. A discount rate of 5 percent will be used along with a period of performance of 30 years.

5.5.2.5 Implementability. The implementability criterion addresses the technical and institutional feasibility of implementing an alternative and the availability of various services and materials required during its implementation. In evaluating this criterion, the following factors will be analyzed:

- technical feasibility including construction and operation, reliability of technology, ease of undertaking additional remedial actions, and monitoring considerations
- institutional feasibility
- availability of services and materials.

Concerns at the Hanford Site regarding implementability are related to the presence of mixed wastes. Assumptions may be necessary with respect to future mixed waste regulations and guidelines.

5.5.2.6 Compliance with Applicable or Relevant and Appropriate Requirements. This evaluation criterion is used to determine how each alternative complies with ARARs discussed in Section 3.2. The detailed analysis will summarize which requirements are applicable or relevant and appropriate to an alternative and describe how the alternative meets these requirements. Other advisories, criteria, and guidance may also be used if necessary to ensure protectiveness.

5.5.2.7 Overall Protection of Human Health and the Environment. This evaluation criterion provides a final check to assess whether each alternative meets the requirement that it is protective of human health and the environment. The overall assessment of protection is based on a composite of factors discussed under long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. The analysis will address how each specific alternative achieves protection over time and how site risks are reduced. A discussion will be included of how each source of contamination is to be eliminated, reduced, or controlled for each alternative.

5.5.3 Comparison of Alternatives

Once the alternatives have been individually assessed against the nine criteria, a comparative analysis will be conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criterion. They key tradeoffs or concerns among alternatives will generally be based on the evaluations of short-term effectiveness; long-term effectiveness, and permanence; reduction of toxicity, mobility, and volume; implementability; and cost. Overall protectiveness and compliance with ARARs will generally serve as a threshold determination in that they either will or will not be met.

The comparative analysis will include a narrative discussion describing the strengths and weaknesses of the alternatives relative to one another with respect to each criterion. The potential advantages in cost or performance of

innovative technologies and the degree of uncertainty in their expected performance will also be discussed. The differences between all the alternatives will be summarized in tabular form.

At this point, the separate alternatives for each media will be combined to present a comprehensive remedy that addresses all the potential threats posed by the operable unit.

5.5.4 Phase III Feasibility Study Report

The analysis of individual alternatives against the nine criteria will be presented as a narrative discussion accompanied by a summary table. The alternative discussion will include data on technology components, quantity of hazardous materials handled, time required for implementation, process sizing, implementation requirements, and assumptions. The key ARARs for each alternative will also be incorporated into those discussions. The discussion will focus on how, and to what extent, the various factors within each of the seven criteria are addressed. A summary table will highlight the assessment of each alternative with respect to each of the seven criteria. A preliminary outline of the Phase III FS report is shown in Table 5-8.

5.5.5 Proposed Plan

A proposed plan will be prepared, with consideration of all information generated through the RI/FS process. The proposed plan will describe the analysis of feasible alternatives and clearly state why the proposed remedy is the most appropriate for the operable unit. Once the lead regulatory agency has concurred on the proposed plan and the Phase III FS report, the documents will be made available for public review and comment.

Table 5-8. Preliminary Outline of the Phase III Feasibility Report

Executive Summary

1. Introduction
   - 1.1 Purpose and Organization of Report
   - 1.2 Summary of Background Information

2. Identification and Screening of Technologies
   - 2.1 Introduction
   - 2.2 Remedial Action Objectives
   - 2.3 General Response Actions
   - 2.4 Identification and Screening of Technology Types and Process Options
   - 2.5 Identification and Screening of Technologies
   - 2.6 Evaluation and Selection of Representative Processes

3. Alternatives Formulation
   - 3.1 Introduction
   - 3.2 Rationale
   - 3.3 Alternatives Formulation

4. Preliminary Screening of Alternatives
   - 4.1 Introduction
   - 4.2 Description of Alternatives
   - 4.3 Evaluation of Effectiveness
   - 4.4 Evaluation of Implementability
   - 4.5 Cost Evaluation

5. Summary of Prescreening Process

6. Detailed Evaluation of Screened Alternatives
   - 6.1 Introduction
   - 6.2 Evaluation of Effectiveness
   - 6.3 Evaluation of Implementability
   - 6.4 Reduction of Mobility, Toxicity, or Volume
   - 6.5 Compliance with ARARs
   - 6.6 Protection of Human Health and the Environment
   - 6.7 Costs
   - 6.8 Acceptance

7. Summary Comparison of Remedial Alternatives.

References
Appendices

6.0 SCHEDULE

The anticipated schedule for completing Phases I and II RI and Phases I, II and III FS are presented in Plate 6-1. Assumptions used to generate this schedule include:

- Review and approval of the 200-BP-1 work plan and support project plans for the RI/FS will take 7 months by the regulatory agencies which includes public comment period.
- Preparation includes all activities necessary to start field tasks. These activities include but are not limited to: coordination with field personnel and operations managers; development and approval of technical procedures, as required; receipt of a radiation work permit; test field monitoring and sampling equipment; coordination with laboratories; coordination with decontamination and waste disposal facilities; coordination with contractors and/or consultants.
- For samples having radioactivity of 5 mrems/hr or greater, the schedule assumes adequate laboratory capabilities (Level IV RAS or equivalent) and capacity for chemical analysis (both radiochemical and TCL) will be available on the Hanford Site by January, 1990.
- Tasks 1 through 9 will begin prior to final approval by the regulatory agencies of the work plan and support project plans.
- Two drill rigs will be used during Task 2 and Task 6.
- Drilling contractors will be prequalified and will not have to be procured through a competitive bid process.
- Chemical analysis of samples will take 6 to 8 weeks.
- Existing wells included for testing, monitoring, and sampling during this RI are adequately constructed and usable for intended purposes.
- Time is necessary to develop technical procedures for conducting borehole geophysics, seismic refraction surveys, geodetic surveys, topographic mapping, column leach tests, and sorption tests. Two months time has been included within the schedule for development of procedures.
- The schedule assumes adequate support personnel (RPTs, trained drilling contractors, etc.) will be available for conducting necessary tasks.
- Review of draft reports by Westinghouse Hanford and DOE is assumed to take 6 weeks by each.
- During Task 6 - Stage 2, it is assumed that three monitoring wells in the unconfined aquifer and one monitoring well in the confined aquifer will be installed.

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- Review of primary RI/FS reports by the regulatory agencies will take a minimum of 4 months. The 4-month time period includes 1.5 months for initial regulatory review, 1.5 months for revisions to report, and 1 month for regulatory acceptance. Additional time may be required to finalize the reports if dispute resolution is needed, as indicated in the Action Plan. Each phase of the investigation will begin prior to final approval of the primary reports by the regulatory agencies.

There is high uncertainty associated with the anticipated schedule for conducting the Phase II RI. Specific tasks are not identified and will be dependent on results of Phase I RI and Phase I and II FS.

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Plate 6-1. Anticipated Schedule for the Remedial Investigation/Feasibility Study for the 200-BP-1 Operable Unit

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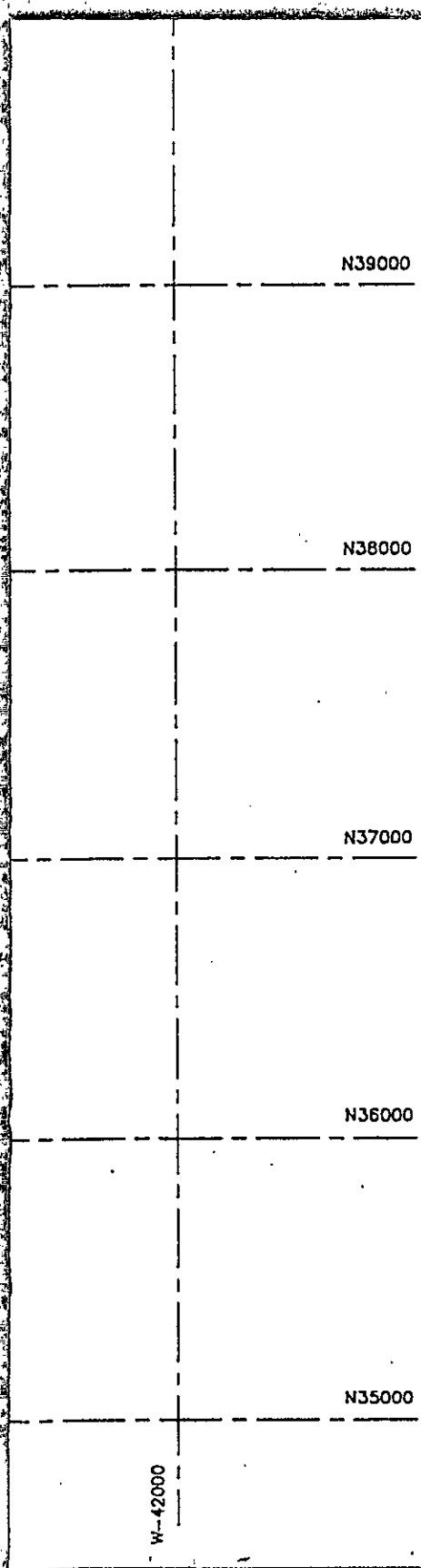


PLATE **2-1**

200 AREA OPERABLE UNITS

883-1726/9431

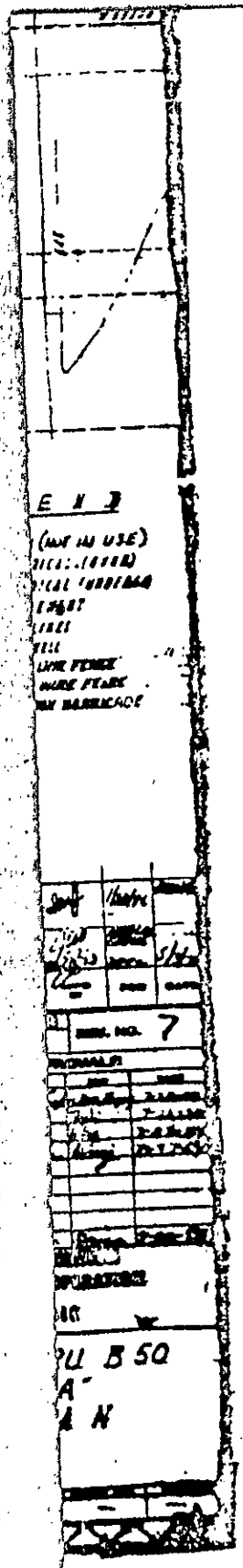
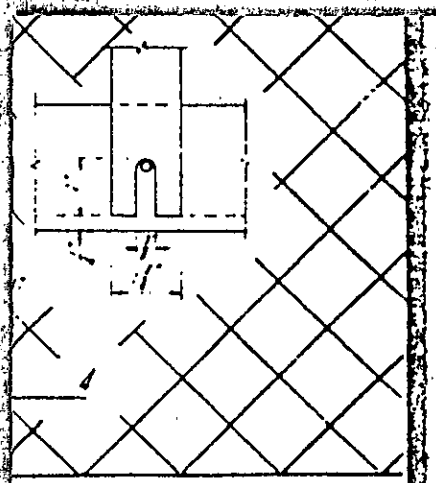


PLATE 2-2
LOCATION OF
UNDERGROUND DISTRIBUTION
PIPELINES AND CRIBS
216-B-43 THROUGH 50
IN 200-BP-1

883-1726/9428



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ADED BLIND
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CRIBS

REV. NO. 2

APPROVALS

ATOMIC ENERGY COMMISSION
ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC

216-B 43 THRU B50
CRIB AREA
B DETAILS

PLATE **2-3**

CONSTRUCTION DETAILS FOR CRIBS 216-B-43 THROUGH 50

883-1726/9429

PLATE **2-4**

AS-BUILT DRAWING OF THE 216-B-57 CRIB

883-1726/9430

Source:
Prepared from PNL Hanford Groundwater Database, Dec. 1987.

PLATE 3-1
LOCATION OF
200 EAST AREA
MONITORING WELLS

883-1726/12574

APPENDIX A

SOURCE INVENTORY

(U.S. Department of Energy, 1988b. Preliminary Assessment/Site Inspection Activities on Inactive Waste Sites at Hanford (draft) - Volumes 1, 2 and 3, prepared by Westinghouse Hanford Company, Richland, WA, for U.S. Department of Energy.)

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SITE ID NO.: 216-8-43

ALIAS: 216-BY-1 Cavern, 216-BY-1 Crib
STATUS: Inactive
DIMENSIONS:
Length: 75 ft
Width: 75 ft
Depth: 15 ft
Diameter: 0 ft

FACILITY: Crib
ELEVATION: 623 ft
WATERTABLE: 228 ft
HRS Migration Score: 57.887

LOCATION: 200 East
COORDINATES: N46332/W53355 (Center of Crib)

SITE DESCRIPTION:

Four 4 ft. diameter x 4 ft. long concrete pipes placed vertically 7 ft. below grade, on a 5 ft. bed of 3 in. gravel (380 cu. yds.). Pipes are ararnged in a square with the centers spaced 15 ft. apart in a 30 ft. x 30 ft. x 15 ft. deep excavation. Surface dimensions are 75 ft. x 75 ft. Each culvert is fed by an 8 in. steel pipe coming from main, forming a chevron pattern. Each culvert has a concrete cover.

SERVICE DATES: 1954-1954

SERVICE HISTORY:

From 11/54 to 11/54 the site received the scavenged TBP supernatant waste from the 221-U building. The site was retired in 11/54. The waste is high salt, neutral/basic.

REFERENCES:
Documents: ARH-2806, RHO-CD-673, HW-55176
Photographs: 122440-56-CN
Drawings: H-2-34761, H-3-57210

883-1726/9843

SITE ID NO.: 216-B-43

CHEMICALS DISPOSED

SODIUM:	170000 kg	FERROCYANIDE:	1100 kg
POTASSIUM:	0 kg	FLUORIDE:	0 kg
AMMONIUM NITRATE:	0 kg	SODIUM SILICATE:	0 kg
NITRITE:	0 kg	OXALATE:	0 kg
NITRIC ACID:	0 kg	SODIUM HYDROXIDE:	0 kg
NITRATE:	400000 kg	SODIUM ALUMINATE:	0 kg
SULFURIC ACID:	0 kg	TRIBUTYL PHOSPHATE:	0 kg
SULFATE:	29000 kg	PARAFFIN HYDROCARBON:	0 kg
PHOSPHATE:	21000 kg	AMMONIUM CARBONATE:	0 kg
SODIUM DICHROMATE:	0 kg		

TOTAL VOLUME DISPOSED: 2120000 Liters

RADIONUCLIDE INVENTORY
(in curies)

H-3:	170.00000	CE-144:	0.00000
C-14:	0.00000	PR-144:	0.00000
MN-54:	0.00000	PM-147:	0.00000
CO-60:	0.01570	EU-152:	0.00000
NI-63:	0.00000	EU-154:	0.00000
KR-85:	0.00000	EU-155:	0.00000
SR-90:	630.00000	NP-237:	0.00000
Y-91:	0.00000	PU-238:	0.00000
NB-95:	0.00000	PU-239:	0.02850
ZR-95:	0.00000	PU-240:	0.00770
TC-99:	0.00000	PU-241:	0.00000
RU-103:	0.00000	AM-241:	0.00000
RU-106:	0.00000	U-233:	0.00000
SN-113:	0.00000	U-235:	0.00000
SB-125:	0.00000	U-238:	0.00456
I-129:	0.00000	TH-232:	0.00000
CS-134:	0.00000	BETA:	1530.00000
CS-137:	142.00000	GAMMA:	0.00000
CE-141:	0.00000	ALPHA:	0.00000

These values are decayed through April 1, 1986.

883-1726/9894

SITE ID NO.: 216-8-44

ALIAS: 216-8Y-2 Cavern, 216-8Y-2 Crib
STATUS: Inactive
DIMENSIONS:
Length: 75 ft
Width: 75 ft
Depth: 15 ft
Diameter: 0 ft

FACILITY: Crib
ELEVATION: 623 ft
WATERTABLE: 222 ft
HRS Migration Score: 60.403

LOCATION: 200 East
COORDINATES: N46417/W53355 (Center of crib)

SITE DESCRIPTION:

Four 4 ft. diameter x 4 ft. long concrete pipes placed vertically 7 ft. below grade, on a 5 ft. bed of 3 in. gravel (380 cu. yd.). Pipes are arranged in a square with the centers spaced 15 ft. apart in a 30 ft. x 30 ft. x 15 ft. deep excavation. Surface dimensions are 75 ft. x 75 ft. Each culvert is fed by an 8 in. steel pipe coming from main, forming a chevron pattern. Each culvert has a concrete cover.

SERVICE DATES: 1954-1955

SERVICE HISTORY:

From 11/54 to 3/55 the site received scavenged TBP supernatant waste from the 221-U building. The site was retired in 3/55. The waste is high salt, neutral/basic.

REFERENCES:
Documents: ARH-2806, RHO-CD-673, HW-55176
Photographs: 122440-56-CN
Drawings: H-2-34761, H-3-57210

883-1726/9893

SITE ID NO.: 216-B-44

CHEMICALS DISPOSED

SODIUM:	330000 kg	FERROCYANIDE:	3000 kg
POTASSIUM:	0 kg	FLUORIDE:	0 kg
AMMONIUM NITRATE:	0 kg	SODIUM SILICATE:	0 kg
NITRITE:	0 kg	OXALATE:	0 kg
NITRIC ACID:	0 kg	SODIUM HYDROXIDE:	0 kg
NITRATE:	800000 kg	SODIUM ALUMINATE:	0 kg
SULFURIC ACID:	0 kg	TRIBUTYL PHOSPHATE:	0 kg
SULFATE:	60000 kg	PARAFFIN HYDROCARBON:	0 kg
PHOSPHATE:	40000 kg	AMMONIUM CARBONATE:	0 kg
SODIUM DICHROMATE:	0 kg		

TOTAL VOLUME DISPOSED: 5600000 Liters

RADIONUCLIDE INVENTORY
(in curies)

H-3:	450.00000	CE-144:	0.00000
C-14:	0.00000	PR-144:	0.00000
MN-54:	0.00000	PM-147:	0.00000
CO-60:	0.08480	EU-152:	0.00000
NI-63:	0.00000	EU-154:	0.00000
KR-85:	0.00000	EU-155:	0.00000
SR-90:	1310.00000	NP-237:	0.00000
Y-91:	0.00000	PU-238:	0.00000
NB-95:	0.00000	PU-239:	0.85600
ZR-95:	0.00000	PU-240:	0.23100
TC-99:	0.00000	PU-241:	0.00000
RU-103:	0.00000	AM-241:	0.00000
RU-106:	0.00000	U-233:	0.00000
SN-113:	0.00000	U-235:	0.00000
SB-125:	0.00000	U-238:	0.00076
I-129:	0.00000	TH-232:	0.00000
CS-134:	0.00000	BETA:	3270.00000
CS-137:	336.00000	GAMMA:	0.00000
CE-141:	0.00000	ALPHA:	0.00000

These values are decayed through April 1, 1986.

883-1726/9892

SITE ID NO.: 216-B-45

ALIAS: 216-BY-3 Cavern, 216-BY-3 Crib
STATUS: Inactive
DIMENSIONS:
Length: 75 ft
Width: 75 ft
Depth: 15 ft
Diameter: 0 ft

FACILITY: Crib
ELEVATION: 623 ft
WATERTABLE: 220 ft
HRS Migration Score: 62.920

LOCATION: 200 East
COORDINATES: N46502/W53355 (Center of crib)

SITE DESCRIPTION:

Four 4 ft. diameter x 4 ft. long concrete pipes placed vertically 8 ft. below grade, on a 5 ft. bed of 3 in. gravel (380 cu. yd.). Pipes are arranged in a square with the centers spaced 15 ft. apart in a 30 ft. x 30 ft. x 15 ft. deep excavation. Surface dimensions are 75 ft. x 75 ft. Each culvert is fed by an 8 in. steel pipe coming from main, forming a chevron pattern. Each culvert has a concrete cover.

SERVICE DATES: 1955-1955

SERVICE HISTORY:

From 4/55 to 6/55 the site received the scavenged TBP supernatant waste from 221-U building. The site was retired in 6/55. The waste is high salt, neutral/basic.

REFERENCES:
Documents: ARH-2806, RHO-CD-673, HW-55176
Photographs: 122440-56-CN
Drawings: H-2-34761, H-3-57210

883-1726/9825

SITE ID NO.: 216-B-45

CHEMICALS DISPOSED

SODIUM:	340000 kg	FERROCYANIDE:	2600 kg
POTASSIUM:	0 kg	FLUORIDE:	0 kg
AMMONIUM NITRATE:	0 kg	SODIUM SILICATE:	0 kg
NITRITE:	0 kg	OXALATE:	0 kg
NITRIC ACID:	0 kg	SODIUM HYDROXIDE:	0 kg
NITRATE:	900000 kg	SODIUM ALUMINATE:	0 kg
SULFURIC ACID:	0 kg	TRIBUTYL PHOSPHATE:	0 kg
SULFATE:	60000 kg	PARAFFIN HYDROCARBON:	0 kg
PHOSPHATE:	41000 kg	AMMONIUM CARBONATE:	0 kg
SODIUM DICHROMATE:	0 kg		

TOTAL VOLUME DISPOSED: 4920000 Liters

RADIONUCLIDE INVENTORY
(in curies)

H-3:	390.00000	CE-144:	0.00000
C-14:	0.00000	PR-144:	0.00000
MN-54:	0.00000	PM-147:	0.00000
CO-60:	0.08990	EU-152:	0.00000
NI-63:	0.00000	EU-154:	0.00000
KR-85:	0.00000	EU-155:	0.00000
SR-90:	1290.00000	NP-237:	0.00000
Y-91:	0.00000	PU-238:	0.00000
NB-95:	0.00000	PU-239:	0.57100
ZR-95:	0.00000	PU-240:	0.15400
TC-99:	0.00000	PU-241:	0.00000
RU-103:	0.00000	AM-241:	0.00000
RU-106:	0.00000	U-233:	0.00000
SN-113:	0.00000	U-235:	0.00000
SB-125:	0.00000	U-238:	0.00228
I-129:	0.00000	TH-232:	0.00000
CS-134:	0.00000	BETA:	3980.00000
CS-137:	727.00000	GAMMA:	0.00000
CE-141:	0.00000	ALPHA:	0.00000

These values are decayed through April 1, 1986.

883-1726/9824

SITE ID NO.: 216-B-46

ALIAS: 216-BY-4 Cavern, 216-BY-4 Crib
STATUS: Inactive
DIMENSIONS:
Length: 75 ft
Width: 75 ft
Depth: 15 ft
Diameter: 0 ft

FACILITY: Crib
ELEVATION: 623 ft
WATERTABLE: 219 ft
HRS Migration Score: 62.920

LOCATION: 200 East
COORDINATES: N46587/W53355 (Center of crib)

SITE DESCRIPTION:

Four 4 ft. diameter x 4 ft. long concrete pipes placed vertically 7 ft. below grade, on a 5 ft. bed of 3 in. gravel (380 cu. yd.). Pipes are arranged in a square with the centers spaced 15 ft. apart in a 30 ft. x 30 ft. x 15 ft. deep excavation. Surface dimensions are 75 ft. x 75 ft. Each culvert is fed by an 8 in. steel pipe coming from main, forming a chevron pattern. Each culvert has a concrete cover.

SERVICE DATES: 1955-1955

SERVICE HISTORY:

From 9/55 to 12/55 the site received scavenged TBP supernatant waste from 221-U building. The site was retired in 12/55. The waste is high salt, neutral/basic.

REFERENCES:
Documents: ARH-2806, RHO-CD-673, HW-55176
Photographs: 122440-56-CN
Drawings: H-2-34761, H-3-57210

883-1726/9823

SITE ID NO.: 216-B-46

CHEMICALS DISPOSED

SODIUM:	500000 kg	FERROCYANIDE:	4000 kg
POTASSIUM:	0 kg	FLUORIDE:	0 kg
AMMONIUM NITRATE:	0 kg	SODIUM SILICATE:	0 kg
NITRITE:	0 kg	OXALATE:	0 kg
NITRIC ACID:	0 kg	SODIUM HYDROXIDE:	0 kg
NITRATE:	1200000 kg	SODIUM ALUMINATE:	0 kg
SULFURIC ACID:	0 kg	TRIBUTYL PHOSPHATE:	0 kg
SULFATE:	100000 kg	PARAFFIN HYDROCARBON:	0 kg
PHOSPHATE:	70000 kg	AMMONIUM CARBONATE:	0 kg
SODIUM DICHROMATE:	0 kg		

TOTAL VOLUME DISPOSED: 6700000 Liters

RADIONUCLIDE INVENTORY
(in curies)

H-3:	536.00000	CE-144:	0.00000
C-14:	0.00000	PR-144:	0.00000
MN-54:	0.00000	PM-147:	0.00000
CO-60:	0.08990	EU-152:	0.00000
NI-63:	0.00000	EU-154:	0.00000
KR-85:	0.00000	EU-155:	0.00000
SR-90:	692.00000	NP-237:	0.00000
Y-91:	0.00000	PU-238:	0.00000
NB-95:	0.00000	PU-239:	1.14000
ZR-95:	0.00000	PU-240:	0.30800
TC-99:	0.00000	PU-241:	0.00000
RU-103:	0.00000	AM-241:	0.00000
RU-106:	0.00001	U-233:	0.00000
SN-113:	0.00000	U-235:	0.00000
SB-125:	0.00000	U-238:	0.06360
I-129:	0.00000	TH-232:	0.00000
CS-134:	0.00000	BETA:	1580.00000
CS-137:	96.90000	GAMMA:	0.00000
CE-141:	0.00000	ALPHA:	0.00000

These values are decayed through April 1, 1986.

883-1726/9821

SITE ID NO.: 216-B-47

ALIAS: 216-BY-5 Cavern, 216-BY-5 Crib
STATUS: Inactive
DIMENSIONS:
Length: 75 ft
Width: 75 ft
Depth: 15 ft
Diameter: 0 ft

FACILITY: Crib
ELEVATION: 623 ft
WATERTABLE: 230 ft
HRS Migration Score: 1.307

LOCATION: 200 East
COORDINATES: N46332/W53499 (Center of crib)

SITE DESCRIPTION:

Four 4 ft. diameter x 4 ft. long concrete pipes placed vertically 7 ft. below grade, on a 5 ft. bed of 3 in. gravel (380 cu. yd.). Pipes are arranged in a square with the centers spaced 15 ft. apart in a 30 ft. x 30 ft. x 15 ft. deep excavation. Surface dimensions are 75 ft. x 75 ft. Each culvert is fed by an 8 in. steel pipe coming from main, forming a chevron pattern. Each culvert has a concrete cover.

SERVICE DATES: 1955-1955

SERVICE HISTORY:

From 9/55 to 9/55 the site received scavenged TBP supernatant waste from the 221-U Bldg. The site was retired in 9/55. The waste is high salt, neutral/basic.

REFERENCES:
Documents: ARH-2806, RHO-CD-673, HW-55176
Photographs: 122440-56-CN
Drawings: H-2-34761, H-3-57210

883-1726/9822

SITE ID NO.: 216-B-47

CHEMICALS DISPOSED

SODIUM:	310000 kg	FERROCYANIDE:	2000 kg
POTASSIUM:	0 kg	FLUORIDE:	0 kg
AMMONIUM NITRATE:	0 kg	SODIUM SILICATE:	0 kg
NITRITE:	0 kg	OXALATE:	0 kg
NITRIC ACID:	0 kg	SODIUM HYDROXIDE:	0 kg
NITRATE:	700000 kg	SODIUM ALUMINATE:	0 kg
SULFURIC ACID:	0 kg	TRIBUTYL PHOSPHATE:	0 kg
SULFATE:	60000 kg	PARAFFIN HYDROCARBON:	0 kg
PHOSPHATE:	40000 kg	AMMONIUM CARBONATE:	0 kg
SODIUM DICHROMATE:	0 kg		

TOTAL VOLUME DISPOSED: 3710000 Liters

RADIONUCLIDE INVENTORY
(in curies)

H-3:	0.00000	CE-144:	0.00000
C-14:	0.00000	PR-144:	0.00000
MN-54:	0.00000	PM-147:	0.00000
CO-60:	0.01789	EU-152:	0.00000
NI-63:	0.00000	EU-154:	0.00000
KR-85:	0.00000	EU-155:	0.00000
SR-90:	286.03017	NP-237:	0.00000
Y-91:	0.00000	PU-238:	0.00000
NB-95:	0.00000	PU-239:	0.28500
ZR-95:	0.00000	PU-240:	0.07660
TC-99:	0.00000	PU-241:	0.00000
RU-103:	0.00000	AM-241:	0.00000
RU-106:	0.00000	U-233:	0.00000
SN-113:	0.00000	U-235:	0.00000
SB-125:	0.00000	U-238:	0.00228
I-129:	0.00000	TH-232:	0.00000
CS-134:	0.00000	BETA:	720.20859
CS-137:	72.66759	GAMMA:	0.00000
CE-141:	0.00000	ALPHA:	0.00000

These values are decayed through April 1, 1986.

883-1726/9891

9011711023

SITE ID NO.: 216-8-48

ALIAS: 216-8Y-6 Cavern, 216-8Y-6 Crib
STATUS: Inactive
DIMENSIONS:
Length: 75 ft
Width: 75 ft
Depth: 15 ft
Diameter: 0 ft

FACILITY: Crib
ELEVATION: 623 ft
WATERTABLE: 225 ft
HRS Migration Score: 62.920

LOCATION: 200 East
COORDINATES: N46417/W53499 (Center of crib)

SITE DESCRIPTION:

Four 4 ft.diameter x 4 ft. long concrete pipes placed vertically 7 ft. below grade, ona 5 ft. bed of 3 in. gravel (380 cu. yd.). Pipes are arranged in a square with the centers spaced 15 ft. apart in a 30 ft. x 30 ft. x 15 ft. deep excavation. Surface dimensions are 75 ft. x 75 ft. Each culvert is fed by an 8 in. steel pipe coming from main, forming a chevron pattern. Each culvert has a concrete cover.

SERVICE DATES: 1955-1957

SERVICE HISTORY:

From 11/55 to 7/57 the site received scavenged TBP supernatant waste from the 221-U building. The site was retired in 7/57. The waste is high salt, neutral/basic.

REFERENCES:
Documents: ARH-2806, RHO-CD-673, HW-55176
Photographs: 122440-56-CN
Drawings: H-2-34761, H-3-57210

883-1726/9820

SITE ID NO.: 216-8-48

CHEMICALS DISPOSED

SODIUM:	400000 kg	FERROCYANIDE:	2200 kg
POTASSIUM:	0 kg	FLUORIDE:	0 kg
AMMONIUM NITRATE:	0 kg	SODIUM SILICATE:	0 kg
NITRITE:	0 kg	OXALATE:	0 kg
NITRIC ACID:	0 kg	SODIUM HYDROXIDE:	0 kg
NITRATE:	1000000 kg	SODIUM ALUMINATE:	0 kg
SULFURIC ACID:	0 kg	TRIBUTYL PHOSPHATE:	0 kg
SULFATE:	80000 kg	PARAFFIN HYDROCARBON:	0 kg
PHOSPHATE:	60000 kg	AMMONIUM CARBONATE:	0 kg
SODIUM DICHROMATE:	0 kg		

TOTAL VOLUME DISPOSED: 4090000 Liters

RADIONUCLIDE INVENTORY
(in curies)

H-3:	327.00000	CE-144:	0.00000
C-14:	0.00000	PR-144:	0.00000
MN-54:	0.00000	PM-147:	0.00000
CO-60:	0.01790	EU-152:	0.00000
NI-63:	0.00000	EU-154:	0.00000
KR-85:	0.00000	EU-155:	0.00000
SR-90:	600.00000	NP-237:	0.00000
Y-91:	0.00000	PU-238:	0.00000
NB-95:	0.00000	PU-239:	0.28500
ZR-95:	0.00000	PU-240:	0.07700
TC-99:	0.00000	PU-241:	0.00000
RU-103:	0.00000	AM-241:	0.00000
RU-106:	0.00000	U-233:	0.00000
SN-113:	0.00000	U-235:	0.00000
SB-125:	0.00000	U-238:	0.00076
I-129:	0.00000	TH-232:	0.00000
CS-134:	0.00000	BETA:	1630.00000
CS-137:	218.00000	GAMMA:	0.00000
CE-141:	0.00000	ALPHA:	0.00000

These values are decayed through April 1, 1986.

883-1726/9889

SITE ID NO.: 216-B-49

ALIAS: 216-BY-7 Cavern, 216-BY-7 Crib
STATUS: Inactive
DIMENSIONS:
Length: 75 ft
Width: 75 ft
Depth: 15 ft
Diameter: 0 ft

FACILITY: Crib
ELEVATION: 623 ft
WATERTABLE: 223 ft
HRS Migration Score: 62.920

LOCATION: 200 East
COORDINATES: N46502/W53499 (Center of crib)

SITE DESCRIPTION:

Four 4 ft. diameter x 4 ft. long concrete pipes palced vertically 7 ft. below grade, on a 5 ft. bed of 3 in. gravel (380 cu. yd.). Pipes are arranged in a square with the centers spaced 15 ft. apart in a 30 ft. x 30 ft. x 15 ft. deep excavation. Surface dimensions are 75 ft. x 75 ft. Each culvert is fed by an 8 in. steel pipe coming from main, forming a chevron pattern. Each culvert has a concrete cover.

SERVICE DATES: 1955-1955

SERVICE HISTORY:

From 11/55 to 12/55 the site received scavenged TBP supernatant waste from 221-U building. The site was retired in 12/55. The waste is high salt, neutral/basic.

REFERENCES:
Documents: ARH-2806, RHO-CD-673, HW-55176
Photographs: 122440-56-CN
Drawings: H-2-34761, H-3-57210

883-1726/9888

SITE ID NO.: 216-B-49

CHEMICALS DISPOSED

SODIUM:	600000 kg	FERROCYANIDE:	4000 kg
POTASSIUM:	0 kg	FLUORIDE:	0 kg
AMMONIUM NITRATE:	0 kg	SODIUM SILICATE:	0 kg
NITRITE:	0 kg	OXALATE:	0 kg
NITRIC ACID:	0 kg	SODIUM HYDROXIDE:	0 kg
NITRATE:	1500000 kg	SODIUM ALUMINATE:	0 kg
SULFURIC ACID:	0 kg	TRIBUTYL PHOSPHATE:	0 kg
SULFATE:	80000 kg	PARAFFIN HYDROCARBON:	0 kg
PHOSPHATE:	60000 kg	AMMONIUM CARBONATE:	0 kg
SODIUM DICHROMATE:	0 kg		

TOTAL VOLUME DISPOSED: 6700000 Liters

RADIONUCLIDE INVENTORY
(in curies)

H-3:	536.00000	CE-144:	0.00000
C-14:	0.00000	PR-144:	0.00000
MN-54:	0.00000	PM-147:	0.00000
CO-60:	0.08990	EU-152:	0.00000
NI-63:	0.00000	EU-154:	0.00000
KR-85:	0.00000	EU-155:	0.00000
SR-90:	1240.00000	NP-237:	0.00000
Y-91:	0.00000	PU-238:	0.00000
NB-95:	0.00000	PU-239:	0.85600
ZR-95:	0.00000	PU-240:	0.23100
TC-99:	0.00000	PU-241:	0.00000
RU-103:	0.00000	AM-241:	0.00000
RU-106:	0.00001	U-233:	0.00000
SN-113:	0.00000	U-235:	0.00000
SB-125:	0.00000	U-238:	0.10600
I-129:	0.00000	TH-232:	0.00000
CS-134:	0.00000	BETA:	2880.00000
CS-137:	198.00000	GAMMA:	0.00000
CE-141:	0.00000	ALPHA:	0.00000

These values are decayed through April 1, 1986.

883-1726/9887

SITE ID NO.: 216-B-50

ALIAS: 216-BY-8 Cavern, 216-BY-8 Crib
STATUS: Inactive
DIMENSIONS:
Length: 75 ft
Width: 75 ft
Depth: 15 ft
Diameter: 0 ft

FACILITY: Crib
ELEVATION: 621 ft
WATERTABLE: 223 ft
HRS Migration Score: 50.336

LOCATION: 200 East
COORDINATES: N46587/W53499 (Center of crib)

SITE DESCRIPTION:

Four 4 ft. diameter x 4 ft. long concrete pipes palced vertically 7 ft. below grade, on a 5 ft. bed of 3 in. gravel (380 cu. yd.). Pipes are arranged in a square with the centers spaced 15 ft. apart in a 30 ft. x 15 ft. deep excavation. Surface dimensions are 75 ft. x 75 ft. Each culvert is fed by an 8 in. steel pipe coming from main, forming a chevron pattern. Each culvert has a concrete cover.

SERVICE DATES: 1965-1974

SERVICE HISTORY:

From 1/65 to 1/74 the site received the waste storage tank condensate from the ITS #1 Unit in the 241-BY Tank Farm. The site was retired in 1/74.

REFERENCES:
Documents: ARH-2806, RHO-CD-673, HW-55176
Photographs: 122440-56-CN
Drawings: H-2-34761, H-3-57210

883-1726/9886

SITE ID NO.: 216-8-50

CHEMICALS DISPOSED

SODIUM:	500 kg	FERROCYANIDE:	0 kg
POTASSIUM:	0 kg	FLUORIDE:	0 kg
AMMONIUM NITRATE:	10000 kg	SODIUM SILICATE:	0 kg
NITRITE:	0 kg	OXALATE:	0 kg
NITRIC ACID:	0 kg	SODIUM HYDROXIDE:	0 kg
NITRATE:	1500 kg	SODIUM ALUMINATE:	0 kg
SULFURIC ACID:	0 kg	TRIBUTYL PHOSPHATE:	0 kg
SULFATE:	0 kg	PARAFFIN HYDROCARBON:	0 kg
PHOSPHATE:	0 kg	AMMONIUM CARBONATE:	9100 kg
SODIUM DICHROMATE:	0 kg		

TOTAL VOLUME DISPOSED: 54800000 Liters

RADIONUCLIDE INVENTORY
(in curies)

H-3:	90.00000	CE-144:	0.00000
C-14:	0.00000	PR-144:	0.00000
MN-54:	0.00000	PM-147:	0.00000
CO-60:	0.02830	EU-152:	0.00000
NI-63:	0.00000	EU-154:	0.00000
KR-85:	0.00000	EU-155:	0.00000
SR-90:	3.72000	NP-237:	0.00000
Y-91:	0.00000	PU-238:	0.00000
NB-95:	0.00000	PU-239:	0.01360
ZR-95:	0.00000	PU-240:	0.00368
TC-99:	0.00000	PU-241:	0.00000
RU-103:	0.00000	AM-241:	0.00000
RU-106:	0.00001	U-233:	0.00000
SN-113:	0.00000	U-235:	0.00000
SB-125:	0.00000	U-238:	0.00010
I-129:	0.00000	TH-232:	0.00000
CS-134:	0.00000	BETA:	114.00000
CS-137:	55.80000	GAMMA:	0.00000
CE-141:	0.00000	ALPHA:	0.00000

These values are decayed through April 1, 1986.

883-1726/9885

SITE ID NO.: 216-B-57

ALIAS: 216-B-57
STATUS: Inactive
DIMENSIONS:
Length: 200 ft
Width: 15 ft
Depth: 10 ft
Diameter: 0 ft

FACILITY: Crib
ELEVATION: 634 ft
WATERTABLE: 235 ft
HRS Migration Score: 50.336

LOCATION: 200 East
COORDINATES: N46160/W53775, N46360/W53775 (Center line of crib)

SITE DESCRIPTION:

Crib, 200 ft. x 15 ft. x 10 ft. deep, filled to 4 ft. above crib bottom with gravel (approximately 620 cu. yd.). A 12 in. corrugated perforated pipe runs the length of the crib 3 ft. above the bottom. Side slopes are 1.5:1.

SERVICE DATES: 1968-1973

SERVICE HISTORY:

From 2/68 to 6/73 the site received the waste storage tank condensate from the ITS #2 Unit in 241-BY Tank Farm. The site was retired in 6/73.

REFERENCES:
Documents: ARH-2806, RHO-CD-673, HW-55176
Photographs: 122440-57-CN
Drawings: H-2-34761, H-3-57210

883-1726/9884

SITE ID NO.: 216-8-57

CHEMICALS DISPOSED

SODIUM:	0 kg	FERROCYANIDE:	0 kg
POTASSIUM:	0 kg	FLUORIDE:	0 kg
AMMONIUM NITRATE:	0 kg	SODIUM SILICATE:	0 kg
NITRITE:	0 kg	OXALATE:	0 kg
NITRIC ACID:	0 kg	SODIUM HYDROXIDE:	0 kg
NITRATE:	0 kg	SODIUM ALUMINATE:	0 kg
SULFURIC ACID:	0 kg	TRIBUTYL PHOSPHATE:	0 kg
SULFATE:	0 kg	PARAFFIN HYDROCARBON:	0 kg
PHOSPHATE:	0 kg	AMMONIUM CARBONATE:	12000 kg
SODIUM DICHROMATE:	0 kg		

TOTAL VOLUME DISPOSED: 84400000 Liters

RADIONUCLIDE INVENTORY
(in curies)

H-3:	0.00000	CE-144:	0.00000
C-14:	0.00000	PR-144:	0.00000
MN-54:	0.00000	PM-147:	0.00000
CO-60:	0.01470	EU-152:	0.00000
NI-63:	0.00000	EU-154:	0.00000
KR-85:	0.00000	EU-155:	0.00000
SR-90:	2.01000	NP-237:	0.00000
Y-91:	0.00000	PU-238:	0.00000
NB-95:	0.00000	PU-239:	0.01061
ZR-95:	0.00000	PU-240:	0.00287
TC-99:	0.00000	PU-241:	0.00000
RU-103:	0.00000	AM-241:	0.00000
RU-106:	0.00006	U-233:	0.00000
SN-113:	0.00000	U-235:	0.00000
SB-125:	0.00000	U-238:	0.00029
I-129:	0.00000	TH-232:	0.00000
CS-134:	0.00000	BETA:	475.00000
CS-137:	246.00000	GAMMA:	0.00000
CE-141:	0.00000	ALPHA:	0.00000

These values are decayed through April 1, 1986.

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SITE ID NO.: UPR-200-E-9
(Current designation UN-200-E-9)

DIMENSIONS:
Length:
Width:
Depth:
Area:

ELEVATION:
WATERTABLE:

LOCATION: 200 East
COORDINATES:

HRS Migration Score: ENS

DESCRIPTION OF RELEASE:

The 216-BY-5 flush tank leaked supernatant waste from the TBP Building to the ground.

DATE OF OCCURRENCE: September 15, 1955

DESCRIPTION OF WASTE:

Approximately 11,000 gallons of supernatant waste from the TBP Bldg.

EXTENT OF CONTAMINATION:

An area directly north of the 216-BY cribs flush tank.

REMEDIAL ACTION:

Most of the waste was removed to a site south of 261-BY-1 crib and covered with 2 ft. of clean soil. The contamination left near the flush tank was covered with 10 ft. of clean soil.

REFERENCES:
Documents: HW-60807
Photographs:
Drawings:

883-1726/12668

SITE ID NO.: UPR-200-E-110
(Current designation UN-200-E-110)

DIMENSIONS:
Length:
Width:
Depth:
Area:

ELEVATION: 634 feet
WATERTABLE: 235 feet

LOCATION: 200 East
COORDINATES: N46045/E53425

HRS Migration Score: 1.143

DESCRIPTION OF RELEASE:

Several employees potentially overexposed as a result of the approaching of an undiscovered spread of process waste at the 241-BY tank farm.

DATE OF OCCURRENCE: August 7, 1955

DESCRIPTION OF WASTE:

First cycle waste from 112 tank.

EXTENT OF CONTAMINATION:

A crescent shaped ground area of approximately 25000 square feet around the 112-BY pit contaminated to 22 rads/hr. A firehose and 2 workers' gloves received contamination.

REMEDIAL ACTION:

Unknown.

REFERENCES:
Documents: HW-39007
Photographs:
Drawings:

9011710103

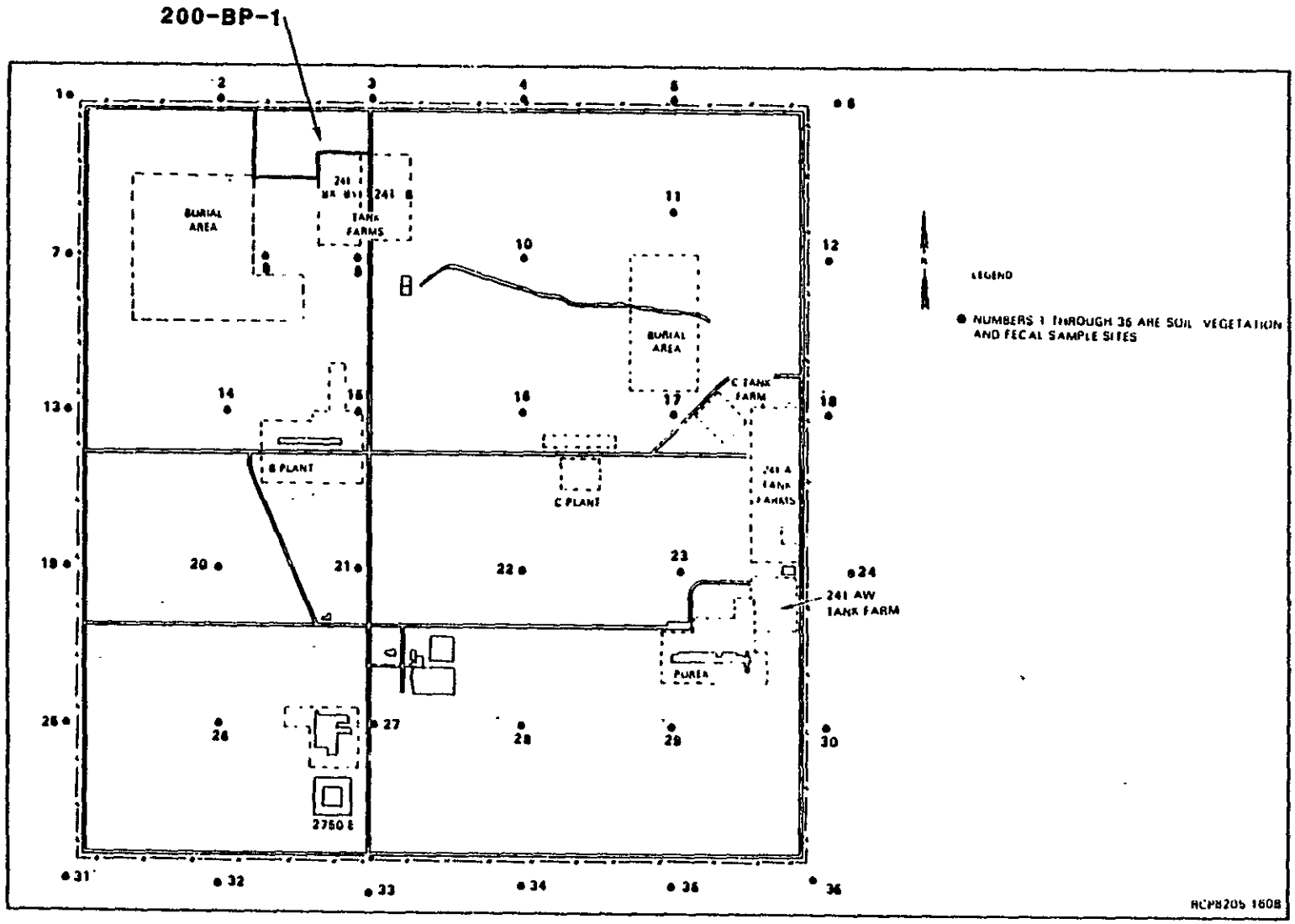
883-1726/12666

APPENDIX B

SURFACE SOIL MONITORING RESULTS

(Elder, R.E., G.W. Egert, A.R. Johnson, and W.L. Osborne, 1988. Westinghouse Hanford Company Environmental Surveillance Annual Report 200/600 Areas, WHC-EP-0145, prepared by Westinghouse Hanford Company, Richland, WA, for U.S. Department of Energy.)

9 0 1 1 7 1 1 0 3 4



Reference: Elder et al, 1988

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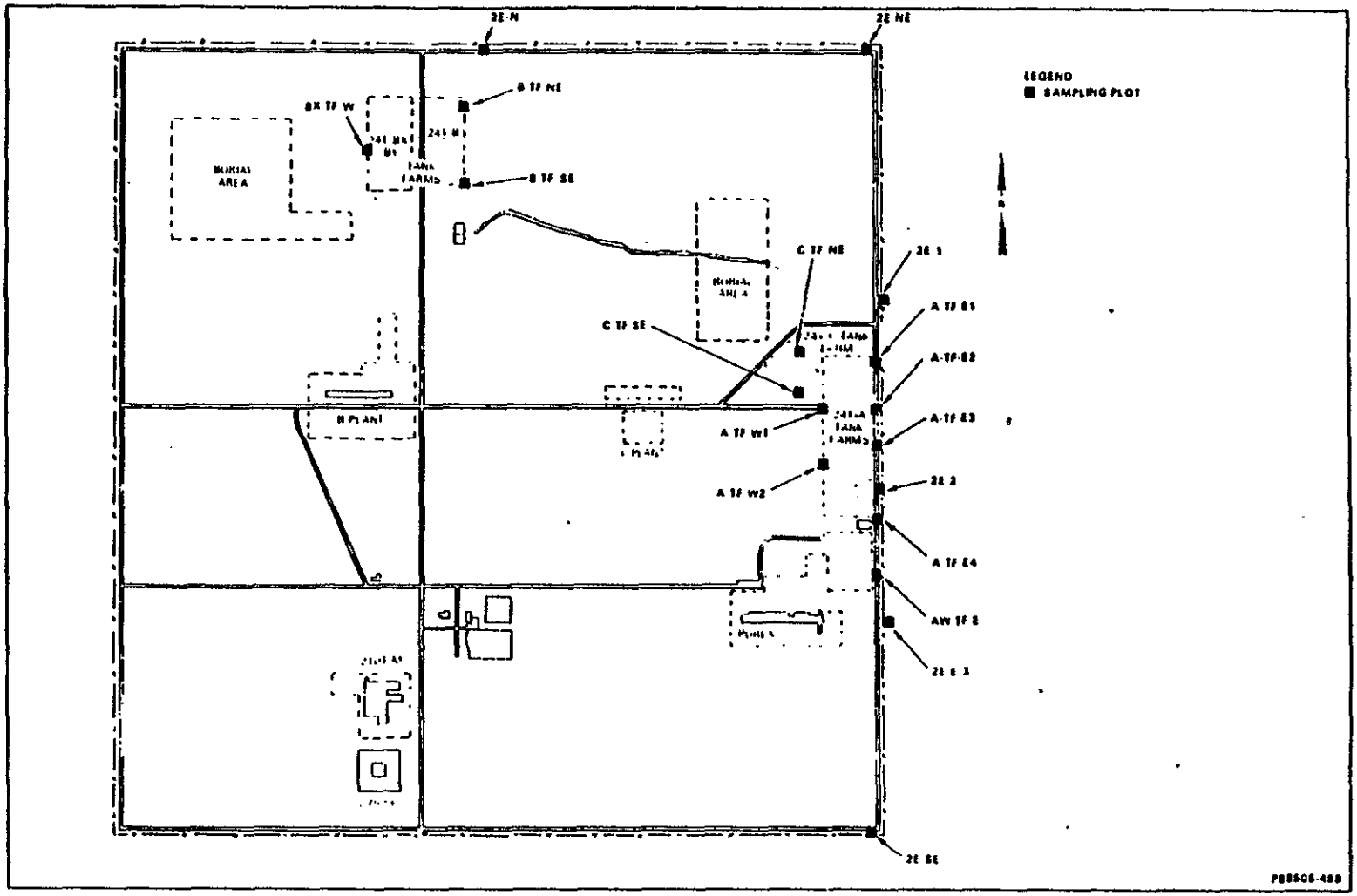
Figure B-1. The 200 East Area Grid Sampling Sites



Reference: Elder et al, 1988

883-1726/9881

Figure B-2. Fenceline Soil Sampling Plots in the 200 East Area

Location	Mn-54 ± Error	Co-58 ± Error	Co-60 ± Error	Zn-65 ± Error	Sr-90 ± Error	Zr-95 ± Error	Tc-99 ± Error
2E 1	< 8.6E-3 ± 1.5E-2	< 3.4E-3 ± 1.5E-2	< -8.0E-3 ± 1.6E-2	< 1.4E-2 ± 3.1E-2	2.4E-1 ± 6.1E-2	< -9.0E-3 ± 3.3E-2	a
2E 3	1.9E-2 ± 1.7E-2	< 1.2E-2 ± 1.7E-2	< 3.0E-3 ± 1.5E-2	< -3.6E-2 ± 4.6E-2	7.8E-1 ± 2.0E-1	< -2.3E-3 ± 3.6E-2	a
2E 4	< 1.3E-2 ± 2.1E-2	< 1.2E-2 ± 2.0E-2	< -2.5E-2 ± 2.4E-2	< 1.6E-2 ± 4.8E-2	9.3E-1 ± 2.3E-1	< 1.1E-2 ± 4.0E-2	< -4.1E-1 ± 9.6E-1
2E 4B	< -3.9E-3 ± 2.3E-2	< -2.7E-2 ± 2.5E-2	< -5.0E-3 ± 2.3E-2	< -8.8E-3 ± 5.4E-2	5.9E-1 ± 1.5E-1	< 3.6E-2 ± 4.4E-2	< 4.2E-1 ± 1.1E+0
2E 8	2.3E-2 ± 1.5E-2	< -8.7E-3 ± 1.6E-2	< 1.2E-2 ± 1.7E-2	< -2.4E-2 ± 3.8E-2	4.0E-1 ± 9.9E-2	< 2.0E-2 ± 2.9E-2	< 4.7E-1 ± 1.1E+0
2E10	< 6.4E-3 ± 1.9E-2	< -1.0E-2 ± 1.9E-2	< 0.0E+0 ± 1.5E-2	< 2.9E-2 ± 4.3E-2	2.3E+0 ± 5.7E-1	3.7E-2 ± 3.2E-2	a
2E12	2.2E-2 ± 1.5E-2	< -6.4E-3 ± 1.8E-2	< -2.6E-3 ± 2.0E-2	< -3.2E-2 ± 4.7E-2	4.1E-1 ± 1.0E-1	5.0E-2 ± 2.9E-2	a
2E14	< 1.3E-2 ± 1.5E-2	< 1.6E-3 ± 1.4E-2	1.9E-2 ± 1.6E-2	< -9.6E-3 ± 3.7E-2	5.0E-1 ± 1.2E-1	< 8.1E-3 ± 3.3E-2	< 4.0E-1 ± 1.1E+0
2E14B	< -6.0E-3 ± 2.0E-2	< 1.5E-2 ± 1.8E-2	< -3.1E-3 ± 1.6E-2	< -7.8E-2 ± 5.2E-2	5.1E-1 ± 1.3E-1	< 2.6E-2 ± 3.7E-2	< -4.2E-2 ± 9.8E-1
2E16	2.6E-2 ± 1.5E-2	< -1.7E-2 ± 2.0E-2	< 9.9E-3 ± 1.6E-2	< -2.2E-2 ± 4.5E-2	1.7E+0 ± 4.1E-1	< 2.4E-2 ± 3.6E-2	a
2E17	< 1.9E-3 ± 1.9E-2	2.3E-2 ± 1.4E-2	< -1.2E-2 ± 1.9E-2	< -9.6E-2 ± 5.4E-2	5.2E+0 ± 1.3E+0	< 1.1E-2 ± 3.6E-2	a
2E18	3.1E-2 ± 1.5E-2	< 1.4E-3 ± 1.6E-2	< 1.0E-2 ± 1.4E-2	< 3.2E-2 ± 3.6E-2	1.2E+0 ± 3.0E-1	< -4.8E-4 ± 3.1E-2	a
2E19	< -1.4E-2 ± 1.7E-2	< -2.1E-2 ± 1.7E-2	1.5E-2 ± 1.4E-2	< 2.2E-3 ± 3.5E-2	1.9E-1 ± 4.9E-2	3.7E-2 ± 2.7E-2	a
2E21	3.0E-2 ± 1.4E-2	< 7.4E-3 ± 1.6E-2	< -9.1E-4 ± 1.7E-2	< 2.6E-2 ± 3.7E-2	2.0E-1 ± 5.2E-2	6.9E-2 ± 2.9E-2	< 4.6E-1 ± 1.1E+0
2E23	< 1.7E-3 ± 2.1E-2	< -2.7E-3 ± 1.9E-2	2.9E-2 ± 2.0E-2	< -6.1E-2 ± 5.7E-2	1.6E+0 ± 3.9E-1	< 3.2E-2 ± 3.7E-2	a
2E24	< -3.8E-3 ± 1.4E-2	< -8.1E-3 ± 1.6E-2	< 9.0E-3 ± 1.1E-2	< -2.2E-2 ± 4.0E-2	1.2E+0 ± 3.0E-1	4.1E-2 ± 2.7E-2	< 7.6E-3 ± 7.7E-1
2E26	< 1.0E-2 ± 1.8E-2	< 1.3E-3 ± 1.7E-2	< -1.1E-2 ± 2.1E-2	< 1.5E-3 ± 3.8E-2	2.1E-1 ± 5.3E-2	< -5.7E-4 ± 3.4E-2	a
2E28	< -2.0E-2 ± 1.8E-2	< -1.2E-3 ± 1.5E-2	< 3.6E-3 ± 1.6E-2	< -1.4E-3 ± 3.2E-2	2.3E-1 ± 5.8E-2	< 2.9E-2 ± 3.0E-2	a
2E28B	< -1.6E-2 ± 1.8E-2	< -1.5E-3 ± 1.6E-2	< 4.8E-3 ± 1.8E-2	< 1.6E-2 ± 3.8E-2	2.3E-1 ± 5.8E-2	< 1.6E-2 ± 2.8E-2	a
2E30	< -1.3E-2 ± 1.8E-2	< -7.3E-3 ± 1.5E-2	< 5.0E-3 ± 1.7E-2	< 6.2E-3 ± 3.3E-2	2.0E-1 ± 5.0E-2	< 3.5E-3 ± 3.1E-2	a
2E32	2.1E-2 ± 1.6E-2	< -9.0E-3 ± 1.6E-2	< -2.0E-2 ± 2.0E-2	< -2.4E-2 ± 4.3E-2	1.2E-1 ± 3.1E-2	< -3.6E-2 ± 3.6E-2	a
2E34	< 8.3E-3 ± 1.7E-2	< 5.6E-3 ± 1.6E-2	< -1.9E-2 ± 1.9E-2	< -4.6E-2 ± 4.7E-2	5.6E-1 ± 1.4E-1	< 1.5E-2 ± 3.5E-2	a
2E35	1.9E-2 ± 1.4E-2	< 7.7E-3 ± 1.6E-2	< 3.1E-3 ± 1.2E-2	< 4.9E-3 ± 3.5E-2	4.8E-1 ± 1.2E-1	< 2.3E-2 ± 3.0E-2	a
2EA	1.9E-2 ± 1.4E-2	< 8.4E-3 ± 1.6E-2	< -1.1E-3 ± 1.6E-2	< -1.1E-2 ± 3.9E-2	1.5E-1 ± 3.9E-2	< 1.4E-2 ± 2.8E-2	a
2EB	< 7.8E-3 ± 1.6E-2	< -8.6E-3 ± 1.8E-2	< 1.1E-2 ± 1.5E-2	< -1.1E-2 ± 4.0E-2	2.6E-1 ± 6.6E-2	4.9E-2 ± 3.1E-2	a
2EC	< -6.1E-4 ± 1.8E-2	< -9.3E-3 ± 1.9E-2	< -1.8E-3 ± 1.7E-2	< -2.7E-2 ± 4.5E-2	3.8E-1 ± 9.5E-2	3.9E-2 ± 3.3E-2	a
2ED	1.8E-2 ± 1.5E-2	< 8.7E-3 ± 1.7E-2	2.5E-2 ± 1.5E-2	4.6E-2 ± 3.8E-2	7.0E-1 ± 1.7E-1	< 2.2E-2 ± 3.4E-2	< 2.2E-2 ± 9.8E-1
2EDB	1.7E-2 ± 1.6E-2	< 7.6E-3 ± 1.3E-2	< 8.4E-3 ± 1.6E-2	< 4.0E-3 ± 3.6E-2	6.6E-1 ± 1.6E-1	< -2.0E-3 ± 3.2E-2	< 5.2E-1 ± 1.1E+0
GRT1	3.9E-2 ± 1.6E-2	< -1.4E-2 ± 1.8E-2	< -2.3E-2 ± 2.0E-2	4.8E-2 ± 3.9E-2	4.4E-1 ± 1.1E-1	4.1E-2 ± 3.7E-2	< 5.2E-1 ± 8.6E-1
GRT2	< 1.1E-2 ± 1.7E-2	< -7.1E-3 ± 1.8E-2	1.8E-2 ± 1.7E-2	8.2E-2 ± 3.9E-2	3.9E-1 ± 1.0E-1	< -3.1E-2 ± 4.1E-2	< 5.3E-1 ± 1.1E+0
GRT4	2.3E-2 ± 1.7E-2	< -3.1E-3 ± 1.8E-2	< -2.3E-2 ± 2.0E-2	< 1.8E-3 ± 4.0E-2	3.4E-1 ± 8.5E-2	< 1.8E-2 ± 3.2E-2	< 2.4E-1 ± 8.5E-1
GRT5	< 1.3E-2 ± 1.5E-2	< 9.2E-4 ± 1.7E-2	< 1.2E-3 ± 1.7E-2	< 8.4E-3 ± 4.1E-2	2.2E-1 ± 5.5E-2	< 2.1E-3 ± 3.3E-2	< 2.7E-1 ± 8.5E-1
GRT6	< -7.1E-3 ± 2.0E-2	< 8.8E-3 ± 1.8E-2	< -2.5E-3 ± 2.1E-2	< 2.3E-2 ± 4.2E-2	4.1E-1 ± 1.0E-1	< 3.2E-2 ± 3.7E-2	< 2.5E-1 ± 8.5E-1
Maximum	3.9E-2	2.3E-2	2.9E-2	8.2E-2	5.2E+0	6.9E-2	5.3E-1
Minimum	-2.0E-2	-2.7E-2	-2.5E-2	-9.6E-2	1.2E-1	-3.6E-2	-4.1E-1
Mean	9.5E-3	-1.1E-3	8.6E-4	-4.4E-3	7.2E-1	1.9E-2	2.6E-1
Background (b)					1.5E-1		
Soil standards (c)			3.0E+2		4.0E+2		2.0E+3

Reference: Elder et al, 1988

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Figure B-3. Grid Site Soil Results for 200 East Area for 1987 (pCi/g dry weight)

Location	Ru-106 ± Error	I-129 ± Error	Cs-134 ± Error	Cs-137 ± Error	Ce-141 ± Error	Ce-144 ± Error	Eu-152 ± Error
2E 1	< 2.0E-2 ± 1.3E-1	a	3.7E-2 ± 1.9E-2	1.7E+0 ± 1.8E-1	< -9.4E-3 ± 3.0E-2	< -1.3E-2 ± 9.0E-2	1.0E-1 ± 6.0E-2
2E 3	< 1.5E-1 ± 2.0E-1	a	4.8E-2 ± 2.1E-2	1.3E+1 ± 1.3E+0	< -1.2E-3 ± 4.8E-2	< -5.1E-2 ± 1.5E-1	< 4.8E-2 ± 6.9E-2
2E 4	< -3.6E-2 ± 2.4E-1	< -4.3E-1 ± 7.2E-1	< 2.3E-2 ± 2.7E-2	1.8E+1 ± 1.8E+0	< -5.5E-2 ± 6.5E-2	< -2.4E-1 ± 2.2E-1	< 4.8E-2 ± 9.6E-2
2E 4B	< 1.6E-1 ± 3.4E-1	< -4.0E-1 ± 6.1E-1	4.8E-2 ± 2.9E-2	1.6E+1 ± 1.6E+0	< -8.2E-3 ± 7.8E-2	< -2.2E-1 ± 2.6E-1	< -5.9E-2 ± 1.3E-1
2E 8	< 8.2E-2 ± 1.5E-1	< -2.6E-1 ± 4.2E-1	4.9E-2 ± 2.0E-2	3.8E+0 ± 3.9E-1	< -9.0E-3 ± 3.1E-2	< -9.3E-3 ± 1.0E-1	8.9E-2 ± 7.2E-2
2E10	< -8.3E-2 ± 2.8E-1	a	4.6E-2 ± 2.1E-2	3.1E+1 ± 3.1E+0	< -4.1E-2 ± 6.2E-2	< 3.2E-2 ± 2.1E-1	1.2E-1 ± 7.1E-2
2E12	< 2.1E-2 ± 1.3E-1	a	4.5E-2 ± 2.0E-2	1.5E-1 ± 3.0E-2	< -4.4E-3 ± 3.5E-2	< -7.0E-3 ± 9.7E-2	1.1E-1 ± 8.8E-2
2E14	< -9.8E-2 ± 1.5E-1	< 2.9E-1 ± 3.2E-1	4.5E-2 ± 2.0E-2	2.9E+0 ± 3.0E-1	< 9.5E-3 ± 3.4E-2	< -4.7E-2 ± 1.2E-1	< -4.5E-2 ± 8.9E-2
2E14B	< -4.1E-2 ± 2.0E-1	4.6E-1 ± 2.9E-1	4.5E-2 ± 2.4E-2	2.9E+0 ± 3.0E-1	< -6.3E-3 ± 4.7E-2	< -6.4E-2 ± 1.6E-1	< 1.3E-2 ± 9.0E-2
2E16	2.3E-1 ± 1.3E-1	a	< 1.9E-2 ± 2.2E-2	4.3E+0 ± 4.4E-1	< 6.7E-3 ± 3.6E-2	< 1.0E-2 ± 1.2E-1	< 8.0E-2 ± 8.2E-2
2E17	2.6E-1 ± 1.7E-1	a	3.7E-2 ± 2.1E-2	5.7E+0 ± 5.9E-1	4.1E-2 ± 3.8E-2	< -8.4E-2 ± 1.3E-1	< -5.5E-2 ± 9.8E-2
2E18	< -4.6E-2 ± 1.6E-1	a	3.2E-2 ± 1.9E-2	4.6E+0 ± 4.7E-1	< -2.4E-2 ± 3.9E-2	< -2.6E-2 ± 1.1E-1	7.6E-2 ± 6.6E-2
2E19	< -9.2E-2 ± 1.3E-1	a	4.2E-2 ± 2.0E-2	7.3E-1 ± 8.3E-2	< -1.8E-2 ± 3.2E-2	1.4E-1 ± 9.6E-2	9.3E-2 ± 6.3E-2
2E21	< -2.4E-3 ± 1.6E-1	< -9.1E-2 ± 5.1E-1	3.1E-2 ± 2.2E-2	6.4E-1 ± 7.8E-2	< -4.7E-2 ± 4.0E-2	< 1.5E-2 ± 1.3E-1	1.0E-1 ± 7.9E-2
2E23	< 1.4E-1 ± 2.4E-1	a	< 1.7E-2 ± 2.6E-2	1.1E+1 ± 1.1E+0	< 2.0E-2 ± 5.1E-2	< -1.1E-1 ± 1.8E-1	< 6.9E-2 ± 8.6E-2
2E24	< 1.5E-1 ± 1.6E-1	< -3.2E-1 ± 3.7E-1	3.5E-2 ± 1.9E-2	6.8E+0 ± 6.9E-1	< 2.2E-2 ± 3.6E-2	< -5.0E-2 ± 1.2E-1	1.0E-1 ± 6.5E-2
2E26	< 1.3E-1 ± 1.3E-1	a	5.0E-2 ± 2.3E-2	6.8E-1 ± 8.2E-2	< -1.1E-2 ± 3.5E-2	< -5.7E-3 ± 1.2E-1	< -5.1E-2 ± 1.0E-1
2E28	< 8.7E-2 ± 1.4E-1	a	3.2E-2 ± 2.0E-2	6.0E-1 ± 7.3E-2	< -1.6E-2 ± 3.0E-2	< 2.4E-2 ± 9.3E-2	< -3.8E-2 ± 9.2E-2
2E28B	< 1.1E-1 ± 1.3E-1	a	4.5E-2 ± 1.9E-2	4.0E-1 ± 5.1E-2	< 9.4E-3 ± 2.8E-2	< -3.2E-2 ± 9.2E-2	1.6E-1 ± 6.8E-2
2E30	5.0E-1 ± 1.7E-1	a	4.7E-2 ± 1.8E-2	2.2E-1 ± 3.3E-2	< -1.9E-2 ± 2.8E-2	< 2.4E-2 ± 9.6E-2	< 5.7E-2 ± 6.2E-2
2E32	< -4.6E-2 ± 1.3E-1	a	3.4E-2 ± 2.0E-2	4.7E-1 ± 5.9E-2	< 2.5E-2 ± 3.2E-2	< 1.4E-2 ± 1.0E-1	9.1E-2 ± 7.2E-2
2E34	< 2.4E-2 ± 1.4E-1	a	4.8E-2 ± 2.2E-2	2.2E-1 ± 4.1E-2	< -6.7E-3 ± 3.6E-2	< 7.6E-3 ± 1.1E-1	1.3E-1 ± 7.6E-2
2E35	< -4.7E-2 ± 1.3E-1	a	4.4E-2 ± 1.7E-2	6.1E-1 ± 7.2E-2	< -2.0E-2 ± 3.1E-2	< -1.1E-2 ± 8.6E-2	< -1.7E-2 ± 8.3E-2
2EA	< 7.4E-2 ± 1.2E-1	a	4.0E-2 ± 1.9E-2	3.8E-1 ± 4.8E-2	< -2.4E-3 ± 2.6E-2	< 3.9E-2 ± 8.6E-2	8.4E-2 ± 6.4E-2
2EB	< -1.1E-1 ± 1.3E-1	a	4.2E-2 ± 2.0E-2	1.0E+0 ± 1.1E-1	< 2.2E-2 ± 3.1E-2	1.1E-1 ± 1.0E-1	1.3E-1 ± 6.4E-2
2EC	< -1.2E-1 ± 1.5E-1	a	5.0E-2 ± 2.1E-2	8.3E-1 ± 9.6E-2	< 4.1E-3 ± 3.6E-2	< 8.5E-3 ± 1.2E-1	1.8E-1 ± 7.4E-2
2ED	< 2.7E-2 ± 1.5E-1	5.6E-1 ± 3.2E-1	4.3E-2 ± 2.2E-2	2.8E+0 ± 2.9E-1	3.8E-2 ± 3.3E-2	< -1.5E-2 ± 1.1E-1	< 5.5E-2 ± 7.8E-2
2EDB	< 1.0E-1 ± 1.3E-1	< 1.0E-1 ± 3.4E-1	6.6E-2 ± 2.1E-2	2.8E+0 ± 2.9E-1	< 1.9E-2 ± 3.1E-2	< 9.2E-3 ± 1.1E-1	1.5E-1 ± 6.8E-2
GRT1	< -1.8E-1 ± 1.7E-1	< -1.4E-1 ± 3.4E-1	3.9E-2 ± 2.2E-2	1.8E+0 ± 1.9E-1	< -1.5E-2 ± 3.5E-2	< -9.3E-2 ± 1.2E-1	1.3E-1 ± 8.1E-2
GRT2	< 1.2E-1 ± 1.6E-1	< 1.8E-1 ± 3.3E-1	3.2E-2 ± 2.4E-2	2.3E+0 ± 2.4E-1	< -1.5E-2 ± 4.4E-2	< -2.3E-2 ± 1.4E-1	9.2E-2 ± 8.6E-2
GRT4	< -2.7E-3 ± 1.8E-1	< -1.1E+0 ± 6.5E-1	6.5E-2 ± 2.4E-2	1.3E+0 ± 1.4E-1	< -3.4E-2 ± 4.4E-2	< -2.3E-2 ± 1.3E-1	1.1E-1 ± 7.4E-2
GRT5	< -2.0E-1 ± 1.5E-1	3.6E-1 ± 3.0E-1	6.3E-2 ± 2.0E-2	1.2E+0 ± 1.3E-1	< -7.2E-3 ± 3.1E-2	< -6.0E-2 ± 1.0E-1	9.3E-2 ± 7.2E-2
GRT6	< -1.3E-2 ± 1.5E-1	3.9E-1 ± 2.9E-1	3.8E-2 ± 2.3E-2	2.3E+0 ± 2.5E-1	< -3.6E-3 ± 3.9E-2	< -2.9E-2 ± 1.3E-1	< 4.6E-2 ± 8.3E-2
Maximum	5.0E-1	5.6E-1	6.6E-2	3.1E+1	4.1E-2	1.4E-1	1.8E-1
Minimum	-2.0E-1	-1.1E+0	1.7E-2	1.5E-1	-5.5E-2	-2.4E-1	-5.9E-2
Mean	3.8E-2	-2.5E-2	4.2E-2	4.3E+0	-4.8E-3	-2.4E-2	6.9E-2
Background (b)				6.0E-1			
Soil standards (c)		2.0E+3		4.0E+2			8.0E+2

Reference: Elder et al, 1988

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Figure B-3 (cont.). Grid Site Soil Results for 200 East Area for 1987 (pCi/g dry weight)

Location	Eu-154 ± Error	Eu-155 ± Error	Pu-238 ± Error	Pu-239 ± Error	U-Total ± Error
2E 1	< -4.1E-2 ± 5.0E-2	< 2.4E-2 ± 4.9E-2	4.7E-4 ± 2.7E-4	2.6E-2 ± 3.2E-3	1.8E-1 ± 5.5E-2
2E 3	< 3.2E-2 ± 4.7E-2	< 7.4E-2 ± 8.2E-2	8.0E-4 ± 4.2E-4	2.3E-2 ± 3.0E-3	2.3E-1 ± 7.1E-2
2E 4	< 4.4E-2 ± 6.8E-2	< -2.2E-2 ± 1.2E-1	5.1E-4 ± 3.7E-4	3.6E-2 ± 4.3E-3	3.2E-1 ± 9.2E-2
2E 4B	< -3.9E-2 ± 7.1E-2	< 8.3E-2 ± 1.4E-1	8.2E-4 ± 6.9E-4	3.5E-2 ± 5.7E-3	2.4E-1 ± 7.2E-2
2E 8	< -4.4E-2 ± 5.7E-2	6.1E-2 ± 5.6E-2	6.8E-4 ± 3.1E-4	2.4E-2 ± 3.0E-3	2.7E-1 ± 8.1E-2
2E10	< -6.2E-2 ± 6.4E-2	< 1.0E-2 ± 1.1E-1	5.4E-4 ± 5.3E-4	4.3E-2 ± 5.8E-3	2.1E-1 ± 6.4E-2
2E12	< 4.6E-2 ± 5.0E-2	7.0E-2 ± 5.4E-2	4.5E-4 ± 2.5E-4	7.4E-3 ± 1.2E-3	1.3E-1 ± 4.3E-2
2E14	< -8.1E-2 ± 6.4E-2	< 4.6E-2 ± 6.8E-2	4.0E-4 ± 2.6E-4	1.3E-2 ± 1.8E-3	2.0E-1 ± 6.2E-2
2E14B	< 4.4E-2 ± 6.2E-2	1.4E-1 ± 8.7E-2	7.5E-4 ± 3.4E-4	1.6E-2 ± 2.2E-3	1.8E-1 ± 5.8E-2
2E16	< 3.3E-2 ± 5.2E-2	< -3.0E-2 ± 5.5E-2	1.2E-3 ± 3.9E-4	1.2E-1 ± 1.2E-2	3.1E-1 ± 9.0E-2
2E17	< 4.4E-2 ± 5.4E-2	< -2.8E-2 ± 7.5E-2	4.6E-4 ± 3.9E-4	1.7E-2 ± 2.8E-3	1.6E-1 ± 5.2E-2
2E18	7.1E-2 ± 4.2E-2	< 3.9E-3 ± 6.1E-2	< 2.1E-5 ± 1.1E-4	6.8E-3 ± 1.2E-3	2.6E-1 ± 7.7E-2
2E19	< -2.4E-2 ± 5.7E-2	< 3.0E-2 ± 5.9E-2	4.3E-4 ± 2.7E-4	2.0E-2 ± 2.7E-3	1.4E-1 ± 4.5E-2
2E21	< 3.4E-2 ± 4.4E-2	8.4E-2 ± 7.5E-2	4.1E-4 ± 2.5E-4	2.3E-2 ± 2.8E-3	2.1E-1 ± 6.4E-2
2E23	< 4.8E-2 ± 6.8E-2	1.5E-1 ± 1.0E-1	1.5E-1 ± 1.5E-2	3.9E-2 ± 4.7E-3	2.9E-1 ± 8.7E-2
2E24	< -3.9E-2 ± 5.2E-2	< -1.3E-2 ± 6.9E-2	4.1E-4 ± 3.3E-4	2.5E-2 ± 3.2E-3	2.1E-1 ± 6.4E-2
2E26	< 3.2E-2 ± 5.4E-2	< 4.6E-2 ± 7.0E-2	4.6E-4 ± 2.5E-4	1.5E-2 ± 2.0E-3	1.7E-1 ± 5.4E-2
2E28	< 3.9E-2 ± 5.0E-2	< 2.2E-2 ± 4.4E-2	< 8.6E-5 ± 1.3E-4	2.1E-2 ± 2.6E-3	3.0E-1 ± 9.0E-2
2E28B	< -5.4E-2 ± 5.9E-2	< 5.0E-2 ± 5.1E-2	4.6E-4 ± 2.5E-4	1.3E-2 ± 1.7E-3	3.5E-1 ± 1.0E-1
2E30	< 4.3E-2 ± 4.9E-2	< 3.8E-2 ± 5.5E-2	5.9E-4 ± 2.7E-4	1.7E-2 ± 2.1E-3	5.1E-2 ± 2.3E-2
2E32	< -2.5E-2 ± 6.0E-2	< 5.6E-2 ± 6.1E-2	< -2.6E-5 ± 7.2E-5	2.7E-3 ± 6.0E-4	1.3E-1 ± 4.4E-2
2E34	< 4.2E-2 ± 5.6E-2	< 1.7E-2 ± 6.0E-2	2.8E-4 ± 2.1E-4	8.8E-3 ± 1.4E-3	2.9E-1 ± 8.5E-2
2E35	< -2.5E-2 ± 5.0E-2	5.7E-2 ± 4.6E-2	2.5E-4 ± 1.8E-4	1.0E-2 ± 1.4E-3	2.3E-1 ± 6.8E-2
2EA	< 3.0E-2 ± 4.9E-2	< -1.2E-2 ± 5.0E-2	< 9.0E-5 ± 1.3E-4	7.2E-3 ± 1.1E-3	2.0E-1 ± 6.0E-2
2EB	< 4.1E-2 ± 5.1E-2	< 7.5E-3 ± 6.2E-2	2.8E-4 ± 2.0E-4	2.0E-2 ± 2.5E-3	1.7E-1 ± 5.3E-2
2EC	< 1.2E-3 ± 5.3E-2	1.3E-1 ± 6.9E-2	< 1.4E-4 ± 1.6E-4	2.0E-2 ± 2.5E-3	2.3E-1 ± 7.1E-2
2ED	8.4E-2 ± 4.7E-2	< 6.0E-2 ± 6.2E-2	6.5E-4 ± 2.9E-4	4.5E-2 ± 5.1E-3	3.4E-1 ± 9.8E-2
2EDB	< -3.9E-2 ± 6.1E-2	5.8E-2 ± 5.5E-2	5.0E-4 ± 2.4E-4	4.0E-2 ± 4.4E-3	3.7E-1 ± 1.1E-1
GRT1	< -4.6E-2 ± 6.0E-2	< 4.0E-2 ± 5.9E-2	3.9E-4 ± 2.5E-4	1.7E-2 ± 2.2E-3	2.2E-1 ± 6.9E-2
GRT2	< 2.3E-2 ± 5.7E-2	< -6.7E-3 ± 8.4E-2	7.7E-4 ± 2.9E-4	7.1E-2 ± 7.5E-3	3.2E-1 ± 9.4E-2
GRT4	< -1.5E-2 ± 6.3E-2	< 7.5E-2 ± 7.6E-2	3.4E-4 ± 1.9E-4	1.6E-2 ± 1.9E-3	3.1E-1 ± 9.1E-2
GRT5	< 2.1E-2 ± 5.9E-2	< 2.4E-2 ± 5.6E-2	2.6E-4 ± 1.8E-4	6.9E-3 ± 1.0E-3	3.5E-1 ± 1.0E-1
GRT6	< 4.4E-2 ± 5.7E-2	< 5.6E-2 ± 7.3E-2	8.5E-4 ± 3.5E-4	1.6E-2 ± 2.2E-3	3.5E-1 ± 1.0E-1
Maximum	8.4E-2	1.5E-1	1.5E-1	1.2E-1	3.7E-1
Minimum	-8.1E-2	-3.0E-2	-2.6E-5	2.7E-3	5.1E-2
Mean	8.0E-3	4.2E-2	4.9E-3	2.5E-2	2.4E-1
Background (b)				9.0E-3	3.7E-1
Soil standards (c)	2.0E+2	2.0E+2	6.0E+1	6.0E+1	

(a) Not analyzed for this radionuclide
(b) Derived from PNL 1987 data (PNL 1988) Background numbers represent mean + 2 SE.
(c) Boothe 1987

Reference:
Elder et al, 1988

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Figure B-3. (cont.) Grid Site Soil Results for 200 East Area for 1987 (pCi/g dry weight)

Location	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2E 1	4.2E+0 ± 2.6E-1	1.3E+0 ± 1.0E-1	3.4E+0 ± 1.6E-1	5.7E-2 ± 4.6E-2	1.6E+0 ± 1.2E-1	1.3E+0 ± 1.1E-1	b	b	b	1.7E+0 ± 1.8E-1
2E 2	2.0E+1 ± 5.6E-1	3.7E+0 ± 1.7E-1	2.1E-1 ± 4.2E-2	1.9E+0 ± 1.7E-1	1.9E+0 ± 1.1E-1	1.6E-1 ± 4.2E-2	b	6.8E+0 ± 4.6E-1	1.1E-1 ± 3.2E-2	b
2E 3	5.1E+1 ± 8.9E-1	3.4E+0 ± 1.6E-1	7.4E+0 ± 2.4E-1	1.6E+1 ± 5.2E-1	5.5E+0 ± 2.2E-1	1.2E+1 ± 3.1E-1	1.8E+1 ± 3.0E-1	3.2E+1 ± 1.9E+0	1.7E+1 ± 1.7E+0	1.3E+1 ± 1.3E+0
2E 4	2.3E+1 ± 5.9E-1	5.0E+0 ± 2.0E-1	2.3E+0 ± 1.2E-1	1.0E+1 ± 3.9E-1	4.7E+0 ± 2.0E-1	2.9E+0 ± 1.6E-1	1.2E+1 ± 2.5E-1	1.7E+1 ± 1.1E+0	1.9E+1 ± 2.0E+0	1.8E+1 ± 1.8E+0
2E 5	5.5E+0 ± 3.0E-1	2.2E+0 ± 1.3E-1	1.4E+0 ± 1.0E-1	1.4E+0 ± 1.2E-1	5.0E-1 ± 7.4E-2	1.7E+0 ± 1.1E-1	3.5E+0 ± 1.4E-1	6.5E+0 ± 4.3E-1	6.4E+0 ± 6.5E-1	b
2E 6	5.5E+0 ± 2.9E-1	2.1E+0 ± 1.3E-1	1.7E+0 ± 1.2E-1	1.8E+0 ± 1.6E-1	2.0E+0 ± 1.4E-1	7.3E-1 ± 7.8E-2	5.0E+0 ± 1.7E-1	4.5E+0 ± 3.2E-1	b	b
2E 7	3.4E+0 ± 2.3E-1	1.0E+0 ± 9.3E-2	1.3E+0 ± 9.9E-2	2.2E+0 ± 1.9E-1	1.5E-1 ± 2.7E-2	1.7E+0 ± 1.3E-1	1.2E+0 ± 7.0E-2	b	b	b
2E 8	1.3E+1 ± 4.6E-1	4.6E+0 ± 1.9E-1	1.9E+0 ± 1.2E-1	2.4E+0 ± 1.8E-1	9.6E+0 ± 3.2E-1	1.7E-1 ± 4.3E-2	3.9E+0 ± 1.3E-1	1.2E+1 ± 7.8E-1	5.8E+0 ± 6.0E-1	3.8E+0 ± 3.9E-1
2E 9	3.8E+1 ± 7.8E-1	b	3.6E+0 ± 1.6E-1	3.0E+1 ± 7.0E-1	1.3E+1 ± 3.3E-1	8.3E+0 ± 2.6E-1	1.0E+1 ± 2.3E-1	1.3E+1 ± 8.1E-1	1.7E+1 ± 1.7E+0	b
2E10	4.3E+1 ± 8.2E-1	8.6E+0 ± 2.6E-1	8.6E+0 ± 2.8E-1	3.1E+0 ± 2.0E-1	3.9E+0 ± 1.1E-1	3.1E+0 ± 1.6E-1	1.2E+1 ± 2.4E-1	2.2E+1 ± 1.4E+0	1.0E+1 ± 1.0E+0	3.1E+1 ± 3.1E+0
2E11	1.3E+1 ± 4.1E-1	7.4E+0 ± 2.4E-1	7.9E+0 ± 2.6E-1	2.7E+0 ± 2.1E-1	3.3E+0 ± 1.6E-1	2.2E+1 ± 5.9E-1	8.5E+0 ± 2.2E-1	1.3E+1 ± 8.3E-1	1.4E+1 ± 1.4E+0	b
2E12	3.5E+1 ± 7.9E-1	3.2E-1 ± 5.5E-2	6.7E+0 ± 2.4E-1	1.6E+1 ± 4.4E-1	3.5E+1 ± 9.3E-1	3.0E+1 ± 2.7E-1	1.5E+1 ± 3.1E-1	1.2E+1 ± 7.8E-1	2.6E+1 ± 2.6E+0	1.5E-1 ± 3.0E-2
2E13	1.5E+0 ± 1.5E-1	2.9E-1 ± 5.2E-2	2.6E-1 ± 5.3E-2	2.1E+0 ± 1.6E-1	8.8E-1 ± 7.8E-2	3.5E-1 ± 5.3E-2	b	1.2E+0 ± 1.2E-1	1.0E+0 ± 1.2E-1	b
2E14	8.7E-1 ± 1.2E-1	6.7E-1 ± 7.6E-2	8.4E-1 ± 8.2E-2	6.7E-1 ± [illegible]	1.0E+0 ± 5.7E-2	1.5E+0 ± 1.0E-1	1.6E+0 ± 8.7E-2	1.4E+0 ± 1.2E-1	2.3E+1 ± 2.3E+0	2.9E+0 ± 3.0E-1
2E15	2.0E+0 ± 1.7E-1	1.4E+0 ± 1.1E-1	1.3E+0 ± 9.2E-2	2.8E+0 ± 1.8E-1	3.7E+0 ± 2.3E-2	1.4E+0 ± 9.4E-2	b	3.3E+0 ± 2.3E-1	2.1E+0 ± 2.4E-1	b
2E16	9.8E+0 ± 3.8E-1	1.8E+0 ± 1.2E-1	1.7E+0 ± 1.1E-1	1.6E+0 ± 1.4E-1	9.8E-1 ± 9.6E-2	2.4E+0 ± 1.3E-1	1.7E+0 ± 9.3E-2	3.1E+0 ± 2.2E-1	4.3E+0 ± 4.6E-1	4.3E+0 ± 4.4E-1
2E17	8.7E+0 ± 3.6E-1	2.0E+0 ± 1.3E-1	3.0E+0 ± 1.7E-1	2.3E+0 ± 1.6E-1	4.5E+0 ± 1.2E-1	1.2E+0 ± 9.8E-2	4.4E+0 ± 1.4E-1	3.4E+0 ± 2.5E-1	2.2E+0 ± 2.5E-1	5.7E+0 ± 5.9E-1
2E18	1.3E+1 ± 4.5E-1	3.4E+0 ± 1.7E-1	5.3E+0 ± 2.0E-1	4.6E+0 ± 2.3E-1	9.8E+0 ± 1.7E-1	8.2E+0 ± 2.3E-1	5.8E+0 ± 1.7E-1	5.2E+0 ± 3.5E-1	1.0E+1 ± 1.1E+0	4.6E+0 ± 4.7E-1
2E19	2.1E+0 ± 1.8E-1	2.4E-1 ± 4.8E-2	7.9E-1 ± 9.0E-2	9.4E-1 ± 1.2E-1	2.6E-1 ± 4.7E-2	1.7E+0 ± 1.2E-1	1.1E+0 ± 7.6E-2	b	b	7.3E-1 ± 8.3E-2
2E20	1.4E+0 ± 1.4E-1	7.1E-1 ± 7.8E-2	6.3E-1 ± 7.3E-2	7.3E-1 ± 1.1E-1	7.5E-1 ± 8.6E-2	6.8E-1 ± 7.8E-2	b	1.9E+0 ± 1.5E-1	1.5E+0 ± 1.7E-1	b
2E21	1.1E+0 ± 1.3E-1	2.5E-1 ± 4.9E-2	6.8E-1 ± 7.7E-2	1.2E+0 ± 1.2E-1	9.5E-1 ± 8.3E-2	8.5E-1 ± 8.5E-2	8.5E-1 ± 7.0E-2	1.0E+0 ± 9.4E-2	b	6.4E-1 ± 7.8E-2
2E22	2.8E+0 ± 2.0E-1	5.4E-1 ± 6.9E-2	2.2E+0 ± 1.4E-1	1.5E+0 ± 1.3E-1	2.0E+0 ± 1.2E-1	2.1E+0 ± 1.2E-1	b	2.3E+0 ± 1.9E-1	3.4E+0 ± 3.2E-1	b
2E23	1.1E+1 ± 4.1E-1	6.6E+0 ± 2.3E-1	8.9E-1 ± 8.5E-2	1.1E+1 ± 5.1E-1	8.3E+0 ± 2.7E-1	5.6E+0 ± 2.2E-1	4.3E+0 ± 1.4E-1	9.3E+0 ± 6.1E-1	1.0E+1 ± 1.0E+0	1.1E+1 ± 1.1E+0
2E24	1.6E+1 ± 5.0E-1	9.7E+0 ± 2.8E-1	5.1E+0 ± 2.1E-1	1.2E+1 ± 4.2E-1	6.7E+0 ± 2.0E-1	4.9E+0 ± 1.8E-1	1.1E+1 ± 2.1E-1	4.9E+0 ± 3.5E-1	9.0E+0 ± 9.2E-1	6.8E+0 ± 6.9E-1
2E25	1.5E+0 ± 1.4E-1	4.5E-1 ± 6.4E-2	5.5E-1 ± 6.6E-2	6.1E-1 ± 8.1E-2	7.9E-1 ± 7.4E-2	5.9E-1 ± 7.3E-2	b	b	b	b
2E26	1.4E+0 ± 1.4E-1	5.1E-1 ± 6.7E-2	4.2E-1 ± 6.4E-2	1.2E+0 ± 1.3E-1	9.6E-1 ± 9.7E-2	6.9E-1 ± 7.7E-2	b	b	b	6.8E-1 ± 8.2E-2
2E27	5.6E-1 ± 8.9E-2	5.8E-1 ± 7.1E-2	3.8E-1 ± 5.5E-2	4.6E-1 ± 8.9E-2	2.3E-1 ± 5.2E-2	2.8E-1 ± 5.3E-2	2.4E-1 ± 4.4E-2	3.2E-1 ± 5.2E-2	3.2E-1 ± 5.1E-2	b
2E28	1.0E+0 ± 1.2E-1	3.0E-1 ± 5.3E-2	3.7E-1 ± 6.3E-2	7.1E-1 ± 9.4E-2	3.3E-1 ± 6.0E-2	4.3E-1 ± 6.4E-2	b	9.4E-1 ± 9.9E-2	b	6.0E-1 ± 7.3E-2
2E29	3.3E+0 ± 2.2E-1	b	1.3E+0 ± 1.0E-1	5.5E+0 ± 2.2E-1	1.0E+0 ± 1.4E-1	3.9E-1 ± 5.4E-2	2.2E+0 ± 1.0E-1	3.0E+0 ± 2.3E-1	2.4E+0 ± 2.6E-1	b
2E30	2.9E+0 ± 2.1E-1	2.7E+0 ± 1.5E-1	5.3E-1 ± 7.4E-2	5.9E-1 ± 9.3E-2	1.1E+0 ± 9.9E-2	b	1.9E-1 ± 3.4E-2	2.3E-1 ± 4.2E-2	b	2.2E-1 ± 3.3E-2
2E31	5.6E-1 ± 9.2E-2	5.3E-1 ± 6.8E-2	3.3E-1 ± 5.4E-2	3.6E-1 ± 6.9E-2	3.2E-1 ± 5.9E-2	3.5E-1 ± 5.8E-2	4.5E-1 ± 5.7E-2	4.3E-1 ± 6.3E-2	5.0E-1 ± 7.1E-2	b
2E32	1.1E+0 ± 1.3E-1	7.7E-1 ± 8.1E-2	3.7E-1 ± 5.4E-2	2.3E-1 ± 5.8E-2	5.7E-1 ± 6.3E-2	8.3E-1 ± 8.8E-2	3.4E-1 ± 4.8E-2	1.4E+0 ± 1.0E-1	7.7E-1 ± 1.0E-1	4.7E-1 ± 5.9E-2
2E33	9.8E-2 ± 4.1E-2	1.1E-1 ± 3.7E-2	1.1E-1 ± 3.7E-2	6.7E-3 ± 2.9E-2	1.0E-1 ± 3.9E-2	5.0E-2 ± 3.0E-2	4.5E-2 ± 2.2E-2	5.8E-2 ± 2.4E-2	b	b
2E34	1.9E+0 ± 1.6E-1	8.7E-1 ± 8.5E-2	1.2E+0 ± 1.0E-1	6.0E-1 ± 9.1E-2	8.3E-1 ± 9.1E-2	7.5E-1 ± 7.6E-2	1.0E+0 ± 7.1E-2	1.1E+0 ± 9.0E-2	1.6E+0 ± 1.8E-1	2.2E-1 ± 4.1E-2
2E35	1.1E+0 ± 1.2E-1	5.2E-1 ± 6.7E-2	6.3E-1 ± 7.2E-2	3.0E-1 ± 6.2E-2	7.1E-1 ± 7.2E-2	5.8E-1 ± 6.8E-2	7.1E-1 ± 6.4E-2	8.6E-1 ± 6.8E-2	b	6.1E-1 ± 7.2E-2
2E36	1.3E+0 ± 1.4E-1	6.7E-1 ± 7.6E-2	5.0E-1 ± 6.4E-2	4.3E-1 ± 7.6E-2	1.1E+0 ± 8.6E-2	5.0E-1 ± 6.2E-2	8.0E-1 ± 5.8E-2	6.6E-1 ± 6.2E-2	5.3E-1 ± 7.2E-2	b
2EA	5.7E-1 ± 9.4E-2	2.1E-1 ± 4.6E-2	3.7E-1 ± 6.0E-2	2.7E-1 ± 6.3E-2	4.8E-1 ± 4.0E-2	3.5E-1 ± 5.7E-2	3.9E-1 ± 4.6E-2	3.3E-1 ± 4.0E-2	6.0E-1 ± 7.7E-2	3.8E-1 ± 4.8E-2
2EB	2.5E+0 ± 2.0E-1	4.9E-1 ± 6.6E-2	4.6E-1 ± 6.4E-2	1.1E+0 ± 1.3E-1	1.9E+0 ± 7.5E-2	4.2E-1 ± 6.1E-2	8.1E-1 ± 7.0E-2	2.9E+0 ± 1.9E-1	9.8E-1 ± 1.2E-1	1.0E+0 ± 1.1E-1
2EC	1.3E+0 ± 1.4E-1	1.2E+0 ± 9.9E-2	4.0E-1 ± 5.6E-2	8.1E-1 ± 1.0E-1	1.2E+0 ± 8.9E-2	2.0E+0 ± 1.3E-1	1.7E+0 ± 8.2E-2	1.8E+0 ± 1.3E-1	1.8E+0 ± 1.9E-1	8.3E-1 ± 9.6E-2
2ED	6.7E+0 ± 3.1E-1	2.8E+0 ± 1.5E-1	2.6E+0 ± 1.4E-1	1.6E+0 ± 1.3E-1	5.4E+0 ± 2.1E-1	1.6E+0 ± 1.2E-1	2.3E+0 ± 1.0E-1	8.2E+0 ± 5.1E-1	2.3E+0 ± 2.5E-1	2.8E+0 ± 2.9E-1
Mean (a)	8.8E+0 ± 4.0E+0	2.1E+0 ± 8.0E-1	2.0E+0 ± 7.3E-1	3.5E+0 ± 1.9E+0	3.4E+0 ± 1.9E+0	3.2E+0 ± 1.9E+0	4.2E+0 ± 1.8E+0	5.7E+0 ± 2.4E+0	6.6E+0 ± 2.8E+0	4.6E+0 ± 3.0E+0

Reference: Elder et al, 1988

883-1726/9877

Figure B-4. The ^{137}Cs Concentrations in Soil, 1978 through 1987 (pCi/g)

Location	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2E 1	7.7E-1 ± 4.0E-2	2.5E-1 ± 2.7E-2	3.4E-1 ± 6.3E-2	1.8E-1 ± 2.9E-2	1.6E-1 ± 4.3E-2	9.8E-2 ± 3.1E-2	b	b	b	2.4E-1 ± 6.1E-2
2E 2	1.5E+0 ± 4.7E-2	5.2E-1 ± 3.6E-2	2.2E-2 ± 2.9E-2	3.4E-1 ± 2.9E-2	1.2E-1 ± 3.1E-2	4.7E-2 ± 1.7E-2	b	3.9E-1 ± 8.3E-2	5.1E-2 ± 1.7E-2	b
2E 3	3.1E+0 ± 6.8E-2	4.7E-1 ± 3.2E-2	6.1E-1 ± 3.2E-2	4.2E-1 ± 2.9E-2	4.5E-1 ± 9.0E-2	3.2E-1 ± 5.1E-2	2.5E+0 ± 1.1E-1	7.6E-1 ± 1.5E-1	7.2E-1 ± 1.8E-1	7.8E-1 ± 2.0E-1
2E 4	1.0E+0 ± 3.8E-2	4.7E-1 ± 3.0E-2	3.4E-1 ± 6.8E-2	6.0E-1 ± 3.0E-2	2.6E-1 ± 6.1E-2	3.6E-1 ± 3.8E-2	1.0E+0 ± 8.7E-2	8.6E-1 ± 1.6E-1	8.6E-1 ± 1.6E-1	9.3E-1 ± 2.3E-1
2E 5	7.7E-1 ± 4.1E-2	5.2E-1 ± 3.4E-2	6.0E-2 ± 2.8E-2	3.5E-1 ± 2.9E-2	2.2E-1 ± 3.9E-2	1.3E-1 ± 2.3E-2	6.6E-1 ± 5.1E-2	6.1E-1 ± 1.2E-1	8.4E-1 ± 1.6E-1	b
2E 6	1.4E+0 ± 4.6E-2	8.5E-1 ± 4.3E-2	5.5E-1 ± 2.8E-2	6.8E-1 ± 3.2E-2	4.4E-1 ± 9.7E-2	1.2E-1 ± 1.6E-2	8.6E-1 ± 6.1E-2	7.0E-1 ± 1.4E-1	b	b
2E 7	4.5E-1 ± 3.1E-2	4.7E-1 ± 3.2E-2	3.1E-1 ± 2.5E-2	3.3E-1 ± 2.9E-2	8.3E-2 ± 2.8E-2	2.9E-1 ± 3.1E-2	2.9E-1 ± 3.9E-2	b	b	b
2E 8	1.4E+0 ± 4.8E-2	9.6E-1 ± 4.4E-2	1.7E-1 ± 3.2E-2	5.3E-1 ± 2.9E-2	7.9E-1 ± 7.6E-2	7.0E-2 ± 1.6E-2	2.4E+0 ± 9.7E-2	6.9E-1 ± 1.3E-1	7.6E-1 ± 1.4E-1	4.0E-1 ± 9.9E-2
2E 9	6.9E+0 ± 9.9E-2	b	8.9E-1 ± 3.3E-2	3.2E+0 ± 6.8E-2	1.5E+0 ± 1.0E-1	8.9E-1 ± 5.5E-2	2.1E+0 ± 1.8E-1	2.6E+0 ± 4.7E-1	1.6E+0 ± 3.0E-1	b
2E10	1.4E+0 ± 4.4E-2	6.2E-1 ± 3.6E-2	4.6E-1 ± 1.6E-1	9.5E-1 ± 3.7E-2	2.3E-1 ± 4.2E-2	3.2E-1 ± 3.8E-2	1.1E+0 ± 1.0E-1	1.1E+0 ± 2.0E-1	5.4E-1 ± 1.0E-1	2.3E+0 ± 5.7E-1
2E11	3.3E+0 ± 6.9E-2	1.6E+0 ± 5.7E-2	2.1E+0 ± 5.3E-1	7.7E-1 ± 3.3E-2	8.4E-1 ± 7.6E-2	1.9E+0 ± 9.2E-2	2.0E+0 ± 8.5E-2	2.2E+0 ± 4.0E-1	8.9E-1 ± 1.7E-1	b
2E12	2.4E+0 ± 5.9E-2	2.0E-1 ± 2.7E-2	1.3E+0 ± 5.0E-2	1.7E+0 ± 4.8E-2	2.5E+0 ± 1.3E-1	2.5E+0 ± 1.3E-1	1.6E+0 ± 8.1E-2	1.4E+0 ± 2.5E-1	2.1E+0 ± 3.8E-1	4.1E-1 ± 1.0E-1
2E13	7.6E-2 ± 1.4E-2	2.4E-1 ± 2.7E-2	1.7E-1 ± 2.9E-2	1.7E-1 ± 2.9E-2	2.3E-1 ± 4.8E-2	5.7E-1 ± 4.7E-2	b	2.7E-1 ± 5.4E-2	2.8E-1 ± 5.8E-2	b
2E14	1.5E-1 ± 1.6E-2	2.4E-1 ± 2.7E-2	1.8E-1 ± 2.9E-2	1.4E-1 ± 2.9E-2	1.2E-1 ± 3.6E-2	5.1E-1 ± 6.4E-2	2.8E-1 ± 5.4E-2	2.4E-1 ± 5.0E-2	1.5E+0 ± 2.8E-1	5.0E-1 ± 1.2E-1
2E15	6.4E-1 ± 3.1E-2	1.6E+0 ± 5.9E-2	2.4E+1 ± 1.4E+0	1.6E+0 ± 4.9E-2	1.0E+0 ± 8.4E-2	5.5E-1 ± 6.3E-2	b	9.9E-1 ± 1.9E-1	1.3E+0 ± 2.3E-1	b
2E16	3.2E+0 ± 6.9E-2	1.7E+0 ± 6.9E-2	8.2E-1 ± 3.6E-2	2.1E+0 ± 5.6E-2	5.4E-1 ± 7.1E-2	2.7E+0 ± 1.5E-1	1.4E+0 ± 9.2E-2	1.7E+0 ± 3.1E-1	2.7E+0 ± 5.0E-1	1.7E+0 ± 4.1E-1
2E17	2.6E+0 ± 1.2E+0	1.6E+0 ± 5.3E-2	5.7E-1 ± 2.9E-2	1.4E+0 ± 4.6E-2	2.7E+0 ± 1.2E-1	1.6E+1 ± 9.8E-1	1.5E+0 ± 9.2E-2	2.7E+0 ± 4.9E-1	3.0E+0 ± 5.6E-1	5.2E+0 ± 1.3E+0
2E18	1.6E-1 ± 1.6E-2	5.9E-1 ± 3.6E-2	3.5E-1 ± 2.9E-1	1.1E+0 ± 3.9E-2	1.3E+0 ± 8.6E-2	1.1E+0 ± 9.1E-2	9.3E-1 ± 8.7E-2	1.2E+0 ± 2.2E-1	1.3E+0 ± 2.4E-1	1.2E+0 ± 3.0E-1
2E19	1.6E-1 ± 1.5E-2	2.1E-1 ± 2.7E-2	2.2E-1 ± 2.9E-2	2.7E-1 ± 2.9E-2	1.4E-1 ± 3.0E-2	5.7E-1 ± 5.9E-2	4.1E-1 ± 1.3E-1	b	b	1.9E-1 ± 4.9E-2
2E20	6.0E-2 ± 1.4E-2	3.5E-1 ± 2.9E-2	6.4E+0 ± 1.4E+0	4.2E-1 ± 2.9E-2	1.9E-1 ± 3.9E-2	7.3E-1 ± 6.4E-2	b	4.8E-1 ± 9.3E-2	3.2E-1 ± 6.4E-2	b
2E21	1.7E-1 ± 1.7E-2	2.5E-1 ± 2.7E-2	6.1E+0 ± 1.4E+0	2.4E-1 ± 2.9E-2	2.6E-1 ± 7.0E-2	5.2E-1 ± 6.3E-2	2.8E-1 ± 5.7E-2	4.2E-1 ± 8.2E-2	b	2.0E-1 ± 5.2E-2
2E22	4.4E-1 ± 2.5E-2	3.5E-1 ± 3.7E-2	1.4E-1 ± 2.9E-2	5.3E-1 ± 2.9E-2	4.7E-1 ± 5.6E-2	6.9E-1 ± 6.9E-2	b	8.4E-1 ± 1.6E-1	5.6E-1 ± 1.1E-1	b
2E23	1.7E+0 ± 4.9E-2	1.1E+0 ± 5.0E-2	1.3E+1 ± 3.1E+0	1.5E+0 ± 4.4E-2	8.8E-1 ± 7.6E-2	6.2E-1 ± 7.2E-2	1.3E+0 ± 8.7E-2	2.3E+0 ± 4.3E-1	4.7E+0 ± 8.5E-1	1.6E+0 ± 3.9E-1
2E24	2.0E+0 ± 5.4E-2	2.8E+0 ± 7.7E-2	5.8E-1 ± 9.0E-2	1.9E+0 ± 5.2E-2	1.5E+0 ± 1.2E-1	1.9E+0 ± 1.3E-1	2.4E+0 ± 1.8E-1	1.3E+0 ± 2.4E-1	1.3E+0 ± 2.3E-1	1.2E+0 ± 3.0E-1
2E25	3.9E-1 ± 2.4E-2	3.4E-1 ± 2.9E-2	3.6E+0 ± 1.4E+0	2.0E-1 ± 2.9E-2	2.4E-1 ± 4.3E-2	2.8E-1 ± 5.0E-2	b	b	b	b
2E26	2.3E-1 ± 2.0E-2	2.7E-1 ± 2.8E-2	4.1E-2 ± 2.9E-2	3.3E-1 ± 2.9E-2	2.3E-1 ± 4.8E-2	7.9E-1 ± 9.0E-2	b	b	b	2.1E-1 ± 5.3E-2
2E27	1.3E-1 ± 1.5E-2	2.4E-1 ± 2.7E-2	5.1E-2 ± 2.9E-2	1.2E-1 ± 2.9E-2	1.0E-1 ± 3.4E-2	4.6E-1 ± 5.2E-2	1.2E-1 ± 5.5E-2	2.5E-1 ± 5.1E-2	1.2E-1 ± 3.4E-2	b
2E28	2.8E-1 ± 2.0E-2	3.2E-1 ± 2.7E-2	1.2E+1 ± 1.4E+0	2.6E-1 ± 2.9E-2	1.8E-1 ± 5.9E-2	7.3E-1 ± 7.7E-2	b	6.9E-1 ± 1.3E-1	b	2.3E-1 ± 5.8E-2
2E29	2.4E-1 ± 1.9E-2	b	7.9E+0 ± 1.4E+0	9.6E-1 ± 3.6E-2	1.7E-1 ± 6.7E-2	5.8E-1 ± 6.8E-2	5.1E-1 ± 6.1E-2	1.9E+0 ± 3.5E-1	4.2E-1 ± 8.2E-2	b
2E30	7.4E-1 ± 3.4E-2	8.2E-1 ± 4.1E-2	1.6E-1 ± 2.9E-2	3.6E-1 ± 2.9E-2	6.7E-1 ± 7.2E-2	b	1.8E-1 ± 6.8E-2	6.5E-1 ± 1.2E-1	b	2.0E-1 ± 5.0E-2
2E31	1.1E-1 ± 1.4E-2	2.8E-1 ± 2.7E-2	4.7E+0 ± 1.4E+0	2.1E-1 ± 2.9E-2	1.0E-1 ± 3.6E-2	4.4E-1 ± 4.8E-2	2.5E-1 ± 7.2E-2	5.6E-1 ± 1.1E-1	1.3E-1 ± 3.0E-2	b
2E32	1.8E-1 ± 1.6E-2	3.6E-1 ± 2.9E-2	3.7E-1 ± 3.9E-2	2.6E-1 ± 2.9E-2	1.1E-1 ± 3.8E-2	9.8E-1 ± 8.9E-2	8.2E-1 ± 5.9E-2	1.1E+0 ± 2.0E-1	7.2E-1 ± 1.4E-1	1.2E-1 ± 3.1E-2
2E33	4.8E-2 ± 1.2E-2	1.8E-1 ± 2.7E-2	2.2E-2 ± 2.9E-2	8.8E-2 ± 2.9E-2	6.1E-2 ± 2.3E-2	3.1E-1 ± 5.2E-2	7.4E-2 ± 2.2E-2	2.9E-1 ± 6.0E-2	b	b
2E34	8.4E-1 ± 3.9E-2	1.1E+0 ± 4.9E-2	3.0E+1 ± 4.3E+0	1.2E+0 ± 4.3E-2	3.6E-1 ± 5.1E-2	1.1E+0 ± 8.3E-2	1.9E+0 ± 9.3E-2	1.1E+0 ± 2.0E-1	7.2E-1 ± 1.3E-1	5.6E-1 ± 1.4E-1
2E35	3.7E-1 ± 2.3E-2	4.2E-1 ± 3.1E-2	1.8E+1 ± 2.2E+0	3.7E-1 ± 2.9E-2	5.2E-1 ± 1.4E-1	5.1E-1 ± 5.3E-2	6.3E-1 ± 6.0E-2	8.0E-1 ± 1.5E-1	b	4.8E-1 ± 1.2E-1
2E36	5.2E-1 ± 3.1E-2	3.0E-1 ± 2.7E-2	1.0E-1 ± 2.9E-2	2.3E-1 ± 2.9E-2	3.7E-1 ± 5.6E-2	4.3E-1 ± 4.5E-2	3.2E-1 ± 3.9E-2	6.0E-1 ± 1.1E-1	1.1E+0 ± 2.0E-1	b
2EA	8.9E-2 ± 1.3E-2	2.5E-1 ± 2.7E-2	1.5E-1 ± 2.9E-2	2.1E-1 ± 2.9E-2	1.8E-1 ± 3.7E-2	4.2E-1 ± 4.3E-2	2.5E-1 ± 4.9E-2	3.4E-1 ± 7.0E-2	1.8E-1 ± 4.0E-2	1.5E-1 ± 3.9E-2
2EB	5.6E-1 ± 3.2E-2	2.4E-1 ± 2.7E-2	7.8E+0 ± 1.4E+0	3.6E-1 ± 2.9E-2	3.5E-1 ± 6.4E-2	3.1E-1 ± 4.1E-2	3.7E-1 ± 4.6E-2	1.1E+0 ± 2.2E-1	2.6E-1 ± 5.4E-2	2.6E-1 ± 6.6E-2
2EC	3.9E-1 ± 2.7E-2	3.9E-1 ± 2.9E-2	1.9E-1 ± 2.9E-2	2.9E-1 ± 2.9E-2	7.2E-1 ± 2.4E-1	6.1E-1 ± 5.8E-2	4.8E-1 ± 5.5E-2	6.8E-1 ± 1.4E-1	4.0E-1 ± 7.9E-2	3.8E-1 ± 9.5E-2
2ED	1.2E+0 ± 3.8E-2	8.5E-1 ± 4.3E-2	3.4E-1 ± 8.1E-2	1.2E+0 ± 4.7E-2	1.1E+0 ± 1.1E-1	6.5E-1 ± 6.5E-2	6.6E-1 ± 5.7E-2	1.8E+0 ± 3.4E-1	7.2E-1 ± 1.4E-1	7.0E-1 ± 1.7E-1
Mean (a)	1.1E+0 ± 4.2E-1	6.4E-1 ± 1.8E-1	3.6E+0 ± 2.2E+0	7.0E-1 ± 2.1E-1	5.6E-1 ± 1.9E-1	1.1E+0 ± 8.1E-1	9.6E-1 ± 2.7E-1	1.0E+0 ± 2.3E-1	1.0E+0 ± 3.9E-1	8.4E-1 ± 4.6E-1

Reference: Elder et al, 1988

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Figure B-5. The ^{90}Sr Concentrations in Soil, 1978 through 1987 (pCi/g)

Location	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2E1	2.7E-2 ± 2.3E-2	1.8E-2 ± 5.8E-3	4.9E-2 ± 9.7E-3	1.2E-2 ± 5.2E-3	1.4E-2 ± 5.5E-3	1.8E-2 ± 5.0E-3	b	b	b	2.6E-2 ± 3.2E-3
2E2	8.2E-2 ± 1.3E-2	4.0E-2 ± 1.2E-2	2.6E-3 ± 2.9E-3	c	1.1E-2 ± 3.3E-3	3.3E-3 ± 1.9E-3	b	3.3E-2 ± 3.8E-3	3.0E-3 ± 9.0E-4	b
2E3	1.2E-1 ± 3.8E-2	6.4E-3 ± 5.8E-3	2.0E-2 ± 6.6E-3	c	1.2E-2 ± 3.3E-3	5.1E-2 ± 1.1E-2	2.0E-2 ± 3.8E-3	3.6E-2 ± 4.3E-3	2.1E-2 ± 4.0E-3	2.3E-2 ± 3.0E-3
2E4	2.3E-2 ± 1.8E-2	1.4E-2 ± 5.4E-3	2.3E-2 ± 6.4E-3	c	2.1E-2 ± 4.6E-3	1.3E-2 ± 2.9E-3	3.2E-2 ± 3.0E-3	2.7E-2 ± 3.3E-3	3.1E-2 ± 4.0E-3	3.6E-2 ± 4.3E-3
2E5	1.2E-2 ± 1.0E-2	6.2E-3 ± 6.9E-3	1.8E-2 ± 6.5E-3	c	1.5E-2 ± 6.1E-3	6.0E-3 ± 3.4E-3	2.4E-2 ± 5.4E-3	3.0E-2 ± 4.4E-3	2.8E-2 ± 3.7E-3	b
2E6	3.3E-2 ± 2.2E-2	1.1E-2 ± 6.0E-3	3.7E-2 ± 7.7E-3	c	1.5E-2 ± 6.5E-3	2.4E-2 ± 8.2E-3	3.3E-2 ± 3.9E-3	2.9E-2 ± 4.0E-3	b	b
2E7	3.5E-2 ± 1.7E-2	1.9E-2 ± 5.3E-3	9.0E-2 ± 1.3E-3	2.7E-2 ± 4.6E-3	3.1E-3 ± 1.8E-3	7.4E-3 ± 4.1E-3	1.6E-2 ± 1.4E-2	b	b	b
2E8	7.8E-2 ± 1.1E-2	2.0E-2 ± 6.6E-3	1.4E-2 ± 5.4E-3	c	6.6E-2 ± 1.3E-2	4.2E-3 ± 2.4E-3	2.7E-2 ± 2.4E-3	9.7E-2 ± 1.0E-2	3.3E-2 ± 4.3E-3	2.4E-2 ± 3.0E-3
2E9	2.8E-2 ± 8.9E-3	b	3.3E-2 ± 9.3E-3	c	2.2E-2 ± 8.8E-3	1.4E-2 ± 5.0E-3	1.6E-2 ± 3.1E-3	2.0E-2 ± 3.2E-3	1.8E-2 ± 3.5E-3	b
2E10	6.6E-2 ± 1.5E-2	1.4E-2 ± 4.7E-3	4.8E-2 ± 1.1E-2	c	1.1E-3 ± 2.4E-3	6.4E-3 ± 2.9E-3	2.6E-2 ± 1.7E-3	4.4E-2 ± 5.4E-3	1.5E-2 ± 2.3E-3	4.3E-2 ± 5.8E-3
2E11	4.2E-2 ± 1.4E-2	6.9E-2 ± 1.3E-2	4.3E-2 ± 3.3E-3	c	1.9E-2 ± 7.1E-3	5.4E-2 ± 8.9E-3	4.3E-2 ± 2.5E-3	7.3E-2 ± 7.7E-3	7.3E-2 ± 8.1E-3	b
2E12	6.8E-2 ± 2.0E-2	4.5E-4 ± 2.2E-3	1.8E-1 ± 7.0E-2	2.3E-2 ± 8.7E-3	3.7E-2 ± 7.1E-3	6.4E-2 ± 5.3E-3	3.3E-2 ± 3.7E-3	2.8E-2 ± 3.9E-3	4.2E-2 ± 4.9E-3	7.4E-3 ± 1.2E-3
2E13	2.0E-2 ± 9.4E-3	6.3E-3 ± 3.8E-3	1.2E-1 ± 8.3E-3	3.7E-2 ± 7.9E-3	1.8E-2 ± 4.8E-3	2.1E-2 ± 6.4E-3	b	1.3E-2 ± 4.8E-3	1.7E-2 ± 2.5E-3	b
2E14	1.2E-2 ± 5.8E-3	6.5E-3 ± 3.3E-3	c	c	1.9E-2 ± 5.5E-3	1.6E-2 ± 2.8E-3	1.4E-2 ± 2.1E-3	1.9E-2 ± 2.6E-3	1.5E-2 ± 2.2E-3	1.3E-2 ± 1.8E-3
2E15	1.0E-1 ± 1.2E-1	5.1E-2 ± 1.1E-2	7.0E-2 ± 7.8E-3	1.7E-1 ± 1.8E-2	1.2E-1 ± 1.5E-2	8.8E-2 ± 7.1E-3	b	8.7E-2 ± 9.7E-3	5.9E-2 ± 7.1E-3	b
2E16	1.7E-1 ± 1.7E-2	4.4E-2 ± 7.2E-3	7.7E-2 ± 1.3E-2	2.3E-2 ± 7.5E-3	2.5E-2 ± 6.6E-3	5.8E-2 ± 3.9E-3	8.2E-2 ± 5.7E-3	1.1E-1 ± 1.1E-2	8.2E-2 ± 1.4E-2	1.2E-1 ± 1.2E-2
2E17	4.7E-2 ± 1.0E-2	1.5E-2 ± 5.0E-3	1.0E-2 ± 4.3E-3	c	4.8E-2 ± 1.3E-2	2.4E-4 ± 5.8E-4	8.2E-3 ± 1.6E-3	2.0E-2 ± 4.7E-3	7.5E-3 ± 2.4E-3	1.7E-2 ± 2.8E-3
2E18	1.4E-2 ± 3.9E-3	8.1E-3 ± 5.2E-3	7.2E-3 ± 6.3E-3	c	8.1E-3 ± 3.3E-3	1.3E-2 ± 3.9E-3	9.1E-5 ± 1.3E-4	1.1E-2 ± 1.9E-3	1.1E-2 ± 1.8E-3	6.8E-3 ± 1.2E-3
2E19	7.5E-2 ± 1.1E-2	1.0E-2 ± 5.7E-3	3.2E-2 ± 1.3E-2	c	1.2E-2 ± 7.1E-3	2.6E-2 ± 2.6E-3	2.2E-2 ± 2.4E-3	b	b	2.0E-2 ± 2.7E-3
2E20	5.2E-2 ± 2.8E-2	1.2E-2 ± 7.8E-3	2.5E-2 ± 8.4E-3	c	3.0E-2 ± 7.2E-3	4.1E-2 ± 3.5E-3	b	4.3E-2 ± 4.7E-3	3.9E-2 ± 5.4E-3	b
2E21	1.6E-2 ± 1.5E-2	9.9E-3 ± 4.2E-3	5.6E-1 ± 3.2E-2	2.9E-2 ± 8.6E-3	8.9E-2 ± 2.1E-2	3.0E-2 ± 3.6E-3	3.6E-2 ± 2.8E-3	6.2E-2 ± 6.6E-3	b	2.3E-2 ± 2.8E-3
2E22	1.7E-1 ± 3.9E-2	5.7E-2 ± 1.1E-2	6.9E-2 ± 1.1E-2	1.1E-1 ± 1.7E-2	2.0E-1 ± 2.6E-2	7.3E-1 ± 4.2E-2	b	1.5E-1 ± 1.6E-2	2.2E-1 ± 2.7E-2	b
2E23	1.0E-1 ± 1.4E-2	5.9E-2 ± 1.6E-2	1.9E-2 ± 7.8E-3	c	1.3E-1 ± 2.0E-2	9.4E-2 ± 1.5E-2	1.1E-1 ± 7.6E-3	1.8E-1 ± 1.8E-2	1.2E-1 ± 1.6E-2	3.9E-2 ± 4.7E-3
2E24	5.0E-2 ± 2.5E-2	4.5E-2 ± 9.6E-3	5.2E-2 ± 1.3E-2	4.4E-2 ± 1.1E-2	3.2E-2 ± 7.7E-3	2.0E-2 ± 5.2E-3	4.7E-2 ± 5.6E-3	2.6E-2 ± 3.2E-3	4.0E-2 ± 5.0E-3	2.5E-2 ± 3.2E-3
2E25	7.2E-2 ± 3.1E-2	1.5E-2 ± 6.1E-3	1.2E-2 ± 6.1E-3	c	1.1E-2 ± 5.5E-3	1.3E-2 ± 3.7E-3	b	b	b	b
2E26	2.7E-2 ± 1.5E-2	9.4E-3 ± 5.1E-3	1.5E-1 ± 2.1E-2	2.3E-2 ± 6.5E-3	2.3E-2 ± 4.9E-3	1.4E-2 ± 3.1E-3	b	b	b	1.5E-2 ± 2.0E-3
2E27	6.6E-3 ± 9.2E-3	1.2E-2 ± 5.4E-3	3.6E-2 ± 1.1E-2	c	1.1E-2 ± 3.1E-3	3.0E-3 ± 1.3E-3	2.2E-2 ± 2.9E-3	5.4E-3 ± 3.3E-3	6.5E-3 ± 2.4E-3	b
2E28	4.0E-2 ± 1.8E-2	7.1E-3 ± 3.6E-3	3.3E-2 ± 7.3E-3	c	9.7E-3 ± 3.7E-3	7.6E-3 ± 1.9E-3	b	3.1E-2 ± 4.1E-3	b	2.1E-2 ± 2.6E-3
2E29	9.5E-2 ± 2.7E-2	b	6.6E-3 ± 7.7E-3	c	1.3E-2 ± 4.2E-3	9.5E-3 ± 1.7E-3	5.2E-2 ± 5.9E-3	7.7E-2 ± 7.8E-3	4.6E-2 ± 7.1E-3	b
2E30	1.8E-1 ± 4.3E-2	1.4E-1 ± 1.8E-2	c	4.8E-2 ± 7.9E-3	8.7E-2 ± 1.2E-2	b	2.0E-2 ± 2.6E-3	1.9E-2 ± 2.6E-3	b	1.7E-2 ± 2.1E-3
2E31	8.2E-3 ± 1.1E-2	1.4E-2 ± 5.1E-3	9.5E-3 ± 4.5E-3	c	1.2E-2 ± 2.2E-3	4.7E-3 ± 1.9E-3	9.7E-3 ± 4.0E-3	7.4E-3 ± 2.2E-3	9.1E-3 ± 1.8E-3	b
2E32	1.5E-2 ± 1.5E-2	1.5E-2 ± 4.9E-3	1.4E-2 ± 4.9E-3	c	2.8E-2 ± 9.5E-3	1.2E-2 ± 2.0E-3	1.1E-2 ± 1.5E-3	2.6E-2 ± 5.0E-3	1.4E-2 ± 2.8E-3	2.7E-3 ± 6.0E-4
2E33	-7.5E-4 ± 7.5E-3	2.8E-3 ± 2.9E-3	5.2E-3 ± 3.5E-3	c	5.0E-3 ± 2.1E-3	2.0E-3 ± 1.5E-3	1.4E-3 ± 7.4E-4	5.4E-4 ± 3.6E-4	b	b
2E34	1.6E-2 ± 1.7E-2	1.2E-2 ± 4.5E-3	2.5E-2 ± 6.3E-3	c	8.0E-3 ± 4.8E-3	1.3E-2 ± 1.6E-3	2.6E-2 ± 2.8E-3	1.6E-2 ± 2.4E-3	2.8E-2 ± 4.7E-3	8.8E-3 ± 1.4E-3
2E35	1.5E-2 ± 1.5E-2	8.1E-3 ± 4.4E-3	1.1E-2 ± 3.9E-3	c	1.7E-2 ± 6.1E-3	1.0E-2 ± 2.1E-3	1.4E-2 ± 2.7E-3	1.7E-2 ± 2.7E-3	b	1.0E-2 ± 1.4E-3
2E36	7.0E-3 ± 1.5E-2	1.1E-2 ± 5.4E-3	1.9E-2 ± 1.1E-2	c	2.4E-2 ± 7.7E-3	1.4E-2 ± 3.2E-3	2.3E-2 ± 6.2E-3	1.6E-2 ± 2.6E-3	1.2E-2 ± 2.8E-3	b
2EA	6.1E-3 ± 1.4E-2	-1.8E-2 ± 5.4E-3	7.8E-3 ± 7.5E-3	c	7.4E-3 ± 4.3E-3	3.8E-3 ± 1.2E-3	1.1E-2 ± 2.2E-3	5.9E-3 ± 1.5E-3	1.1E-2 ± 3.4E-3	7.2E-3 ± 1.1E-3
2EB	4.2E-2 ± 1.7E-2	1.3E-2 ± 4.8E-3	1.8E-2 ± 5.7E-3	c	2.9E-2 ± 6.5E-3	2.9E-2 ± 3.5E-3	1.4E-2 ± 3.3E-3	2.4E-2 ± 3.2E-3	1.1E-2 ± 2.3E-3	2.0E-2 ± 2.5E-3
2EC	1.7E-2 ± 9.0E-3	1.3E-2 ± 4.2E-3	1.3E-2 ± 9.8E-3	c	1.4E-2 ± 4.7E-3	1.1E-2 ± 2.4E-3	2.2E-2 ± 5.1E-3	1.8E-2 ± 2.6E-3	2.0E-2 ± 2.9E-3	2.0E-2 ± 2.5E-3
2ED	4.9E-2 ± 1.1E-2	2.6E-2 ± 7.2E-3	2.3E-2 ± 6.9E-3	c	4.8E-2 ± 5.9E-3	3.2E-2 ± 4.7E-3	2.3E-2 ± 2.7E-3	7.1E-2 ± 7.3E-3	3.1E-2 ± 4.2E-3	4.5E-2 ± 5.1E-3
Mean (a)	5.1E-2 ± 1.6E-2	2.2E-2 ± 8.9E-3	5.2E-2 ± 3.0E-2	4.9E-2 ± 2.9E-2	3.3E-2 ± 1.3E-2	4.1E-2 ± 3.7E-2	2.7E-2 ± 8.2E-3	4.2E-2 ± 1.4E-2	3.7E-2 ± 1.7E-2	2.4E-2 ± 9.3E-3

Reference: Elder et al, 1988

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Figure B-6. The ^{239}Pu Concentrations in Soil, 1978 through 1987 (pCi/g)

Location	Mn-54 ± Error	Co-58 ± Error	Co-60 ± Error	Zn-65 ± Error	Sr-90 ± Error	Zr-95 ± Error
200 East Area						
2E-1	< 5.8E-3 ± 1.6E-2	< 3.4E-3 ± 1.5E-2	< 1.3E-2 ± 1.6E-2	< -5.5E-2 ± 4.2E-2	3.5E-1 ± 8.7E-2	< -7.9E-3 ± 3.0E-2
2E-2	< 8.4E-3 ± 1.6E-2	< 3.1E-4 ± 1.7E-2	< -7.6E-3 ± 1.6E-2	< 1.6E-2 ± 4.0E-2	2.6E+0 ± 6.6E-1	< -2.4E-2 ± 3.2E-2
2E-3	2.3E-2 ± 1.7E-2	< 7.8E-3 ± 1.6E-2	< 6.4E-3 ± 1.6E-2	< 3.3E-2 ± 3.6E-2	5.7E-1 ± 1.4E-1	< 2.6E-2 ± 3.1E-2
2E-N	2.7E-2 ± 1.3E-2	< -3.3E-3 ± 1.3E-2	1.6E-2 ± 1.3E-2	< -3.6E-2 ± 3.4E-2	1.9E+0 ± 4.7E-1	< 4.8E-3 ± 2.4E-2
2E-NE	< -1.1E-2 ± 1.8E-2	< -1.0E-2 ± 1.8E-2	< 1.2E-2 ± 1.5E-2	< -1.5E-3 ± 3.6E-2	1.0E+0 ± 2.5E-1	< -2.5E-2 ± 2.7E-2
2E-SE	< -9.1E-4 ± 9.9E-3	< -6.9E-3 ± 9.6E-3	1.3E-2 ± 9.7E-3	< -2.5E-2 ± 2.9E-2	3.5E-1 ± 9.0E-2	< 1.0E-2 ± 2.0E-2
A-TF-E1	< 3.7E-3 ± 1.6E-2	< -2.6E-3 ± 1.7E-2	< -1.2E-2 ± 1.6E-2	< -5.7E-2 ± 4.8E-2	4.8E-1 ± 1.2E-1	< 3.0E-2 ± 3.0E-2
A-TF-E2	< -1.5E-3 ± 1.6E-2	< 2.8E-4 ± 1.5E-2	1.8E-2 ± 1.2E-2	< -3.1E-2 ± 4.0E-2	4.3E+0 ± 1.1E+0	< 1.0E-2 ± 2.8E-2
A-TF-E3	< 9.0E-3 ± 1.3E-2	< -2.9E-3 ± 1.3E-2	< 7.0E-3 ± 1.5E-2	< -3.2E-2 ± 4.0E-2	1.6E+0 ± 3.9E-1	< -2.1E-2 ± 2.7E-2
A-TF-E4	< 1.1E-2 ± 1.5E-2	< 8.9E-3 ± 1.4E-2	< -9.2E-3 ± 2.0E-2	< -1.3E-2 ± 4.6E-2	4.9E+0 ± 1.2E+0	< -1.2E-3 ± 3.4E-2
A-TF-W1	< -1.5E-2 ± 2.0E-2	2.1E-2 ± 1.5E-2	3.0E-2 ± 1.7E-2	< -2.4E-2 ± 4.1E-2	1.8E+0 ± 4.4E-1	4.4E-2 ± 3.2E-2
A-TF-W2	< 2.2E-4 ± 1.3E-2	< 1.7E-3 ± 1.3E-2	< 5.9E-3 ± 1.4E-2	< 1.8E-2 ± 3.5E-2	1.1E+0 ± 2.7E-1	3.3E-2 ± 2.3E-2
AW-TF-E	< 4.8E-3 ± 1.1E-2	< -1.3E-2 ± 1.4E-2	< -1.4E-2 ± 1.3E-2	< 1.1E-2 ± 3.1E-2	1.6E-1 ± 4.0E-2	< 5.6E-3 ± 1.9E-2
B-TF-NE	1.1E-2 ± 1.1E-2	1.2E-2 ± 1.1E-2	1.8E-2 ± 1.2E-2	< -1.5E-2 ± 3.7E-2	8.2E+0 ± 2.0E+0	< -3.1E-2 ± 2.9E-2
B-TF-SE	< 3.4E-3 ± 1.5E-2	< 7.2E-3 ± 1.4E-2	2.4E-2 ± 1.3E-2	5.6E-2 ± 3.1E-2	6.4E+0 ± 1.6E+0	3.8E-2 ± 2.8E-2
BX-TF-W	< -2.8E-3 ± 1.6E-2	< -2.1E-2 ± 1.6E-2	< -2.2E-2 ± 1.8E-2	< -4.0E-2 ± 3.9E-2	2.7E-1 ± 7.2E-2	< -3.8E-2 ± 2.8E-2
C-TF-NE	< -3.3E-3 ± 2.0E-2	< 6.3E-3 ± 1.9E-2	3.0E-2 ± 1.6E-2	< -7.7E-3 ± 3.8E-2	1.1E+1 ± 2.6E+0	< 5.8E-3 ± 3.3E-2
C-TF-SE	< 2.0E-3 ± 1.6E-2	< -1.1E-2 ± 1.7E-2	2.2E-2 ± 1.5E-2	< -1.6E-2 ± 4.0E-2	1.5E+1 ± 3.5E+0	< 0.0E+0 ± 2.8E-2
Maximum	2.7E-2	2.1E-2	3.0E-2	5.6E-2	1.5E+1	4.4E-2
Minimum	-1.5E-2	-2.1E-2	-2.2E-2	-5.7E-2	1.6E-1	-3.8E-2
Soil Standards (c)			300		400	

Reference: Elder et al, 1988

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Figure B-7. Soil Results for 200 Area Fencelines for 1987 (pCi/g dry weight)

Location	Ru-106 ± Error	Cs-134 ± Error	Cs-137 ± Error	Ce-141 ± Error	Ce-144 ± Error	Eu-152 ± Error
200 East Area						
2E-1	< 1.2E-1 ± 1.3E-1	< 1.0E-2 ± 2.0E-2	1.1E+0 ± 1.2E-1	< 9.1E-3 ± 2.8E-2	< 2.9E-2 ± 9.3E-2	1.3E-1 ± 6.6E-2
2E-2	< 2.3E-1 ± 2.5E-1	7.5E-2 ± 2.1E-2	2.5E+1 ± 2.5E+0	< -3.1E-2 ± 5.9E-2	< 8.2E-2 ± 2.0E-1	< 5.6E-2 ± 7.4E-2
2E-3	4.4E-1 ± 1.8E-1	4.9E-2 ± 2.4E-2	4.9E-1 ± 6.4E-2	< -8.7E-3 ± 2.9E-2	< -9.3E-2 ± 9.8E-2	1.0E-1 ± 6.1E-2
2E-N	< 7.9E-2 ± 1.6E-1	6.5E-2 ± 1.7E-2	9.1E+0 ± 9.2E-1	< 1.2E-2 ± 2.9E-2	< -3.7E-3 ± 1.0E-1	9.4E-2 ± 6.8E-2
2E-NE	< 3.1E-2 ± 1.4E-1	3.2E-2 ± 2.0E-2	1.1E+0 ± 1.2E-1	< 1.8E-2 ± 2.8E-2	< -6.4E-2 ± 1.0E-1	< -2.0E-3 ± 8.1E-2
2E-SE	< -3.2E-2 ± 7.9E-2	4.7E-2 ± 1.4E-2	1.2E-1 ± 2.0E-2	< -2.2E-2 ± 1.8E-2	< 5.9E-2 ± 6.1E-2	< 4.1E-2 ± 4.7E-2
A-TF-E1	< 1.3E-1 ± 1.6E-1	3.7E-2 ± 2.5E-2	2.1E+0 ± 2.2E-1	< -1.6E-2 ± 3.2E-2	< -2.0E-2 ± 1.1E-1	8.4E-2 ± 8.2E-2
A-TF-E2	< -5.2E-2 ± 1.7E-1	8.0E-2 ± 2.2E-2	1.1E+1 ± 1.1E+0	< 7.3E-3 ± 3.7E-2	< 4.5E-3 ± 1.3E-1	1.0E-1 ± 6.3E-2
A-TF-E3	< 1.4E-1 ± 1.9E-1	8.5E-2 ± 2.9E-2	1.1E+1 ± 1.1E+0	< 2.7E-3 ± 3.8E-2	< 2.5E-2 ± 1.3E-1	< 4.6E-2 ± 6.1E-2
A-TF-E4	< -1.5E-2 ± 3.8E-1	3.6E-2 ± 2.1E-2	4.2E+1 ± 4.2E+0	< -5.3E-2 ± 7.0E-2	< -8.6E-3 ± 2.3E-1	1.2E-1 ± 6.3E-2
A-TF-W1	< -1.6E-1 ± 1.8E-1	7.5E-2 ± 2.7E-2	3.7E+0 ± 3.8E-1	< -2.0E-2 ± 3.7E-2	< -7.5E-2 ± 1.2E-1	1.1E-1 ± 7.6E-2
A-TF-W2	< -6.2E-2 ± 1.2E-1	2.6E-2 ± 1.8E-2	1.7E+0 ± 1.8E-1	< 1.9E-2 ± 2.5E-2	< 2.1E-2 ± 8.4E-2	< 3.9E-2 ± 6.1E-2
AW-TF-E	< -6.1E-2 ± 1.0E-1	4.3E-2 ± 1.4E-2	3.1E-1 ± 4.1E-2	< 2.7E-3 ± 2.0E-2	< 5.3E-4 ± 6.8E-2	< 4.7E-2 ± 5.1E-2
B-TF-NE	< -5.3E-2 ± 2.6E-1	< 1.3E-2 ± 1.8E-2	2.8E+1 ± 2.8E+0	< 1.6E-2 ± 5.4E-2	< -5.8E-2 ± 1.8E-1	< 1.2E-2 ± 7.4E-2
B-TF-SE	< -7.0E-2 ± 2.0E-1	2.2E-2 ± 2.1E-2	1.4E+1 ± 1.4E+0	5.2E-2 ± 4.7E-2	< -1.9E-2 ± 1.6E-1	< 2.2E-3 ± 7.3E-2
BX-TF-W	< -8.6E-2 ± 2.3E-1	4.5E-2 ± 2.1E-2	2.3E+1 ± 2.3E+0	< -2.6E-2 ± 5.1E-2	< 1.1E-1 ± 1.7E-1	1.9E-1 ± 5.7E-2
C-TF-NE	< -5.9E-2 ± 5.1E-1	6.5E-2 ± 2.6E-2	8.2E+1 ± 8.2E+0	< 1.0E-2 ± 9.4E-2	< 1.5E-1 ± 3.2E-1	< 6.8E-2 ± 8.4E-2
C-TF-SE	< 2.5E-1 ± 2.5E-1	6.9E-2 ± 2.4E-2	2.3E+1 ± 2.3E+0	< 4.9E-3 ± 5.4E-2	< -2.5E-2 ± 1.9E-1	9.5E-2 ± 6.8E-2
Maximum	4.4E-1	8.5E-2	8.2E+1	5.2E-2	1.5E-1	1.9E-1
Minimum	-1.6E-1	1.0E-2	1.2E-1	-5.3E-2	-9.3E-2	-2.0E-3
Soil Standards (c)			400			800

Reference: Elder et al, 1988

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Figure B-7 (cont.). Soil Results for 200 Area Fenceline for 1987 (pCi/g dry weight)

Location	Eu-154 ± Error	Eu-155 ± Error	Pu-238 ± Error	Pu-239 ± Error	Uranium ± Error
200 East Area					
2E-1	1.2E-1 ± 4.5E-2	< -3.7E-2 ± 5.7E-2	< 4.4E-5 ± 1.2E-4	1.1E-3 ± 4.0E-4	3.2E-1 ± 1.5E-1
2E-2	< 5.0E-2 ± 5.3E-2	< 8.7E-2 ± 1.2E-1	< 2.7E-4 ± 4.0E-4	7.3E-3 ± 1.7E-3	3.9E-1 ± 1.8E-1
2E-3	< 7.4E-3 ± 5.2E-2	< -4.0E-3 ± 5.9E-2	3.9E-4 ± 2.4E-4	1.0E-2 ± 1.6E-3	2.4E-1 ± 1.2E-1
2E-N	< 3.3E-2 ± 4.2E-2	7.1E-2 ± 5.8E-2	< 2.0E-4 ± 2.9E-4	6.0E-3 ± 1.4E-3	2.8E-1 ± 1.3E-1
2E-NE	< 3.9E-2 ± 4.4E-2	< 4.1E-2 ± 5.3E-2	< 1.6E-4 ± 1.8E-4	5.1E-3 ± 1.0E-3	1.2E-1 ± 6.2E-2
2E-SE	< 5.6E-3 ± 3.7E-2	< 2.4E-2 ± 3.3E-2	< -3.1E-6 ± 8.5E-5	1.5E-3 ± 4.2E-4	2.4E-1 ± 1.2E-1
A-TF-E1	< 4.0E-2 ± 4.8E-2	< 5.3E-2 ± 6.3E-2	< -1.0E-5 ± 7.7E-5	< 6.1E-5 ± 9.1E-5	2.8E-1 ± 1.3E-1
A-TF-E2	5.1E-2 ± 4.5E-2	7.3E-2 ± 6.4E-2	9.0E-4 ± 4.3E-4	7.6E-3 ± 1.4E-3	3.1E-1 ± 1.4E-1
A-TF-E3	7.1E-2 ± 4.8E-2	< 1.2E-2 ± 7.1E-2	< -5.9E-5 ± 1.3E-4	1.4E-3 ± 5.4E-4	3.6E-1 ± 1.7E-1
A-TF-E4	< 2.0E-2 ± 5.4E-2	< 6.1E-2 ± 1.3E-1	8.6E-4 ± 7.6E-4	8.2E-3 ± 2.1E-3	1.7E-1 ± 1.0E-1
A-TF-W1	< 9.2E-3 ± 4.7E-2	< 1.4E-2 ± 7.5E-2	< 1.8E-4 ± 2.4E-4	5.1E-3 ± 1.3E-3	2.7E-1 ± 1.3E-1
A-TF-W2	< 2.0E-2 ± 4.4E-2	< 4.7E-2 ± 5.0E-2	< 1.6E-4 ± 2.2E-4	1.3E-3 ± 5.5E-4	2.2E-1 ± 1.1E-1
AW-TF-E	< 1.2E-2 ± 4.1E-2	< 5.8E-3 ± 3.7E-2	3.3E-4 ± 2.3E-4	5.2E-3 ± 9.8E-4	5.1E-1 ± 2.8E-1
B-TF-NE	< -1.1E-2 ± 5.1E-2	< 2.5E-2 ± 1.0E-1	< 1.8E-4 ± 4.6E-4	9.9E-3 ± 2.1E-3	5.5E-2 ± 3.9E-2
B-TF-SE	< -2.5E-3 ± 4.6E-2	< 7.5E-2 ± 9.3E-2	< 6.3E-5 ± 2.7E-4	5.5E-3 ± 1.3E-3	1.3E-1 ± 6.7E-2
BX-TF-W	< 1.1E-2 ± 4.5E-2	< 7.0E-4 ± 9.3E-2	< -1.0E-4 ± 2.2E-4	2.7E-3 ± 9.6E-4	3.3E-1 ± 1.6E-1
C-TF-NE	< 1.7E-2 ± 5.2E-2	< 2.2E-2 ± 1.8E-1	< 3.9E-4 ± 6.3E-4	2.2E-2 ± 4.1E-3	2.7E-1 ± 1.3E-1
C-TF-SE	< -1.0E-2 ± 6.2E-2	< -3.2E-2 ± 1.0E-1	7.5E-4 ± 6.4E-4	1.5E-2 ± 2.9E-3	2.7E-1 ± 1.3E-1
Maximum	1.2E-1	8.7E-2	9.0E-4	2.2E-2	5.1E-1
Minimum	-1.1E-2	-3.7E-2	-1.0E-4	6.1E-5	5.5E-2
Soil Standards (c)	200	200	60	60	

(a) No counting error available, samples sent to 222-S laboratory.
(b) Radionuclide not reported.
(c) Boothe 1987.

Reference: Elder et al, 1988

883-1726/9872

Figure B-7 (cont.). Soil Results for 200 Area Fenceline for 1987 (pCi/g dry weight)

Location	1984	1985	1986	1987
200 East Area				
2E-1	3.5E+0 ± 1.3E-1	3.6E+0 ± 2.9E-1	1.3E+0 ± 1.5E-1	1.1E+0 ± 1.2E-1
2E-2	2.5E+1 ± 3.3E-3	2.1E+1 ± 1.4E+0	2.1E+1 ± 2.2E+0	2.5E+1 ± 2.5E+0
2E-3	a	6.0E-1 ± 1.2E-1	2.2E-1 ± 4.6E-2	4.9E-1 ± 6.4E-2
2E-N	1.6E+1 ± 2.7E-1	1.6E+1 ± 1.1E+0	1.1E+1 ± 1.1E+0	9.1E+0 ± 9.2E-1
2E-NE	1.5E+0 ± 8.6E-2	1.5E+0 ± 1.8E-1	1.5E+0 ± 1.8E-1	1.1E+0 ± 1.2E-1
2E-SE	1.2E-1 ± 2.8E-2	6.3E-2 ± 5.2E-2	1.7E-1 ± 4.3E-2	1.2E-1 ± 2.0E-2
A-TF-E1	1.0E+0 ± 6.4E-2	9.6E-1 ± 1.4E-1	2.4E+0 ± 2.7E-1	2.1E+0 ± 2.2E-1
A-TF-E2	3.7E+0 ± 1.2E-1	5.4E+0 ± 4.0E-1	1.3E+1 ± 1.3E+0	1.1E+1 ± 1.1E+0
A-TF-E3	5.8E+0 ± 1.4E-1	4.6E+0 ± 3.5E-1	1.5E+1 ± 1.5E+0	1.1E+1 ± 1.1E+0
A-TF-E4	5.2E+2 ± 3.3E+0	8.6E+1 b	9.0E+1 ± 9.1E+0	4.2E+1 ± 4.2E+0
A-TF-W1	9.3E-2 ± 3.3E-2	6.8E-1 ± 9.3E-2	2.9E+0 ± 3.1E-1	3.7E+0 ± 3.8E-1
A-TF-W2	8.6E-1 ± 5.8E-2	1.7E+0 ± 1.7E-1	8.3E-1 ± 1.1E-1	1.7E+0 ± 1.8E-1
AW-TF-E	1.3E+0 ± 7.1E-2	9.3E-2 ± 5.0E-2	2.2E-1 ± 4.3E-2	3.1E-1 ± 4.1E-2
B-TF-NE	3.9E+1 ± 4.4E-1	8.1E+1 b	2.6E+1 ± 2.6E+0	2.8E+1 ± 2.8E+0
B-TF-SE	1.1E+1 ± 2.3E-1	1.1E+1 ± 7.4E-1	9.4E+0 ± 9.6E-1	1.4E+1 ± 1.4E+0
BX-TF-W	7.5E+0 ± 1.7E-1	2.4E+0 ± 2.2E-1	2.3E+0 b	2.3E+1 ± 2.3E+0
C-TF-NE	4.0E+0 ± 1.5E-1	3.3E+0 ± 2.7E-1	4.6E+0 ± 4.9E-1	8.2E+1 ± 8.2E+0
C-TF-SE	2.0E+1 ± 2.8E-1	a	3.9E+1 b	2.3E+1 ± 2.3E+0
Maximum	5.2E+2	8.6E+1	9.0E+1	8.2E+1
Minimum	9.3E-2	6.3E-2	1.7E-1	1.2E-1

(a) Site not sampled.
(b) Counting error not available.

Reference: Elder et al, 1988

883-1726/9871

Figure B-8. The ^{137}Cs Concentrations in Soil at the 200 Area Fencelines, 1984 through 1987 (pCi/g dry weight)

Location	1984	1985	1986	1987
200 East Area				
2E-1	1.3E+0 ± 6.0E-2	1.1E+0 ± 2.1E-1	4.4E-1 ± 8.6E-2	3.5E-1 ± 8.7E-2
2E-2	2.3E+0 ± 8.3E-2	2.7E+0 ± 5.0E-1	2.4E+0 ± 4.3E-1	2.6E+0 ± 6.6E-1
2E-3	a	1.0E+0 ± 1.9E-1	3.1E-1 ± 6.2E-2	5.7E-1 ± 1.4E-1
2E-N	2.0E+0 ± 8.4E-2	2.0E+0 ± 3.7E-1	1.7E+0 ± 3.1E-1	1.9E+0 ± 4.7E-1
2E-NE	1.3E+0 ± 6.3E-2	1.9E+0 ± 3.4E-1	1.5E+0 ± 2.7E-1	1.0E+0 ± 2.5E-1
2E-SE	1.0E-1 ± 1.9E-2	1.6E+0 ± 2.9E-1	4.8E-1 ± 9.5E-2	3.5E-1 ± 9.0E-2
A-TF-E1	1.6E-1 ± 2.8E-2	3.6E-1 ± 7.1E-2	4.0E-1 ± 7.9E-2	4.8E-1 ± 1.2E-1
A-TF-E2	4.6E-1 ± 4.4E-2	8.3E-1 ± 1.6E-1	2.4E+0 ± 4.4E-1	4.3E+0 ± 1.1E+0
A-TF-E3	1.3E+0 ± 6.1E-2	1.2E+0 ± 2.2E-1	5.3E+0 ± 9.6E-1	1.6E+0 ± 3.9E-1
A-TF-E4	2.1E+1 ± 5.6E-1	7.8E+0 b	7.7E+0 ± 1.4E+0	4.9E+0 ± 1.2E+0
A-TF-W1	5.5E-2 ± 1.6E-2	6.6E-1 ± 1.2E-1	1.0E+0 ± 1.9E-1	1.8E+0 ± 4.4E-1
A-TF-W2	8.8E-1 ± 6.7E-2	2.5E+0 ± 4.4E-1	7.6E-1 ± 1.5E-1	1.1E+0 ± 2.7E-1
AW-TF-E	4.7E-1 ± 4.5E-2	3.4E-2 ± 1.9E-2	3.7E-1 ± 7.3E-2	1.6E-1 ± 4.0E-2
B-TF-NE	1.1E+1 ± 1.8E-1	1.0E+1 b	5.8E+0 ± 1.0E+0	8.2E+0 ± 2.0E+0
B-TF-SE	4.3E+0 ± 1.2E-1	7.1E+0 ± 1.3E+0	3.3E+0 ± 6.0E-1	6.4E+0 ± 1.6E+0
BX-TF-W	1.4E+0 ± 7.0E-2	1.4E-1 ± 3.0E-2	5.1E+0 b	2.7E-1 ± 7.2E-2
C-TF-NE	1.6E+0 ± 7.3E-2	4.7E+0 ± 8.8E-1	3.6E+0 ± 6.7E-1	1.1E+1 ± 2.6E+0
C-TF-SE	2.2E+1 ± 2.7E-1	a	3.2E+1 b	1.5E+1 ± 3.5E+0
Maximum	2.2E+1	1.0E+1	3.2E+1	1.5E+1
Minimum	5.5E-2	3.4E-2	3.1E-1	1.6E-1

(a) Site not sampled.
(b) Counting error not available.

Reference: Elder et al, 1988

883-1726/9870

Figure B-9. The ^{90}Sr Concentrations in Soil at the 200 Area Fencelines, 1984 through 1987 (pCi/g dry weight)

Location	1984	1985	1986	1987
200 East Area				
2E-1	5.2E-3 ± 1.3E-3	2.8E-2 ± 3.4E-3	1.9E-3 ± 8.4E-4	1.1E-3 ± 4.0E-4
2E-2	3.0E-3 ± 2.7E-3	8.5E-3 ± 1.5E-3	7.0E-3 ± 1.5E-3	7.3E-3 ± 1.7E-3
2E-3	a	4.2E-2 ± 4.7E-3	1.0E-2 ± 1.8E-3	1.0E-2 ± 1.6E-3
2E-N	1.2E-2 ± 2.5E-3	7.5E-3 ± 1.4E-3	6.7E-3 ± 1.4E-3	6.0E-3 ± 1.4E-3
2E-NE	4.3E-3 ± 1.0E-3	5.1E-3 ± 1.2E-3	4.7E-3 ± 1.1E-3	5.1E-3 ± 1.0E-3
2E-SE	2.4E-3 ± 8.7E-4	1.9E-3 ± 7.4E-4	1.4E-3 ± 6.3E-4	1.5E-3 ± 4.2E-4
A-TF-E1	1.0E-3 ± 7.5E-4	2.3E-3 ± 6.9E-4	3.4E-3 ± 1.1E-3	6.1E-5 ± 9.1E-5
A-TF-E2	3.2E-3 ± 1.7E-3	2.6E-3 ± 8.3E-4	4.4E-3 ± 1.2E-3	7.6E-3 ± 1.4E-3
A-TF-E3	3.3E-4 ± 7.3E-4	7.8E-4 ± 4.0E-4	2.8E-3 ± 7.9E-4	1.4E-3 ± 5.4E-4
A-TF-E4	3.1E-2 ± 5.1E-3	2.3E+2 b	1.4E-2 ± 2.3E-3	8.2E-3 ± 2.1E-3
A-TF-W1	8.1E-4 ± 3.7E-4	1.3E-3 ± 5.0E-4	3.3E-3 ± 8.1E-4	5.1E-3 ± 1.3E-3
A-TF-W2	2.4E-3 ± 5.3E-4	1.8E-3 ± 9.7E-4	1.4E-3 ± 5.8E-4	1.3E-3 ± 5.5E-4
AW-TF-E	9.0E-4 ± 3.9E-4	7.1E-2 ± 7.3E-3	1.5E-3 ± 6.5E-4	5.2E-3 ± 9.8E-4
B-TF-NE	2.1E-3 ± 5.0E-4	a	8.1E-3 ± 1.5E-3	9.9E-3 ± 2.1E-3
B-TF-SE	2.2E-3 ± 5.4E-4	5.7E-3 ± 1.1E-3	5.0E-3 ± 1.1E-3	5.5E-3 ± 1.3E-3
BX-TF-W	1.5E-2 ± 1.6E-3	3.8E-3 ± 9.4E-4	<1	2.7E-3 ± 9.6E-4
C-TF-NE	2.5E-2 ± 2.2E-3	7.4E-4 ± 4.3E-4	3.4E-2 ± 4.5E-3	2.2E-2 ± 4.1E-3
C-TF-SE	5.7E-2 ± 7.9E-3	a	<1	1.5E-2 ± 2.9E-3
Maximum	5.7E-2	2.3E+2	3.4E-2	2.2E-2
Minimum	3.3E-4	7.4E-4	1.4E-3	6.1E-5

(a) Site not sampled.
(b) Counting error not available.

Reference: Elder et al, 1988

883-1726/9869

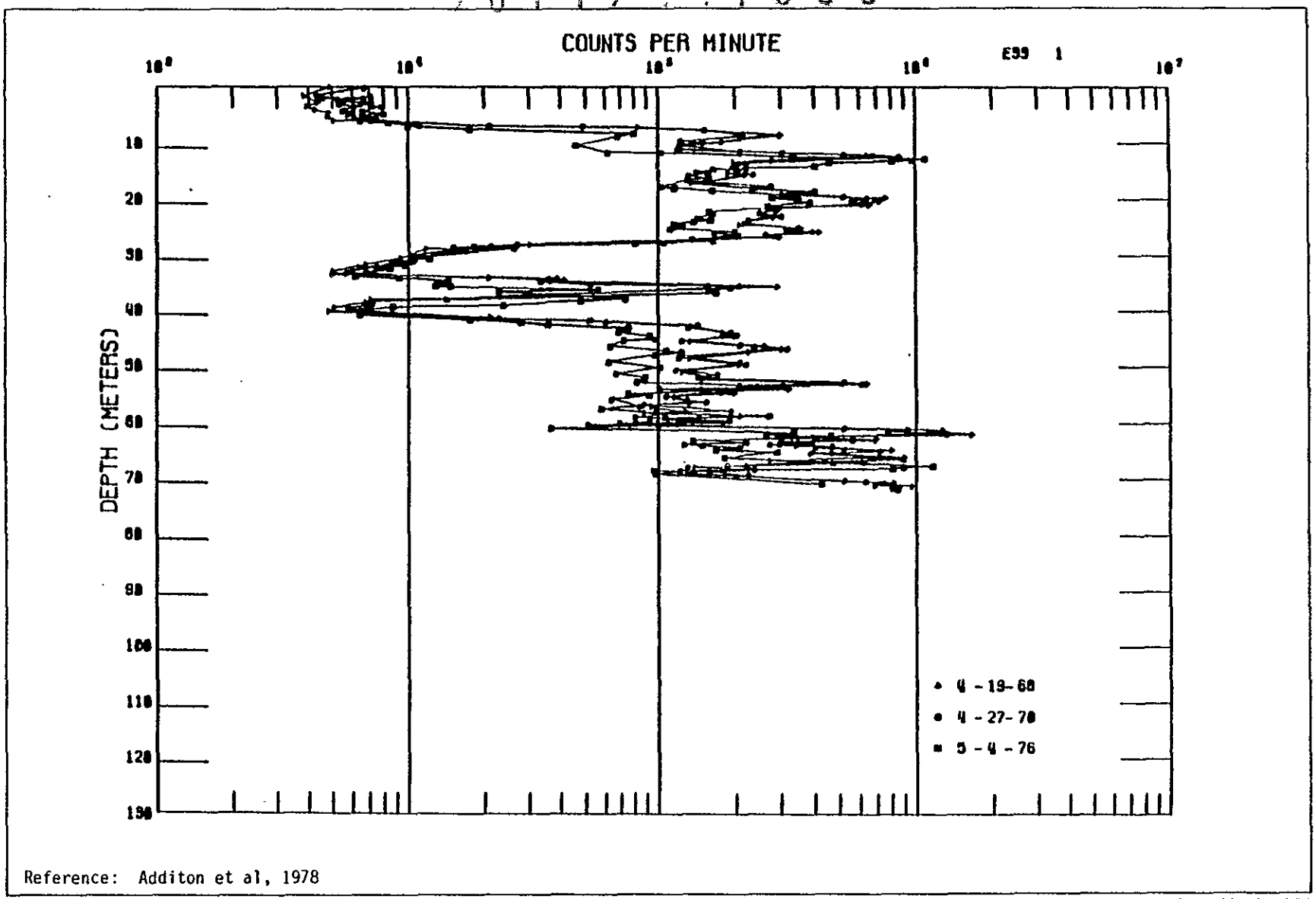
Figure B-10. The ^{239}Pu Concentrations in Soil at the 200 Area Fencelines, 1984 through 1987 (pCi/g dry weight)

APPENDIX C

BOREHOLE SCINTILLATION LOGS

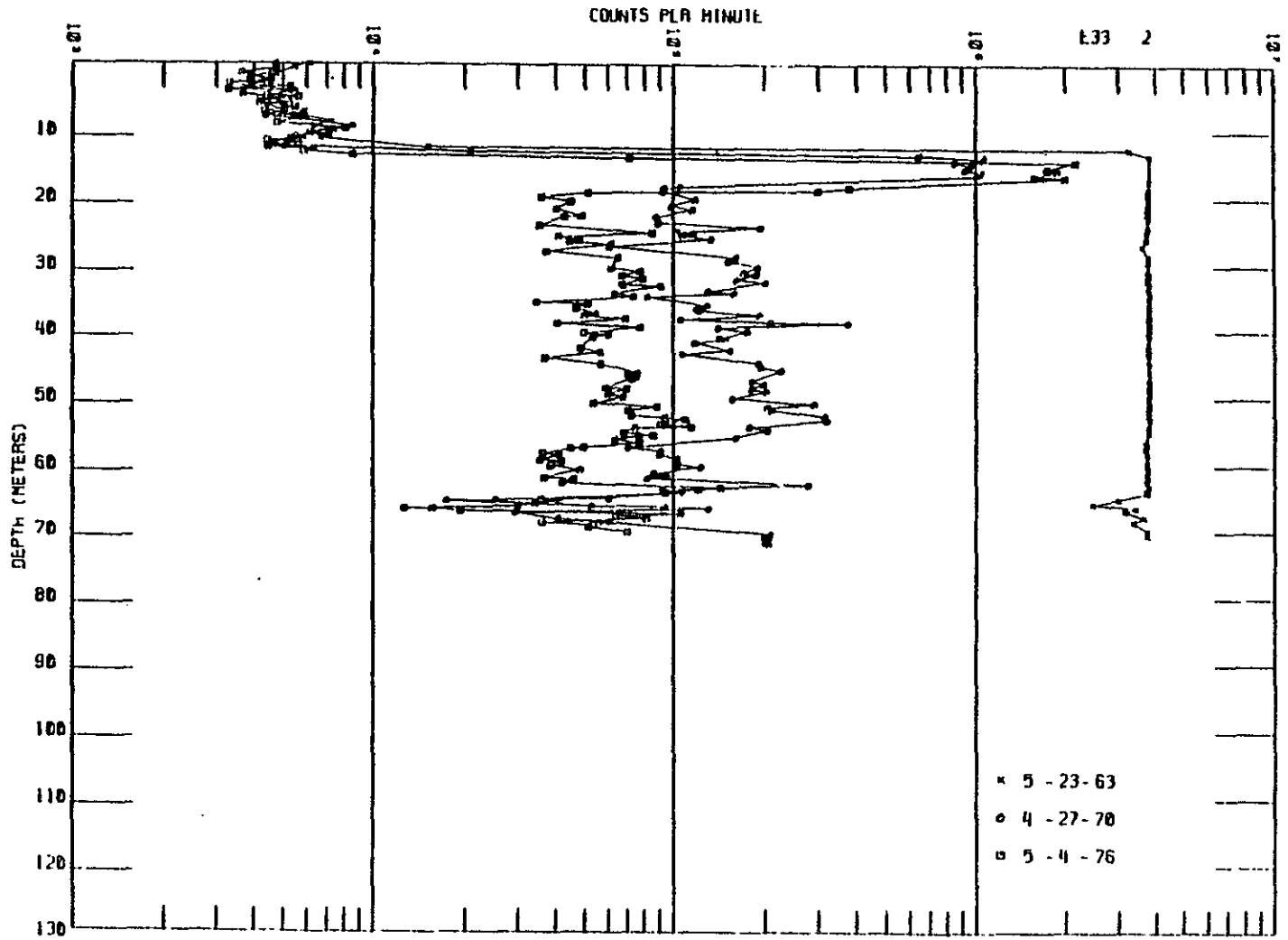
(Additon, M.K., K.R. Fecht, T.L. Jones, and G.V. Last, 1978. Scintillation Probe Profiles 200 East Area Crib Monitoring Wells, RHO-LB-28, prepared by Rockwell International, Richland, WA, for U.S. Department of Energy, Richland, WA.)

9011710049



883-1611/12686

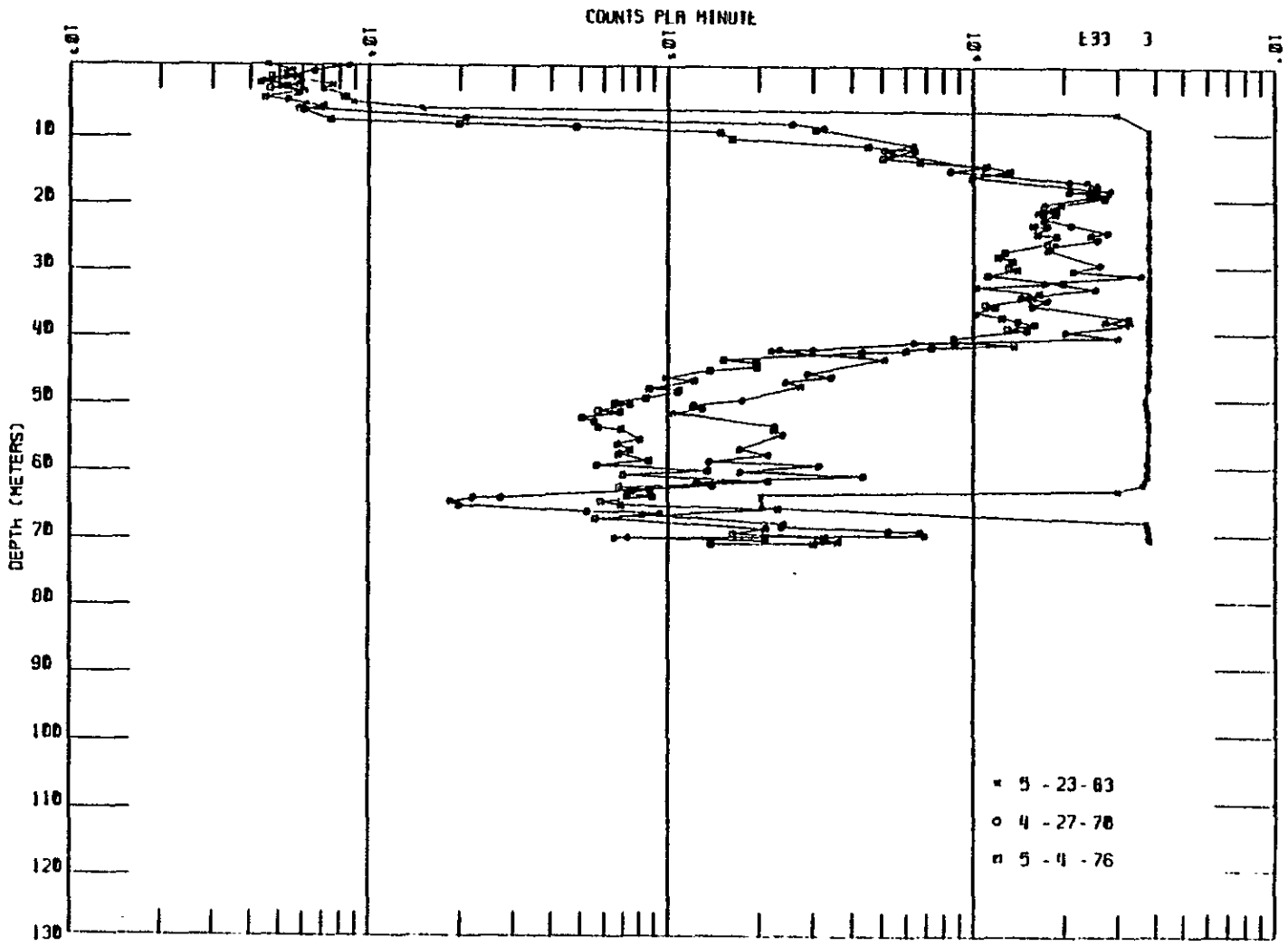
Figure C-1. Borehole Installation Log for Well E33-1



Reference: Additon et al, 1978

883-1611/12687

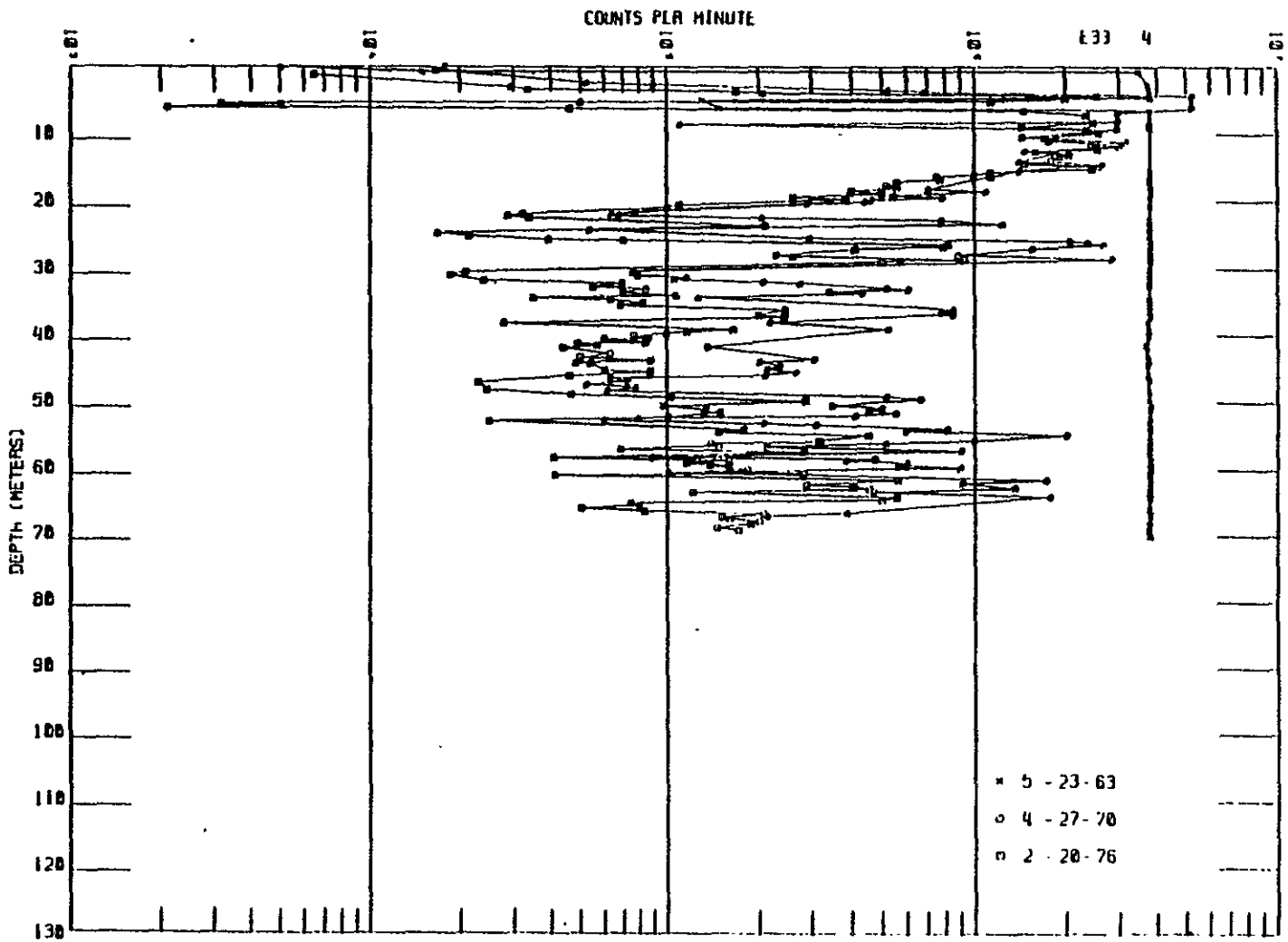
Figure C-2. Borehole Installation Log for Well E33-2.



Reference: Additon et al, 1978

883-1611/12688

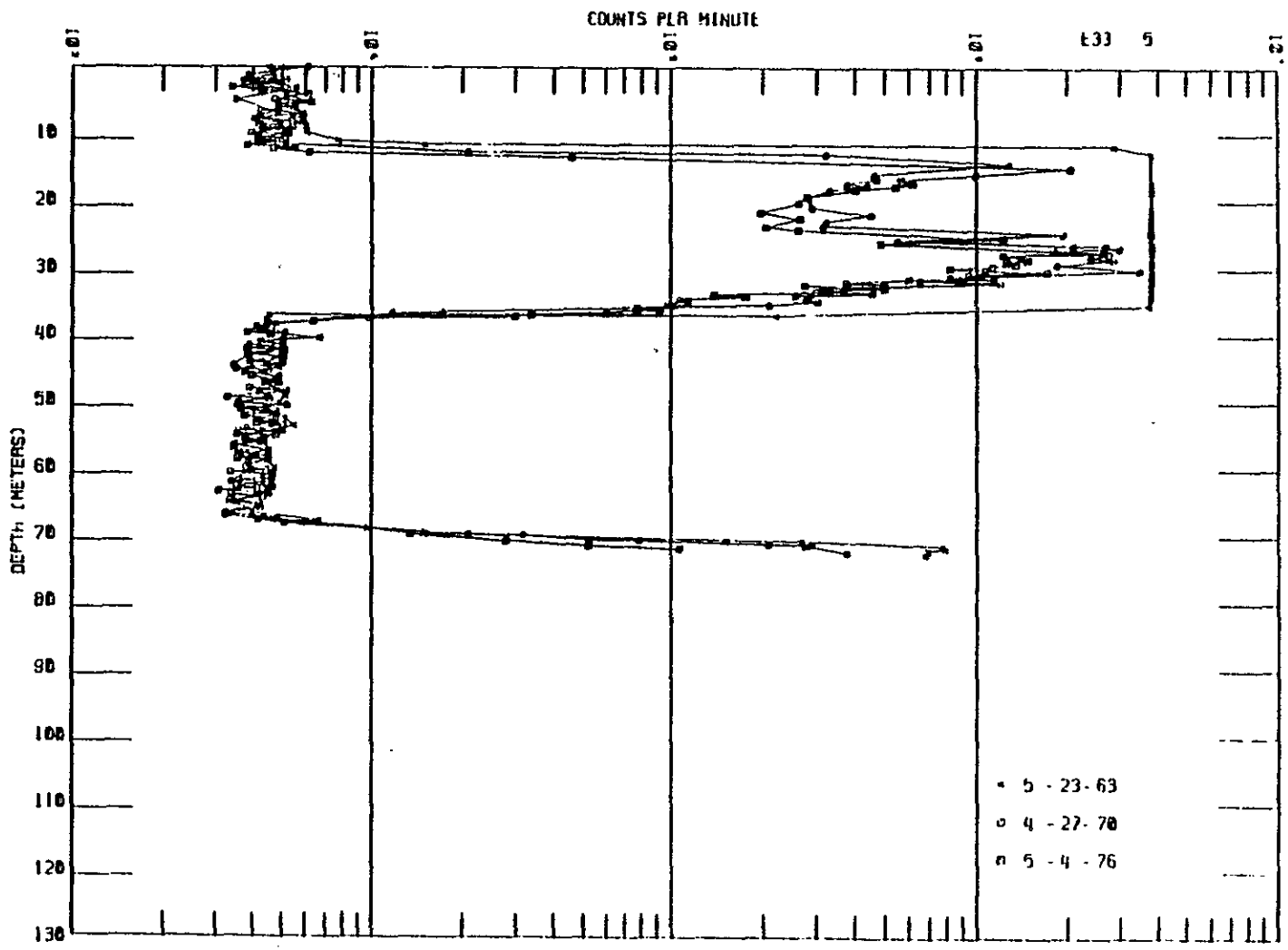
Figure C-3. Borehole Installation Log for Well E33-3



Reference: Additon et al, 1978

883-1611/12689

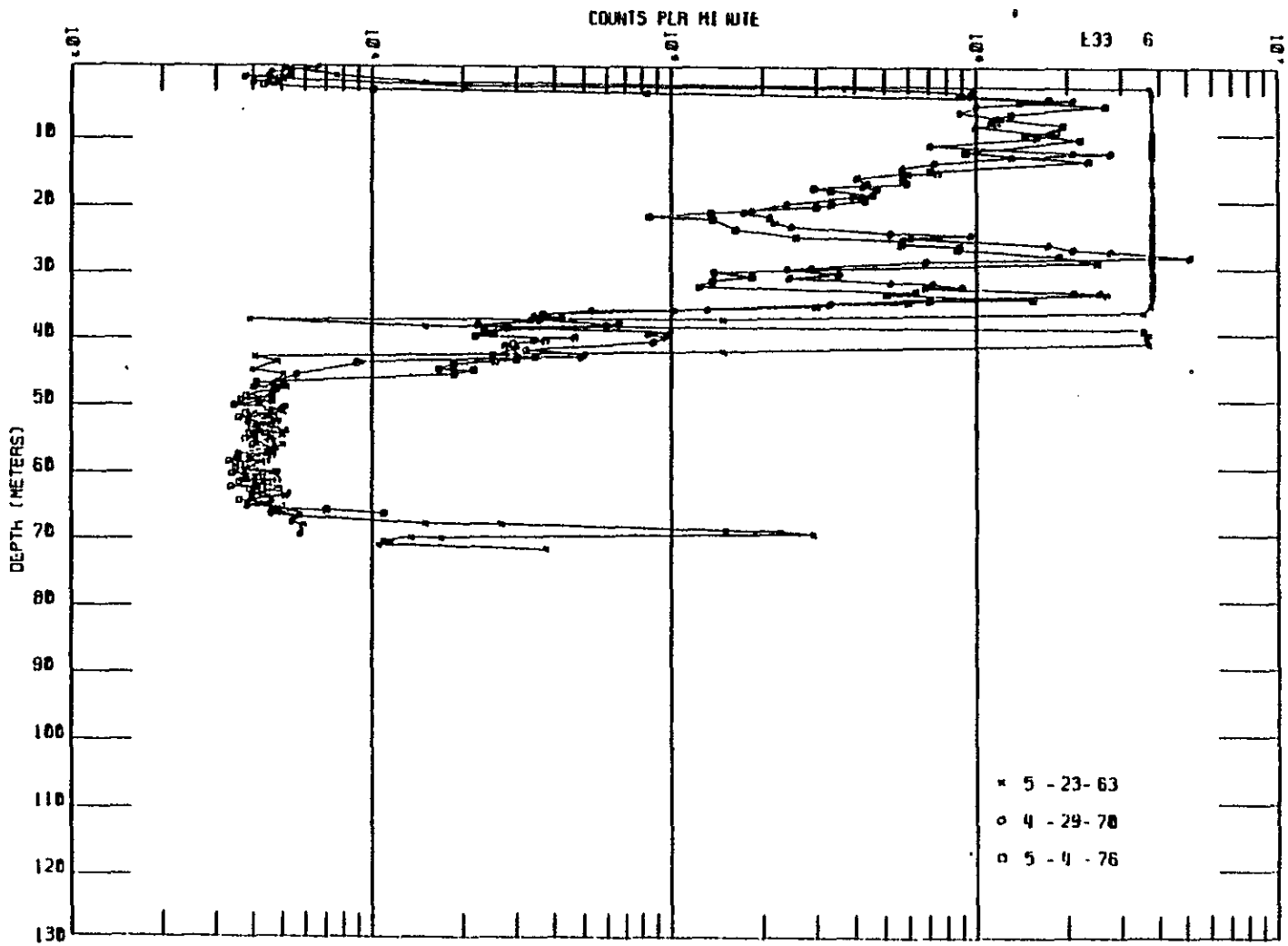
Figure C-4. Borehole Installation Log for Well E33-4



Reference: Additon et al, 1978

883-1611/12690

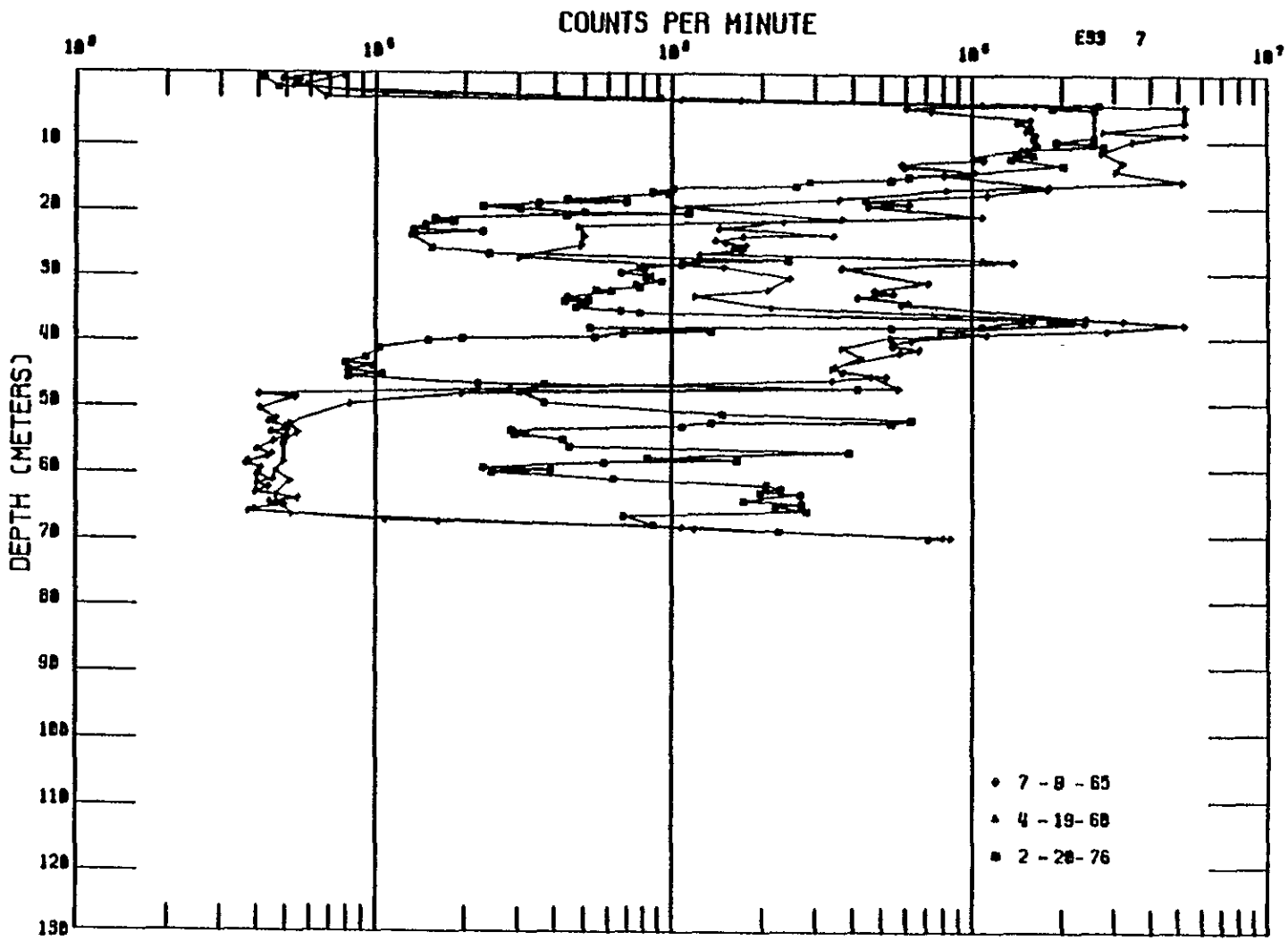
Figure C-5. Borehole Installation Log for Well E33-5



Reference: Additon et al, 1978

883-1611/12691

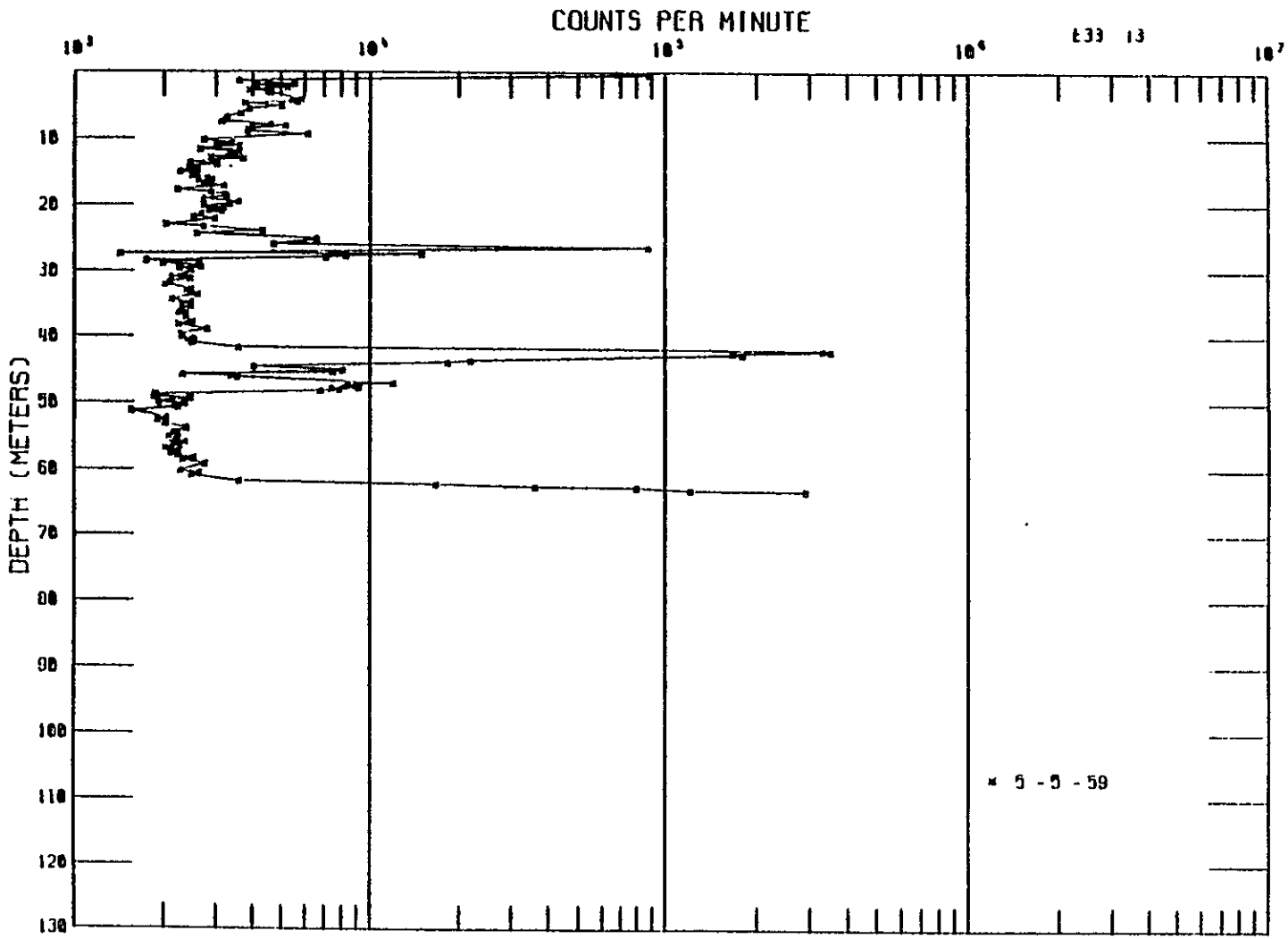
Figure C-6. Borehole Installation Log for Well E33-6



Reference: Additon et al, 1978

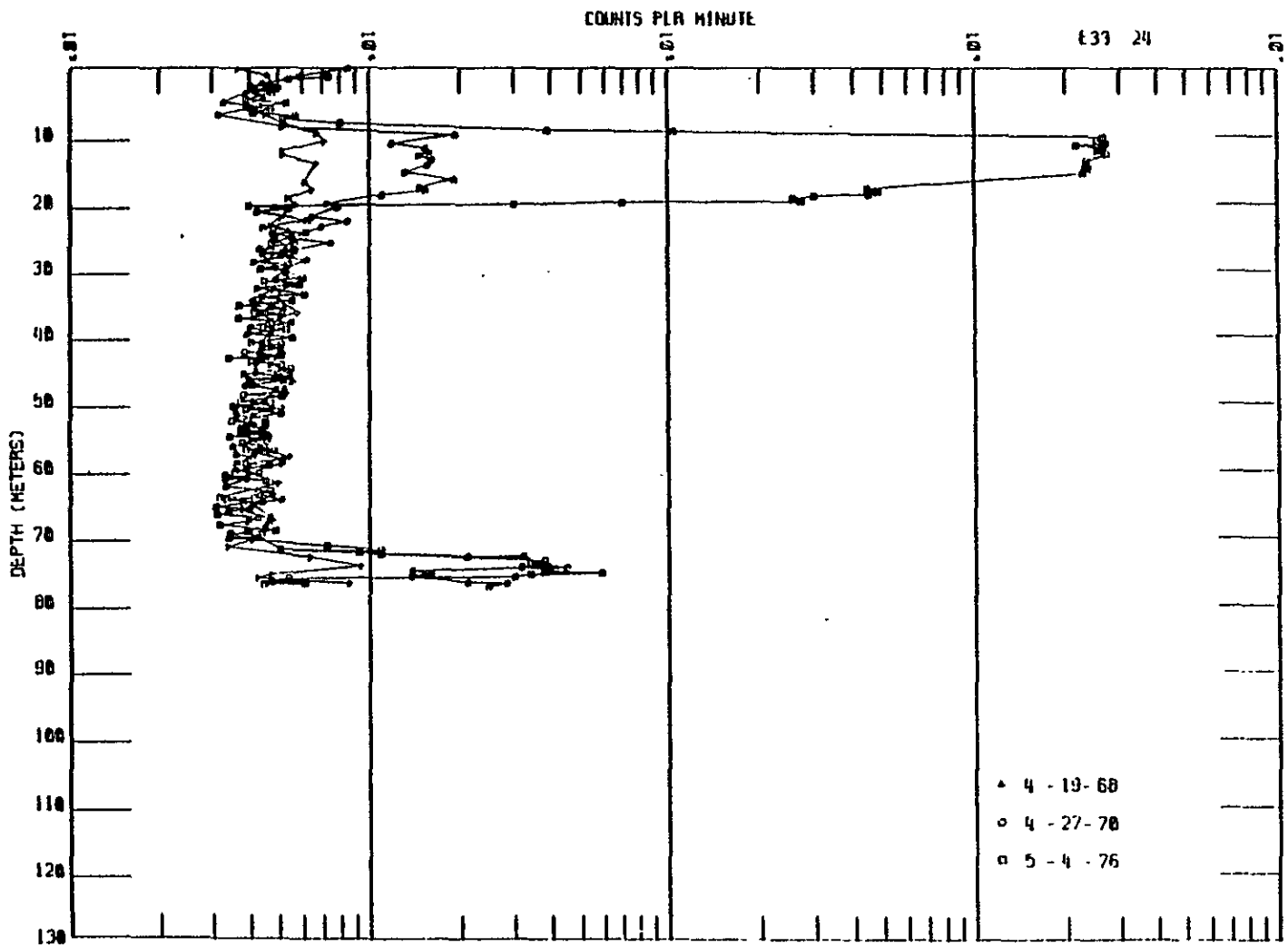
883-1611/12692

Figure C-7. Borehole Installation Log for Well E33-7



Reference: Additon et al, 1978

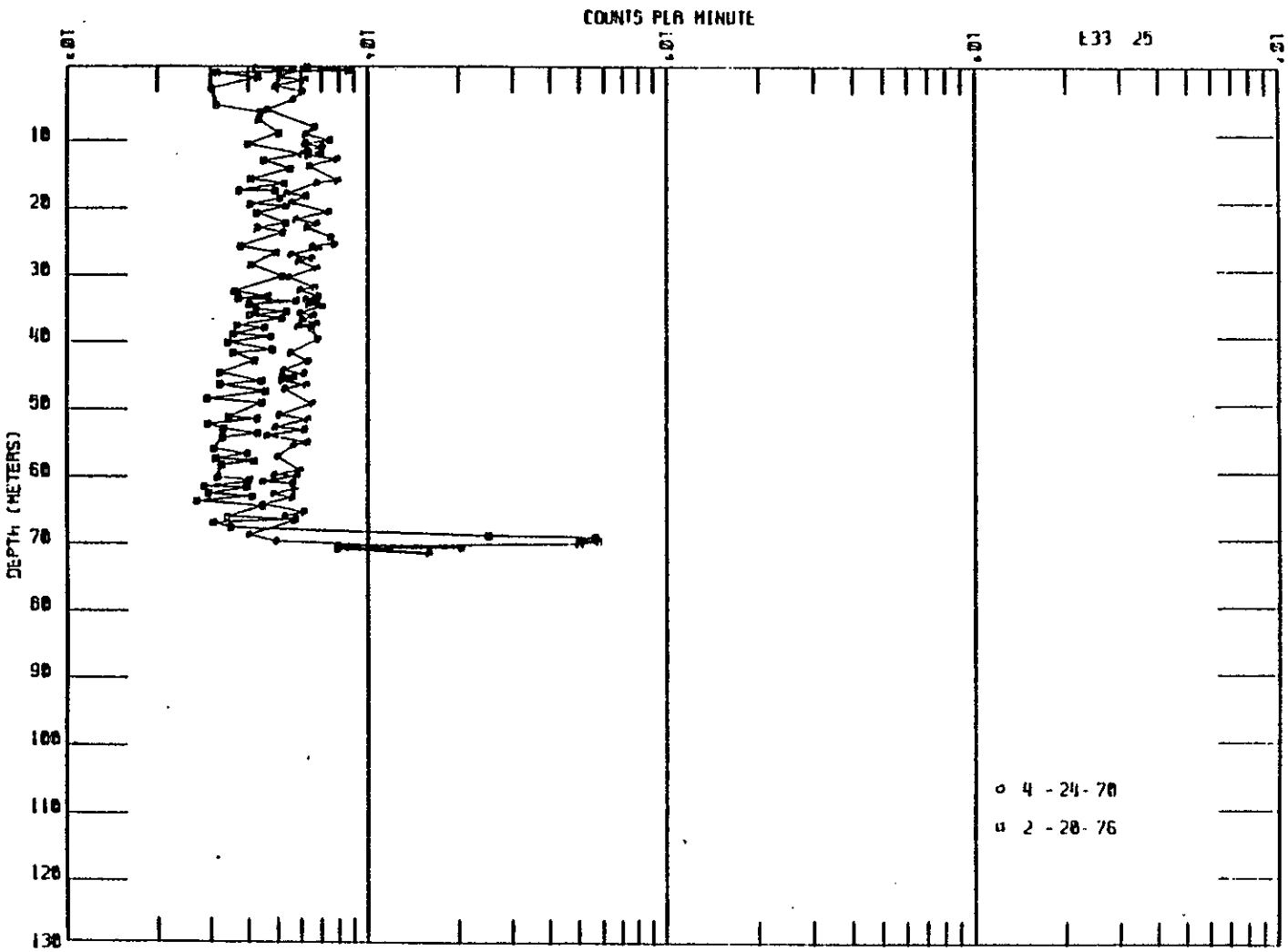
Figure C-8. Borehole Installation Log for Well E33-13



Reference: Additon et al, 1978

883-1611/12693

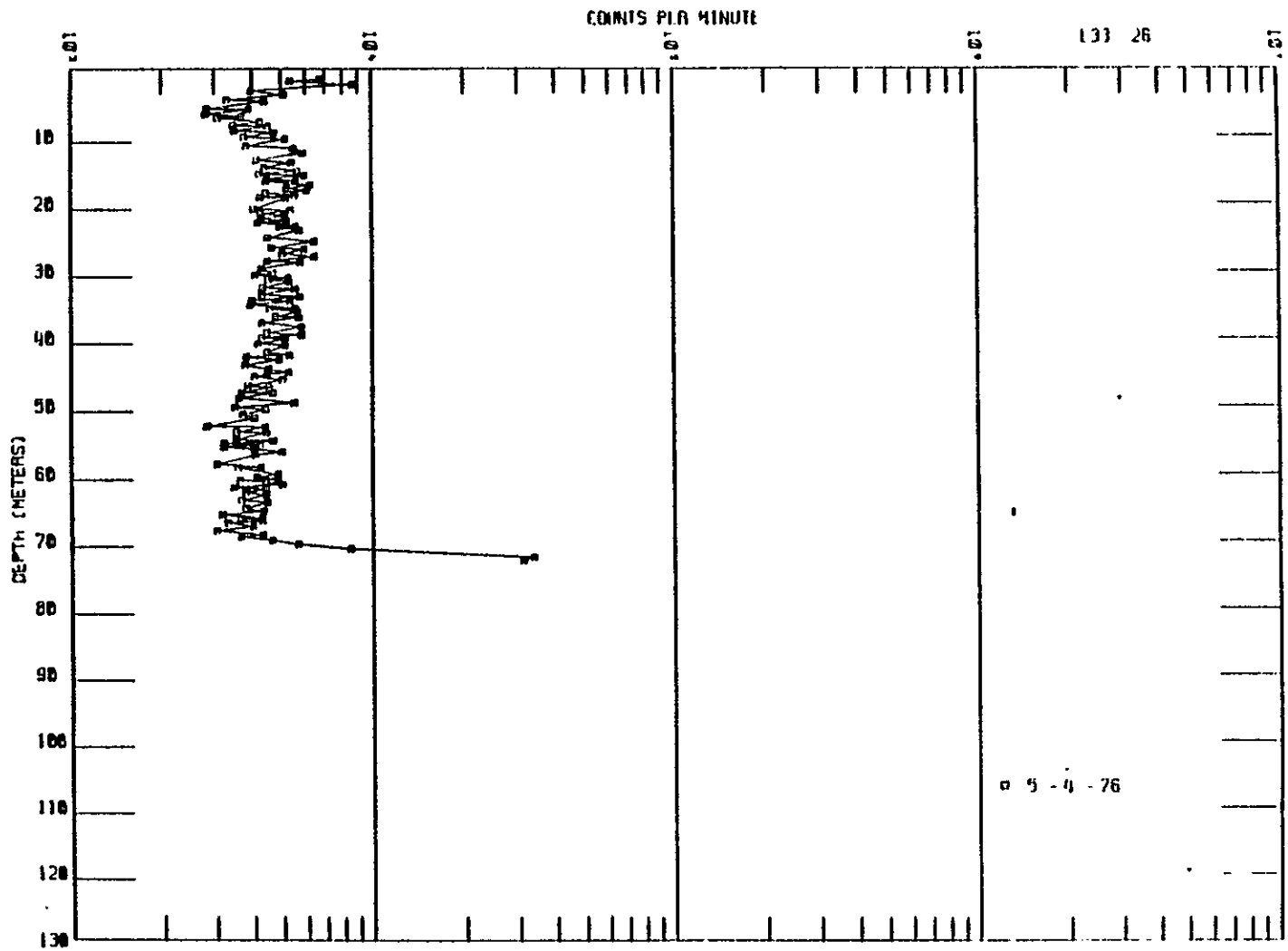
Figure C-9. Borehole Installation Log for Well E33-24



Reference: Additon et al, 1978

883-1611/12694

Figure C-10. Borehole Installation Log for Well E33-25



Reference: Additon et al, 1978

Figure C-11. Borehole Installation Log for Well E33-26

APPENDIX D

GROUNDWATER ANALYSIS BY PARAMETER

(Pacific Northwest Laboratory, 1988c. Preliminary Assessment/Site Inspection Activities on Inactive Waste Sites at Hanford (Draft) - Volume 2, prepared by Pacific Northwest Laboratory, Richland, WA.

List of Compounds	Code Number
ammonium ion	(C80)
cesium-137	(024)
chloride	(C75)
chromium (filtered)	(H22)
cobalt-60	(010)
cyanide	(C70)
fluoride	(C74)
hydrogen ion activity (pH-field)	(199)
kerosene	(C79)
nitrate	(C72)
phosphate	(C76)
plutonium-238	(102)
plutonium-239/240	(100)
ruthenium-106	(034)
selenium (filtered)	(H39)
sodium (filtered)	(H24)
specific electrical conductance	(191)
strontium-90	(121)
sulfate	(C73)
technetium-99	(197)
total gross alpha	(212)
total gross beta	(111)
total organic carbon	(C69)
total uranium	(104)
tributylphosphate acid	(I21)
tritium	(108)

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Ammonium ion

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C80	2-E32-1	PPB	50.	108.	09/13/85
C80	2-E32-1	PPB	50.	50.	05/05/86
C80	2-E32-1	PPB	50.	50.	08/12/86
C80	2-E32-1	PPB	50.	50.	08/06/87
C80	2-E32-1	PPB	50.	50.	12/31/87
C80	2-E32-1	PPB	50.	50.	03/02/88
C80	2-E33-1A	PPB	50.	64.	05/19/87
C80	2-E33-1A	PPB	50.	50.	08/04/87
C80	2-E33-1A	PPB	50.	50.	12/06/87
C80	2-E33-1A	PPB	50.	50.	03/02/88
C80	2-E33-2	PPB	50.	50.	06/23/87
C80	2-E33-3	PPB	50.	70.	05/19/87
C80	2-E33-3	PPB	50.	50.	08/06/87
C80	2-E33-3	PPB	50.	50.	12/06/87
C80	2-E33-3	PPB	50.	50.	03/23/88
C80	2-E33-5	PPB	50.	71.	05/19/87
C80	2-E33-5	PPB	50.	50.	08/10/87
C80	2-E33-5	PPB	50.	50.	12/06/87
C80	2-E33-5	PPB	50.	50.	03/29/88
C80	2-E33-8	PPB	50.	50.	05/22/87
C80	2-E33-8	PPB	50.	50.	08/04/87
C80	2-E33-18	PPB	50.	50.	03/24/87
C80	2-E33-18	PPB	50.	59.	05/19/87
C80	2-E33-18	PPB	50.	50.	08/04/87
C80	2-E33-24	PPB	50.	64.	05/27/87
C80	2-E33-24	PPB	50.	50.	08/06/87
C80	6-49-55A	PPB	50.	256.	08/26/87
C80	6-49-55A	PPB	50.	640.	11/30/87
C80	6-49-55A	PPB	50.	640.	11/30/87
C80	6-49-55A	PPB	50.	620.	11/30/87
C80	6-49-55A	PPB	50.	1450.	02/12/88
C80	6-49-55A	PPB	50.	1490.	02/12/88
C80	6-49-55A	PPB	50.	1450.	02/12/88
C80	6-49-55A	PPB	50.	800.	06/15/88
C80	6-49-55A	PPB	50.	800.	06/15/88
C80	6-49-55A	PPB	50.	800.	06/15/88
C80	6-49-57	PPB	50.	170.	08/16/85
C80	6-49-57	PPB	50.	50.	05/08/86
C80	6-49-57	PPB	50.	50.	08/13/86
C80	6-49-57	PPB	50.	50.	03/19/87
C80	6-49-57	PPB	50.	50.	05/14/87
C80	6-49-57	PPB	50.	50.	09/10/87
C80	6-49-57	PPB	50.	66.	11/30/87
C80	6-49-57	PPB	50.	50.	11/30/87
C80	6-49-57	PPB	50.	50.	11/30/87
C80	6-49-57	PPB	50.	50.	02/09/88
C80	6-49-57	PPB	50.	50.	02/09/88
C80	6-49-57	PPB	50.	50.	02/09/88
C80	6-49-57	PPB	50.	50.	06/01/88
C80	6-50-53	PPB	50.	185.	08/16/85
C80	6-50-53	PPB	50.	98.	05/12/86
C80	6-50-53	PPB	50.	50.	08/04/86
C80	6-50-53	PPB	50.	68.	03/19/87
C80	6-50-53	PPB	50.	72.	05/15/87
C80	6-50-53	PPB	50.	50.	08/26/87
C80	6-50-53	PPB	50.	50.	12/07/87
C80	6-50-53	PPB	50.	50.	12/07/87

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C80	6-50-53	PPB	50.	50.	12/07/87
C80	6-50-53	PPB	50.	82.	03/06/88
C80	6-50-53	PPB	50.	55.	06/06/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Cesium-137

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
024	2-E33-1A	PCI/L	20.	4.88	01/25/85
024	2-E33-1A	PCI/L	20.	-2.09	04/08/85
024	2-E33-1A	PCI/L	20.	2.24	08/28/85
024	2-E33-1A	PCI/L	20.	3.56	11/13/85
024	2-E33-1A	PCI/L	20.	-1.38	02/19/86
024	2-E33-1A	PCI/L	20.	2.89	04/30/86
024	2-E33-1A	PCI/L	20.	-3.42	08/08/86
024	2-E33-1A	PCI/L	20.	-4.53	10/28/86
024	2-E33-1A	PCI/L	20.	3.78	03/15/87
024	2-E33-1A	PCI/L	20.	-2.	05/19/87
024	2-E33-1A	PCI/L	20.	-2.33	08/04/87
024	2-E33-1A	PCI/L	20.	-2.05	12/06/87
024	2-E33-1A	PCI/L	20.	3.89	02/28/88
024	2-E33-3	PCI/L	20.	1.42	01/25/85
024	2-E33-3	PCI/L	20.	6.39	04/08/85
024	2-E33-3	PCI/L	20.	-11.4	08/28/85
024	2-E33-3	PCI/L	20.	0.	11/13/85
024	2-E33-3	PCI/L	20.	-2.87	02/19/86
024	2-E33-3	PCI/L	20.	-0.958	04/30/86
024	2-E33-3	PCI/L	20.	7.68	08/08/86
024	2-E33-3	PCI/L	20.	-2.75	10/28/86
024	2-E33-3	PCI/L	20.	4.	03/15/87
024	2-E33-3	PCI/L	20.	-1.71	05/19/87
024	2-E33-3	PCI/L	20.	5.11	08/06/87
024	2-E33-3	PCI/L	20.	0.662	12/06/87
024	2-E33-3	PCI/L	20.	2.61	02/28/88
024	2-E33-5	PCI/L	20.	-1.42	01/03/85
024	2-E33-5	PCI/L	20.	4.78	01/25/85
024	2-E33-5	PCI/L	20.	4.79	04/10/85
024	2-E33-5	PCI/L	20.	-3.84	08/28/85
024	2-E33-5	PCI/L	20.	7.19	11/13/85
024	2-E33-5	PCI/L	20.	1.6	02/19/86
024	2-E33-5	PCI/L	20.	7.91	04/30/86
024	2-E33-5	PCI/L	20.	-2.99	08/11/86
024	2-E33-5	PCI/L	20.	2.88	10/28/86
024	2-E33-5	PCI/L	20.	4.82	03/15/87
024	2-E33-5	PCI/L	20.	-1.71	05/19/87
024	2-E33-5	PCI/L	20.	-10.3	08/10/87
024	2-E33-5	PCI/L	20.	-0.751	12/06/87
024	2-E33-5	PCI/L	20.	1.06	02/28/88
024	2-E33-7	PCI/L	20.	0.639	01/03/85
024	2-E33-7	PCI/L	20.	1.04	02/13/85
024	2-E33-7	PCI/L	20.	1.78	02/27/86
024	2-E33-7	PCI/L	20.	-15.7	04/30/86
024	2-E33-7	PCI/L	20.	-8.98	08/14/86
024	2-E33-7	PCI/L	20.	5.55	10/28/86
024	2-E33-7	PCI/L	20.	1.92	03/24/87
024	2-E33-7	PCI/L	20.	-15.1	05/19/87
024	2-E33-7	PCI/L	20.	13.4	08/04/87
024	2-E33-7	PCI/L	20.	-11.3	10/28/87
024	2-E33-7	PCI/L	20.	2.63	02/28/88
024	2-E33-7	PCI/L	20.	6.33	05/12/88
024	2-E33-7	PCI/L	20.	0.745	07/26/88
024	2-E33-8	PCI/L	20.	0.348	01/25/85
024	2-E33-8	PCI/L	20.	2.85	04/08/85
024	2-E33-8	PCI/L	20.	1.07	08/29/85
024	2-E33-8	PCI/L	20.	1.03	11/13/85

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
024	2-E33-8	PCI/L	20.	-8.94	02/19/86
024	2-E33-8	PCI/L	20.	-1.92	04/30/86
024	2-E33-8	PCI/L	20.	-1.03	08/08/86
024	2-E33-8	PCI/L	20.	4.82	10/28/86
024	2-E33-8	PCI/L	20.	0.666	03/15/87
024	2-E33-8	PCI/L	20.	-0.854	05/22/87
024	2-E33-8	PCI/L	20.	5.51	08/04/87
024	2-E33-8	PCI/L	20.	3.01	10/28/87
024	2-E33-8	PCI/L	20.	2.83	02/28/88
024	2-E33-9	PCI/L	20.	10.7	01/03/85
024	2-E33-9	PCI/L	20.	8.19	02/13/85
024	2-E33-9	PCI/L	20.	5.43	05/14/85
024	2-E33-9	PCI/L	20.	7.91	02/27/86
024	2-E33-9	PCI/L	20.	3.44	05/05/86
024	2-E33-9	PCI/L	20.	17.9	11/04/86
024	2-E33-9	PCI/L	20.	-5.34	04/02/87
024	2-E33-9	PCI/L	20.	12.	06/29/87
024	2-E33-9	PCI/L	20.	11.	09/02/87
024	2-E33-9	PCI/L	20.	6.84	10/28/87
024	2-E33-9	PCI/L	20.	7.64	05/12/88
024	2-E33-9	PCI/L	20.	3.39	07/29/88
024	2-E33-12	PCI/L	20.	7.26	09/11/86
024	2-E33-12	PCI/L	20.	-7.56	04/01/87
024	2-E33-12	PCI/L	20.	1.	09/01/87
024	2-E33-12	PCI/L	20.	0.228	02/28/88
024	2-E33-14	PCI/L	20.	3.66	04/01/87
024	2-E33-14	PCI/L	20.	-0.689	09/01/87
024	2-E33-18	PCI/L	20.	3.79	01/03/85
024	2-E33-18	PCI/L	20.	-2.07	02/13/85
024	2-E33-18	PCI/L	20.	7.65	04/15/85
024	2-E33-18	PCI/L	20.	4.79	09/05/85
024	2-E33-18	PCI/L	20.	1.07	12/19/85
024	2-E33-18	PCI/L	20.	-8.62	02/27/86
024	2-E33-18	PCI/L	20.	6.19	05/05/86
024	2-E33-18	PCI/L	20.	-0.689	08/11/86
024	2-E33-18	PCI/L	20.	4.82	10/29/86
024	2-E33-18	PCI/L	20.	3.02	03/24/87
024	2-E33-18	PCI/L	20.	-0.855	05/19/87
024	2-E33-18	PCI/L	20.	-1.89	08/04/87
024	2-E33-18	PCI/L	20.	-4.45	10/26/87
024	2-E33-18	PCI/L	20.	-3.76	03/01/88
024	2-E33-20	PCI/L	20.	1.72	04/01/87
024	2-E33-20	PCI/L	20.	1.03	09/02/87
024	2-E33-24	PCI/L	20.	1.07	01/03/85
024	2-E33-24	PCI/L	20.	8.36	01/25/85
024	2-E33-24	PCI/L	20.	-4.87	04/10/85
024	2-E33-24	PCI/L	20.	4.48	08/29/85
024	2-E33-24	PCI/L	20.	-1.78	12/19/85
024	2-E33-24	PCI/L	20.	3.1	02/19/86
024	2-E33-24	PCI/L	20.	-9.89	04/30/86
024	2-E33-24	PCI/L	20.	1.67	08/11/86
024	2-E33-24	PCI/L	20.	3.44	10/28/86
024	2-E33-24	PCI/L	20.	0.666	03/15/87
024	2-E33-24	PCI/L	20.	0.958	05/27/87
024	2-E33-24	PCI/L	20.	-2.65	08/06/87
024	2-E33-24	PCI/L	20.	5.64	10/28/87
024	2-E33-24	PCI/L	20.	-6.36	02/28/88
024	2-E33-26	PCI/L	20.	5.7	01/25/85
024	2-E33-26	PCI/L	20.	0.	04/08/85
024	2-E33-26	PCI/L	20.	0.32	08/28/85
024	2-E33-26	PCI/L	20.	-5.16	11/13/85
024	2-E33-26	PCI/L	20.	-6.07	02/19/86
024	2-E33-26	PCI/L	20.	0.688	04/30/86
024	2-E33-26	PCI/L	20.	6.55	08/08/86
024	2-E33-26	PCI/L	20.	5.51	10/28/86
024	2-E33-26	PCI/L	20.	-1.14	03/15/87
024	2-E33-26	PCI/L	20.	-1.6543E37	06/16/87
024	2-E33-26	PCI/L	20.	-6.4	09/01/87

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
024	2-E33-26	PCI/L	20.	1.99	10/28/87
024	2-E33-26	PCI/L	20.	1.94	02/22/88
024	6-49-55A	PCI/L	20.	2.33	02/28/87
024	6-49-55A	PCI/L	20.	-4.92	05/31/87
024	6-49-55A	PCI/L	20.	4.	08/25/87
024	6-49-55A	PCI/L	20.	-5.96	11/30/87
024	6-49-55A	PCI/L	20.	-4.64	02/12/88
024	6-49-55A	PCI/L	20.	-0.847	04/15/88
024	6-49-55A	PCI/L	20.	-2.63	04/15/88
024	6-49-55B	PCI/L	20.	-5.16	09/09/86
024	6-49-57	PCI/L	20.	24.	11/13/86
024	6-49-57	PCI/L	20.	-5.55	02/28/87
024	6-49-57	PCI/L	20.	-2.56	05/14/87
024	6-49-57	PCI/L	20.	9.33	08/25/87
024	6-49-57	PCI/L	20.	5.47	11/30/87
024	6-49-57	PCI/L	20.	-4.68	02/09/88
024	6-49-57	PCI/L	20.	4.11	06/01/88
024	6-50-53	PCI/L	20.	-1.13	02/28/87
024	6-50-53	PCI/L	20.	-8.63	05/15/87
024	6-50-53	PCI/L	20.	-2.65	08/25/87
024	6-50-53	PCI/L	20.	5.63	12/07/87
024	6-50-53	PCI/L	20.	3.18	03/06/88
024	6-50-53	PCI/L	20.	-1.5	04/15/88
024	6-50-53	PCI/L	20.	-0.373	04/15/88
024	6-53-55A	PCI/L	20.	1.72	01/17/85
024	6-53-55A	PCI/L	20.	-0.344	02/11/85
024	6-53-55A	PCI/L	20.	0.356	03/14/85
024	6-53-55A	PCI/L	20.	-2.78	04/01/85
024	6-53-55A	PCI/L	20.	-0.696	05/03/85
024	6-53-55A	PCI/L	20.	3.13	06/11/85
024	6-53-55A	PCI/L	20.	-2.75	07/12/85
024	6-53-55A	PCI/L	20.	4.13	08/13/85
024	6-53-55A	PCI/L	20.	5.16	09/19/85
024	6-53-55A	PCI/L	20.	1.03	10/07/85
024	6-53-55A	PCI/L	20.	-5.34	11/08/85
024	6-53-55A	PCI/L	20.	3.83	01/09/86
024	6-53-55A	PCI/L	20.	-0.639	02/06/86
024	6-53-55A	PCI/L	20.	-6.39	03/07/86
024	6-53-55A	PCI/L	20.	3.79	04/11/86
024	6-53-55A	PCI/L	20.	0.32	05/06/86
024	6-53-55A	PCI/L	20.	1.67	06/03/86
024	6-53-55A	PCI/L	20.	5.	06/30/86
024	6-53-55A	PCI/L	20.	0.	08/04/86
024	6-53-55A	PCI/L	20.	-2.88	09/04/86
024	6-53-55A	PCI/L	20.	3.1	10/08/86
024	6-53-55A	PCI/L	20.	0.	11/04/86
024	6-53-55A	PCI/L	20.	1.28	12/09/86
024	6-53-55A	PCI/L	20.	4.91	04/06/87
024	6-53-55A	PCI/L	20.	4.	07/08/87
024	6-53-55A	PCI/L	20.	7.7	10/06/87
024	6-53-55A	PCI/L	20.	5.64	01/08/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Chloride

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C75	2-E32-1	PPB	500.	5040.	09/13/85
C75	2-E32-1	PPB	500.	8890.	05/05/86
C75	2-E32-1	PPB	500.	12100.	08/12/86
C75	2-E32-1	PPB	500.	12500.	08/06/87
C75	2-E32-1	PPB	500.	17200.	12/31/87
C75	2-E32-1	PPB	500.	15000.	03/02/88
C75	2-E33-1A	PPB	500.	2260.	05/19/87
C75	2-E33-1A	PPB	500.	3830.	08/04/87
C75	2-E33-1A	PPB	500.	7470.	12/06/87
C75	2-E33-1A	PPB	500.	10000.	03/02/88
C75	2-E33-2	PPB	500.	3260.	06/23/87
C75	2-E33-3	PPB	500.	2930.	05/19/87
C75	2-E33-3	PPB	500.	3530.	08/06/87
C75	2-E33-3	PPB	500.	3740.	12/06/87
C75	2-E33-3	PPB	500.	4680.	03/23/88
C75	2-E33-5	PPB	500.	4480.	05/19/87
C75	2-E33-5	PPB	500.	5240.	08/10/87
C75	2-E33-5	PPB	500.	5680.	12/06/87
C75	2-E33-5	PPB	500.	6040.	03/29/88
C75	2-E33-8	PPB	500.	4180.	05/22/87
C75	2-E33-8	PPB	500.	4710.	08/04/87
C75	2-E33-18	PPB	500.	2670.	03/24/87
C75	2-E33-18	PPB	500.	2230.	05/19/87
C75	2-E33-18	PPB	500.	3560.	08/04/87
C75	2-E33-24	PPB	500.	3840.	05/27/87
C75	2-E33-24	PPB	500.	4860.	08/06/87
C75	6-49-55A	PPB	500.	16200.	08/26/87
C75	6-49-55A	PPB	500.	15000.	11/30/87
C75	6-49-55A	PPB	500.	15100.	11/30/87
C75	6-49-55A	PPB	500.	15100.	11/30/87
C75	6-49-55A	PPB	500.	14100.	02/12/88
C75	6-49-55A	PPB	500.	14200.	02/12/88
C75	6-49-55A	PPB	500.	13900.	02/12/88
C75	6-49-55A	PPB	500.	15200.	06/15/88
C75	6-49-57	PPB	500.	3700.	08/16/85
C75	6-49-57	PPB	500.	2680.	05/08/86
C75	6-49-57	PPB	500.	2900.	08/13/86
C75	6-49-57	PPB	500.	4930.	03/19/87
C75	6-49-57	PPB	500.	3010.	05/14/87
C75	6-49-57	PPB	500.	3550.	09/10/87
C75	6-49-57	PPB	500.	4210.	11/30/87
C75	6-49-57	PPB	500.	4190.	11/30/87
C75	6-49-57	PPB	500.	4190.	11/30/87
C75	6-49-57	PPB	500.	3910.	02/09/88
C75	6-49-57	PPB	500.	4050.	02/09/88
C75	6-49-57	PPB	500.	3970.	02/09/88
C75	6-49-57	PPB	500.	5280.	06/01/88
C75	6-50-53	PPB	500.	66600.	08/16/85
C75	6-50-53	PPB	500.	58800.	05/12/86
C75	6-50-53	PPB	500.	51100.	08/04/86
C75	6-50-53	PPB	500.	52500.	03/19/87
C75	6-50-53	PPB	500.	40100.	05/15/87
C75	6-50-53	PPB	500.	40800.	08/26/87
C75	6-50-53	PPB	500.	112000.	12/07/87
C75	6-50-53	PPB	500.	113000.	12/07/87
C75	6-50-53	PPB	500.	113000.	12/07/87
C75	6-50-53	PPB	500.	38200.	03/06/88

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C75	6-50-53	PPB	500.	37300.	03/06/88
C75	6-50-53	PPB	500.	35500.	03/06/88
C75	6-50-53	PPB	500.	36800.	06/06/88
C75	6-50-53	PPB	500.	36300.	06/06/88
C75	6-50-53	PPB	500.	33900.	06/06/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Chromium, filtered

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
H22	2-E32-1	PPB	10.	10.	08/06/87
H22	2-E32-1	PPB	10.	10.	12/31/87
H22	2-E32-1	PPB	10.	10.	03/02/88
H22	2-E33-1A	PPB	10.	11.	05/19/87
H22	2-E33-1A	PPB	10.	11.	08/04/87
H22	2-E33-1A	PPB	10.	13.	12/06/87
H22	2-E33-1A	PPB	10.	10.	03/02/88
H22	2-E33-2	PPB	10.	10.	06/23/87
H22	2-E33-3	PPB	10.	12.	05/19/87
H22	2-E33-3	PPB	10.	10.	08/06/87
H22	2-E33-3	PPB	10.	13.	12/06/87
H22	2-E33-3	PPB	10.	10.	03/23/88
H22	2-E33-5	PPB	10.	10.	05/19/87
H22	2-E33-5	PPB	10.	10.	08/10/87
H22	2-E33-5	PPB	10.	11.	12/06/87
H22	2-E33-5	PPB	10.	10.	03/29/88
H22	2-E33-8	PPB	10.	10.	05/22/87
H22	2-E33-8	PPB	10.	10.	08/04/87
H22	2-E33-18	PPB	10.	10.	03/24/87
H22	2-E33-18	PPB	10.	10.	05/19/87
H22	2-E33-18	PPB	10.	10.	08/04/87
H22	2-E33-24	PPB	10.	10.	05/27/87
H22	2-E33-24	PPB	10.	10.	08/06/87
H22	6-49-55A	PPB	10.	10.	08/26/87
H22	6-49-55A	PPB	10.	10.	11/30/87
H22	6-49-55A	PPB	10.	10.	11/30/87
H22	6-49-55A	PPB	10.	10.	11/30/87
H22	6-49-55A	PPB	10.	10.	02/12/88
H22	6-49-55A	PPB	10.	10.	06/15/88
H22	6-49-55A	PPB	10.	10.	06/15/88
H22	6-49-55A	PPB	10.	10.	06/15/88
H22	6-49-57	PPB	10.	11.	03/19/87
H22	6-49-57	PPB	10.	10.	05/14/87
H22	6-49-57	PPB	10.	10.	09/10/87
H22	6-49-57	PPB	10.	11.	11/30/87
H22	6-49-57	PPB	10.	11.	11/30/87
H22	6-49-57	PPB	10.	10.	11/30/87
H22	6-49-57	PPB	10.	11.	02/09/88
H22	6-49-57	PPB	10.	11.	02/09/88
H22	6-49-57	PPB	10.	11.	02/09/88
H22	6-49-57	PPB	10.	10.	06/01/88
H22	6-49-57	PPB	10.	10.	06/01/88
H22	6-49-57	PPB	10.	10.	06/01/88
H22	6-50-53	PPB	10.	10.	03/19/87
H22	6-50-53	PPB	10.	10.	05/15/87
H22	6-50-53	PPB	10.	10.	08/26/87
H22	6-50-53	PPB	10.	10.	12/07/87
H22	6-50-53	PPB	10.	10.	12/07/87
H22	6-50-53	PPB	10.	10.	12/07/87
H22	6-50-53	PPB	10.	10.	03/06/88
H22	6-50-53	PPB	10.	10.	03/06/88
H22	6-50-53	PPB	10.	10.	03/06/88
H22	6-50-53	PPB	10.	10.	06/06/88
H22	6-50-53	PPB	10.	10.	06/06/88
H22	6-50-53	PPB	10.	10.	06/06/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Cobalt-60

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
010	2-E33-1A	PCI/L	22.5	-5.46	01/25/85
010	2-E33-1A	PCI/L	22.5	20.6	04/08/85
010	2-E33-1A	PCI/L	22.5	9.13	08/28/85
010	2-E33-1A	PCI/L	22.5	4.73	11/13/85
010	2-E33-1A	PCI/L	22.5	12.4	02/19/86
010	2-E33-1A	PCI/L	22.5	20.1	04/30/86
010	2-E33-1A	PCI/L	22.5	2.12	08/08/86
010	2-E33-1A	PCI/L	22.5	8.5	10/28/86
010	2-E33-1A	PCI/L	22.5	13.4	03/15/87
010	2-E33-1A	PCI/L	22.5	2.67	05/19/87
010	2-E33-1A	PCI/L	22.5	19.3	08/04/87
010	2-E33-1A	PCI/L	22.5	5.63	12/06/87
010	2-E33-1A	PCI/L	22.5	-1.71	02/28/88
010	2-E33-3	PCI/L	22.5	71.1	01/25/85
010	2-E33-3	PCI/L	22.5	232.	04/08/85
010	2-E33-3	PCI/L	22.5	175.	08/28/85
010	2-E33-3	PCI/L	22.5	106.	11/13/85
010	2-E33-3	PCI/L	22.5	31.9	02/19/86
010	2-E33-3	PCI/L	22.5	72.7	04/30/86
010	2-E33-3	PCI/L	22.5	57.8	08/08/86
010	2-E33-3	PCI/L	22.5	7.89	10/28/86
010	2-E33-3	PCI/L	22.5	1.07	03/15/87
010	2-E33-3	PCI/L	22.5	9.82	05/19/87
010	2-E33-3	PCI/L	22.5	24.1	08/06/87
010	2-E33-3	PCI/L	22.5	7.46	12/06/87
010	2-E33-3	PCI/L	22.5	7.88	02/28/88
010	2-E33-5	PCI/L	22.5	18.9	01/03/85
010	2-E33-5	PCI/L	22.5	13.3	01/25/85
010	2-E33-5	PCI/L	22.5	29.3	04/10/85
010	2-E33-5	PCI/L	22.5	28.4	08/28/85
010	2-E33-5	PCI/L	22.5	17.9	11/13/85
010	2-E33-5	PCI/L	22.5	27.3	02/19/86
010	2-E33-5	PCI/L	22.5	53.4	04/30/86
010	2-E33-5	PCI/L	22.5	18.3	08/11/86
010	2-E33-5	PCI/L	22.5	28.3	10/28/86
010	2-E33-5	PCI/L	22.5	22.7	03/15/87
010	2-E33-5	PCI/L	22.5	18.2	05/19/87
010	2-E33-5	PCI/L	22.5	30.8	08/10/87
010	2-E33-5	PCI/L	22.5	13.9	12/06/87
010	2-E33-5	PCI/L	22.5	13.2	02/28/88
010	2-E33-7	PCI/L	22.5	114.	01/03/85
010	2-E33-7	PCI/L	22.5	82.	02/13/85
010	2-E33-7	PCI/L	22.5	70.8	02/27/86
010	2-E33-7	PCI/L	22.5	77.8	04/30/86
010	2-E33-7	PCI/L	22.5	117.	08/14/86
010	2-E33-7	PCI/L	22.5	51.8	10/28/86
010	2-E33-7	PCI/L	22.5	39.3	03/24/87
010	2-E33-7	PCI/L	22.5	74.8	05/19/87
010	2-E33-7	PCI/L	22.5	76.9	08/04/87
010	2-E33-7	PCI/L	22.5	40.1	10/28/87
010	2-E33-7	PCI/L	22.5	53.1	02/28/88
010	2-E33-7	PCI/L	22.5	26.4	05/12/88
010	2-E33-7	PCI/L	22.5	70.7	07/26/88
010	2-E33-8	PCI/L	22.5	10.9	01/25/85
010	2-E33-8	PCI/L	22.5	-4.14	04/08/85
010	2-E33-8	PCI/L	22.5	-5.33	08/29/85
010	2-E33-8	PCI/L	22.5	-1.69	11/13/85

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
010	2-E33-8	PCI/L	22.5	5.05	02/19/86
010	2-E33-8	PCI/L	22.5	-5.56	04/30/86
010	2-E33-8	PCI/L	22.5	1.14	08/08/86
010	2-E33-8	PCI/L	22.5	-2.82	10/28/86
010	2-E33-8	PCI/L	22.5	6.44	03/15/87
010	2-E33-8	PCI/L	22.5	5.6	05/22/87
010	2-E33-8	PCI/L	22.5	4.52	08/04/87
010	2-E33-8	PCI/L	22.5	-4.86	10/28/87
010	2-E33-8	PCI/L	22.5	0.759	02/28/88
010	2-E33-9	PCI/L	22.5	6.77	01/03/85
010	2-E33-9	PCI/L	22.5	9.49	02/13/85
010	2-E33-9	PCI/L	22.5	54.6	05/14/85
010	2-E33-9	PCI/L	22.5	4.51	02/27/86
010	2-E33-9	PCI/L	22.5	-6.77	05/05/86
010	2-E33-9	PCI/L	22.5	12.6	11/04/86
010	2-E33-9	PCI/L	22.5	1.06	04/02/87
010	2-E33-9	PCI/L	22.5	-2.11	06/29/87
010	2-E33-9	PCI/L	22.5	-1.7	09/02/87
010	2-E33-9	PCI/L	22.5	-2.82	10/28/87
010	2-E33-9	PCI/L	22.5	-1.5	05/12/88
010	2-E33-9	PCI/L	22.5	-0.169	07/29/88
010	2-E33-12	PCI/L	22.5	19.6	09/11/86
010	2-E33-12	PCI/L	22.5	18.2	04/01/87
010	2-E33-12	PCI/L	22.5	16.2	09/01/87
010	2-E33-12	PCI/L	22.5	7.73	02/28/88
010	2-E33-14	PCI/L	22.5	2.1	02/13/85
010	2-E33-14	PCI/L	22.5	-0.51	04/08/85
010	2-E33-14	PCI/L	22.5	20.	10/10/85
010	2-E33-14	PCI/L	22.5	-2.6	04/29/86
010	2-E33-14	PCI/L	22.5	-20.	07/08/86
010	2-E33-14	PCI/L	22.5	-0.535	04/01/87
010	2-E33-14	PCI/L	22.5	-3.98	09/01/87
010	2-E33-18	PCI/L	22.5	4.51	01/03/85
010	2-E33-18	PCI/L	22.5	-1.7	02/13/85
010	2-E33-18	PCI/L	22.5	-3.02	04/15/85
010	2-E33-18	PCI/L	22.5	-4.55	09/05/85
010	2-E33-18	PCI/L	22.5	-2.95	12/19/85
010	2-E33-18	PCI/L	22.5	-1.51	02/27/86
010	2-E33-18	PCI/L	22.5	6.77	05/05/86
010	2-E33-18	PCI/L	22.5	6.82	08/11/86
010	2-E33-18	PCI/L	22.5	0.563	10/29/86
010	2-E33-18	PCI/L	22.5	-1.83	03/24/87
010	2-E33-18	PCI/L	22.5	2.81	05/19/87
010	2-E33-18	PCI/L	22.5	-0.609	08/04/87
010	2-E33-18	PCI/L	22.5	2.26	10/26/87
010	2-E33-18	PCI/L	22.5	1.42	03/01/88
010	2-E33-20	PCI/L	22.5	6.78	04/01/87
010	2-E33-20	PCI/L	22.5	-11.4	09/02/87
010	2-E33-24	PCI/L	22.5	-4.73	01/03/85
010	2-E33-24	PCI/L	22.5	-8.51	01/25/85
010	2-E33-24	PCI/L	22.5	-14.5	04/10/85
010	2-E33-24	PCI/L	22.5	2.83	08/29/85
010	2-E33-24	PCI/L	22.5	-0.59	12/19/85
010	2-E33-24	PCI/L	22.5	-1.69	02/19/86
010	2-E33-24	PCI/L	22.5	-3.35	04/30/86
010	2-E33-24	PCI/L	22.5	1.62	08/11/86
010	2-E33-24	PCI/L	22.5	7.89	10/28/86
010	2-E33-24	PCI/L	22.5	5.37	03/15/87
010	2-E33-24	PCI/L	22.5	7.07	05/27/87
010	2-E33-24	PCI/L	22.5	-4.87	08/06/87
010	2-E33-24	PCI/L	22.5	6.07	10/28/87
010	2-E33-24	PCI/L	22.5	9.3	02/28/88
010	2-E33-26	PCI/L	22.5	22.6	01/25/85
010	2-E33-26	PCI/L	22.5	1.77	04/08/85
010	2-E33-26	PCI/L	22.5	12.2	08/28/85
010	2-E33-26	PCI/L	22.5	6.21	11/13/85
010	2-E33-26	PCI/L	22.5	16.2	02/19/86
010	2-E33-26	PCI/L	22.5	-7.33	04/30/86

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
010	2-E33-26	PCI/L	22.5	13.7	08/08/86
010	2-E33-26	PCI/L	22.5	9.58	10/28/86
010	2-E33-26	PCI/L	22.5	11.6	03/15/87
010	2-E33-26	PCI/L	22.5	-1.6543E37	06/16/87
010	2-E33-26	PCI/L	22.5	4.57	09/01/87
010	2-E33-26	PCI/L	22.5	19.2	10/28/87
010	2-E33-26	PCI/L	22.5	11.3	02/22/88
010	6-49-55A	PCI/L	22.5	73.	03/18/85
010	6-49-55A	PCI/L	22.5	130.	06/15/85
010	6-49-55A	PCI/L	22.5	140.	10/22/85
010	6-49-55A	PCI/L	22.5	20.	12/06/85
010	6-49-55A	PCI/L	22.5	160.	03/05/86
010	6-49-55A	PCI/L	22.5	160.	09/06/86
010	6-49-55A	PCI/L	22.5	220.	11/13/86
010	6-49-55A	PCI/L	22.5	228.	02/28/87
010	6-49-55A	PCI/L	22.5	206.	05/31/87
010	6-49-55A	PCI/L	22.5	182.	08/25/87
010	6-49-55A	PCI/L	22.5	198.	11/30/87
010	6-49-55A	PCI/L	22.5	222.	02/12/88
010	6-49-55A	PCI/L	22.5	147.	04/15/88
010	6-49-55A	PCI/L	22.5	180.	04/15/88
010	6-49-55B	PCI/L	22.5	-6.2	09/09/86
010	6-49-57	PCI/L	22.5	44.	02/22/85
010	6-49-57	PCI/L	22.5	-8.8	06/15/85
010	6-49-57	PCI/L	22.5	44.	08/16/85
010	6-49-57	PCI/L	22.5	90.	12/12/85
010	6-49-57	PCI/L	22.5	13.	03/05/86
010	6-49-57	PCI/L	22.5	32.	06/02/86
010	6-49-57	PCI/L	22.5	35.	09/06/86
010	6-49-57	PCI/L	22.5	62.	11/13/86
010	6-49-57	PCI/L	22.5	35.	02/28/87
010	6-49-57	PCI/L	22.5	25.2	05/14/87
010	6-49-57	PCI/L	22.5	24.7	08/25/87
010	6-49-57	PCI/L	22.5	29.3	11/30/87
010	6-49-57	PCI/L	22.5	9.81	02/09/88
010	6-49-57	PCI/L	22.5	18.8	06/01/88
010	6-50-53	PCI/L	22.5	6.7	04/01/85
010	6-50-53	PCI/L	22.5	30.	08/06/85
010	6-50-53	PCI/L	22.5	20.	08/16/85
010	6-50-53	PCI/L	22.5	50.	12/09/85
010	6-50-53	PCI/L	22.5	140.	03/05/86
010	6-50-53	PCI/L	22.5	210.	06/02/86
010	6-50-53	PCI/L	22.5	300.	09/25/86
010	6-50-53	PCI/L	22.5	370.	11/26/86
010	6-50-53	PCI/L	22.5	260.	02/28/87
010	6-50-53	PCI/L	22.5	275.	05/15/87
010	6-50-53	PCI/L	22.5	411.	08/25/87
010	6-50-53	PCI/L	22.5	487.	12/07/87
010	6-50-53	PCI/L	22.5	352.	03/06/88
010	6-50-53	PCI/L	22.5	469.	04/15/88
010	6-50-53	PCI/L	22.5	460.	04/15/88
010	6-53-55A	PCI/L	22.5	5.64	01/17/85
010	6-53-55A	PCI/L	22.5	-5.65	02/11/85
010	6-53-55A	PCI/L	22.5	2.37	03/14/85
010	6-53-55A	PCI/L	22.5	3.63	04/01/85
010	6-53-55A	PCI/L	22.5	4.83	05/03/85
010	6-53-55A	PCI/L	22.5	1.21	06/11/85
010	6-53-55A	PCI/L	22.5	4.52	07/12/85
010	6-53-55A	PCI/L	22.5	0.567	08/13/85
010	6-53-55A	PCI/L	22.5	5.66	09/19/85
010	6-53-55A	PCI/L	22.5	2.26	10/07/85
010	6-53-55A	PCI/L	22.5	2.36	11/08/85
010	6-53-55A	PCI/L	22.5	1.01	01/09/86
010	6-53-55A	PCI/L	22.5	-8.09	02/06/86
010	6-53-55A	PCI/L	22.5	1.01	03/07/86
010	6-53-55A	PCI/L	22.5	0.564	04/11/86
010	6-53-55A	PCI/L	22.5	4.04	05/06/86
010	6-53-55A	PCI/L	22.5	2.14	06/03/86

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
010	6-53-55A	PCI/L	22.5	-10.2	06/30/86
010	6-53-55A	PCI/L	22.5	-6.03	08/04/86
010	6-53-55A	PCI/L	22.5	3.04	09/04/86
010	6-53-55A	PCI/L	22.5	2.26	10/08/86
010	6-53-55A	PCI/L	22.5	-3.03	11/04/86
010	6-53-55A	PCI/L	22.5	-0.7	12/09/86
010	6-53-55A	PCI/L	22.5	4.87	04/06/87
010	6-53-55A	PCI/L	22.5	5.36	07/08/87
010	6-53-55A	PCI/L	22.5	2.81	10/06/87
010	6-53-55A	PCI/L	22.5	-3.04	01/08/88

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DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Cyanide

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C70	2-E32-1	PPB	10.	10.	08/06/87
C70	2-E32-1	PPB	10.	10.	12/31/87
C70	2-E32-1	PPB	10.	10.	03/02/88
C70	2-E33-1A	PPB	10.	10.	05/19/87
C70	2-E33-1A	PPB	10.	15.9	08/04/87
C70	2-E33-1A	PPB	10.	10.	12/06/87
C70	2-E33-1A	PPB	10.	10.	03/02/88
C70	2-E33-2	PPB	10.	10.	06/23/87
C70	2-E33-3	PPB	10.	10.	05/19/87
C70	2-E33-3	PPB	10.	38.7	08/06/87
C70	2-E33-3	PPB	10.	10.	12/06/87
C70	2-E33-3	PPB	10.	17.	03/23/88
C70	2-E33-5	PPB	10.	20.	05/19/87
C70	2-E33-5	PPB	10.	26.4	08/10/87
C70	2-E33-5	PPB	10.	15.8	12/06/87
C70	2-E33-5	PPB	10.	17.	03/29/88
C70	2-E33-8	PPB	10.	10.	05/22/87
C70	2-E33-8	PPB	10.	10.	08/04/87
C70	2-E33-18	PPB	10.	10.	03/24/87
C70	2-E33-18	PPB	10.	10.	05/19/87
C70	2-E33-18	PPB	10.	10.	08/04/87
C70	2-E33-24	PPB	10.	10.	05/27/87
C70	2-E33-24	PPB	10.	10.	08/06/87
C70	6-49-55A	PPB	10.	271.	08/26/87
C70	6-49-55A	PPB	10.	342.	11/30/87
C70	6-49-55A	PPB	10.	141.	02/12/88
C70	6-49-55A	PPB	10.	247.	02/12/88
C70	6-49-55A	PPB	10.	106.	02/12/88
C70	6-49-55A	PPB	10.	104.	06/15/88
C70	6-49-55A	PPB	10.	77.	06/15/88
C70	6-49-55A	PPB	10.	10.	06/15/88
C70	6-49-57	PPB	10.	34.4	03/19/87
C70	6-49-57	PPB	10.	23.	05/14/87
C70	6-49-57	PPB	10.	19.	09/10/87
C70	6-49-57	PPB	10.	61.9	11/30/87
C70	6-49-57	PPB	10.	48.9	11/30/87
C70	6-49-57	PPB	10.	61.5	11/30/87
C70	6-49-57	PPB	10.	27.	02/09/88
C70	6-49-57	PPB	10.	21.	02/09/88
C70	6-49-57	PPB	10.	21.	02/09/88
C70	6-49-57	PPB	10.	28.	06/01/88
C70	6-49-57	PPB	10.	25.	06/01/88
C70	6-49-57	PPB	10.	27.	06/01/88
C70	6-50-53	PPB	10.	405.	03/19/87
C70	6-50-53	PPB	10.	460.	05/15/87
C70	6-50-53	PPB	10.	971.	08/26/87
C70	6-50-53	PPB	10.	622.	12/07/87
C70	6-50-53	PPB	10.	1120.	12/07/87
C70	6-50-53	PPB	10.	1120.	12/07/87
C70	6-50-53	PPB	10.	422.	03/06/88
C70	6-50-53	PPB	10.	827.	03/06/88
C70	6-50-53	PPB	10.	489.	03/06/88
C70	6-50-53	PPB	10.	1690.	06/06/88
C70	6-50-53	PPB	10.	1300.	06/06/88
C70	6-50-53	PPB	10.	1360.	06/06/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Fluoride

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C74	2-E32-1	PPB	500.	701.	09/13/85
C74	2-E32-1	PPB	500.	595.	05/05/86
C74	2-E32-1	PPB	500.	510.	08/12/86
C74	2-E32-1	PPB	500.	564.	08/06/87
C74	2-E32-1	PPB	500.	865.	12/31/87
C74	2-E32-1	PPB	500.	507.	03/02/88
C74	2-E33-1A	PPB	500.	675.	05/19/87
C74	2-E33-1A	PPB	500.	500.	08/04/87
C74	2-E33-1A	PPB	500.	587.	12/06/87
C74	2-E33-1A	PPB	500.	500.	03/02/88
C74	2-E33-2	PPB	500.	861.	06/23/87
C74	2-E33-3	PPB	500.	967.	05/19/87
C74	2-E33-3	PPB	500.	781.	08/06/87
C74	2-E33-3	PPB	500.	799.	12/06/87
C74	2-E33-3	PPB	500.	549.	03/23/88
C74	2-E33-5	PPB	500.	560.	05/19/87
C74	2-E33-5	PPB	500.	500.	08/10/87
C74	2-E33-5	PPB	500.	532.	12/06/87
C74	2-E33-5	PPB	500.	500.	03/29/88
C74	2-E33-8	PPB	500.	500.	05/22/87
C74	2-E33-8	PPB	500.	500.	08/04/87
C74	2-E33-18	PPB	500.	500.	03/24/87
C74	2-E33-18	PPB	500.	500.	05/19/87
C74	2-E33-18	PPB	500.	500.	08/04/87
C74	2-E33-24	PPB	500.	500.	05/27/87
C74	2-E33-24	PPB	500.	500.	08/06/87
C74	6-49-55A	PPB	500.	500.	08/26/87
C74	6-49-55A	PPB	500.	777.	11/30/87
C74	6-49-55A	PPB	500.	740.	11/30/87
C74	6-49-55A	PPB	500.	727.	11/30/87
C74	6-49-55A	PPB	500.	500.	02/12/88
C74	6-49-55A	PPB	500.	500.	02/12/88
C74	6-49-55A	PPB	500.	500.	02/12/88
C74	6-49-55A	PPB	500.	500.	06/15/88
C74	6-49-57	PPB	500.	1670.	08/16/85
C74	6-49-57	PPB	500.	1490.	05/08/86
C74	6-49-57	PPB	500.	1120.	08/13/86
C74	6-49-57	PPB	500.	1410.	03/19/87
C74	6-49-57	PPB	500.	1140.	05/14/87
C74	6-49-57	PPB	500.	812.	09/10/87
C74	6-49-57	PPB	500.	1080.	11/30/87
C74	6-49-57	PPB	500.	1040.	11/30/87
C74	6-49-57	PPB	500.	1040.	11/30/87
C74	6-49-57	PPB	500.	1010.	02/09/88
C74	6-49-57	PPB	500.	1010.	02/09/88
C74	6-49-57	PPB	500.	1010.	02/09/88
C74	6-49-57	PPB	500.	878.	06/01/88
C74	6-50-53	PPB	500.	360.	08/16/85
C74	6-50-53	PPB	500.	500.	05/12/86
C74	6-50-53	PPB	500.	500.	08/04/86
C74	6-50-53	PPB	500.	500.	03/19/87
C74	6-50-53	PPB	500.	500.	05/15/87
C74	6-50-53	PPB	500.	500.	08/26/87
C74	6-50-53	PPB	500.	1130.	12/07/87
C74	6-50-53	PPB	500.	1130.	12/07/87
C74	6-50-53	PPB	500.	1100.	12/07/87
C74	6-50-53	PPB	500.	567.	03/06/88

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C74	6-50-53	PPB	500.	564.	03/06/88
C74	6-50-53	PPB	500.	500.	03/06/88
C74	6-50-53	PPB	500.	1020.	06/06/88
C74	6-50-53	PPB	500.	1000.	06/06/88
C74	6-50-53	PPB	500.	1000.	06/06/88

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DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

pH

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
199	2-E32-1		0.1	8.4	09/13/85
199	2-E32-1		0.1	7.1	05/05/86
199	2-E32-1		0.1	7.6	08/12/86
199	2-E32-1		0.1	7.2	08/06/87
199	2-E32-1		0.1	7.6	12/31/87
199	2-E32-1		0.1	8.4	03/02/88
199	2-E33-1A		0.1	7.6	05/19/87
199	2-E33-1A		0.1	7.6	08/04/87
199	2-E33-1A		0.1	7.6	12/06/87
199	2-E33-1A		0.1	8.4	03/02/88
199	2-E33-3		0.1	7.7	05/19/87
199	2-E33-3		0.1	7.5	08/06/87
199	2-E33-3		0.1	7.5	12/06/87
199	2-E33-3		0.1	8.1	03/23/88
199	2-E33-5		0.1	7.5	05/19/87
199	2-E33-5		0.1	7.1	08/10/87
199	2-E33-5		0.1	7.3	12/06/87
199	2-E33-5		0.1	7.2	03/29/88
199	2-E33-8		0.1	6.3	05/22/87
199	2-E33-8		0.1	7.2	08/04/87
199	2-E33-18		0.1	8.1	03/24/87
199	2-E33-18		0.1	7.8	05/19/87
199	2-E33-18		0.1	7.5	08/04/87
199	2-E33-24		0.1	5.8	05/27/87
199	2-E33-24		0.1	7.5	08/06/87
199	6-49-55A		0.1	7.5	08/26/87
199	6-49-55A		0.1	7.7	11/30/87
199	6-49-55A		0.1	7.6	02/12/88
199	6-49-57		0.1	7.7	08/16/85
199	6-49-57		0.1	7.2	05/08/86
199	6-49-57		0.1	7.1	08/13/86
199	6-49-57		0.1	7.9	03/19/87
199	6-49-57		0.1	7.8	05/14/87
199	6-49-57		0.1	7.2	09/10/87
199	6-49-57		0.1	7.7	11/30/87
199	6-49-57		0.1	7.8	02/09/88
199	6-49-57		0.1	8.7	06/01/88
199	6-50-53		0.1	7.8	08/16/85
199	6-50-53		0.1	7.9	05/12/86
199	6-50-53		0.1	6.8	08/04/86
199	6-50-53		0.1	8.1	03/19/87
199	6-50-53		0.1	7.8	05/15/87
199	6-50-53		0.1	7.6	08/26/87
199	6-50-53		0.1	8.2	12/07/87
199	6-50-53		0.1	8.2	03/06/88
199	6-50-53		0.1	7.5	06/06/88

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DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Kerosene

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C79	2-E32-1	PPB	10000.	10000.	09/13/85
C79	2-E32-1	PPB	10000.	10000.	05/05/86
C79	2-E32-1	PPB	10000.	10000.	08/12/86
C79	2-E32-1	PPB	10000.	10000.	08/06/87
C79	2-E32-1	PPB	10000.	10000.	12/31/87
C79	2-E32-1	PPB	10000.	10000.	03/02/88
C79	2-E33-1A	PPB	10000.	10000.	05/19/87
C79	2-E33-1A	PPB	10000.	10000.	08/04/87
C79	2-E33-1A	PPB	10000.	10000.	12/06/87
C79	2-E33-1A	PPB	10000.	10000.	03/02/88
C79	2-E33-2	PPB	10000.	10000.	06/23/87
C79	2-E33-3	PPB	10000.	10000.	12/06/87
C79	2-E33-3	PPB	10000.	10000.	03/23/88
C79	2-E33-5	PPB	10000.	10000.	12/06/87
C79	2-E33-5	PPB	10000.	10000.	03/29/88
C79	2-E33-8	PPB	10000.	10000.	05/22/87
C79	2-E33-8	PPB	10000.	10000.	08/04/87
C79	6-49-55A	PPB	10000.	10000.	08/26/87
C79	6-49-55A	PPB	10000.	10000.	11/30/87
C79	6-49-55A	PPB	10000.	10000.	02/12/88
C79	6-49-55A	PPB	10000.	10000.	06/15/88
C79	6-49-57	PPB	10000.	10000.	08/16/85
C79	6-49-57	PPB	10000.	10000.	05/08/86
C79	6-49-57	PPB	10000.	10000.	08/13/86
C79	6-49-57	PPB	10000.	10000.	03/19/87
C79	6-49-57	PPB	10000.	10000.	05/14/87
C79	6-49-57	PPB	10000.	10000.	11/30/87
C79	6-49-57	PPB	10000.	10000.	02/09/88
C79	6-49-57	PPB	10000.	10000.	06/01/88
C79	6-50-53	PPB	10000.	10000.	08/16/85
C79	6-50-53	PPB	10000.	10000.	05/12/86
C79	6-50-53	PPB	10000.	10000.	08/04/86
C79	6-50-53	PPB	10000.	10000.	08/26/87
C79	6-50-53	PPB	10000.	10000.	12/07/87
C79	6-50-53	PPB	10000.	10000.	03/06/88
C79	6-50-53	PPB	10000.	10000.	06/06/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Nitrate

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C72	2-E32-1	PPB	500.	22300.	09/13/85
C72	2-E32-1	PPB	500.	16500.	05/05/86
C72	2-E32-1	PPB	500.	14600.	08/12/86
C72	2-E32-1	PPB	500.	504.	03/15/87
C72	2-E32-1	PPB	500.	10500.	08/06/87
C72	2-E32-1	PPB	500.	10600.	12/31/87
C72	2-E32-1	PPB	500.	10200.	03/02/88
C72	2-E33-1A	PPB	500.	52300.	05/19/87
C72	2-E33-1A	PPB	500.	54200.	08/04/87
C72	2-E33-1A	PPB	500.	14000.	12/06/87
C72	2-E33-1A	PPB	500.	6640.	03/02/88
C72	2-E33-2	PPB	500.	39400.	06/23/87
C72	2-E33-3	PPB	500.	44200.	05/19/87
C72	2-E33-3	PPB	500.	60800.	08/06/87
C72	2-E33-3	PPB	500.	37800.	12/06/87
C72	2-E33-3	PPB	500.	44600.	03/23/88
C72	2-E33-5	PPB	500.	35200.	05/19/87
C72	2-E33-5	PPB	500.	37900.	08/10/87
C72	2-E33-5	PPB	500.	34600.	12/06/87
C72	2-E33-5	PPB	500.	30900.	03/29/88
C72	2-E33-8	PPB	500.	8250.	05/22/87
C72	2-E33-8	PPB	500.	8880.	08/04/87
C72	2-E33-9	PPB	500.	8970.	11/04/86
C72	2-E33-9	PPB	500.	1660.	04/02/87
C72	2-E33-12	PPB	500.	500.	04/01/87
C72	2-E33-14	PPB	500.	19500.	04/01/87
C72	2-E33-18	PPB	500.	17200.	03/24/87
C72	2-E33-18	PPB	500.	16700.	05/19/87
C72	2-E33-18	PPB	500.	15700.	08/04/87
C72	2-E33-20	PPB	500.	2200.	10/29/86
C72	2-E33-20	PPB	500.	2740.	04/01/87
C72	2-E33-20	PPB	500.	9730.	04/12/87
C72	2-E33-24	PPB	500.	18000.	05/27/87
C72	2-E33-24	PPB	500.	16100.	08/06/87
C72	6-49-55A	PPB	500.	152000.	09/06/86
C72	6-49-55A	PPB	500.	169000.	11/13/86
C72	6-49-55A	PPB	500.	200000.	02/28/87
C72	6-49-55A	PPB	500.	198000.	05/31/87
C72	6-49-55A	PPB	500.	214000.	08/26/87
C72	6-49-55A	PPB	500.	251000.	11/30/87
C72	6-49-55A	PPB	500.	252000.	11/30/87
C72	6-49-55A	PPB	500.	253000.	11/30/87
C72	6-49-55A	PPB	500.	233000.	02/12/88
C72	6-49-55A	PPB	500.	231000.	02/12/88
C72	6-49-55A	PPB	500.	229000.	02/12/88
C72	6-49-55A	PPB	500.	209000.	06/15/88
C72	6-49-55B	PPB	500.	500.	10/27/86
C72	6-49-55B	PPB	500.	-1.6543E37	06/11/87
C72	6-49-57	PPB	500.	114000.	08/16/85
C72	6-49-57	PPB	500.	69300.	05/08/86
C72	6-49-57	PPB	500.	73700.	08/13/86
C72	6-49-57	PPB	500.	74700.	09/06/86
C72	6-49-57	PPB	500.	76100.	11/13/86
C72	6-49-57	PPB	500.	64900.	02/28/87
C72	6-49-57	PPB	500.	59800.	03/19/87
C72	6-49-57	PPB	500.	46800.	05/14/87
C72	6-49-57	PPB	500.	50500.	09/10/87

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C72	6-49-57	PPB	500.	69900.	11/30/87
C72	6-49-57	PPB	500.	70000.	11/30/87
C72	6-49-57	PPB	500.	69800.	11/30/87
C72	6-49-57	PPB	500.	47800.	02/09/88
C72	6-49-57	PPB	500.	48200.	02/09/88
C72	6-49-57	PPB	500.	47600.	02/09/88
C72	6-49-57	PPB	500.	49800.	06/01/88
C72	6-50-53	PPB	500.	44100.	08/16/85
C72	6-50-53	PPB	500.	252000.	05/12/86
C72	6-50-53	PPB	500.	288000.	08/04/86
C72	6-50-53	PPB	500.	319000.	09/25/86
C72	6-50-53	PPB	500.	340000.	11/26/86
C72	6-50-53	PPB	500.	317000.	02/28/87
C72	6-50-53	PPB	500.	298000.	03/19/87
C72	6-50-53	PPB	500.	346000.	05/15/87
C72	6-50-53	PPB	500.	460000.	08/26/87
C72	6-50-53	PPB	500.	506000.	12/07/87
C72	6-50-53	PPB	500.	507000.	12/07/87
C72	6-50-53	PPB	500.	505000.	12/07/87
C72	6-50-53	PPB	500.	538000.	03/06/88
C72	6-50-53	PPB	500.	533000.	03/06/88
C72	6-50-53	PPB	500.	509000.	03/06/88
C72	6-50-53	PPB	500.	559000.	06/06/88
C72	6-50-53	PPB	500.	557000.	06/06/88
C72	6-50-53	PPB	500.	554000.	06/06/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Phosphate

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C76	2-E32-1	PPB	1000.	1000.	09/13/85
C76	2-E32-1	PPB	1000.	1000.	05/05/86
C76	2-E32-1	PPB	1000.	1000.	08/12/86
C76	2-E32-1	PPB	1000.	1000.	08/06/87
C76	2-E32-1	PPB	1000.	1000.	12/31/87
C76	2-E32-1	PPB	1000.	1000.	03/02/88
C76	2-E33-1A	PPB	1000.	1000.	05/19/87
C76	2-E33-1A	PPB	1000.	1000.	08/04/87
C76	2-E33-1A	PPB	1000.	1000.	12/06/87
C76	2-E33-1A	PPB	1000.	1000.	03/02/88
C76	2-E33-2	PPB	1000.	1000.	06/23/87
C76	2-E33-3	PPB	1000.	1000.	05/19/87
C76	2-E33-3	PPB	1000.	1000.	08/06/87
C76	2-E33-3	PPB	1000.	1000.	12/06/87
C76	2-E33-3	PPB	1000.	1000.	03/23/88
C76	2-E33-5	PPB	1000.	1000.	05/19/87
C76	2-E33-5	PPB	1000.	1000.	08/10/87
C76	2-E33-5	PPB	1000.	1000.	12/06/87
C76	2-E33-5	PPB	1000.	1000.	03/29/88
C76	2-E33-8	PPB	1000.	1000.	05/22/87
C76	2-E33-8	PPB	1000.	1000.	08/04/87
C76	2-E33-18	PPB	1000.	1000.	03/24/87
C76	2-E33-18	PPB	1000.	1000.	05/19/87
C76	2-E33-18	PPB	1000.	1000.	08/04/87
C76	2-E33-24	PPB	1000.	1000.	05/27/87
C76	2-E33-24	PPB	1000.	1000.	08/06/87
C76	6-49-55A	PPB	1000.	1000.	08/26/87
C76	6-49-55A	PPB	1000.	1000.	11/30/87
C76	6-49-55A	PPB	1000.	1000.	11/30/87
C76	6-49-55A	PPB	1000.	1000.	11/30/87
C76	6-49-55A	PPB	1000.	1000.	02/12/88
C76	6-49-55A	PPB	1000.	1000.	02/12/88
C76	6-49-55A	PPB	1000.	1000.	02/12/88
C76	6-49-55A	PPB	1000.	1000.	06/15/88
C76	6-49-57	PPB	1000.	1000.	08/16/85
C76	6-49-57	PPB	1000.	1000.	05/08/86
C76	6-49-57	PPB	1000.	1000.	08/13/86
C76	6-49-57	PPB	1000.	1000.	03/19/87
C76	6-49-57	PPB	1000.	1000.	05/14/87
C76	6-49-57	PPB	1000.	1000.	09/10/87
C76	6-49-57	PPB	1000.	1000.	11/30/87
C76	6-49-57	PPB	1000.	1000.	11/30/87
C76	6-49-57	PPB	1000.	1000.	11/30/87
C76	6-49-57	PPB	1000.	1000.	02/09/88
C76	6-49-57	PPB	1000.	1000.	02/09/88
C76	6-49-57	PPB	1000.	1000.	02/09/88
C76	6-49-57	PPB	1000.	1000.	06/01/88
C76	6-50-53	PPB	1000.	1000.	08/16/85
C76	6-50-53	PPB	1000.	1000.	05/12/86
C76	6-50-53	PPB	1000.	1000.	08/04/86
C76	6-50-53	PPB	1000.	1000.	03/19/87
C76	6-50-53	PPB	1000.	1000.	05/15/87
C76	6-50-53	PPB	1000.	1000.	08/26/87
C76	6-50-53	PPB	1000.	1000.	12/07/87
C76	6-50-53	PPB	1000.	1000.	12/07/87
C76	6-50-53	PPB	1000.	1000.	12/07/87
C76	6-50-53	PPB	1000.	1000.	03/06/88

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C76	6-50-53	PPB	1000.	1000.	03/06/88
C76	6-50-53	PPB	1000.	1000.	03/06/88
C76	6-50-53	PPB	1000.	1000.	06/06/88
C76	6-50-53	PPB	1000.	1000.	06/06/88
C76	6-50-53	PPB	1000.	1000.	06/06/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Plutonium-238

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
102	2-E33-1A	PCI/L	17.	0.	03/15/87
102	2-E33-1A	PCI/L	17.	-0.00283	08/04/87
102	2-E33-3	PCI/L	17.	-0.00272	03/15/87
102	2-E33-3	PCI/L	17.	0.	03/15/87
102	2-E33-3	PCI/L	17.	-0.000717	08/06/87
102	2-E33-3	PCI/L	17.	0.00114	08/06/87
102	2-E33-3	PCI/L	17.	0.0538	08/06/87
102	2-E33-5	PCI/L	17.	0.00263	03/15/87
102	2-E33-5	PCI/L	17.	0.0114	08/10/87
102	2-E33-7	PCI/L	17.	0.	03/24/87
102	2-E33-7	PCI/L	17.	-0.00252	08/04/87
102	2-E33-8	PCI/L	17.	0.	03/15/87
102	2-E33-8	PCI/L	17.	-0.000717	08/04/87
102	2-E33-9	PCI/L	17.	-0.00305	09/02/87
102	2-E33-12	PCI/L	17.	0.	04/01/87
102	2-E33-12	PCI/L	17.	0.00179	09/01/87
102	2-E33-14	PCI/L	17.	0.00207	04/01/87
102	2-E33-14	PCI/L	17.	0.0162	09/01/87
102	2-E33-18	PCI/L	17.	0.	03/24/87
102	2-E33-18	PCI/L	17.	0.00615	08/04/87
102	2-E33-20	PCI/L	17.	0.	04/01/87
102	2-E33-20	PCI/L	17.	-0.000717	09/02/87
102	2-E33-24	PCI/L	17.	0.	03/15/87
102	2-E33-24	PCI/L	17.	-0.000717	08/06/87

9011710093

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Plutonium-239/240

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
100	2-E33-1A	PCI/L	17.	0.	03/15/87
100	2-E33-1A	PCI/L	17.	-0.00137	08/04/87
100	2-E33-3	PCI/L	17.	0.00271	03/15/87
100	2-E33-3	PCI/L	17.	0.	03/15/87
100	2-E33-3	PCI/L	17.	1.2	03/15/87
100	2-E33-3	PCI/L	17.	-0.00137	08/06/87
100	2-E33-3	PCI/L	17.	-0.00137	08/06/87
100	2-E33-3	PCI/L	17.	0.574	08/06/87
100	2-E33-5	PCI/L	17.	0.00263	03/15/87
100	2-E33-5	PCI/L	17.	-0.00439	08/10/87
100	2-E33-7	PCI/L	17.	0.	03/24/87
100	2-E33-7	PCI/L	17.	-0.00137	08/04/87
100	2-E33-8	PCI/L	17.	0.	03/15/87
100	2-E33-8	PCI/L	17.	-0.00137	08/04/87
100	2-E33-9	PCI/L	17.	-0.00137	09/02/87
100	2-E33-12	PCI/L	17.	0.	04/01/87
100	2-E33-12	PCI/L	17.	0.00114	09/01/87
100	2-E33-14	PCI/L	17.	0.	04/01/87
100	2-E33-14	PCI/L	17.	-0.00811	09/01/87
100	2-E33-18	PCI/L	17.	-0.00571	03/24/87
100	2-E33-18	PCI/L	17.	0.000917	08/04/87
100	2-E33-20	PCI/L	17.	-0.00195	04/01/87
100	2-E33-20	PCI/L	17.	-0.00137	09/02/87
100	2-E33-24	PCI/L	17.	-0.00297	03/15/87
100	2-E33-24	PCI/L	17.	0.00259	08/06/87

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Ruthenium-106

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
034	2-E33-1A	PCI/L	172.5	47.3	01/25/85
034	2-E33-1A	PCI/L	172.5	-11.6	04/08/85
034	2-E33-1A	PCI/L	172.5	-10.8	08/28/85
034	2-E33-1A	PCI/L	172.5	14.9	11/13/85
034	2-E33-1A	PCI/L	172.5	8.62	02/19/86
034	2-E33-1A	PCI/L	172.5	27.4	04/30/86
034	2-E33-1A	PCI/L	172.5	30.	08/08/86
034	2-E33-1A	PCI/L	172.5	15.7	10/28/86
034	2-E33-1A	PCI/L	172.5	9.7	03/15/87
034	2-E33-1A	PCI/L	172.5	11.2	05/19/87
034	2-E33-1A	PCI/L	172.5	39.6	08/04/87
034	2-E33-1A	PCI/L	172.5	-51.8	12/06/87
034	2-E33-1A	PCI/L	172.5	0.	02/28/88
034	2-E33-3	PCI/L	172.5	-39.3	01/25/85
034	2-E33-3	PCI/L	172.5	0.	04/08/85
034	2-E33-3	PCI/L	172.5	58.8	08/28/85
034	2-E33-3	PCI/L	172.5	35.	11/13/85
034	2-E33-3	PCI/L	172.5	29.1	02/19/86
034	2-E33-3	PCI/L	172.5	-2.65	04/30/86
034	2-E33-3	PCI/L	172.5	36.3	08/08/86
034	2-E33-3	PCI/L	172.5	-104.	10/28/86
034	2-E33-3	PCI/L	172.5	48.6	03/15/87
034	2-E33-3	PCI/L	172.5	-101.	05/19/87
034	2-E33-3	PCI/L	172.5	35.	08/06/87
034	2-E33-3	PCI/L	172.5	13.9	12/06/87
034	2-E33-3	PCI/L	172.5	41.4	02/28/88
034	2-E33-5	PCI/L	172.5	-5.96	01/03/85
034	2-E33-5	PCI/L	172.5	40.5	01/25/85
034	2-E33-5	PCI/L	172.5	10.7	04/10/85
034	2-E33-5	PCI/L	172.5	37.9	08/28/85
034	2-E33-5	PCI/L	172.5	-106.	11/13/85
034	2-E33-5	PCI/L	172.5	47.6	02/19/86
034	2-E33-5	PCI/L	172.5	-25.5	04/30/86
034	2-E33-5	PCI/L	172.5	14.9	08/11/86
034	2-E33-5	PCI/L	172.5	-84.8	10/28/86
034	2-E33-5	PCI/L	172.5	-5.96	03/15/87
034	2-E33-5	PCI/L	172.5	-7.22	05/19/87
034	2-E33-5	PCI/L	172.5	7.18	08/10/87
034	2-E33-5	PCI/L	172.5	-144.	12/06/87
034	2-E33-5	PCI/L	172.5	-5.4	02/28/88
034	2-E33-7	PCI/L	172.5	-13.4	01/03/85
034	2-E33-7	PCI/L	172.5	-44.6	02/13/85
034	2-E33-7	PCI/L	172.5	35.3	02/27/86
034	2-E33-7	PCI/L	172.5	45.	04/30/86
034	2-E33-7	PCI/L	172.5	-44.6	08/14/86
034	2-E33-7	PCI/L	172.5	-10.7	10/28/86
034	2-E33-7	PCI/L	172.5	-5.39	03/24/87
034	2-E33-7	PCI/L	172.5	60.4	05/19/87
034	2-E33-7	PCI/L	172.5	-32.3	08/04/87
034	2-E33-7	PCI/L	172.5	15.8	10/28/87
034	2-E33-7	PCI/L	172.5	-25.6	02/28/88
034	2-E33-7	PCI/L	172.5	3.13	05/12/88
034	2-E33-7	PCI/L	172.5	-28.1	07/26/88
034	2-E33-8	PCI/L	172.5	8.88	01/25/85
034	2-E33-8	PCI/L	172.5	14.9	04/08/85
034	2-E33-8	PCI/L	172.5	-27.1	08/29/85
034	2-E33-8	PCI/L	172.5	5.84	11/13/85

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
034	2-E33-8	PCI/L	172.5	21.2	02/19/86
034	2-E33-8	PCI/L	172.5	-45.	04/30/86
034	2-E33-8	PCI/L	172.5	42.5	08/08/86
034	2-E33-8	PCI/L	172.5	-14.4	10/28/86
034	2-E33-8	PCI/L	172.5	-17.2	03/15/87
034	2-E33-8	PCI/L	172.5	39.5	05/22/87
034	2-E33-8	PCI/L	172.5	0.	08/04/87
034	2-E33-8	PCI/L	172.5	59.9	10/28/87
034	2-E33-8	PCI/L	172.5	-24.2	02/28/88
034	2-E33-9	PCI/L	172.5	-63.9	01/03/85
034	2-E33-9	PCI/L	172.5	39.6	02/13/85
034	2-E33-9	PCI/L	172.5	42.6	05/14/85
034	2-E33-9	PCI/L	172.5	-43.1	02/27/86
034	2-E33-9	PCI/L	172.5	-55.	05/05/86
034	2-E33-9	PCI/L	172.5	-89.1	11/04/86
034	2-E33-9	PCI/L	172.5	-97.	04/02/87
034	2-E33-9	PCI/L	172.5	-14.5	06/29/87
034	2-E33-9	PCI/L	172.5	38.3	09/02/87
034	2-E33-9	PCI/L	172.5	8.7	10/28/87
034	2-E33-9	PCI/L	172.5	9.63	05/12/88
034	2-E33-9	PCI/L	172.5	-57.	07/29/88
034	2-E33-12	PCI/L	172.5	-138.	09/11/86
034	2-E33-12	PCI/L	172.5	9.52	04/01/87
034	2-E33-12	PCI/L	172.5	111.	09/01/87
034	2-E33-12	PCI/L	172.5	23.5	02/28/88
034	2-E33-14	PCI/L	172.5	-61.7	04/01/87
034	2-E33-14	PCI/L	172.5	-82.	09/01/87
034	2-E33-18	PCI/L	172.5	-8.71	01/03/85
034	2-E33-18	PCI/L	172.5	29.7	02/13/85
034	2-E33-18	PCI/L	172.5	60.7	04/15/85
034	2-E33-18	PCI/L	172.5	8.01	09/05/85
034	2-E33-18	PCI/L	172.5	-23.6	12/19/85
034	2-E33-18	PCI/L	172.5	-15.8	02/27/86
034	2-E33-18	PCI/L	172.5	-37.7	05/05/86
034	2-E33-18	PCI/L	172.5	-15.1	08/11/86
034	2-E33-18	PCI/L	172.5	14.4	10/29/86
034	2-E33-18	PCI/L	172.5	47.7	03/24/87
034	2-E33-18	PCI/L	172.5	-57.9	05/19/87
034	2-E33-18	PCI/L	172.5	6.39	08/04/87
034	2-E33-18	PCI/L	172.5	-46.7	10/26/87
034	2-E33-18	PCI/L	172.5	-31.8	03/01/88
034	2-E33-20	PCI/L	172.5	-32.1	04/01/87
034	2-E33-20	PCI/L	172.5	-81.8	09/02/87
034	2-E33-24	PCI/L	172.5	-23.9	01/03/85
034	2-E33-24	PCI/L	172.5	2.99	01/25/85
034	2-E33-24	PCI/L	172.5	-143.	04/10/85
034	2-E33-24	PCI/L	172.5	-44.1	08/29/85
034	2-E33-24	PCI/L	172.5	-20.7	12/19/85
034	2-E33-24	PCI/L	172.5	14.4	02/19/86
034	2-E33-24	PCI/L	172.5	34.3	04/30/86
034	2-E33-24	PCI/L	172.5	-26.2	08/11/86
034	2-E33-24	PCI/L	172.5	-11.6	10/28/86
034	2-E33-24	PCI/L	172.5	28.6	03/15/87
034	2-E33-24	PCI/L	172.5	50.2	05/27/87
034	2-E33-24	PCI/L	172.5	38.2	08/06/87
034	2-E33-24	PCI/L	172.5	3.15	10/28/87
034	2-E33-24	PCI/L	172.5	24.2	02/28/88
034	2-E33-26	PCI/L	172.5	12.2	01/25/85
034	2-E33-26	PCI/L	172.5	23.8	04/08/85
034	2-E33-26	PCI/L	172.5	-27.1	08/28/85
034	2-E33-26	PCI/L	172.5	11.7	11/13/85
034	2-E33-26	PCI/L	172.5	7.93	02/19/86
034	2-E33-26	PCI/L	172.5	26.	04/30/86
034	2-E33-26	PCI/L	172.5	-12.2	08/08/86
034	2-E33-26	PCI/L	172.5	14.4	10/28/86
034	2-E33-26	PCI/L	172.5	67.9	03/15/87
034	2-E33-26	PCI/L	172.5	-1.6543E37	06/16/87
034	2-E33-26	PCI/L	172.5	38.	09/01/87

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
034	2-E33-26	PCI/L	172.5	19.5	10/28/87
034	2-E33-26	PCI/L	172.5	-37.3	02/22/88
034	6-49-55A	PCI/L	172.5	-33.6	02/28/87
034	6-49-55A	PCI/L	172.5	-6.48	05/31/87
034	6-49-55A	PCI/L	172.5	32.7	08/25/87
034	6-49-55A	PCI/L	172.5	-44.1	11/30/87
034	6-49-55A	PCI/L	172.5	-31.1	02/12/88
034	6-49-55A	PCI/L	172.5	31.3	04/15/88
034	6-49-55A	PCI/L	172.5	34.9	04/15/88
034	6-49-55B	PCI/L	172.5	-46.	09/09/86
034	6-49-57	PCI/L	172.5	-82.7	02/28/87
034	6-49-57	PCI/L	172.5	21.6	05/14/87
034	6-49-57	PCI/L	172.5	-17.1	08/25/87
034	6-49-57	PCI/L	172.5	51.5	11/30/87
034	6-49-57	PCI/L	172.5	42.3	02/09/88
034	6-49-57	PCI/L	172.5	11.7	06/01/88
034	6-50-53	PCI/L	172.5	25.3	02/28/87
034	6-50-53	PCI/L	172.5	85.7	05/15/87
034	6-50-53	PCI/L	172.5	6.45	08/25/87
034	6-50-53	PCI/L	172.5	-19.3	12/07/87
034	6-50-53	PCI/L	172.5	-23.5	03/06/88
034	6-50-53	PCI/L	172.5	-41.3	04/15/88
034	6-50-53	PCI/L	172.5	13.7	04/15/88
034	6-53-55A	PCI/L	172.5	2.91	01/17/85
034	6-53-55A	PCI/L	172.5	-67.4	02/11/85
034	6-53-55A	PCI/L	172.5	36.5	03/14/85
034	6-53-55A	PCI/L	172.5	8.8	04/01/85
034	6-53-55A	PCI/L	172.5	20.2	05/03/85
034	6-53-55A	PCI/L	172.5	70.3	06/11/85
034	6-53-55A	PCI/L	172.5	-5.87	07/12/85
034	6-53-55A	PCI/L	172.5	20.8	08/13/85
034	6-53-55A	PCI/L	172.5	-8.83	09/19/85
034	6-53-55A	PCI/L	172.5	-61.3	10/07/85
034	6-53-55A	PCI/L	172.5	-5.97	11/08/85
034	6-53-55A	PCI/L	172.5	-58.	01/09/86
034	6-53-55A	PCI/L	172.5	-21.3	02/06/86
034	6-53-55A	PCI/L	172.5	5.32	03/07/86
034	6-53-55A	PCI/L	172.5	26.	04/11/86
034	6-53-55A	PCI/L	172.5	53.1	05/06/86
034	6-53-55A	PCI/L	172.5	-2.79	06/03/86
034	6-53-55A	PCI/L	172.5	-17.2	06/30/86
034	6-53-55A	PCI/L	172.5	-6.9	08/04/86
034	6-53-55A	PCI/L	172.5	-13.5	09/04/86
034	6-53-55A	PCI/L	172.5	11.7	10/08/86
034	6-53-55A	PCI/L	172.5	-50.2	11/04/86
034	6-53-55A	PCI/L	172.5	-35.7	12/09/86
034	6-53-55A	PCI/L	172.5	-99.	04/06/87
034	6-53-55A	PCI/L	172.5	-14.3	07/08/87
034	6-53-55A	PCI/L	172.5	3.66	10/06/87
034	6-53-55A	PCI/L	172.5	-6.31	01/08/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Selenium, filtered

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
H39	2-E32-1	PPB	5.	5.	08/06/87
H39	2-E32-1	PPB	5.	5.	12/31/87
H39	2-E32-1	PPB	5.	5.	03/02/88
H39	2-E33-1A	PPB	5.	5.	05/19/87
H39	2-E33-1A	PPB	5.	5.	08/04/87
H39	2-E33-1A	PPB	5.	5.	12/06/87
H39	2-E33-1A	PPB	5.	5.	03/02/88
H39	2-E33-2	PPB	5.	5.	06/23/87
H39	2-E33-3	PPB	5.	5.	05/19/87
H39	2-E33-3	PPB	5.	5.	08/06/87
H39	2-E33-3	PPB	5.	5.	12/06/87
H39	2-E33-3	PPB	5.	5.	03/23/88
H39	2-E33-5	PPB	5.	5.	05/19/87
H39	2-E33-5	PPB	5.	5.	08/10/87
H39	2-E33-5	PPB	5.	5.	12/06/87
H39	2-E33-5	PPB	5.	5.	03/29/88
H39	2-E33-8	PPB	5.	5.	05/22/87
H39	2-E33-8	PPB	5.	5.	08/04/87
H39	2-E33-18	PPB	5.	5.	03/24/87
H39	2-E33-18	PPB	5.	5.	05/19/87
H39	2-E33-18	PPB	5.	5.	08/04/87
H39	2-E33-24	PPB	5.	5.	05/27/87
H39	2-E33-24	PPB	5.	5.	08/06/87
H39	6-49-55A	PPB	5.	5.	08/26/87
H39	6-49-55A	PPB	5.	5.	11/30/87
H39	6-49-55A	PPB	5.	5.	11/30/87
H39	6-49-55A	PPB	5.	5.	11/30/87
H39	6-49-55A	PPB	5.	6.	02/12/88
H39	6-49-55A	PPB	5.	5.	06/15/88
H39	6-49-55A	PPB	5.	5.	06/15/88
H39	6-49-55A	PPB	5.	5.	06/15/88
H39	6-49-57	PPB	5.	5.	03/19/87
H39	6-49-57	PPB	5.	5.	05/14/87
H39	6-49-57	PPB	5.	5.	09/10/87
H39	6-49-57	PPB	5.	5.	11/30/87
H39	6-49-57	PPB	5.	5.	11/30/87
H39	6-49-57	PPB	5.	5.	11/30/87
H39	6-49-57	PPB	5.	5.	02/09/88
H39	6-49-57	PPB	5.	5.	02/09/88
H39	6-49-57	PPB	5.	5.	02/09/88
H39	6-49-57	PPB	5.	5.	06/01/88
H39	6-49-57	PPB	5.	5.	06/01/88
H39	6-49-57	PPB	5.	5.	06/01/88
H39	6-50-53	PPB	5.	10.	03/19/87
H39	6-50-53	PPB	5.	5.	05/15/87
H39	6-50-53	PPB	5.	11.	08/26/87
H39	6-50-53	PPB	5.	13.	12/07/87
H39	6-50-53	PPB	5.	15.	12/07/87
H39	6-50-53	PPB	5.	14.	12/07/87
H39	6-50-53	PPB	5.	19.	03/06/88
H39	6-50-53	PPB	5.	19.	03/06/88
H39	6-50-53	PPB	5.	19.	03/06/88
H39	6-50-53	PPB	5.	27.	06/06/88
H39	6-50-53	PPB	5.	23.	06/06/88
H39	6-50-53	PPB	5.	25.	06/06/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Sodium, filtered

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
H24	2-E32-1	PPB	100.	20200.	08/06/87
H24	2-E32-1	PPB	100.	20500.	12/31/87
H24	2-E32-1	PPB	100.	21200.	03/02/88
H24	2-E33-1A	PPB	100.	35100.	05/19/87
H24	2-E33-1A	PPB	100.	35100.	08/04/87
H24	2-E33-1A	PPB	100.	32700.	12/06/87
H24	2-E33-1A	PPB	100.	15500.	03/02/88
H24	2-E33-2	PPB	100.	31900.	06/23/87
H24	2-E33-3	PPB	100.	31500.	05/19/87
H24	2-E33-3	PPB	100.	32900.	08/06/87
H24	2-E33-3	PPB	100.	26800.	12/06/87
H24	2-E33-3	PPB	100.	27700.	03/23/88
H24	2-E33-5	PPB	100.	24900.	05/19/87
H24	2-E33-5	PPB	100.	23000.	08/10/87
H24	2-E33-5	PPB	100.	21500.	12/06/87
H24	2-E33-5	PPB	100.	20000.	03/29/88
H24	2-E33-8	PPB	100.	12900.	05/22/87
H24	2-E33-8	PPB	100.	12800.	08/04/87
H24	2-E33-18	PPB	100.	13800.	03/24/87
H24	2-E33-18	PPB	100.	14700.	05/19/87
H24	2-E33-18	PPB	100.	291000.	08/04/87
H24	2-E33-24	PPB	100.	16900.	05/27/87
H24	2-E33-24	PPB	100.	15400.	08/06/87
H24	6-49-55A	PPB	100.	44400.	08/26/87
H24	6-49-55A	PPB	100.	45600.	11/30/87
H24	6-49-55A	PPB	100.	46600.	11/30/87
H24	6-49-55A	PPB	100.	45400.	11/30/87
H24	6-49-55A	PPB	100.	47700.	02/12/88
H24	6-49-55A	PPB	100.	48200.	06/15/88
H24	6-49-55A	PPB	100.	46700.	06/15/88
H24	6-49-55A	PPB	100.	46000.	06/15/88
H24	6-49-57	PPB	100.	51200.	03/19/87
H24	6-49-57	PPB	100.	49800.	05/14/87
H24	6-49-57	PPB	100.	45200.	09/10/87
H24	6-49-57	PPB	100.	46300.	11/30/87
H24	6-49-57	PPB	100.	48800.	11/30/87
H24	6-49-57	PPB	100.	46900.	11/30/87
H24	6-49-57	PPB	100.	43900.	02/09/88
H24	6-49-57	PPB	100.	45200.	02/09/88
H24	6-49-57	PPB	100.	45300.	02/09/88
H24	6-49-57	PPB	100.	41200.	06/01/88
H24	6-49-57	PPB	100.	45000.	06/01/88
H24	6-49-57	PPB	100.	44800.	06/01/88
H24	6-50-53	PPB	100.	51100.	03/19/87
H24	6-50-53	PPB	100.	51300.	05/15/87
H24	6-50-53	PPB	100.	55500.	08/26/87
H24	6-50-53	PPB	100.	59200.	12/07/87
H24	6-50-53	PPB	100.	61100.	12/07/87
H24	6-50-53	PPB	100.	61600.	12/07/87
H24	6-50-53	PPB	100.	60200.	03/06/88
H24	6-50-53	PPB	100.	65900.	03/06/88
H24	6-50-53	PPB	100.	65100.	03/06/88
H24	6-50-53	PPB	100.	62800.	06/06/88
H24	6-50-53	PPB	100.	59000.	06/06/88
H24	6-50-53	PPB	100.	61300.	06/06/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Specific conductance

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
191	2-E32-1	UMHO	1.	355.	09/13/85
191	2-E32-1	UMHO	1.	322.	09/13/85
191	2-E32-1	UMHO	1.	351.	05/05/86
191	2-E32-1	UMHO	1.	307.	08/12/86
191	2-E32-1	UMHO	1.	275.	08/06/87
191	2-E32-1	UMHO	1.	270.	12/31/87
191	2-E32-1	UMHO	1.	292.	03/02/88
191	2-E33-1A	UMHO	1.	268.	05/19/87
191	2-E33-1A	UMHO	1.	335.	08/04/87
191	2-E33-1A	UMHO	1.	351.	12/06/87
191	2-E33-1A	UMHO	1.	269.	03/02/88
191	2-E33-3	UMHO	1.	263.	05/19/87
191	2-E33-3	UMHO	1.	356.	08/06/87
191	2-E33-3	UMHO	1.	303.	12/06/87
191	2-E33-3	UMHO	1.	335.	03/23/88
191	2-E33-5	UMHO	1.	260.	05/19/87
191	2-E33-5	UMHO	1.	311.	08/10/87
191	2-E33-5	UMHO	1.	345.	12/06/87
191	2-E33-5	UMHO	1.	323.	03/29/88
191	2-E33-8	UMHO	1.	255.	05/22/87
191	2-E33-8	UMHO	1.	234.	08/04/87
191	2-E33-18	UMHO	1.	233.	03/24/87
191	2-E33-18	UMHO	1.	221.	05/19/87
191	2-E33-18	UMHO	1.	277.	08/04/87
191	2-E33-24	UMHO	1.	251.	05/27/87
191	2-E33-24	UMHO	1.	286.	08/06/87
191	6-49-55A	UMHO	1.	733.	08/26/87
191	6-49-55A	UMHO	1.	850.	11/30/87
191	6-49-55A	UMHO	1.	767.	02/12/88
191	6-49-57	UMHO	1.	600.	08/16/85
191	6-49-57	UMHO	1.	541.	08/16/85
191	6-49-57	UMHO	1.	427.	05/08/86
191	6-49-57	UMHO	1.	362.	08/13/86
191	6-49-57	UMHO	1.	417.	03/19/87
191	6-49-57	UMHO	1.	348.	05/14/87
191	6-49-57	UMHO	1.	294.	09/10/87
191	6-49-57	UMHO	1.	337.	11/30/87
191	6-49-57	UMHO	1.	401.	02/09/88
191	6-49-57	UMHO	1.	390.	06/01/88
191	6-50-53	UMHO	1.	829.	08/16/85
191	6-50-53	UMHO	1.	804.	08/16/85
191	6-50-53	UMHO	1.	1072.	05/12/86
191	6-50-53	UMHO	1.	1149.	08/04/86
191	6-50-53	UMHO	1.	1413.	03/19/87
191	6-50-53	UMHO	1.	1349.	05/15/87
191	6-50-53	UMHO	1.	1266.	08/26/87
191	6-50-53	UMHO	1.	1152.	12/07/87
191	6-50-53	UMHO	1.	1295.	03/06/88
191	6-50-53	UMHO	1.	1588.	06/06/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Strontium-90

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
121	2-E33-1A	PCI/L	5.	0.12	08/28/85
121	2-E33-1A	PCI/L	5.	0.593	02/19/86
121	2-E33-1A	PCI/L	5.	0.742	04/30/86
121	2-E33-1A	PCI/L	5.	-0.131	08/08/86
121	2-E33-1A	PCI/L	5.	0.419	10/28/86
121	2-E33-1A	PCI/L	5.	0.576	03/15/87
121	2-E33-1A	PCI/L	5.	0.0994	05/19/87
121	2-E33-1A	PCI/L	5.	0.184	08/04/87
121	2-E33-1A	PCI/L	5.	0.0543	12/06/87
121	2-E33-1A	PCI/L	5.	0.0386	02/28/88
121	2-E33-3	PCI/L	5.	0.876	04/08/85
121	2-E33-3	PCI/L	5.	0.286	08/28/85
121	2-E33-3	PCI/L	5.	0.377	11/13/85
121	2-E33-3	PCI/L	5.	0.437	02/19/86
121	2-E33-3	PCI/L	5.	0.277	04/30/86
121	2-E33-3	PCI/L	5.	0.73	08/08/86
121	2-E33-3	PCI/L	5.	0.276	10/28/86
121	2-E33-3	PCI/L	5.	0.508	03/15/87
121	2-E33-3	PCI/L	5.	0.452	08/06/87
121	2-E33-3	PCI/L	5.	0.0413	02/28/88
121	2-E33-5	PCI/L	5.	0.167	08/28/85
121	2-E33-5	PCI/L	5.	0.163	02/19/86
121	2-E33-5	PCI/L	5.	-0.00184	04/30/86
121	2-E33-5	PCI/L	5.	0.26	08/11/86
121	2-E33-5	PCI/L	5.	0.305	10/28/86
121	2-E33-5	PCI/L	5.	0.0677	03/15/87
121	2-E33-5	PCI/L	5.	0.631	05/19/87
121	2-E33-5	PCI/L	5.	0.277	08/10/87
121	2-E33-5	PCI/L	5.	0.826	12/06/87
121	2-E33-5	PCI/L	5.	-0.141	02/28/88
121	2-E33-7	PCI/L	5.	0.726	02/27/86
121	2-E33-7	PCI/L	5.	0.767	04/30/86
121	2-E33-7	PCI/L	5.	0.204	08/14/86
121	2-E33-7	PCI/L	5.	1.11	10/28/86
121	2-E33-7	PCI/L	5.	-0.458	03/24/87
121	2-E33-7	PCI/L	5.	0.76	05/19/87
121	2-E33-7	PCI/L	5.	40.3	08/04/87
121	2-E33-7	PCI/L	5.	0.251	10/28/87
121	2-E33-7	PCI/L	5.	0.0632	02/28/88
121	2-E33-7	PCI/L	5.	0.896	05/12/88
121	2-E33-8	PCI/L	5.	0.329	08/29/85
121	2-E33-8	PCI/L	5.	0.288	02/19/86
121	2-E33-8	PCI/L	5.	-0.0116	04/30/86
121	2-E33-8	PCI/L	5.	0.549	08/08/86
121	2-E33-8	PCI/L	5.	0.0622	10/28/86
121	2-E33-8	PCI/L	5.	0.179	03/15/87
121	2-E33-8	PCI/L	5.	0.657	05/22/87
121	2-E33-8	PCI/L	5.	0.0562	08/04/87
121	2-E33-8	PCI/L	5.	0.518	10/28/87
121	2-E33-8	PCI/L	5.	-0.00992	02/28/88
121	2-E33-9	PCI/L	5.	0.795	01/03/85
121	2-E33-9	PCI/L	5.	0.796	02/13/85
121	2-E33-9	PCI/L	5.	0.556	05/14/85
121	2-E33-9	PCI/L	5.	0.666	02/27/86
121	2-E33-9	PCI/L	5.	0.717	05/05/86
121	2-E33-9	PCI/L	5.	1.47	11/04/86
121	2-E33-9	PCI/L	5.	1.41	04/02/87

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
121	2-E33-9	PCI/L	5.	2.01	06/29/87
121	2-E33-9	PCI/L	5.	1.09	09/02/87
121	2-E33-9	PCI/L	5.	1.09	10/28/87
121	2-E33-9	PCI/L	5.	0.676	05/12/88
121	2-E33-12	PCI/L	5.	0.825	04/01/87
121	2-E33-12	PCI/L	5.	0.279	09/01/87
121	2-E33-12	PCI/L	5.	0.154	02/28/88
121	2-E33-14	PCI/L	5.	1.67	04/01/87
121	2-E33-14	PCI/L	5.	0.172	09/01/87
121	2-E33-14	PCI/L	5.	-0.148	02/28/88
121	2-E33-18	PCI/L	5.	-0.482	01/03/85
121	2-E33-18	PCI/L	5.	0.638	02/13/85
121	2-E33-18	PCI/L	5.	0.141	04/15/85
121	2-E33-18	PCI/L	5.	0.354	09/05/85
121	2-E33-18	PCI/L	5.	0.254	12/19/85
121	2-E33-18	PCI/L	5.	0.427	02/27/86
121	2-E33-18	PCI/L	5.	-0.211	05/05/86
121	2-E33-18	PCI/L	5.	2.66	08/11/86
121	2-E33-18	PCI/L	5.	0.371	10/29/86
121	2-E33-18	PCI/L	5.	0.665	03/24/87
121	2-E33-18	PCI/L	5.	2.41	08/04/87
121	2-E33-18	PCI/L	5.	-0.337	03/01/88
121	2-E33-20	PCI/L	5.	3.18	01/03/85
121	2-E33-20	PCI/L	5.	2.42	02/13/85
121	2-E33-20	PCI/L	5.	1.66	05/14/85
121	2-E33-20	PCI/L	5.	1.4	09/07/85
121	2-E33-20	PCI/L	5.	1.8	02/27/86
121	2-E33-20	PCI/L	5.	2.01	05/05/86
121	2-E33-20	PCI/L	5.	1.53	08/14/86
121	2-E33-20	PCI/L	5.	1.72	10/29/86
121	2-E33-20	PCI/L	5.	2.	04/01/87
121	2-E33-20	PCI/L	5.	0.735	09/02/87
121	2-E33-20	PCI/L	5.	2.62	03/01/88
121	2-E33-24	PCI/L	5.	0.0506	08/29/85
121	2-E33-24	PCI/L	5.	0.282	02/19/86
121	2-E33-24	PCI/L	5.	2.6	04/30/86
121	2-E33-24	PCI/L	5.	0.436	08/11/86
121	2-E33-24	PCI/L	5.	-0.226	10/28/86
121	2-E33-24	PCI/L	5.	0.311	03/15/87
121	2-E33-24	PCI/L	5.	0.539	05/27/87
121	2-E33-24	PCI/L	5.	0.935	08/06/87
121	2-E33-24	PCI/L	5.	-0.0199	10/28/87
121	2-E33-24	PCI/L	5.	-0.487	02/28/88
121	2-E33-26	PCI/L	5.	0.199	08/28/85
121	2-E33-26	PCI/L	5.	0.691	02/19/86
121	2-E33-26	PCI/L	5.	0.428	04/30/86
121	2-E33-26	PCI/L	5.	0.187	08/08/86
121	2-E33-26	PCI/L	5.	-0.0654	10/28/86
121	2-E33-26	PCI/L	5.	0.612	03/15/87
121	2-E33-26	PCI/L	5.	-1.6543E37	06/16/87
121	2-E33-26	PCI/L	5.	0.49	09/01/87
121	2-E33-26	PCI/L	5.	0.185	10/28/87
121	2-E33-26	PCI/L	5.	-0.301	02/22/88
121	6-49-55A	PCI/L	5.	0.635	02/12/88
121	6-49-55A	PCI/L	5.	0.176	04/15/88
121	6-49-55A	PCI/L	5.	0.24	04/15/88
121	6-49-55B	PCI/L	5.	0.147	02/19/88
121	6-49-55B	PCI/L	5.	0.147	05/03/88
121	6-49-57	PCI/L	5.	0.257	11/30/87
121	6-49-57	PCI/L	5.	0.0239	02/09/88
121	6-49-57	PCI/L	5.	0.204	06/01/88
121	6-50-53	PCI/L	5.	0.165	12/07/87
121	6-50-53	PCI/L	5.	0.473	03/06/88
121	6-50-53	PCI/L	5.	-0.303	04/15/88
121	6-50-53	PCI/L	5.	0.332	04/15/88
121	6-53-55A	PCI/L	5.	0.0968	01/17/85
121	6-53-55A	PCI/L	5.	-0.414	02/11/85
121	6-53-55A	PCI/L	5.	-0.39	03/14/85

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
121	6-53-55A	PCI/L	5.	0.153	04/01/85
121	6-53-55A	PCI/L	5.	-0.433	05/03/85
121	6-53-55A	PCI/L	5.	0.887	06/11/85
121	6-53-55A	PCI/L	5.	0.0329	07/12/85
121	6-53-55A	PCI/L	5.	0.535	08/13/85
121	6-53-55A	PCI/L	5.	0.0206	09/19/85
121	6-53-55A	PCI/L	5.	0.65	10/07/85
121	6-53-55A	PCI/L	5.	0.143	11/08/85
121	6-53-55A	PCI/L	5.	1.63	01/09/86
121	6-53-55A	PCI/L	5.	0.869	02/06/86
121	6-53-55A	PCI/L	5.	0.476	03/07/86
121	6-53-55A	PCI/L	5.	0.109	04/11/86
121	6-53-55A	PCI/L	5.	0.0278	05/06/86
121	6-53-55A	PCI/L	5.	0.659	06/03/86
121	6-53-55A	PCI/L	5.	0.227	06/30/86
121	6-53-55A	PCI/L	5.	0.437	08/04/86
121	6-53-55A	PCI/L	5.	1.05	09/04/86
121	6-53-55A	PCI/L	5.	0.171	10/08/86
121	6-53-55A	PCI/L	5.	0.544	11/04/86
121	6-53-55A	PCI/L	5.	0.364	12/09/86
121	6-53-55A	PCI/L	5.	-0.2	04/06/87
121	6-53-55A	PCI/L	5.	0.185	07/08/87
121	6-53-55A	PCI/L	5.	0.268	10/06/87
121	6-53-55A	PCI/L	5.	0.0173	01/08/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Sulfate

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C73	2-E32-1	PPB	500.	42100.	09/13/85
C73	2-E32-1	PPB	500.	40700.	05/05/86
C73	2-E32-1	PPB	500.	33000.	08/12/86
C73	2-E32-1	PPB	500.	33700.	08/06/87
C73	2-E32-1	PPB	500.	34200.	12/31/87
C73	2-E32-1	PPB	500.	32500.	03/02/88
C73	2-E33-1A	PPB	500.	42000.	05/19/87
C73	2-E33-1A	PPB	500.	33700.	08/04/87
C73	2-E33-1A	PPB	500.	41800.	12/06/87
C73	2-E33-1A	PPB	500.	29500.	03/02/88
C73	2-E33-2	PPB	500.	30100.	06/23/87
C73	2-E33-3	PPB	500.	28900.	05/19/87
C73	2-E33-3	PPB	500.	34400.	08/06/87
C73	2-E33-3	PPB	500.	33500.	12/06/87
C73	2-E33-3	PPB	500.	29900.	03/23/88
C73	2-E33-5	PPB	500.	38600.	05/19/87
C73	2-E33-5	PPB	500.	41600.	08/10/87
C73	2-E33-5	PPB	500.	40900.	12/06/87
C73	2-E33-5	PPB	500.	35400.	03/29/88
C73	2-E33-8	PPB	500.	27900.	05/22/87
C73	2-E33-8	PPB	500.	26800.	08/04/87
C73	2-E33-18	PPB	500.	26800.	03/24/87
C73	2-E33-18	PPB	500.	27600.	05/19/87
C73	2-E33-18	PPB	500.	30300.	08/04/87
C73	2-E33-24	PPB	500.	32900.	05/27/87
C73	2-E33-24	PPB	500.	33400.	08/06/87
C73	6-49-55A	PPB	500.	158000.	08/26/87
C73	6-49-55A	PPB	500.	148000.	11/30/87
C73	6-49-55A	PPB	500.	148000.	11/30/87
C73	6-49-55A	PPB	500.	148000.	11/30/87
C73	6-49-55A	PPB	500.	143000.	02/12/88
C73	6-49-55A	PPB	500.	144000.	02/12/88
C73	6-49-55A	PPB	500.	142000.	02/12/88
C73	6-49-55A	PPB	500.	142000.	06/15/88
C73	6-49-57	PPB	500.	52700.	08/16/85
C73	6-49-57	PPB	500.	34600.	05/08/86
C73	6-49-57	PPB	500.	35300.	08/13/86
C73	6-49-57	PPB	500.	37800.	03/19/87
C73	6-49-57	PPB	500.	29900.	05/14/87
C73	6-49-57	PPB	500.	34100.	09/10/87
C73	6-49-57	PPB	500.	38900.	11/30/87
C73	6-49-57	PPB	500.	38900.	11/30/87
C73	6-49-57	PPB	500.	38800.	11/30/87
C73	6-49-57	PPB	500.	33200.	02/09/88
C73	6-49-57	PPB	500.	33700.	02/09/88
C73	6-49-57	PPB	500.	33200.	02/09/88
C73	6-49-57	PPB	500.	34800.	06/01/88
C73	6-50-53	PPB	500.	176000.	08/16/85
C73	6-50-53	PPB	500.	287000.	05/12/86
C73	6-50-53	PPB	500.	283000.	08/04/86
C73	6-50-53	PPB	500.	328000.	03/19/87
C73	6-50-53	PPB	500.	386000.	05/15/87
C73	6-50-53	PPB	500.	377000.	08/26/87
C73	6-50-53	PPB	500.	474000.	12/07/87
C73	6-50-53	PPB	500.	444000.	12/07/87
C73	6-50-53	PPB	500.	385000.	12/07/87
C73	6-50-53	PPB	500.	434000.	03/06/88

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C73	6-50-53	PPB	500.	426000.	03/06/88
C73	6-50-53	PPB	500.	405000.	03/06/88
C73	6-50-53	PPB	500.	396000.	06/06/88
C73	6-50-53	PPB	500.	394000.	06/06/88
C73	6-50-53	PPB	500.	393000.	06/06/88

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Analytical Data Collected Between
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CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
197	2-E33-1A	PCI/L	15.	964.	08/04/87
197	2-E33-1A	PCI/L	15.	625.	02/28/88
197	2-E33-3	PCI/L	15.	2710.	08/08/86
197	2-E33-3	PCI/L	15.	1400.	08/06/87
197	2-E33-5	PCI/L	15.	1980.	08/10/87
197	2-E33-5	PCI/L	15.	1480.	02/28/88
197	2-E33-7	PCI/L	15.	3660.	08/14/86
197	2-E33-7	PCI/L	15.	4700.	08/04/87
197	2-E33-7	PCI/L	15.	3630.	02/28/88
197	2-E33-8	PCI/L	15.	192.	08/04/87
197	2-E33-8	PCI/L	15.	287.	02/28/88
197	2-E33-9	PCI/L	15.	592.	09/02/87
197	2-E33-12	PCI/L	15.	132.	02/28/88
197	2-E33-18	PCI/L	15.	32.3	03/01/88
197	2-E33-20	PCI/L	15.	30.2	03/01/88
197	2-E33-24	PCI/L	15.	1580.	08/06/87
197	2-E33-24	PCI/L	15.	1550.	02/28/88
197	2-E33-26	PCI/L	15.	1420.	09/01/87
197	6-49-55A	PCI/L	15.	12500.	02/12/88
197	6-49-55B	PCI/L	15.	0.486	02/19/88
197	6-49-57	PCI/L	15.	1330.	02/09/88
197	6-50-53	PCI/L	15.	13600.	08/26/87
197	6-50-53	PCI/L	15.	29100.	12/07/87
197	6-50-53	PCI/L	15.	26500.	03/06/88
197	6-50-53	PCI/L	15.	28000.	04/15/88

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AREA 2-BP-OPERABLE UNIT

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Analytical Data Collected Between
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CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
212	2-E32-1	PCI/L	4.	4.	09/13/85
212	2-E32-1	PCI/L	4.	6.25	05/05/86
212	2-E32-1	PCI/L	4.	2.18	08/12/86
212	2-E32-1	PCI/L	4.	2.85	08/06/87
212	2-E32-1	PCI/L	4.	2.83	12/31/87
212	2-E33-1A	PCI/L	4.	1.64	05/19/87
212	2-E33-1A	PCI/L	4.	1.59	08/04/87
212	2-E33-1A	PCI/L	4.	1.65	12/06/87
212	2-E33-2	PCI/L	4.	0.546	06/23/87
212	2-E33-3	PCI/L	4.	1.43	05/19/87
212	2-E33-3	PCI/L	4.	1.24	08/06/87
212	2-E33-3	PCI/L	4.	1.98	12/06/87
212	2-E33-5	PCI/L	4.	0.857	05/19/87
212	2-E33-5	PCI/L	4.	0.592	08/10/87
212	2-E33-5	PCI/L	4.	0.833	12/06/87
212	2-E33-8	PCI/L	4.	2.1	05/22/87
212	2-E33-8	PCI/L	4.	2.38	08/04/87
212	2-E33-18	PCI/L	4.	2.62	03/24/87
212	2-E33-18	PCI/L	4.	1.19	05/19/87
212	2-E33-18	PCI/L	4.	1.5	08/04/87
212	2-E33-24	PCI/L	4.	0.894	05/27/87
212	2-E33-24	PCI/L	4.	1.51	08/06/87
212	2-E33-26	PCI/L	4.	1.8	04/08/85
212	2-E33-26	PCI/L	4.	4.68	08/28/85
212	2-E33-26	PCI/L	4.	1.8	11/13/85
212	6-49-55A	PCI/L	4.	1.23	08/26/87
212	6-49-55A	PCI/L	4.	4.01	11/30/87
212	6-49-55A	PCI/L	4.	2.59	11/30/87
212	6-49-55A	PCI/L	4.	5.62	11/30/87
212	6-49-55A	PCI/L	4.	1.99	02/12/88
212	6-49-55A	PCI/L	4.	3.28	04/15/88
212	6-49-55A	PCI/L	4.	3.47	04/15/88
212	6-49-55A	PCI/L	4.	3.35	06/15/88
212	6-49-55B	PCI/L	4.	2.09	02/19/88
212	6-49-55B	PCI/L	4.	2.26	05/03/88
212	6-49-55B	PCI/L	4.	2.48	07/20/88
212	6-49-57	PCI/L	4.	2.26	08/16/85
212	6-49-57	PCI/L	4.	2.07	05/08/86
212	6-49-57	PCI/L	4.	1.2	08/13/86
212	6-49-57	PCI/L	4.	1.07	03/19/87
212	6-49-57	PCI/L	4.	0.992	05/14/87
212	6-49-57	PCI/L	4.	0.991	09/10/87
212	6-49-57	PCI/L	4.	1.5	11/30/87
212	6-49-57	PCI/L	4.	0.842	11/30/87
212	6-49-57	PCI/L	4.	0.505	11/30/87
212	6-49-57	PCI/L	4.	1.66	02/09/88
212	6-49-57	PCI/L	4.	0.578	02/09/88
212	6-49-57	PCI/L	4.	1.55	02/09/88
212	6-49-57	PCI/L	4.	0.934	06/01/88
212	6-50-53	PCI/L	4.	2.3	08/16/85
212	6-50-53	PCI/L	4.	3.35	05/12/86
212	6-50-53	PCI/L	4.	1.74	08/04/86
212	6-50-53	PCI/L	4.	3.44	03/19/87
212	6-50-53	PCI/L	4.	2.16	05/15/87
212	6-50-53	PCI/L	4.	2.76	08/26/87
212	6-50-53	PCI/L	4.	6.09	12/07/87
212	6-50-53	PCI/L	4.	4.76	12/07/87

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
212	6-50-53	PCI/L	4.	2.93	12/07/87
212	6-50-53	PCI/L	4.	4.49	03/06/88
212	6-50-53	PCI/L	4.	4.85	03/06/88
212	6-50-53	PCI/L	4.	2.05	03/06/88
212	6-50-53	PCI/L	4.	3.61	03/06/88
212	6-50-53	PCI/L	4.	3.85	04/15/88
212	6-50-53	PCI/L	4.	3.75	04/15/88
212	6-50-53	PCI/L	4.	3.5	06/06/88
212	6-50-53	PCI/L	4.	8.05	06/06/88
212	6-50-53	PCI/L	4.	4.97	06/06/88
212	6-53-55A	PCI/L	4.	1.47	01/17/85
212	6-53-55A	PCI/L	4.	0.534	02/11/85
212	6-53-55A	PCI/L	4.	1.3	03/14/85
212	6-53-55A	PCI/L	4.	0.591	04/01/85
212	6-53-55A	PCI/L	4.	0.697	05/03/85
212	6-53-55A	PCI/L	4.	0.582	06/11/85
212	6-53-55A	PCI/L	4.	0.479	07/12/85
212	6-53-55A	PCI/L	4.	0.423	08/13/85
212	6-53-55A	PCI/L	4.	0.921	09/19/85
212	6-53-55A	PCI/L	4.	0.525	10/07/85
212	6-53-55A	PCI/L	4.	0.813	11/08/85
212	6-53-55A	PCI/L	4.	1.16	01/09/86
212	6-53-55A	PCI/L	4.	0.25	02/06/86
212	6-53-55A	PCI/L	4.	1.13	03/07/86
212	6-53-55A	PCI/L	4.	1.5	04/11/86
212	6-53-55A	PCI/L	4.	0.541	05/06/86
212	6-53-55A	PCI/L	4.	1.24	06/03/86
212	6-53-55A	PCI/L	4.	0.763	06/30/86
212	6-53-55A	PCI/L	4.	0.911	08/04/86
212	6-53-55A	PCI/L	4.	0.527	09/04/86
212	6-53-55A	PCI/L	4.	1.02	10/08/86
212	6-53-55A	PCI/L	4.	1.95	11/04/86
212	6-53-55A	PCI/L	4.	3.3	12/09/86
212	6-53-55A	PCI/L	4.	1.81	02/12/87
212	6-53-55A	PCI/L	4.	0.94	03/07/87
212	6-53-55A	PCI/L	4.	0.775	04/06/87
212	6-53-55A	PCI/L	4.	0.984	05/08/87
212	6-53-55A	PCI/L	4.	0.348	06/04/87
212	6-53-55A	PCI/L	4.	1.23	07/08/87
212	6-53-55A	PCI/L	4.	1.17	08/11/87
212	6-53-55A	PCI/L	4.	1.47	09/08/87
212	6-53-55A	PCI/L	4.	1.16	10/06/87
212	6-53-55A	PCI/L	4.	1.07	11/04/87
212	6-53-55A	PCI/L	4.	0.815	12/01/87
212	6-53-55A	PCI/L	4.	1.14	01/08/88

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Analytical Data Collected Between
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CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
111	2-E32-1	PCI/L	8.	29.2	04/03/85
111	2-E32-1	PCI/L	8.	20.5	08/16/85
111	2-E32-1	PCI/L	8.	21.6	09/13/85
111	2-E32-1	PCI/L	8.	52.7	04/21/86
111	2-E32-1	PCI/L	8.	63.6	05/05/86
111	2-E32-1	PCI/L	8.	46.2	08/08/86
111	2-E32-1	PCI/L	8.	55.7	08/12/86
111	2-E32-1	PCI/L	8.	37.5	03/15/87
111	2-E32-1	PCI/L	8.	33.4	08/06/87
111	2-E32-1	PCI/L	8.	35.9	08/06/87
111	2-E32-1	PCI/L	8.	28.8	12/31/87
111	2-E32-1	PCI/L	8.	25.5	02/22/88
111	2-E33-1A	PCI/L	8.	38.8	01/25/85
111	2-E33-1A	PCI/L	8.	118.	04/08/85
111	2-E33-1A	PCI/L	8.	207.	08/28/85
111	2-E33-1A	PCI/L	8.	225.	11/13/85
111	2-E33-1A	PCI/L	8.	115.	02/19/86
111	2-E33-1A	PCI/L	8.	150.	04/30/86
111	2-E33-1A	PCI/L	8.	121.	08/08/86
111	2-E33-1A	PCI/L	8.	128.	10/28/86
111	2-E33-1A	PCI/L	8.	63.5	03/15/87
111	2-E33-1A	PCI/L	8.	136.	05/19/87
111	2-E33-1A	PCI/L	8.	102.	05/19/87
111	2-E33-1A	PCI/L	8.	126.	08/04/87
111	2-E33-1A	PCI/L	8.	140.	08/04/87
111	2-E33-1A	PCI/L	8.	73.4	12/06/87
111	2-E33-1A	PCI/L	8.	101.	12/06/87
111	2-E33-1A	PCI/L	8.	94.4	02/28/88
111	2-E33-2	PCI/L	8.	61.1	06/23/87
111	2-E33-3	PCI/L	8.	489.	01/25/85
111	2-E33-3	PCI/L	8.	1190.	04/08/85
111	2-E33-3	PCI/L	8.	940.	08/28/85
111	2-E33-3	PCI/L	8.	501.	11/13/85
111	2-E33-3	PCI/L	8.	391.	02/19/86
111	2-E33-3	PCI/L	8.	1210.	04/30/86
111	2-E33-3	PCI/L	8.	828.	08/08/86
111	2-E33-3	PCI/L	8.	129.	10/28/86
111	2-E33-3	PCI/L	8.	65.	03/15/87
111	2-E33-3	PCI/L	8.	86.7	03/15/87
111	2-E33-3	PCI/L	8.	83.4	05/19/87
111	2-E33-3	PCI/L	8.	116.	05/19/87
111	2-E33-3	PCI/L	8.	253.	08/06/87
111	2-E33-3	PCI/L	8.	438.	08/06/87
111	2-E33-3	PCI/L	8.	27.7	12/06/87
111	2-E33-3	PCI/L	8.	29.9	12/06/87
111	2-E33-3	PCI/L	8.	75.7	02/28/88
111	2-E33-5	PCI/L	8.	221.	01/03/85
111	2-E33-5	PCI/L	8.	199.	01/25/85
111	2-E33-5	PCI/L	8.	571.	04/10/85
111	2-E33-5	PCI/L	8.	287.	08/28/85
111	2-E33-5	PCI/L	8.	258.	11/13/85
111	2-E33-5	PCI/L	8.	263.	02/19/86
111	2-E33-5	PCI/L	8.	287.	04/30/86
111	2-E33-5	PCI/L	8.	236.	08/11/86
111	2-E33-5	PCI/L	8.	226.	10/28/86
111	2-E33-5	PCI/L	8.	196.	03/15/87
111	2-E33-5	PCI/L	8.	309.	05/19/87

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111	2-E33-5	PCI/L	8.	293.	05/19/87
111	2-E33-5	PCI/L	8.	245.	08/10/87
111	2-E33-5	PCI/L	8.	256.	08/10/87
111	2-E33-5	PCI/L	8.	169.	12/06/87
111	2-E33-5	PCI/L	8.	244.	12/06/87
111	2-E33-5	PCI/L	8.	228.	02/28/88
111	2-E33-7	PCI/L	8.	530.	01/03/85
111	2-E33-7	PCI/L	8.	790.	02/13/85
111	2-E33-7	PCI/L	8.	496.	02/27/86
111	2-E33-7	PCI/L	8.	864.	04/30/86
111	2-E33-7	PCI/L	8.	665.	08/14/86
111	2-E33-7	PCI/L	8.	589.	10/28/86
111	2-E33-7	PCI/L	8.	553.	03/24/87
111	2-E33-7	PCI/L	8.	810.	05/19/87
111	2-E33-7	PCI/L	8.	1010.	08/04/87
111	2-E33-7	PCI/L	8.	580.	10/28/87
111	2-E33-7	PCI/L	8.	723.	02/28/88
111	2-E33-7	PCI/L	8.	656.	05/12/88
111	2-E33-7	PCI/L	8.	361.	07/26/88
111	2-E33-8	PCI/L	8.	140.	01/25/85
111	2-E33-8	PCI/L	8.	58.6	04/08/85
111	2-E33-8	PCI/L	8.	77.8	08/29/85
111	2-E33-8	PCI/L	8.	78.4	11/13/85
111	2-E33-8	PCI/L	8.	76.7	02/19/86
111	2-E33-8	PCI/L	8.	84.	04/30/86
111	2-E33-8	PCI/L	8.	140.	08/08/86
111	2-E33-8	PCI/L	8.	184.	10/28/86
111	2-E33-8	PCI/L	8.	109.	03/15/87
111	2-E33-8	PCI/L	8.	83.1	05/22/87
111	2-E33-8	PCI/L	8.	65.7	05/22/87
111	2-E33-8	PCI/L	8.	36.6	08/04/87
111	2-E33-8	PCI/L	8.	61.9	08/04/87
111	2-E33-8	PCI/L	8.	57.2	10/28/87
111	2-E33-8	PCI/L	8.	55.6	02/28/88
111	2-E33-9	PCI/L	8.	31.	01/03/85
111	2-E33-9	PCI/L	8.	44.3	02/13/85
111	2-E33-9	PCI/L	8.	173.	05/14/85
111	2-E33-9	PCI/L	8.	37.8	02/27/86
111	2-E33-9	PCI/L	8.	99.9	05/05/86
111	2-E33-9	PCI/L	8.	173.	11/04/86
111	2-E33-9	PCI/L	8.	226.	04/02/87
111	2-E33-9	PCI/L	8.	219.	06/29/87
111	2-E33-9	PCI/L	8.	224.	09/02/87
111	2-E33-9	PCI/L	8.	130.	10/28/87
111	2-E33-9	PCI/L	8.	163.	05/12/88
111	2-E33-12	PCI/L	8.	49.3	02/28/88
111	2-E33-18	PCI/L	8.	11.8	01/03/85
111	2-E33-18	PCI/L	8.	11.2	02/13/85
111	2-E33-18	PCI/L	8.	14.1	04/15/85
111	2-E33-18	PCI/L	8.	11.	09/05/85
111	2-E33-18	PCI/L	8.	10.8	12/19/85
111	2-E33-18	PCI/L	8.	11.4	02/27/86
111	2-E33-18	PCI/L	8.	14.9	05/05/86
111	2-E33-18	PCI/L	8.	13.	08/11/86
111	2-E33-18	PCI/L	8.	8.77	10/29/86
111	2-E33-18	PCI/L	8.	14.9	03/24/87
111	2-E33-18	PCI/L	8.	8.63	03/24/87
111	2-E33-18	PCI/L	8.	11.5	05/19/87
111	2-E33-18	PCI/L	8.	8.85	05/19/87
111	2-E33-18	PCI/L	8.	14.5	08/04/87
111	2-E33-18	PCI/L	8.	10.8	08/04/87
111	2-E33-18	PCI/L	8.	10.6	10/26/87
111	2-E33-18	PCI/L	8.	10.4	03/01/88
111	2-E33-20	PCI/L	8.	16.4	01/03/85
111	2-E33-20	PCI/L	8.	12.7	02/13/85
111	2-E33-20	PCI/L	8.	10.9	05/14/85
111	2-E33-20	PCI/L	8.	10.3	09/07/85
111	2-E33-20	PCI/L	8.	7.3	02/27/86

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
111	2-E33-20	PCI/L	8.	15.5	05/05/86
111	2-E33-20	PCI/L	8.	14.9	08/14/86
111	2-E33-20	PCI/L	8.	10.4	10/29/86
111	2-E33-20	PCI/L	8.	13.6	04/01/87
111	2-E33-20	PCI/L	8.	9.59	04/12/87
111	2-E33-20	PCI/L	8.	8.39	09/02/87
111	2-E33-20	PCI/L	8.	11.6	10/26/87
111	2-E33-20	PCI/L	8.	15.1	03/01/88
111	2-E33-20	PCI/L	8.	9.02	05/12/88
111	2-E33-24	PCI/L	8.	46.4	01/03/85
111	2-E33-24	PCI/L	8.	55.5	01/25/85
111	2-E33-24	PCI/L	8.	54.5	04/10/85
111	2-E33-24	PCI/L	8.	96.3	08/29/85
111	2-E33-24	PCI/L	8.	69.8	12/19/85
111	2-E33-24	PCI/L	8.	67.9	02/19/86
111	2-E33-24	PCI/L	8.	61.2	04/30/86
111	2-E33-24	PCI/L	8.	136.	08/11/86
111	2-E33-24	PCI/L	8.	171.	10/28/86
111	2-E33-24	PCI/L	8.	216.	03/15/87
111	2-E33-24	PCI/L	8.	391.	05/27/87
111	2-E33-24	PCI/L	8.	386.	05/27/87
111	2-E33-24	PCI/L	8.	267.	08/06/87
111	2-E33-24	PCI/L	8.	349.	08/06/87
111	2-E33-24	PCI/L	8.	235.	10/28/87
111	2-E33-24	PCI/L	8.	272.	02/28/88
111	2-E33-26	PCI/L	8.	155.	01/25/85
111	2-E33-26	PCI/L	8.	204.	04/08/85
111	2-E33-26	PCI/L	8.	229.	08/28/85
111	2-E33-26	PCI/L	8.	130.	11/13/85
111	2-E33-26	PCI/L	8.	149.	02/19/86
111	2-E33-26	PCI/L	8.	155.	04/30/86
111	2-E33-26	PCI/L	8.	156.	08/08/86
111	2-E33-26	PCI/L	8.	165.	10/28/86
111	2-E33-26	PCI/L	8.	203.	03/15/87
111	2-E33-26	PCI/L	8.	-1.6543E37	06/16/87
111	2-E33-26	PCI/L	8.	271.	09/01/87
111	2-E33-26	PCI/L	8.	197.	10/28/87
111	2-E33-26	PCI/L	8.	233.	02/22/88
111	6-49-55A	PCI/L	8.	1180.	08/26/87
111	6-49-55A	PCI/L	8.	1390.	11/30/87
111	6-49-55A	PCI/L	8.	1210.	11/30/87
111	6-49-55A	PCI/L	8.	1190.	11/30/87
111	6-49-55A	PCI/L	8.	1550.	02/12/88
111	6-49-55A	PCI/L	8.	1360.	02/12/88
111	6-49-55A	PCI/L	8.	1220.	04/15/88
111	6-49-55A	PCI/L	8.	1220.	04/15/88
111	6-49-55A	PCI/L	8.	1360.	06/15/88
111	6-49-55B	PCI/L	8.	6.7	02/19/88
111	6-49-55B	PCI/L	8.	6.24	05/03/88
111	6-49-55B	PCI/L	8.	6.07	07/20/88
111	6-49-57	PCI/L	8.	329.	08/16/85
111	6-49-57	PCI/L	8.	318.	05/08/86
111	6-49-57	PCI/L	8.	400.	08/13/86
111	6-49-57	PCI/L	8.	292.	03/19/87
111	6-49-57	PCI/L	8.	174.	05/14/87
111	6-49-57	PCI/L	8.	189.	09/10/87
111	6-49-57	PCI/L	8.	299.	11/30/87
111	6-49-57	PCI/L	8.	297.	11/30/87
111	6-49-57	PCI/L	8.	281.	11/30/87
111	6-49-57	PCI/L	8.	240.	02/09/88
111	6-49-57	PCI/L	8.	192.	02/09/88
111	6-49-57	PCI/L	8.	188.	02/09/88
111	6-49-57	PCI/L	8.	180.	02/09/88
111	6-49-57	PCI/L	8.	262.	06/01/88
111	6-49-57	PCI/L	8.	226.	06/01/88
111	6-50-53	PCI/L	8.	80.7	08/16/85
111	6-50-53	PCI/L	8.	855.	05/12/86
111	6-50-53	PCI/L	8.	1250.	08/04/86

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
111	6-50-53	PCI/L	8.	2090.	03/19/87
111	6-50-53	PCI/L	8.	1240.	05/15/87
111	6-50-53	PCI/L	8.	1350.	08/26/87
111	6-50-53	PCI/L	8.	2600.	12/07/87
111	6-50-53	PCI/L	8.	2570.	12/07/87
111	6-50-53	PCI/L	8.	2770.	12/07/87
111	6-50-53	PCI/L	8.	2350.	03/06/88
111	6-50-53	PCI/L	8.	2560.	03/06/88
111	6-50-53	PCI/L	8.	2430.	03/06/88
111	6-50-53	PCI/L	8.	2570.	03/06/88
111	6-50-53	PCI/L	8.	2260.	04/15/88
111	6-50-53	PCI/L	8.	2030.	04/15/88
111	6-50-53	PCI/L	8.	3020.	06/06/88
111	6-50-53	PCI/L	8.	2980.	06/06/88
111	6-50-53	PCI/L	8.	2630.	06/06/88
111	6-53-55A	PCI/L	8.	9.05	01/17/85
111	6-53-55A	PCI/L	8.	48.2	02/11/85
111	6-53-55A	PCI/L	8.	10.1	03/14/85
111	6-53-55A	PCI/L	8.	9.62	04/01/85
111	6-53-55A	PCI/L	8.	7.64	05/03/85
111	6-53-55A	PCI/L	8.	8.85	06/11/85
111	6-53-55A	PCI/L	8.	15.	07/12/85
111	6-53-55A	PCI/L	8.	8.42	08/13/85
111	6-53-55A	PCI/L	8.	10.7	09/19/85
111	6-53-55A	PCI/L	8.	28.3	10/07/85
111	6-53-55A	PCI/L	8.	9.2	11/08/85
111	6-53-55A	PCI/L	8.	5.38	01/09/86
111	6-53-55A	PCI/L	8.	9.57	02/06/86
111	6-53-55A	PCI/L	8.	5.42	03/07/86
111	6-53-55A	PCI/L	8.	7.44	04/11/86
111	6-53-55A	PCI/L	8.	7.39	05/06/86
111	6-53-55A	PCI/L	8.	7.85	06/03/86
111	6-53-55A	PCI/L	8.	8.98	06/30/86
111	6-53-55A	PCI/L	8.	11.2	08/04/86
111	6-53-55A	PCI/L	8.	7.49	09/04/86
111	6-53-55A	PCI/L	8.	4.25	10/08/86
111	6-53-55A	PCI/L	8.	8.65	11/04/86
111	6-53-55A	PCI/L	8.	10.4	12/09/86
111	6-53-55A	PCI/L	8.	7.22	02/12/87
111	6-53-55A	PCI/L	8.	8.57	03/07/87
111	6-53-55A	PCI/L	8.	9.57	04/06/87
111	6-53-55A	PCI/L	8.	6.31	05/08/87
111	6-53-55A	PCI/L	8.	7.63	06/04/87
111	6-53-55A	PCI/L	8.	6.34	07/08/87
111	6-53-55A	PCI/L	8.	8.08	08/11/87
111	6-53-55A	PCI/L	8.	9.	09/08/87
111	6-53-55A	PCI/L	8.	9.07	10/06/87
111	6-53-55A	PCI/L	8.	7.95	11/04/87
111	6-53-55A	PCI/L	8.	7.78	12/01/87
111	6-53-55A	PCI/L	8.	9.06	01/08/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Total organic carbon

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
C69	2-E32-1	PPB	1000.	1200.	09/13/85
C69	2-E32-1	PPB	1000.	431.	05/05/86
C69	2-E32-1	PPB	1000.	894.	08/12/86
C69	2-E32-1	PPB	1000.	546.	08/06/87
C69	2-E32-1	PPB	1000.	341.	12/31/87
C69	2-E32-1	PPB	1000.	438.	03/02/88
C69	2-E33-1A	PPB	1000.	348.	05/19/87
C69	2-E33-1A	PPB	1000.	438.	08/04/87
C69	2-E33-1A	PPB	1000.	437.	12/06/87
C69	2-E33-1A	PPB	1000.	595.	03/02/88
C69	2-E33-2	PPB	1000.	523.	06/23/87
C69	2-E33-3	PPB	1000.	499.	05/19/87
C69	2-E33-3	PPB	1000.	520.	08/06/87
C69	2-E33-3	PPB	1000.	468.	12/06/87
C69	2-E33-3	PPB	1000.	818.	03/23/88
C69	2-E33-5	PPB	1000.	364.	05/19/87
C69	2-E33-5	PPB	1000.	1430.	08/10/87
C69	2-E33-5	PPB	1000.	455.	12/06/87
C69	2-E33-5	PPB	1000.	537.	03/29/88
C69	2-E33-8	PPB	1000.	368.	05/22/87
C69	2-E33-8	PPB	1000.	493.	08/04/87
C69	2-E33-18	PPB	1000.	529.	03/24/87
C69	2-E33-18	PPB	1000.	412.	05/19/87
C69	2-E33-18	PPB	1000.	543.	08/04/87
C69	2-E33-24	PPB	1000.	558.	05/27/87
C69	2-E33-24	PPB	1000.	494.	08/06/87
C69	6-49-55A	PPB	1000.	309.	08/26/87
C69	6-49-55A	PPB	1000.	361.	11/30/87
C69	6-49-55A	PPB	1000.	280.	02/12/88
C69	6-49-55A	PPB	1000.	480.	06/15/88
C69	6-49-57	PPB	1000.	150.	08/16/85
C69	6-49-57	PPB	1000.	808.	05/08/86
C69	6-49-57	PPB	1000.	245.	08/13/86
C69	6-49-57	PPB	1000.	496.	03/19/87
C69	6-49-57	PPB	1000.	528.	05/14/87
C69	6-49-57	PPB	1000.	551.	09/10/87
C69	6-49-57	PPB	1000.	465.	11/30/87
C69	6-49-57	PPB	1000.	367.	02/09/88
C69	6-49-57	PPB	1000.	405.	06/01/88
C69	6-50-53	PPB	1000.	1290.	08/16/85
C69	6-50-53	PPB	1000.	2010.	05/12/86
C69	6-50-53	PPB	1000.	1300.	08/04/86
C69	6-50-53	PPB	1000.	617.	03/19/87
C69	6-50-53	PPB	1000.	727.	05/15/87
C69	6-50-53	PPB	1000.	1560.	08/26/87
C69	6-50-53	PPB	1000.	560.	12/07/87
C69	6-50-53	PPB	1000.	461.	03/06/88
C69	6-50-53	PPB	1000.	468.	06/06/88

AREA 2-BP-OPERABLE UNIT

Total Uranium

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
104	2-E33-1A	PCI/L	0.5	0.868	03/15/87
104	2-E33-1A	PCI/L	0.5	1.2	08/04/87
104	2-E33-1A	PCI/L	0.5	1.41	02/28/88
104	2-E33-3	PCI/L	0.5	1.08	03/15/87
104	2-E33-3	PCI/L	0.5	1.04	03/15/87
104	2-E33-3	PCI/L	0.5	1.17	08/06/87
104	2-E33-3	PCI/L	0.5	1.73	08/06/87
104	2-E33-3	PCI/L	0.5	4.6	08/06/87
104	2-E33-3	PCI/L	0.5	2.19	02/28/88
104	2-E33-5	PCI/L	0.5	0.576	03/15/87
104	2-E33-5	PCI/L	0.5	1.17	08/10/87
104	2-E33-5	PCI/L	0.5	2.09	02/28/88
104	2-E33-7	PCI/L	0.5	1.16	03/24/87
104	2-E33-7	PCI/L	0.5	0.975	08/04/87
104	2-E33-7	PCI/L	0.5	1.5	02/28/88
104	2-E33-8	PCI/L	0.5	1.23	03/15/87
104	2-E33-8	PCI/L	0.5	1.4	08/04/87
104	2-E33-8	PCI/L	0.5	2.44	02/28/88
104	2-E33-9	PCI/L	0.5	1.45	09/02/87
104	2-E33-12	PCI/L	0.5	0.00601	04/01/87
104	2-E33-12	PCI/L	0.5	0.102	09/01/87
104	2-E33-12	PCI/L	0.5	0.236	02/28/88
104	2-E33-14	PCI/L	0.5	1.3	04/01/87
104	2-E33-14	PCI/L	0.5	1.22	09/01/87
104	2-E33-14	PCI/L	0.5	1.15	02/28/88
104	2-E33-18	PCI/L	0.5	1.18	03/24/87
104	2-E33-18	PCI/L	0.5	1.34	08/04/87
104	2-E33-18	PCI/L	0.5	1.63	03/01/88
104	2-E33-20	PCI/L	0.5	1.08	04/01/87
104	2-E33-20	PCI/L	0.5	1.19	09/02/87
104	2-E33-20	PCI/L	0.5	2.16	03/01/88
104	2-E33-24	PCI/L	0.5	1.43	03/15/87
104	2-E33-24	PCI/L	0.5	1.54	08/06/87
104	2-E33-24	PCI/L	0.5	1.9	02/28/88
104	6-49-55A	PCI/L	0.5	2.75	02/28/87
104	6-49-55A	PCI/L	0.5	3.23	08/25/87
104	6-49-55A	PCI/L	0.5	3.83	02/12/88
104	6-49-55A	PCI/L	0.5	2.47	04/15/88
104	6-49-55A	PCI/L	0.5	2.5	04/15/88
104	6-49-57	PCI/L	0.5	1.45	02/09/88
104	6-49-57	PCI/L	0.5	1.38	06/01/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Tributylphosphoric Acid

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
I21	2-E32-1	PPB	10.	10.	12/31/87
I21	2-E32-1	PPB	10.	10.	03/02/88
I21	2-E33-1A	PPB	10.	10.	12/06/87
I21	2-E33-1A	PPB	10.	10.	03/02/88
I21	2-E33-3	PPB	10.	10.	12/06/87
I21	2-E33-3	PPB	10.	10.	03/23/88
I21	2-E33-5	PPB	10.	10.	12/06/87
I21	2-E33-5	PPB	10.	10.	03/29/88
I21	6-49-55A	PPB	10.	10.	11/30/87
I21	6-49-55A	PPB	10.	10.	02/12/88
I21	6-49-55A	PPB	10.	10.	06/15/88
I21	6-49-57	PPB	10.	10.	11/30/87
I21	6-49-57	PPB	10.	10.	02/09/88
I21	6-49-57	PPB	10.	10.	06/01/88
I21	6-50-53	PPB	10.	10.	12/07/87
I21	6-50-53	PPB	10.	10.	03/06/88
I21	6-50-53	PPB	10.	10.	06/06/88

DOE-RL 88-32 DRAFT

AREA 2-BP-OPERABLE UNIT

Tritium

Analytical Data Collected Between
1985 and June 1988

DOE-RL 88-32 DRAFT

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
108	2-E32-1	PCI/L	500.	5120.	04/03/85
108	2-E32-1	PCI/L	500.	3710.	08/16/85
108	2-E32-1	PCI/L	500.	9000.	04/21/86
108	2-E32-1	PCI/L	500.	6740.	08/08/86
108	2-E32-1	PCI/L	500.	6040.	03/15/87
108	2-E32-1	PCI/L	500.	7560.	08/06/87
108	2-E32-1	PCI/L	500.	9390.	02/22/88
108	2-E33-1A	PCI/L	500.	571.	03/15/87
108	2-E33-1A	PCI/L	500.	1650.	08/04/87
108	2-E33-1A	PCI/L	500.	4500.	02/28/88
108	2-E33-2	PCI/L	500.	608.	06/23/87
108	2-E33-3	PCI/L	500.	2870.	01/25/85
108	2-E33-3	PCI/L	500.	3390.	04/08/85
108	2-E33-3	PCI/L	500.	2590.	08/28/85
108	2-E33-3	PCI/L	500.	1310.	11/13/85
108	2-E33-3	PCI/L	500.	1150.	02/19/86
108	2-E33-3	PCI/L	500.	1340.	04/30/86
108	2-E33-3	PCI/L	500.	1210.	08/08/86
108	2-E33-3	PCI/L	500.	854.	10/28/86
108	2-E33-3	PCI/L	500.	309.	03/15/87
108	2-E33-3	PCI/L	500.	819.	05/19/87
108	2-E33-3	PCI/L	500.	858.	08/06/87
108	2-E33-3	PCI/L	500.	1690.	12/06/87
108	2-E33-3	PCI/L	500.	2570.	02/28/88
108	2-E33-5	PCI/L	500.	827.	03/15/87
108	2-E33-5	PCI/L	500.	2480.	08/10/87
108	2-E33-5	PCI/L	500.	4910.	02/28/88
108	2-E33-7	PCI/L	500.	4290.	03/24/87
108	2-E33-7	PCI/L	500.	8310.	08/04/87
108	2-E33-7	PCI/L	500.	7770.	02/28/88
108	2-E33-8	PCI/L	500.	1890.	03/15/87
108	2-E33-8	PCI/L	500.	4560.	08/04/87
108	2-E33-8	PCI/L	500.	4990.	02/28/88
108	2-E33-9	PCI/L	500.	693.	01/03/85
108	2-E33-9	PCI/L	500.	408.	02/13/85
108	2-E33-9	PCI/L	500.	1110.	05/14/85
108	2-E33-9	PCI/L	500.	148.	02/27/86
108	2-E33-9	PCI/L	500.	29.3	05/05/86
108	2-E33-9	PCI/L	500.	507.	11/04/86
108	2-E33-9	PCI/L	500.	1620.	04/02/87
108	2-E33-9	PCI/L	500.	2060.	06/29/87
108	2-E33-9	PCI/L	500.	2450.	09/02/87
108	2-E33-9	PCI/L	500.	3820.	10/28/87
108	2-E33-9	PCI/L	500.	4580.	05/12/88
108	2-E33-12	PCI/L	500.	419.	04/02/85
108	2-E33-12	PCI/L	500.	311.	08/16/85
108	2-E33-12	PCI/L	500.	419.	04/21/86
108	2-E33-12	PCI/L	500.	390.	09/11/86
108	2-E33-12	PCI/L	500.	492.	04/01/87
108	2-E33-12	PCI/L	500.	385.	09/01/87
108	2-E33-12	PCI/L	500.	431.	02/28/88
108	2-E33-14	PCI/L	500.	670.	02/13/85
108	2-E33-14	PCI/L	500.	2400.	04/08/85
108	2-E33-14	PCI/L	500.	370.	10/10/85
108	2-E33-14	PCI/L	500.	500.	04/29/86
108	2-E33-14	PCI/L	500.	580.	07/08/86
108	2-E33-14	PCI/L	500.	374.	04/01/87

CODE NUMBER	WELL# NUMBER	UNITS	DETENTION LIMIT	VALUE	COLLECTION DATE
108	2-E33-14	PCI/L	500.	525.	09/01/87
108	2-E33-14	PCI/L	500.	171.	02/28/88
108	2-E33-18	PCI/L	500.	467.	03/24/87
108	2-E33-18	PCI/L	500.	1910.	08/04/87
108	2-E33-18	PCI/L	500.	4920.	03/01/88
108	2-E33-20	PCI/L	500.	280.	04/01/87
108	2-E33-20	PCI/L	500.	2280.	09/02/87
108	2-E33-20	PCI/L	500.	5070.	03/01/88
108	2-E33-24	PCI/L	500.	12800.	03/15/87
108	2-E33-24	PCI/L	500.	17600.	08/06/87
108	2-E33-24	PCI/L	500.	16100.	02/28/88
108	6-49-55A	PCI/L	500.	5500.	03/18/85
108	6-49-55A	PCI/L	500.	5900.	06/15/85
108	6-49-55A	PCI/L	500.	6900.	10/22/85
108	6-49-55A	PCI/L	500.	6800.	12/06/85
108	6-49-55A	PCI/L	500.	9000.	03/05/86
108	6-49-55A	PCI/L	500.	10000.	06/18/86
108	6-49-55A	PCI/L	500.	12700.	09/06/86
108	6-49-55A	PCI/L	500.	14700.	11/13/86
108	6-49-55A	PCI/L	500.	17800.	02/28/87
108	6-49-55A	PCI/L	500.	16600.	05/31/87
108	6-49-55A	PCI/L	500.	16900.	08/25/87
108	6-49-55A	PCI/L	500.	16100.	11/30/87
108	6-49-55A	PCI/L	500.	14800.	02/12/88
108	6-49-55A	PCI/L	500.	13700.	04/15/88
108	6-49-55A	PCI/L	500.	14100.	04/15/88
108	6-49-55B	PCI/L	500.	-269.	11/02/85
108	6-49-55B	PCI/L	500.	-92.6	04/21/86
108	6-49-55B	PCI/L	500.	-245.	09/09/86
108	6-49-55B	PCI/L	500.	-103.	10/27/86
108	6-49-55B	PCI/L	500.	-1.6543E37	06/11/87
108	6-49-55B	PCI/L	500.	170.	02/19/88
108	6-49-57	PCI/L	500.	8100.	02/22/85
108	6-49-57	PCI/L	500.	5500.	06/15/85
108	6-49-57	PCI/L	500.	7300.	08/16/85
108	6-49-57	PCI/L	500.	5900.	12/12/85
108	6-49-57	PCI/L	500.	4000.	03/05/86
108	6-49-57	PCI/L	500.	2800.	06/02/86
108	6-49-57	PCI/L	500.	3160.	09/06/86
108	6-49-57	PCI/L	500.	3160.	11/13/86
108	6-49-57	PCI/L	500.	2100.	02/28/87
108	6-49-57	PCI/L	500.	1550.	05/14/87
108	6-49-57	PCI/L	500.	1720.	08/25/87
108	6-49-57	PCI/L	500.	3340.	11/30/87
108	6-49-57	PCI/L	500.	3000.	02/09/88
108	6-49-57	PCI/L	500.	4250.	06/01/88
108	6-50-53	PCI/L	500.	-300.	04/01/85
108	6-50-53	PCI/L	500.	110.	08/06/85
108	6-50-53	PCI/L	500.	250.	08/16/85
108	6-50-53	PCI/L	500.	58.	12/09/85
108	6-50-53	PCI/L	500.	700.	03/05/86
108	6-50-53	PCI/L	500.	860.	06/02/86
108	6-50-53	PCI/L	500.	2050.	09/25/86
108	6-50-53	PCI/L	500.	1740.	11/26/86
108	6-50-53	PCI/L	500.	1690.	02/28/87
108	6-50-53	PCI/L	500.	1400.	05/15/87
108	6-50-53	PCI/L	500.	2290.	08/25/87
108	6-50-53	PCI/L	500.	3470.	12/07/87
108	6-50-53	PCI/L	500.	3070.	03/06/88
108	6-50-53	PCI/L	500.	3270.	04/15/88
108	6-50-53	PCI/L	500.	3410.	04/15/88

APPENDIX E

GROUNDWATER ANALYSIS BY WELL

(Pacific Northwest Laboratory, 1988e. Hanford Groundwater Data Base, Richland, WA.)

List of Wells

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AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E32-1

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
108	TRIT		PCI/L	500.	9390.	7	7
109	COLI	Coliform bacteria	MPN	2.2	2400.	2	3
111	BETA	Gross beta	PCI/L	8.	63.6	12	12
115	NITR		MG/L	0.2	36.4	4	4
181	RADI	Radium	PCI/L	1.	0.152	0	4
191	COND	Specific conductance	UMHO	1.	355.	7	7
199	PHFI	pH		0.1	8.4	6	6
207	PH-L			0.01	7.86	4	4
212	ALPH	Gross alpha	PCI/L	4.	6.25	1	5
A01	BERY	Beryllium	PPB	5.	5.	0	4
A02	OSMI	Osmium	PPB	300.	300.	0	3
A03	STRO	Strontium	PPB	300.	300.	0	4
A04	ZINC	Zinc	PPB	5.	8.	2	4
A05	CALC	Calcium	PPB	50.	30800.	4	4
A06	BARI	Barium	PPB	6.	37.	4	4
A07	CADM	Cadmium	PPB	2.	2.	0	4
A08	CHRO	Chromium	PPB	10.	10.	0	4
A09	LEAD		PPB	30.	30.	0	1
A10	SILV	Silver	PPB	10.	10.	0	4
A11	SODI	Sodium	PPB	100.	26000.	4	4
A12	NICK	Nickel	PPB	10.	10.	0	4
A13	COPP	Copper	PPB	10.	10.	0	4
A14	VANA	Vanadium	PPB	5.	25.	4	4
A15	ANTI	Antimony	PPB	100.	100.	0	4
A16	ALUM	Aluminum	PPB	150.	150.	0	4
A17	MANG	Manganese	PPB	5.	5.	0	4
A18	POTA	Potassium	PPB	100.	6090.	4	4
A19	IRON	Iron	PPB	50.	130.	4	4
A20	ARSE	Arsenic	PPB	5.	5.	0	4
A21	MERC	Mercury	PPB	0.1	0.1	0	4
A22	SELE	Selenium	PPB	5.	5.	0	4
A33	ENDR	Endrin	PPB	1.	1.	0	3
A34	METH	Methoxychlor	PPB	3.	1.	0	3
A35	TOXA	Toxaphene	PPB	1.	1.	0	3
A36	a-BH	Alpha-BHC	PPB	1.	1.	0	3
A37	b-BH	Beta-BHC	PPB	1.	1.	0	3
A38	g-BH	Gamma-BHC	PPB	1.	1.	0	3
A39	d-BH	Delta-BHC	PPB	1.	1.	0	3
A50	MAGN	Magnesium	PPB	0.	9180.	2	2
A51	LEAD	Lead (graphite furnace)	PPB	5.	5.	0	3
A54	AR10	Arochlor 1016	PPB	1.	1.	0	2
A55	AR12	Arochlor 1221	PPB	1.	1.	0	2
A56	AR12	Arochlor 1232	PPB	1.	1.	0	2
A57	AR12	Arochlor 1242	PPB	1.	1.	0	2
A58	AR12	Arochlor 1248	PPB	1.	1.	0	2
A59	AR12	Arochlor 1254	PPB	1.	1.	0	2
A60	AR12	Arochlor 1260	PPB	1.	1.	0	2
A61	TETR	Tetrachloromethane	PPB	10.	10.	0	5
A62	BENZ	Benzene	PPB	10.	10.	0	4
A63	DIOX	Dioxane	PPB	500.	500.	0	4
A64	METH	Methyl ethyl ketone	PPB	10.	10.	0	5
A65	PYRI	Pyridine	PPB	500.	500.	0	4
A66	TOLU	Toluene	PPB	10.	10.	0	4
A67	1,1,	1,1,1-trichloroethane	PPB	10.	10.	0	5
A68	1,1,	1,1,2-trichloroethane	PPB	10.	10.	0	5
A69	TRIC	Trichloroethylene	PPB	10.	10.	0	5
A70	PERC	Perchloroethylene	PPB	10.	10.	0	5
A71	OPXY	Xylene-o,p	PPB	10.	10.	0	5

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
A72	ACRO	Acrolein	PPB	10.	10.	0	3
A73	ACRY	Acrylonitrile	PPB	10.	10.	0	3
A74	BIST	Bis(chloromethyl) ether	PPB	10.	10.	0	3
A75	BROM	Bromoacetone	PPB	10.	10.	0	3
A76	METH	Methyl bromide	PPB	10.	10.	0	3
A77	CARB	Carbon disulfide	PPB	10.	10.	0	3
A78	CHLB	Chlorobenzene	PPB	10.	10.	0	3
A79	CHLT	2-chloroethyl vinyl ether	PPB	10.	10.	0	3
A80	CHLF	Chloroform	PPB	10.	10.	0	4
A81	METH	Methyl chloride	PPB	10.	10.	0	3
A82	CHMT	Chloromethyl methyl ether	PPB	10.	10.	0	3
A83	CROT	Crotonaldehyde	PPB	10.	10.	0	3
A84	DIBR	1,2-dibromo-3-chloropropane	PPB	10.	10.	0	3
A85	DIBR	1,2-dibromoethane	PPB	10.	10.	0	3
A86	DIBR	Dibromomethane	PPB	10.	10.	0	3
A87	DIBU	1,4-dichloro-2-butene	PPB	10.	10.	0	3
A88	DICD	Dichlorodifluoromethane	PPB	10.	10.	0	3
A89	1,1-	1,1-dichloroethane	PPB	10.	10.	0	3
A90	1,2-	1,2-dichloroethane	PPB	10.	10.	0	3
A91	TRAN	Trans-1,2-dichloroethene	PPB	10.	10.	0	3
A92	DICE	1,1-dichloroethylene	PPB	10.	10.	0	3
A93	METH	Methylene chloride	PPB	10.	10.	0	4
A94	DICP	1,2-dichloropropane	PPB	10.	10.	0	3
A95	DICP	1,3-dichloropropene	PPB	10.	10.	0	3
A96	NNDI	N,N-diethylhydrazine	PPB	10.	10.	0	3
A99	HYDR	Hydrogen sulfide	PPB	10.	10.	0	3
B01	IODO	Iodomethane	PPB	10.	10.	0	3
B02	METH	Methacrylonitrile	PPB	10.	10.	0	3
B03	METH	Methanethiol	PPB	10.	10.	0	3
B04	PENT	Pentachloroethane	PPB	10.	10.	0	3
B05	1112	1,1,1,2-tetrachlorethane	PPB	10.	10.	0	3
B06	1122	1,1,2,2-tetrachlorethane	PPB	10.	10.	0	3
B08	BROM	Bromoform	PPB	10.	10.	0	3
B09	TRCM	Trichloromethanethiol	PPB	10.	10.	0	3
B10	TRCM	Trichloromonofluoromethane	PPB	10.	10.	0	3
B11	TRCP	Trichloropropane	PPB	10.	10.	0	3
B12	123-	1,2,3-trichloropropane	PPB	10.	10.	0	3
B13	VINY	Vinyl chloride	PPB	10.	10.	0	3
B14	M-XY	Xylene-m	PPB	10.	10.	0	5
B15	DIET	Diethylarsine	PPB	10.	10.	0	3
B19	ACET	Acetonitrile	PPB	3000.	3000.	0	2
B20	ACET	Acetophenone	PPB	10.	10.	0	1
B21	WARF	Warfarin	PPB	10.	10.	0	1
B22	ACEF	2-acetylaminofluorene	PPB	10.	10.	0	1
B23	AMIN	4-aminobyphenyl	PPB	10.	10.	0	1
B24	AMII	5-(aminomethyl)-3-isoxazolo l	PPB	10.	10.	0	1
B25	AMIT	Amitrole	PPB	10.	10.	0	1
B26	ANIL	Aniline	PPB	10.	10.	0	1
B27	ARAM	Aramite	PPB	10.	10.	0	1
B28	AURA	Auramine	PPB	10.	10.	0	1
B29	BENZ	Benz[c]acridine	PPB	10.	10.	0	1
B30	BENZ	Benz[a]anthracene	PPB	10.	10.	0	1
B31	BEND	Benzene, dichloromethyl	PPB	10.	10.	0	1
B32	BENT	Benzenethoil	PPB	10.	10.	0	1
B33	BEND	Benzidine	PPB	10.	10.	0	1
B34	BENZ	Benzo[b]fluoranthene	PPB	10.	10.	0	1
B35	BENZ	Benzo[j]fluoranthene	PPB	10.	10.	0	1
B36	PBEN	P benzoquinone	PPB	10.	10.	0	1
B37	BENZ	Benzyl chloride	PPB	10.	10.	0	1
B38	BIS2	Bis(2-chloroethoxy) methane	PPB	10.	10.	0	1
B39	BIS2	Bis(2-chloroethyl) ether	PPB	10.	10.	0	1
B40	BIS2	Bis(2-ethylhexyl) phthalate	PPB	10.	10.	0	1
B41	BROP	4-bromophenyl phenyl ether	PPB	10.	10.	0	1
B42	BUTB	Butyl benzyl phthalate	PPB	10.	10.	0	1
B43	BUTD	2-sec-butyl-4,6-dinitrophen ol	PPB	10.	10.	0	1

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
B44	CHAL	Chloroalkyl ethers	PPB	10.	10.	0	1
B45	CHLA	P-chloroaniline	PPB	10.	10.	0	1
B46	CHLC	P-chloro-m-cresol	PPB	10.	10.	0	1
B47	CHLE	1-chloro-2,3-epoxypropane	PPB	10.	10.	0	1
B48	CHLN	2-chloronaphthalene	PPB	10.	10.	0	1
B49	CHLP	2-chlorophenol	PPB	10.	10.	0	1
B50	CHRY	Chrysene	PPB	10.	10.	0	1
B51	CRES	Cresols	PPB	10.	10.	0	1
B52	CYCH	2-cyclohexyl-4,6-dinitrophenol	PPB	10.	10.	0	1
B53	DIBA	Dibenz[a,h]acridine	PPB	10.	10.	0	1
B54	DIBA	Dibenz[a,j]acridine	PPB	10.	10.	0	1
B55	DIBA	Dibenz[a,h]anthracene	PPB	10.	10.	0	1
B56	DIBC	7H-dibenzo[c,g]carbazole	PPB	10.	10.	0	1
B57	DIBA	Dibenzo[a,e]pyrene	PPB	10.	10.	0	1
B58	DIBA	Dibenzo[a,h]pyrene	PPB	10.	10.	0	1
B59	DIBA	Dibenzo[a,i]pyrene	PPB	10.	10.	0	1
B60	DIBP	Di-n-butyl phthalate	PPB	10.	10.	0	1
B61	12-d	1,2-dichlorobenzene	PPB	10.	10.	0	6
B62	13-d	1,3-dichlorobenzene	PPB	10.	10.	0	6
B63	14-d	1,4-dichlorobenzene	PPB	10.	10.	0	6
B64	DICH	3,3'-dichlorobenzidine	PPB	20.	20.	0	1
B65	24-d	2,4-dichlorophenol	PPB	10.	10.	0	1
B66	26-d	2,6-dichlorophenol	PPB	10.	10.	0	1
B67	DIEP	Diethyl phthalate	PPB	10.	10.	0	1
B68	DIHY	Dihydrosafrole	PPB	10.	10.	0	1
B69	DIME	3,3'-dimethoxybenzidine	PPB	10.	10.	0	1
B70	DIME	P-dimethylaminoazobenzene	PPB	10.	10.	0	1
B71	DIMB	7,12-dimethylbenz[a]anthracene	PPB	10.	10.	0	1
B72	DIME	3,3'-dimethylbenzidine	PPB	10.	10.	0	1
B73	THIO	Thiofanox	PPB	10.	10.	0	1
B74	DIMP	Alpha,alpha-dimethylphenethylamine	PPB	10.	10.	0	1
B75	DIMP	2,4-dimethylphenol	PPB	10.	10.	0	1
B76	DIMP	Dimethyl phthalate	PPB	10.	10.	0	1
B77	DINB	Dinitrobenzene	PPB	10.	10.	0	1
B78	DINC	4,6-dinitro-o-cresol and salts	PPB	10.	10.	0	1
B79	DINP	2,4-dinitrophenol	PPB	50.	50.	0	1
B80	24-d	2,4-dinitrotoluene	PPB	10.	10.	0	1
B81	26-d	2,6-dinitrotoluene	PPB	10.	10.	0	1
B82	DIOP	Di-n-octyl phthalate	PPB	10.	10.	0	1
B83	DIPH	Diphenylamine	PPB	10.	10.	0	1
B84	DIPH	1,2-diphenylhydrazine	PPB	10.	10.	0	1
B85	DIPR	Di-n-propylnitrosamine	PPB	10.	10.	0	1
B86	ETHM	Ethyleneimine	PPB	10.	10.	0	1
B87	ETHM	Ethyl methanesulfonate	PPB	10.	10.	0	1
B88	FLUO	Fluoranthene	PPB	10.	10.	0	1
B89	HEXC	Hexachlorobenzene	PPB	10.	10.	0	6
B90	HEXC	Hexachlorobutadiene	PPB	10.	10.	0	1
B91	HEXC	Hexachlorocyclopentadiene	PPB	10.	10.	0	1
B92	HEXC	Hexachloroethane	PPB	10.	10.	0	1
B93	INDE	Indeno(1,2,3-cd)pyrene	PPB	10.	10.	0	1
B94	ISOS	Isosafrole	PPB	10.	10.	0	1
B95	MALO	Malononitrile	PPB	10.	10.	0	1
B96	MELP	Melphalan	PPB	10.	10.	0	1
B97	METH	Methapyrilene	PPB	10.	10.	0	1
B98	METH	Metholonyl	PPB	10.	10.	0	1
B99	META	2-methylaziridine	PPB	10.	10.	0	1
C01	METC	3-methylcholanthrene	PPB	10.	10.	0	1
C02	METB	4,4'-methylenebis(2-chloroaniline)	PPB	10.	10.	0	1
C03	META	2-methyllactonitrile	PPB	10.	10.	0	1
C04	META	Methyl methacrylate	PPB	10.	10.	0	3
C05	METM	Methyl methanesulfonate	PPB	10.	10.	0	1
C06	METP	2-methyl-2-(methylthio) propionaldehyde-	PPB	10.	10.	0	1

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
C07	METH	Methylthiouracil	PPB	10.	10.	0	1
C08	NAPH	1,4-naphthoquinone	PPB	10.	10.	0	1
C09	1-na	1-naphthylamine	PPB	10.	10.	0	1
C10	2-na	2-naphthylamine	PPB	10.	10.	0	1
C11	NITR	P-nitroaniline	PPB	50.	50.	0	1
C12	NITB	Nitrobenzine	PPB	10.	10.	0	1
C13	NITP	4-nitrophenol	PPB	50.	50.	0	1
C14	NNIB	N-nitrosodi-n-butylamine	PPB	10.	10.	0	1
C15	NNID	N-nitrosodiethanolamine	PPB	10.	10.	0	1
C16	NNID	N-nitrosodiethylamine	PPB	10.	10.	0	1
C17	NNID	N-nitrosodimethylamine	PPB	10.	10.	0	1
C18	NNIM	N-nitrosomethylethylamine	PPB	10.	10.	0	1
C19	NNIU	N-nitroso-N-methylurethane	PPB	10.	10.	0	1
C20	NNIV	N-nitrosomethylvinylamine	PPB	10.	10.	0	1
C21	NNIM	N-nitrosomorpholine	PPB	10.	10.	0	1
C22	NNIN	N-nitrosonornicotine	PPB	10.	10.	0	1
C23	NNIP	N-nitrosopiperidine	PPB	10.	10.	0	1
C24	NITR	Nitrosopyrrolidine	PPB	10.	10.	0	1
C25	NITR	5-nitro-o-toluidine	PPB	10.	10.	0	1
C26	PENT	Pentachlorobenzene	PPB	10.	10.	0	6
C27	PENT	Pentachloronitrobenzene	PPB	10.	10.	0	1
C28	PENT	Pentachlorophenol	PPB	50.	50.	0	1
C29	PHEN	Phenacetin	PPB	10.	10.	0	1
C30	PHEN	Phenylenediamine	PPB	10.	10.	0	1
C31	PHTH	Phthalic acid esters	PPB	10.	10.	0	1
C32	PICO	2-picoline	PPB	10.	10.	0	1
C33	PRON	Pronamide	PPB	10.	10.	0	1
C34	RESE	Reserpine	PPB	10.	10.	0	1
C35	RESO	Resorcinol	PPB	10.	10.	0	1
C36	SAFR	Safrol	PPB	10.	10.	0	1
C37	TETR	1,2,4,5-tetrachlorobenzene	PPB	10.	10.	0	6
C39	TETR	2,3,4,6-tetrachlorophenol	PPB	10.	10.	0	1
C40	THIU	Thiuram	PPB	10.	10.	0	1
C41	TOLU	Toluenediamine	PPB	10.	10.	0	1
C42	OTOL	O-toluidine hydrochloride	PPB	10.	10.	0	1
C43	TRIC	1,2,4-trichlorobenzene	PPB	10.	10.	0	6
C44	245-	2,4,5-trichlorophenol	PPB	50.	50.	0	1
C45	246-	2,4,6-trichlorophenol	PPB	10.	10.	0	1
C46	TRIP	O,O,O-triethyl phosphorothioate	PPB	10.	10.	0	1
C47	SYMT	Sym-trinitrobenzene	PPB	10.	10.	0	1
C48	TRIS	Tris(2,3-dibromopropyl) phosphate	PPB	10.	10.	0	1
C49	BENZ	Benzo[a]pyrene	PPB	10.	10.	0	1
C50	CHLN	Chlornaphazine	PPB	10.	10.	0	1
C51	BIS2	Bis(2-chloroisopropyl)ether	PPB	10.	10.	0	1
C52	HEXA	Hexachloropropene	PPB	10.	10.	0	2
C54	HEXA	Hexachlorophene	PPB	10.	10.	0	6
C55	NAPH	Naphthalene	PPB	10.	10.	0	6
C56	123T	1,2,3-trichlorobenzene	PPB	10.	10.	0	6
C57	PHEN	Phenol	PPB	10.	10.	0	6
C58	135T	1,3,5-trichlorobenzene	PPB	10.	10.	0	6
C59	1234	1,2,3,4-tetrachlorobenzene	PPB	10.	10.	0	6
C60	1235	1,2,3,5-tetrachlorobenzene	PPB	10.	10.	0	6
C68	TOX	Total organic halogen	PPB	100.	11.2	0	3
C69	TOC	Total organic carbon	PPB	1000.	1200.	1	6
C70	CYAN	Cyanide	PPB	10.	10.	0	3
C71	FORM	Formalin	PPB	500.	500.	0	4
C72	NITR	Nitrate	PPB	500.	22300.	7	7
C73	SULF	Sulfate	PPB	500.	42100.	6	6
C74	FLUO	Fluoride	PPB	500.	865.	6	6
C75	CHLO	Chloride	PPB	500.	17200.	6	6
C76	PHOS	Phosphate	PPB	1000.	1000.	0	6
C79	KERO	Kerosene	PPB	10000.	10000.	0	6
C80	AMMO	Ammonium ion	PPB	50.	108.	1	6
C91	STRY	Strychnine	PPB	50.	50.	0	2
C92	MALH	Maleic hydrizide	PPB	500.	500.	0	2

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
C93	NICO	Nicotinic acid	PPB	100.	100.	0	2
H05	ETHO	Ethylene oxide	PPB	3000.	3000.	0	2
H06	ETHM	Ethyl methacrylate	PPB	3000.	10.	0	3
H13	2,4-	2,4-D	PPB	2.	1.	0	3
H14	2,4,	2,4,5-TP silvex	PPB	2.	1.	0	3
H16	TC	Total carbon	PPB	-1.65E37	24300.	4	4
H18	FZIN	Zinc, filtered	PPB	5.	13.	2	3
H19	FCAL	Calcium, filtered	PPB	50.	30000.	3	3
H20	FBAR	Barium, filtered	PPB	6.	37.	3	3
H21	FCAD	Cadmium, filtered	PPB	2.	2.	0	3
H22	FCHR	Chromium, filtered	PPB	10.	10.	0	3
H23	FSIL	Silver, filtered	PPB	10.	10.	0	3
H24	FSOD	Sodium, filtered	PPB	100.	21200.	3	3
H25	FNIC	Nickel, filtered	PPB	10.	10.	0	3
H26	FCOP	Copper, filtered	PPB	10.	10.	0	3
H27	FVAN	Vanadium, filtered	PPB	5.	24.	3	3
H28	FALU	Aluminum, filtered	PPB	150.	150.	0	3
H29	FMAN	Manganese, filtered	PPB	5.	5.	0	3
H30	FPOT	Potassium, filtered	PPB	100.	5580.	3	3
H31	FIRO	Iron, filtered	PPB	50.	50.	0	3
H32	FMAG	Magnesium, filtered	PPB	0.	9410.	3	3
H33	FBER	Beryllium, filtered	PPB	5.	5.	0	3
H34	FOSM	Osmium, filtered	PPB	300.	300.	0	1
H35	FSTR	Strontium, filtered	PPB	300.	300.	0	3
H36	FANT	Antimony, filtered	PPB	100.	100.	0	3
H37	FARS	Arsenic, filtered	PPB	5.	6.	1	3
H38	FMER	Mercury, filtered	PPB	0.1	0.1	0	3
H39	FSEL	Selenium, filtered	PPB	5.	5.	0	3
H41	FLEA	Lead, filtered	PPB	5.	5.	0	3
H42	TOXL		PPB	20.	20.	0	3
H58	ALKA			-1.65E37	98100.	3	3
H62	LHYD		PPB	30.	30.	0	1
H63	LFLU		PPB	20.	680.	2	2
H65	HNIT		PPB	2500.	10700.	2	2
H68	HEXO		PPB	10.	10.	0	2
I21	TRIB	Tributylphosphoric Acid	PPB	10.	10.	0	2

END OF REPORT FOR WELL# 2-E32-1

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E33-1A

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	20.6	0	13
024	CS-1	Cesium-137	PCI/L	20.	4.88	0	13
034	RU-1	Ruthenium-106	PCI/L	172.5	47.3	0	13
100	PU39		PCI/L	17.	0.	0	2
102	PU-2		PCI/L	17.	0.	0	2
104	U		PCI/L	0.5	1.41	3	3
108	TRIT		PCI/L	500.	4500.	3	3
111	BETA	Gross beta	PCI/L	8.	225.	16	16
121	SR 9	Strontium-90	PCI/L	5.	0.742	0	10
181	RADI	Radium	PCI/L	1.	0.00709	0	1
191	COND	Specific conductance	UMHO	1.	351.	4	4
197	TC-9		PCI/L	15.	964.	2	2
199	PHFI	pH		0.1	8.4	4	4
207	PH-L			0.01	8.08	5	5
212	ALPH	Gross alpha	PCI/L	4.	1.65	0	3
A01	BERY	Beryllium	PPB	5.	5.	0	1
A03	STRO	Strontium	PPB	300.	144.	0	1
A04	ZINC	Zinc	PPB	5.	5.	0	1
A05	CALC	Calcium	PPB	50.	27000.	1	1
A06	BARI	Barium	PPB	6.	39.	1	1
A07	CADM	Cadmium	PPB	2.	2.	0	1
A08	CHRO	Chromium	PPB	10.	10.	0	1
A10	SILV	Silver	PPB	10.	10.	0	1
A11	SODI	Sodium	PPB	100.	15100.	1	1
A12	NICK	Nickel	PPB	10.	10.	0	1
A13	COPP	Copper	PPB	10.	10.	0	1
A14	VANA	Vanadium	PPB	5.	18.	1	1
A15	ANTI	Antimony	PPB	100.	100.	0	1
A16	ALUM	Aluminum	PPB	150.	150.	0	1
A17	MANG	Manganese	PPB	5.	5.	0	1
A18	POTA	Potassium	PPB	100.	5120.	1	1
A19	IRON	Iron	PPB	50.	54.	1	1
A20	ARSE	Arsenic	PPB	5.	5.	0	1
A21	MERC	Mercury	PPB	0.1	0.1	0	1
A22	SELE	Selenium	PPB	5.	5.	0	1
A50	MAGN	Magnesium	PPB	0.	8980.	1	1
A51	LEAD	Lead (graphite furnace)	PPB	5.	5.	0	1
A61	TETR	Tetrachloromethane	PPB	10.	10.	0	4
A62	BENZ	Benzene	PPB	10.	10.	0	3
A63	DIOX	Dioxane	PPB	500.	500.	0	3
A64	METH	Methyl ethyl ketone	PPB	10.	10.	0	4
A65	PYRI	Pyridine	PPB	500.	500.	0	3
A66	TOLU	Toluene	PPB	10.	10.	0	3
A67	1,1,	1,1,1-trichloroethane	PPB	10.	10.	0	4
A68	1,1,	1,1,2-trichloroethane	PPB	10.	10.	0	4
A69	TRIC	Trichloroethylene	PPB	10.	10.	0	4
A70	PERC	Perchloroethylene	PPB	10.	10.	0	4
A71	OPXY	Xylene-o,p	PPB	10.	10.	0	4
A72	ACRO	Acrolein	PPB	10.	10.	0	3
A73	ACRY	Acrylonitrile	PPB	10.	10.	0	3
A74	BIST	Bis(chloromethyl) ether	PPB	10.	10.	0	3
A75	BROM	Bromoacetone	PPB	10.	10.	0	3
A76	METH	Methyl bromide	PPB	10.	10.	0	3
A77	CARB	Carbon disulfide	PPB	10.	10.	0	3
A78	CHLB	Chlorobenzene	PPB	10.	10.	0	3
A79	CHLT	2-chloroethyl vinyl ether	PPB	10.	10.	0	3
A80	CHLF	Chloroform	PPB	10.	10.	0	4
A81	METH	Methyl chloride	PPB	10.	10.	0	3

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
A82	CHMT	Chloromethyl methyl ether	PPB	10.	10.	0	3
A83	CROT	Crotonaldehyde	PPB	10.	10.	0	3
A84	DIBR	1,2-dibromo-3-chloropropane	PPB	10.	10.	0	3
A85	DIBR	1,2-dibromoethane	PPB	10.	10.	0	3
A86	DIBR	Dibromomethane	PPB	10.	10.	0	3
A87	DIBU	1,4-dichloro-2-butene	PPB	10.	10.	0	3
A88	DICD	Dichlorodifluoromethane	PPB	10.	10.	0	3
A89	1,1-	1,1-dichloroethane	PPB	10.	10.	0	3
A90	1,2-	1,2-dichloroethane	PPB	10.	10.	0	3
A91	TRAN	Trans-1,2-dichloroethene	PPB	10.	10.	0	3
A92	DICE	1,1-dichloroethylene	PPB	10.	10.	0	3
A93	METH	Methylene chloride	PPB	10.	10.	0	4
A94	DICP	1,2-dichloropropane	PPB	10.	10.	0	3
A95	DICP	1,3-dichloropropene	PPB	10.	10.	0	3
A96	NNDI	N,N-diethylhydrazine	PPB	10.	10.	0	3
A99	HYDR	Hydrogen sulfide	PPB	10.	10.	0	3
B01	IODO	Iodomethane	PPB	10.	10.	0	3
B02	METH	Methacrylonitrile	PPB	10.	10.	0	3
B03	METH	Methanethiol	PPB	10.	10.	0	3
B04	PENT	Pentachloroethane	PPB	10.	10.	0	3
B05	1112	1,1,1,2-tetrachlorethane	PPB	10.	10.	0	3
B06	1122	1,1,2,2-tetrachlorethane	PPB	10.	10.	0	3
B08	BROM	Bromoform	PPB	10.	10.	0	3
B09	TRCM	Trichloromethanethiol	PPB	10.	10.	0	3
B10	TRCM	Trichloromonofluoromethane	PPB	10.	10.	0	3
B11	TRCP	Trichloropropane	PPB	10.	10.	0	3
B12	123-	1,2,3-trichloropropane	PPB	10.	10.	0	3
B13	VINY	Vinyl chloride	PPB	10.	10.	0	3
B14	M-XY	Xylene-m	PPB	10.	10.	0	4
B15	DIET	Diethylarsine	PPB	10.	10.	0	3
B19	ACET	Acetonitrile	PPB	3000.	3000.	0	2
B20	ACET	Acetophenone	PPB	10.	10.	0	1
B21	WARF	Warfarin	PPB	10.	10.	0	1
B22	ACEF	2-acetylaminofluorene	PPB	10.	10.	0	1
B23	AMIN	4-aminobyphenyl	PPB	10.	10.	0	1
B24	AMII	5-(aminomethyl)-3-isoxazolo l	PPB	10.	10.	0	1
B25	AMIT	Amitrole	PPB	10.	10.	0	1
B26	ANIL	Aniline	PPB	10.	10.	0	1
B27	ARAM	Aramite	PPB	10.	10.	0	1
B28	AURA	Auramine	PPB	10.	10.	0	1
B29	BENZ	Benz[c]acridine	PPB	10.	10.	0	1
B30	BENZ	Benz[a]anthracene	PPB	10.	10.	0	1
B31	BEND	Benzene, dichloromethyl	PPB	10.	10.	0	1
B32	BENT	Benzenethoil	PPB	10.	10.	0	1
B33	BEND	Benzidine	PPB	10.	10.	0	1
B34	BENZ	Benzo[b]fluoranthene	PPB	10.	10.	0	1
B35	BENZ	Benzo[j]fluoranthene	PPB	10.	10.	0	1
B36	PBEN	P benzoquinone	PPB	10.	10.	0	1
B37	BENZ	Benzyl chloride	PPB	10.	10.	0	1
B38	BIS2	Bis(2-chloroethoxy) methane	PPB	10.	10.	0	1
B39	BIS2	Bis(2-chloroethyl) ether	PPB	10.	10.	0	1
B40	BIS2	Bis(2-ethylhexyl) phthalate	PPB	10.	10.	0	1
B41	BROP	4-bromophenyl phenyl ether	PPB	10.	10.	0	1
B42	BUTB	Butyl benzyl phthalate	PPB	10.	10.	0	1
B43	BUTD	2-sec-butyl-4,6-dinitrophen ol	PPB	10.	10.	0	1
B44	CHAL	Chloroalkyl ethers	PPB	10.	10.	0	1
B45	CHLA	P-chloroaniline	PPB	10.	10.	0	1
B46	CHLC	P-chloro-m-cresol	PPB	10.	10.	0	1
B47	CHLE	1-chloro-2,3-epoxypropane	PPB	10.	10.	0	1
B48	CHLN	2-chloronaphthalene	PPB	10.	10.	0	1
B49	CHLP	2-chlorophenol	PPB	10.	10.	0	1
B50	CHRY	Chrysene	PPB	10.	10.	0	1
B51	CRES	Cresols	PPB	10.	10.	0	1
B52	CYCH	2-cyclohexyl-4,6-dinitrophe nol	PPB	10.	10.	0	1

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
B53	DIBA	Dibenz[a,h]acridine	PPB	10.	10.	0	1
B54	DIBA	Dibenz[a,j]acridine	PPB	10.	10.	0	1
B55	DIBA	Dibenz[a,h]anthracene	PPB	10.	10.	0	1
B56	DIBC	7H-dibenzo[c,g]carbazole	PPB	10.	10.	0	1
B57	DIBA	Dibenzo[a,e]pyrene	PPB	10.	10.	0	1
B58	DIBA	Dibenzo[a,h]pyrene	PPB	10.	10.	0	1
B59	DIBA	Dibenzo[a,i]pyrene	PPB	10.	10.	0	1
B60	DIBP	Di-n-butyl phthalate	PPB	10.	10.	0	1
B61	12-d	1,2-dichlorobenzene	PPB	10.	10.	0	4
B62	13-d	1,3-dichlorobenzene	PPB	10.	10.	0	4
B63	14-d	1,4-dichlorobenzene	PPB	10.	10.	0	4
B64	DICH	3,3'-dichlorobenzidine	PPB	20.	20.	0	1
B65	24-d	2,4-dichlorophenol	PPB	10.	10.	0	1
B66	26-d	2,6-dichlorophenol	PPB	10.	10.	0	1
B67	DIEP	Diethyl phthalate	PPB	10.	10.	0	1
B68	DIHY	Dihydrosafrole	PPB	10.	10.	0	1
B69	DIME	3,3'-dimethoxybenzidine	PPB	10.	10.	0	1
B70	DIME	P-dimethylaminoazobenzene	PPB	10.	10.	0	1
B71	DIMB	7,12-dimethylbenz[a]anthracene	PPB	10.	10.	0	1
B72	DIME	3,3'-dimethylbenzidine	PPB	10.	10.	0	1
B73	THIO	Thiofanox	PPB	10.	10.	0	1
B74	DIMP	Alpha,alpha-dimethylphenethylamine	PPB	10.	10.	0	1
B75	DIMP	2,4-dimethylphenol	PPB	10.	10.	0	1
B76	DIMP	Dimethyl phthalate	PPB	10.	10.	0	1
B77	DINB	Dinitrobenzene	PPB	10.	10.	0	1
B78	DINC	4,6-dinitro-o-cresol and salts	PPB	10.	10.	0	1
B79	DINP	2,4-dinitrophenol	PPB	50.	50.	0	1
B80	24-d	2,4-dinitrotoluene	PPB	10.	10.	0	1
B81	26-d	2,6-dinitrotoluene	PPB	10.	10.	0	1
B82	DIOP	Di-n-octyl phthalate	PPB	10.	10.	0	1
B83	DIPH	Diphenylamine	PPB	10.	10.	0	1
B84	DIPH	1,2-diphenylhydrazine	PPB	10.	10.	0	1
B85	DIPR	Di-n-propylnitrosamine	PPB	10.	10.	0	1
B86	ETHM	Ethyleneimine	PPB	10.	10.	0	1
B87	ETHM	Ethyl methanesulfonate	PPB	10.	10.	0	1
B88	FLUO	Fluoranthene	PPB	10.	10.	0	1
B89	HEXC	Hexachlorobenzene	PPB	10.	10.	0	4
B90	HEXC	Hexachlorobutadiene	PPB	10.	10.	0	1
B91	HEXC	Hexachlorocyclopentadiene	PPB	10.	10.	0	1
B92	HEXC	Hexachloroethane	PPB	10.	10.	0	1
B93	INDE	Indeno(1,2,3-cd)pyrene	PPB	10.	10.	0	1
B94	ISOS	Isosafrole	PPB	10.	10.	0	1
B95	MALO	Malononitrile	PPB	10.	10.	0	1
B96	MELP	Melphalan	PPB	10.	10.	0	1
B97	METH	Methapyrilene	PPB	10.	10.	0	1
B98	METH	Metholonyl	PPB	10.	10.	0	1
B99	META	2-methylaziridine	PPB	10.	10.	0	1
C01	METC	3-methylcholanthrene	PPB	10.	10.	0	1
C02	METB	4,4'-methylenebis(2-chloroaniline)	PPB	10.	10.	0	1
C03	META	2-methyllactonitrile	PPB	10.	10.	0	1
C04	META	Methyl methacrylate	PPB	10.	10.	0	3
C05	METM	Methyl methanesulfonate	PPB	10.	10.	0	1
C06	METP	2-methyl-2-(methylthio) propionaldehyde-	PPB	10.	10.	0	1
C07	METH	Methylthiouracil	PPB	10.	10.	0	1
C08	NAPH	1,4-naphthoquinone	PPB	10.	10.	0	1
C09	1-na	1-naphthylamine	PPB	10.	10.	0	1
C10	2-na	2-naphthylamine	PPB	10.	10.	0	1
C11	NITR	P-nitroaniline	PPB	50.	50.	0	1
C12	NITB	Nitrobenzine	PPB	10.	10.	0	1
C13	NITP	4-nitrophenol	PPB	50.	50.	0	1
C14	NNIB	N-nitrosodi-n-butylamine	PPB	10.	10.	0	1
C15	NNID	N-nitrosodiethanolamine	PPB	10.	10.	0	1

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
C16	NNID	N-nitrosodiethylamine	PPB	10.	10.	0	1
C17	NNID	N-nitrosodimethylamine	PPB	10.	10.	0	1
C18	NNIM	N-nitrosomethylethylamine	PPB	10.	10.	0	1
C19	NNIU	N-nitroso-N-methylurethane	PPB	10.	10.	0	1
C20	NNIV	N-nitrosomethylvinylamine	PPB	10.	10.	0	1
C21	NNIM	N-nitrosomorpholine	PPB	10.	10.	0	1
C22	NNIN	N-nitrosonornicotine	PPB	10.	10.	0	1
C23	NNIP	N-nitrosopiperidine	PPB	10.	10.	0	1
C24	NITR	Nitrosopyrrolidine	PPB	10.	10.	0	1
C25	NITR	5-nitro-o-toluidine	PPB	10.	10.	0	1
C26	PENT	Pentachlorobenzene	PPB	10.	10.	0	4
C27	PENT	Pentachloronitrobenzene	PPB	10.	10.	0	1
C28	PENT	Pentachlorophenol	PPB	50.	50.	0	1
C29	PHEN	Phenacetin	PPB	10.	10.	0	1
C30	PHEN	Phenylenediamine	PPB	10.	10.	0	1
C31	PHTH	Phthalic acid esters	PPB	10.	10.	0	1
C32	PICO	2-picoline	PPB	10.	10.	0	1
C33	PRON	Pronamide	PPB	10.	10.	0	1
C34	RESE	Reserpine	PPB	10.	10.	0	1
C35	RESO	Resorcinol	PPB	10.	10.	0	1
C36	SAFR	Safrol	PPB	10.	10.	0	1
C37	TETR	1,2,4,5-tetrachlorobenzene	PPB	10.	10.	0	4
C39	TETR	2,3,4,6-tetrachlorophenol	PPB	10.	10.	0	1
C40	THIU	Thiuram	PPB	10.	10.	0	1
C41	TOLU	Toluenediamine	PPB	10.	10.	0	1
C42	OTOL	O-toluidine hydrochloride	PPB	10.	10.	0	1
C43	TRIC	1,2,4-trichlorobenzene	PPB	10.	10.	0	4
C44	245-	2,4,5-trichlorophenol	PPB	50.	50.	0	1
C45	246-	2,4,6-trichlorophenol	PPB	10.	10.	0	1
C46	TRIP	O,O,O-triethyl phosphorothioate	PPB	10.	10.	0	1
C47	SYMT	Sym-trinitrobenzene	PPB	10.	10.	0	1
C48	TRIS	Tris(2,3-dibromopropyl) phosphate	PPB	10.	10.	0	1
C49	BENZ	Benzo[a]pyrene	PPB	10.	10.	0	1
C50	CHLN	Chlornaphazine	PPB	10.	10.	0	1
C51	BIS2	Bis(2-chloroisopropyl)ether	PPB	10.	10.	0	1
C52	HEXA	Hexachloropropene	PPB	10.	10.	0	1
C54	HEXA	Hexachlorophene	PPB	10.	10.	0	4
C55	NAPH	Naphthalene	PPB	10.	10.	0	4
C56	123T	1,2,3-trichlorobenzene	PPB	10.	10.	0	4
C57	PHEN	Phenol	PPB	10.	10.	0	4
C58	135T	1,3,5-trichlorobenzene	PPB	10.	10.	0	4
C59	1234	1,2,3,4-tetrachlorobenzene	PPB	10.	10.	0	4
C60	1235	1,2,3,5-tetrachlorobenzene	PPB	10.	10.	0	4
C69	TOC	Total organic carbon	PPB	1000.	595.	0	4
C70	CYAN	Cyanide	PPB	10.	15.9	1	4
C71	FORM	Formalin	PPB	500.	500.	0	3
C72	NITR	Nitrate	PPB	500.	54200.	4	4
C73	SULF	Sulfate	PPB	500.	42000.	4	4
C74	FLUO	Fluoride	PPB	500.	675.	2	4
C75	CHLO	Chloride	PPB	500.	10000.	4	4
C76	PHOS	Phosphate	PPB	1000.	1000.	0	4
C79	KERO	Kerosene	PPB	10000.	10000.	0	4
C80	AMMO	Ammonium ion	PPB	50.	64.	1	4
C91	STRY	Strychnine	PPB	50.	50.	0	1
C92	MALH	Maleic hydrizide	PPB	500.	500.	0	1
C93	NICO	Nicotinic acid	PPB	100.	100.	0	1
H05	ETHO	Ethylene oxide	PPB	3000.	3000.	0	2
H06	ETHM	Ethyl methacrylate	PPB	3000.	10.	0	3
H16	TC	Total carbon	PPB	-1.65E37	24600.	3	3
H18	FZIN	Zinc, filtered	PPB	5.	35.	1	4
H19	FCAL	Calcium, filtered	PPB	50.	30100.	4	4
H20	FBAR	Barium, filtered	PPB	6.	41.	4	4
H21	FCAD	Cadmium, filtered	PPB	2.	2.	0	4
H22	FCHR	Chromium, filtered	PPB	10.	13.	3	4
H23	FSIL	Silver, filtered	PPB	10.	10.	0	4

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
H24	FSOD	Sodium, filtered	PPB	100.	35100.	4	4
H25	FNIC	Nickel, filtered	PPB	10.	10.	0	4
H26	FCOP	Copper, filtered	PPB	10.	10.	0	4
H27	FVAN	Vanadium, filtered	PPB	5.	32.	4	4
H28	FALU	Aluminum, filtered	PPB	150.	150.	0	4
H29	FMAN	Manganese, filtered	PPB	5.	5.	0	4
H30	FPOT	Potassium, filtered	PPB	100.	5540.	4	4
H31	FIRO	Iron, filtered	PPB	50.	50.	0	4
H32	FMAG	Magnesium, filtered	PPB	0.	9610.	4	4
H33	FBER	Beryllium, filtered	PPB	5.	5.	0	4
H34	FOSM	Osmium, filtered	PPB	300.	300.	0	2
H35	FSTR	Strontium, filtered	PPB	300.	300.	0	4
H36	FANT	Antimony, filtered	PPB	100.	100.	0	4
H37	FARS	Arsenic, filtered	PPB	5.	13.	3	4
H38	FMER	Mercury, filtered	PPB	0.1	0.1	0	4
H39	FSEL	Selenium, filtered	PPB	5.	5.	0	4
H41	FLEA	Lead, filtered	PPB	5.	5.	0	4
H42	TOXL		PPB	20.	20.	0	4
H58	ALKA			-1.65E37	108000.	5	5
H63	LFLU		PPB	20.	460.	2	2
H64	BISM		PPB	5.	5.	0	1
H65	HNIT		PPB	2500.	46300.	1	1
H68	HEXO		PPB	10.	10.	0	2
I21	TRIB	Tributylphosphoric Acid	PPB	10.	10.	0	2

END OF REPORT FOR WELL# 2-E33-1A

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E33-2

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
108	TRIT		PCI/L	500.	608.	1	1
111	BETA	Gross beta	PCI/L	8.	61.1	1	1
207	PH-L			0.01	7.61	1	1
212	ALPH	Gross alpha	PCI/L	4.	0.546	0	1
A61	TETR	Tetrachloromethane	PPB	10.	10.	0	1
A64	METH	Methyl ethyl ketone	PPB	10.	10.	0	1
A67	1,1,	1,1,1-trichloroethane	PPB	10.	10.	0	1
A68	1,1,	1,1,2-trichloroethane	PPB	10.	10.	0	1
A69	TRIC	Trichloroethylene	PPB	10.	10.	0	1
A70	PERC	Perchloroethylene	PPB	10.	10.	0	1
A71	OPXY	Xylene-o,p	PPB	10.	10.	0	1
A80	CHLF	Chloroform	PPB	10.	10.	0	1
A93	METH	Methylene chloride	PPB	10.	10.	0	1
B14	M-XY	Xylene-m	PPB	10.	10.	0	1
B61	12-d	1,2-dichlorobenzene	PPB	10.	10.	0	1
B62	13-d	1,3-dichlorobenzene	PPB	10.	10.	0	1
B63	14-d	1,4-dichlorobenzene	PPB	10.	10.	0	1
B89	HEXC	Hexachlorobenzene	PPB	10.	10.	0	1
C26	PENT	Pentachlorobenzene	PPB	10.	10.	0	1
C37	TETR	1,2,4,5-tetrachlorobenzene	PPB	10.	10.	0	1
C43	TRIC	1,2,4-trichlorobenzene	PPB	10.	10.	0	1
C54	HEXA	Hexachlorophene	PPB	10.	10.	0	1
C55	NAPH	Naphthalene	PPB	10.	10.	0	1
C56	123T	1,2,3-trichlorobenzene	PPB	10.	10.	0	1
C57	PHEN	Phenol	PPB	10.	10.	0	1
C58	135T	1,3,5-trichlorobenzene	PPB	10.	10.	0	1
C59	1234	1,2,3,4-tetrachlorobenzene	PPB	10.	10.	0	1
C60	1235	1,2,3,5-tetrachlorobenzene	PPB	10.	10.	0	1
C69	TOC	Total organic carbon	PPB	1000.	523.	0	1
C70	CYAN	Cyanide	PPB	10.	10.	0	1
C72	NITR	Nitrate	PPB	500.	39400.	1	1
C73	SULF	Sulfate	PPB	500.	30100.	1	1
C74	FLUO	Fluoride	PPB	500.	861.	1	1
C75	CHLO	Chloride	PPB	500.	3260.	1	1
C76	PHOS	Phosphate	PPB	1000.	1000.	0	1
C79	KERO	Kerosene	PPB	10000.	10000.	0	1
C80	AMMO	Ammonium ion	PPB	50.	50.	0	1
H18	FZIN	Zinc, filtered	PPB	5.	5.	0	1
H19	FCAL	Calcium, filtered	PPB	50.	23900.	1	1
H20	FBAR	Barium, filtered	PPB	6.	21.	1	1
H21	FCAD	Cadmium, filtered	PPB	2.	2.	0	1
H22	FCHR	Chromium, filtered	PPB	10.	10.	0	1
H23	FSIL	Silver, filtered	PPB	10.	10.	0	1
H24	FSOD	Sodium, filtered	PPB	100.	31900.	1	1
H25	FNIC	Nickel, filtered	PPB	10.	10.	0	1
H26	FCOP	Copper, filtered	PPB	10.	10.	0	1
H27	FVAN	Vanadium, filtered	PPB	5.	27.	1	1
H28	FALU	Aluminum, filtered	PPB	150.	150.	0	1
H29	FMAN	Manganese, filtered	PPB	5.	5.	0	1
H30	FPOT	Potassium, filtered	PPB	100.	4760.	1	1
H31	FIRO	Iron, filtered	PPB	50.	50.	0	1
H32	FMAG	Magnesium, filtered	PPB	0.	6870.	1	1
H33	FBER	Beryllium, filtered	PPB	5.	5.	0	1
H34	FOSM	Osmium, filtered	PPB	300.	300.	0	1
H35	FSTR	Strontium, filtered	PPB	300.	300.	0	1
H36	FANT	Antimony, filtered	PPB	100.	100.	0	1
H37	FARS	Arsenic, filtered	PPB	5.	10.	1	1
H38	FMER	Mercury, filtered	PPB	0.1	0.1	0	1

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
H39	FSEL	Selenium, filtered	PPB	5.	5.	0	1
H41	FLEA	Lead, filtered	PPB	5.	5.	0	1
H42	TOXL		PPB	20.	7.	0	1
H58	ALKA			-1.65E37	95600.	1	1

END OF REPORT FOR WELL# 2-E33-2

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E33-3

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	232.	8	13
024	CS-1	Cesium-137	PCI/L	20.	7.68	0	13
034	RU-1	Ruthenium-106	PCI/L	172.5	58.8	0	13
100	PU39		PCI/L	17.	1.2	0	6
102	PU-2		PCI/L	17.	0.0538	0	5
104	U		PCI/L	0.5	4.6	6	6
108	TRIT		PCI/L	500.	3390.	12	13
111	BETA	Gross beta	PCI/L	8.	1210.	17	17
121	SR 9	Strontium-90	PCI/L	5.	0.876	0	10
124	U-CH	Natural uranium	UG/L	0.725	1.56	1	1
181	RADI	Radium	PCI/L	1.	0.	0	2
191	COND	Specific conductance	UMHO	1.	356.	4	4
197	TC-9		PCI/L	15.	2710.	2	2
199	PHFI	pH		0.1	8.1	4	4
207	PH-L			0.01	8.11	5	5
212	ALPH	Gross alpha	PCI/L	4.	1.98	0	3
A01	BERY	Beryllium	PPB	5.	5.	0	1
A03	STRO	Strontium	PPB	300.	169.	0	1
A04	ZINC	Zinc	PPB	5.	8.	1	1
A05	CALC	Calcium	PPB	50.	31900.	1	1
A06	BARI	Barium	PPB	6.	21.	1	1
A07	CADM	Cadmium	PPB	2.	2.	0	1
A08	CHRO	Chromium	PPB	10.	10.	0	1
A10	SILV	Silver	PPB	10.	10.	0	1
A11	SODI	Sodium	PPB	100.	26900.	1	1
A12	NICK	Nickel	PPB	10.	10.	0	1
A13	COPP	Copper	PPB	10.	10.	0	1
A14	VANA	Vanadium	PPB	5.	27.	1	1
A15	ANTI	Antimony	PPB	100.	100.	0	1
A16	ALUM	Aluminum	PPB	150.	150.	0	1
A17	MANG	Manganese	PPB	5.	5.	0	1
A18	POTA	Potassium	PPB	100.	4870.	1	1
A19	IRON	Iron	PPB	50.	47.	0	1
A20	ARSE	Arsenic	PPB	5.	10.	1	1
A21	MERC	Mercury	PPB	0.1	0.25	1	1
A22	SELE	Selenium	PPB	5.	5.	0	1
A50	MAGN	Magnesium	PPB	0.	8760.	1	1
A51	LEAD	Lead (graphite furnace)	PPB	5.	5.	0	1
A61	TETR	Tetrachloromethane	PPB	10.	10.	0	4
A62	BENZ	Benzene	PPB	10.	10.	0	3
A63	DIOX	Dioxane	PPB	500.	500.	0	3
A64	METH	Methyl ethyl ketone	PPB	10.	10.	0	4
A65	PYRI	Pyridine	PPB	500.	500.	0	3
A66	TOLU	Toluene	PPB	10.	10.	0	3
A67	1,1,	1,1,1-trichloroethane	PPB	10.	10.	0	4
A68	1,1,	1,1,2-trichloroethane	PPB	10.	10.	0	4
A69	TRIC	Trichloroethylene	PPB	10.	10.	0	4
A70	PERC	Perchloroethylene	PPB	10.	10.	0	4
A71	OPXY	Xylene-o,p	PPB	10.	10.	0	4
A72	ACRO	Acrolein	PPB	10.	10.	0	3
A73	ACRY	Acrylonitrile	PPB	10.	10.	0	3
A74	BIST	Bis(chloromethyl) ether	PPB	10.	10.	0	3
A75	BROM	Bromoacetone	PPB	10.	10.	0	3
A76	METH	Methyl bromide	PPB	10.	10.	0	3
A77	CARB	Carbon disulfide	PPB	10.	10.	0	3
A78	CHLB	Chlorobenzene	PPB	10.	10.	0	3
A79	CHLT	2-chloroethyl vinyl ether	PPB	10.	10.	0	3
A80	CHLF	Chloroform	PPB	10.	10.	0	4

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
A81	METH	Methyl chloride	PPB	10.	10.	0	3
A82	CHMT	Chloromethyl methyl ether	PPB	10.	10.	0	3
A83	CROT	Crotonaldehyde	PPB	10.	10.	0	3
A84	DIBR	1,2-dibromo-3-chloropropane	PPB	10.	10.	0	3
A85	DIBR	1,2-dibromoethane	PPB	10.	10.	0	3
A86	DIBR	Dibromomethane	PPB	10.	10.	0	3
A87	DIBU	1,4-dichloro-2-butene	PPB	10.	10.	0	3
A88	DICD	Dichlorodifluoromethane	PPB	10.	10.	0	3
A89	1,1-	1,1-dichloroethane	PPB	10.	10.	0	3
A90	1,2-	1,2-dichloroethane	PPB	10.	10.	0	3
A91	TRAN	Trans-1,2-dichloroethene	PPB	10.	10.	0	3
A92	DICE	1,1-dichloroethylene	PPB	10.	10.	0	3
A93	METH	Methylene chloride	PPB	10.	10.	0	4
A94	DICP	1,2-dichloropropane	PPB	10.	10.	0	3
A95	DICP	1,3-dichloropropene	PPB	10.	10.	0	3
A96	NNDI	N,N-diethylhydrazine	PPB	10.	10.	0	3
A99	HYDR	Hydrogen sulfide	PPB	10.	10.	0	3
B01	IODO	Iodomethane	PPB	10.	10.	0	3
B02	METH	Methacrylonitrile	PPB	10.	10.	0	3
B03	METH	Methanethiol	PPB	10.	10.	0	3
B04	PENT	Pentachloroethane	PPB	10.	10.	0	3
B05	1112	1,1,1,2-tetrachlorethane	PPB	10.	10.	0	3
B06	1122	1,1,2,2-tetrachlorethane	PPB	10.	10.	0	3
B08	BROM	Bromoform	PPB	10.	10.	0	3
B09	TRCM	Trichloromethanethiol	PPB	10.	10.	0	3
B10	TRCM	Trichloromonofluoromethane	PPB	10.	10.	0	3
B11	TRCP	Trichloropropane	PPB	10.	10.	0	3
B12	123-	1,2,3-trichloropropane	PPB	10.	10.	0	3
B13	VINY	Vinyl chloride	PPB	10.	10.	0	3
B14	M-XY	Xylene-m	PPB	10.	10.	0	4
B15	DIET	Diethylarsine	PPB	10.	10.	0	3
B19	ACET	Acetonitrile	PPB	3000.	3000.	0	2
B20	ACET	Acetophenone	PPB	10.	10.	0	1
B21	WARF	Warfarin	PPB	10.	10.	0	1
B22	ACEF	2-acetylaminofluorene	PPB	10.	10.	0	1
B23	AMIN	4-aminobyphenyl	PPB	10.	10.	0	1
B24	AMII	5-(aminomethyl)-3-isoxazolo l	PPB	10.	10.	0	1
B25	AMIT	Amitrole	PPB	10.	10.	0	1
B26	ANIL	Aniline	PPB	10.	10.	0	1
B27	ARAM	Aramite	PPB	10.	10.	0	1
B28	AURA	Auramine	PPB	10.	10.	0	1
B29	BENZ	Benz[c]acridine	PPB	10.	10.	0	1
B30	BENZ	Benz[a]anthracene	PPB	10.	10.	0	1
B31	BEND	Benzene, dichloromethyl	PPB	10.	10.	0	1
B32	BENT	Benzenethoil	PPB	10.	10.	0	1
B33	BEND	Benzidine	PPB	10.	10.	0	1
B34	BENZ	Benzo[b]fluoranthene	PPB	10.	10.	0	1
B35	BENZ	Benzo[j]fluoranthene	PPB	10.	10.	0	1
B36	PBEN	P benzoquinone	PPB	10.	10.	0	1
B37	BENZ	Benzyl chloride	PPB	10.	10.	0	1
B38	BIS2	Bis(2-chloroethoxy) methane	PPB	10.	10.	0	1
B39	BIS2	Bis(2-chloroethyl) ether	PPB	10.	10.	0	1
B40	BIS2	Bis(2-ethylhexyl) phthalate	PPB	10.	10.	0	1
B41	BROP	4-bromophenyl phenyl ether	PPB	10.	10.	0	1
B42	BUTB	Butyl benzyl phthalate	PPB	10.	10.	0	1
B43	BUTD	2-sec-butyl-4,6-dinitrophen ol	PPB	10.	10.	0	1
B44	CHAL	Chloroalkyl ethers	PPB	10.	10.	0	1
B45	CHLA	P-chloroaniline	PPB	10.	10.	0	1
B46	CHLC	P-chloro-m-cresol	PPB	10.	10.	0	1
B47	CHLE	1-chloro-2,3-epoxypropane	PPB	10.	10.	0	1
B48	CHLN	2-chloronaphthalene	PPB	10.	10.	0	1
B49	CHLP	2-chlorophenol	PPB	10.	10.	0	1
B50	CHRY	Chrysene	PPB	10.	10.	0	1
B51	CRES	Cresols	PPB	10.	10.	0	1
B52	CYCH	2-cyclohexyl-4,6-dinitrophe nol	PPB	10.	10.	0	1

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
B53	DIBA	Dibenz[a,h]acridine	PPB	10.	10.	0	1
B54	DIBA	Dibenz[a,j]acridine	PPB	10.	10.	0	1
B55	DIBA	Dibenz[a,h]anthracene	PPB	10.	10.	0	1
B56	DIBC	7H-dibenzo[c,g]carbazole	PPB	10.	10.	0	1
B57	DIBA	Dibenzo[a,e]pyrene	PPB	10.	10.	0	1
B58	DIBA	Dibenzo[a,h]pyrene	PPB	10.	10.	0	1
B59	DIBA	Dibenzo[a,i]pyrene	PPB	10.	10.	0	1
B60	DIBP	Di-n-butyl phthalate	PPB	10.	10.	0	1
B61	12-d	1,2-dichlorobenzene	PPB	10.	10.	0	2
B62	13-d	1,3-dichlorobenzene	PPB	10.	10.	0	2
B63	14-d	1,4-dichlorobenzene	PPB	10.	10.	0	2
B64	DICH	3,3'-dichlorobenzidine	PPB	20.	20.	0	1
B65	24-d	2,4-dichlorophenol	PPB	10.	10.	0	1
B66	26-d	2,6-dichlorophenol	PPB	10.	10.	0	1
B67	DIEP	Diethyl phthalate	PPB	10.	10.	0	1
B68	DIHY	Dihydrosafrole	PPB	10.	10.	0	1
B69	DIME	3,3'-dimethoxybenzidine	PPB	10.	10.	0	1
B70	DIME	P-dimethylaminoazobenzene	PPB	10.	10.	0	1
B71	DIMB	7,12-dimethylbenz[a]anthracene	PPB	10.	10.	0	1
B72	DIME	3,3'-dimethylbenzidine	PPB	10.	10.	0	1
B73	THIO	Thiofanox	PPB	10.	10.	0	1
B74	DIMP	Alpha,alpha-dimethylphenethylamine	PPB	10.	10.	0	1
B75	DIMP	2,4-dimethylphenol	PPB	10.	10.	0	1
B76	DIMP	Dimethyl phthalate	PPB	10.	10.	0	1
B77	DINB	Dinitrobenzene	PPB	10.	10.	0	1
B78	DINC	4,6-dinitro-o-cresol and salts	PPB	10.	10.	0	1
B79	DINP	2,4-dinitrophenol	PPB	50.	50.	0	1
B80	24-d	2,4-dinitrotoluene	PPB	10.	10.	0	1
B81	26-d	2,6-dinitrotoluene	PPB	10.	10.	0	1
B82	DIOP	Di-n-octyl phthalate	PPB	10.	10.	0	1
B83	DIPH	Diphenylamine	PPB	10.	10.	0	1
B84	DIPH	1,2-diphenylhydrazine	PPB	10.	10.	0	1
B85	DIPR	Di-n-propylnitrosamine	PPB	10.	10.	0	1
B86	ETHM	Ethyleneimine	PPB	10.	10.	0	1
B87	ETHM	Ethyl methanesulfonate	PPB	10.	10.	0	1
B88	FLUO	Fluoranthene	PPB	10.	10.	0	1
B89	HEXC	Hexachlorobenzene	PPB	10.	10.	0	2
B90	HEXC	Hexachlorobutadiene	PPB	10.	10.	0	1
B91	HEXC	Hexachlorocyclopentadiene	PPB	10.	10.	0	1
B92	HEXC	Hexachloroethane	PPB	10.	10.	0	1
B93	INDE	Indeno(1,2,3-cd)pyrene	PPB	10.	10.	0	1
B94	ISOS	Isosafrole	PPB	10.	10.	0	1
B95	MALO	Malononitrile	PPB	10.	10.	0	1
B96	MELP	Melphalan	PPB	10.	10.	0	1
B97	METH	Methapyrilene	PPB	10.	10.	0	1
B98	METH	Metholonyl	PPB	10.	10.	0	1
B99	META	2-methylaziridine	PPB	10.	10.	0	1
C01	METC	3-methylcholanthrene	PPB	10.	10.	0	1
C02	METB	4,4'-methylenebis(2-chloroaniline)	PPB	10.	10.	0	1
C03	META	2-methyllactonitrile	PPB	10.	10.	0	1
C04	META	Methyl methacrylate	PPB	10.	10.	0	3
C05	METM	Methyl methanesulfonate	PPB	10.	10.	0	1
C06	METP	2-methyl-2-(methylthio) propionaldehyde-	PPB	10.	10.	0	1
C07	METH	Methylthiouracil	PPB	10.	10.	0	1
C08	NAPH	1,4-naphthoquinone	PPB	10.	10.	0	1
C09	1-na	1-naphthylamine	PPB	10.	10.	0	1
C10	2-na	2-naphthylamine	PPB	10.	10.	0	1
C11	NITR	P-nitroaniline	PPB	50.	50.	0	1
C12	NITB	Nitrobenzine	PPB	10.	10.	0	1
C13	NITP	4-nitrophenol	PPB	50.	50.	0	1
C14	NNIB	N-nitrosodi-n-butylamine	PPB	10.	10.	0	1
C15	NNID	N-nitrosodiethanolamine	PPB	10.	10.	0	1

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
C16	NNID	N-nitrosodiethylamine	PPB	10.	10.	0	1
C17	NNID	N-nitrosodimethylamine	PPB	10.	10.	0	1
C18	NNIM	N-nitrosomethylethylamine	PPB	10.	10.	0	1
C19	NNIU	N-nitroso-N-methylurethane	PPB	10.	10.	0	1
C20	NNIV	N-nitrosomethylvinylamine	PPB	10.	10.	0	1
C21	NNIM	N-nitrosomorpholine	PPB	10.	10.	0	1
C22	NNIN	N-nitrosonornicotine	PPB	10.	10.	0	1
C23	NNIP	N-nitrosopiperidine	PPB	10.	10.	0	1
C24	NITR	Nitrosopyrrolidine	PPB	10.	10.	0	1
C25	NITR	5-nitro-o-toluidine	PPB	10.	10.	0	1
C26	PENT	Pentachlorobenzene	PPB	10.	10.	0	2
C27	PENT	Pentachloronitrobenzene	PPB	10.	10.	0	1
C28	PENT	Pentachlorophenol	PPB	50.	50.	0	1
C29	PHEN	Phenacetin	PPB	10.	10.	0	1
C30	PHEN	Phenylenediamine	PPB	10.	10.	0	1
C31	PHTH	Phthalic acid esters	PPB	10.	10.	0	1
C32	PICO	2-picoline	PPB	10.	10.	0	1
C33	PRON	Pronamide	PPB	10.	10.	0	1
C34	RESE	Reserpine	PPB	10.	10.	0	1
C35	RESO	Resorcinol	PPB	10.	10.	0	1
C36	SAFR	Safrol	PPB	10.	10.	0	1
C37	TETR	1,2,4,5-tetrachlorobenzene	PPB	10.	10.	0	2
C39	TETR	2,3,4,6-tetrachlorophenol	PPB	10.	10.	0	1
C40	THIU	Thiuram	PPB	10.	10.	0	1
C41	TOLU	Toluenediamine	PPB	10.	10.	0	1
C42	OTOL	O-toluidine hydrochloride	PPB	10.	10.	0	1
C43	TRIC	1,2,4-trichlorobenzene	PPB	10.	10.	0	2
C44	245-	2,4,5-trichlorophenol	PPB	50.	50.	0	1
C45	246-	2,4,6-trichlorophenol	PPB	10.	10.	0	1
C46	TRIP	O,O,O-triethyl phosphorothioate	PPB	10.	10.	0	1
C47	SYMT	Sym-trinitrobenzene	PPB	10.	10.	0	1
C48	TRIS	Tris(2,3-dibromopropyl) phosphate	PPB	10.	10.	0	1
C49	BENZ	Benzo[a]pyrene	PPB	10.	10.	0	1
C50	CHLN	Chlornaphazine	PPB	10.	10.	0	1
C51	BIS2	Bis(2-chloroisopropyl)ether	PPB	10.	10.	0	1
C52	HEXA	Hexachloropropene	PPB	10.	10.	0	1
C54	HEXA	Hexachlorophene	PPB	10.	10.	0	2
C55	NAPH	Naphthalene	PPB	10.	10.	0	2
C56	123T	1,2,3-trichlorobenzene	PPB	10.	10.	0	2
C57	PHEN	Phenol	PPB	10.	10.	0	2
C58	135T	1,3,5-trichlorobenzene	PPB	10.	10.	0	2
C59	1234	1,2,3,4-tetrachlorobenzene	PPB	10.	10.	0	2
C60	1235	1,2,3,5-tetrachlorobenzene	PPB	10.	10.	0	2
C69	TOC	Total organic carbon	PPB	1000.	818.	0	4
C70	CYAN	Cyanide	PPB	10.	38.7	2	4
C71	FORM	Formalin	PPB	500.	500.	0	3
C72	NITR	Nitrate	PPB	500.	60800.	4	4
C73	SULF	Sulfate	PPB	500.	34400.	4	4
C74	FLUO	Fluoride	PPB	500.	967.	4	4
C75	CHLO	Chloride	PPB	500.	4680.	4	4
C76	PHOS	Phosphate	PPB	1000.	1000.	0	4
C79	KERO	Kerosene	PPB	10000.	10000.	0	2
C80	AMMO	Ammonium ion	PPB	50.	70.	1	4
C91	STRY	Strychnine	PPB	50.	50.	0	1
C92	MALH	Maleic hydrizide	PPB	500.	500.	0	1
C93	NICO	Nicotinic acid	PPB	100.	100.	0	1
H05	ETHO	Ethylene oxide	PPB	3000.	3000.	0	2
H06	ETHM	Ethyl methacrylate	PPB	3000.	10.	0	3
H16	TC	Total carbon	PPB	-1.65E37	24400.	3	3
H18	FZIN	Zinc, filtered	PPB	5.	5.	0	4
H19	FCAL	Calcium, filtered	PPB	50.	31800.	4	4
H20	FBAR	Barium, filtered	PPB	6.	23.	4	4
H21	FCAD	Cadmium, filtered	PPB	2.	2.	0	4
H22	FCHR	Chromium, filtered	PPB	10.	13.	2	4
H23	FSIL	Silver, filtered	PPB	10.	10.	0	4

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
H24	FSOD	Sodium, filtered	PPB	100.	32900.	4	4
H25	FNIC	Nickel, filtered	PPB	10.	10.	0	4
H26	FCOP	Copper, filtered	PPB	10.	10.	0	4
H27	FVAN	Vanadium, filtered	PPB	5.	32.	4	4
H28	FALU	Aluminum, filtered	PPB	150.	150.	0	4
H29	FMAN	Manganese, filtered	PPB	5.	5.	0	4
H30	FPOT	Potassium, filtered	PPB	100.	5080.	4	4
H31	FIRO	Iron, filtered	PPB	50.	50.	0	4
H32	FMAG	Magnesium, filtered	PPB	0.	8910.	4	4
H33	FBER	Beryllium, filtered	PPB	5.	5.	0	4
H34	FOSM	Osmium, filtered	PPB	300.	300.	0	2
H35	FSTR	Strontium, filtered	PPB	300.	300.	0	4
H36	FANT	Antimony, filtered	PPB	100.	100.	0	4
H37	FARS	Arsenic, filtered	PPB	5.	13.	4	4
H38	FMER	Mercury, filtered	PPB	0.1	0.17	2	4
H39	FSEL	Selenium, filtered	PPB	5.	5.	0	4
H41	FLEA	Lead, filtered	PPB	5.	5.	0	4
H42	TOXL		PPB	20.	33.6	1	4
H58	ALKA			-1.65E37	107000.	5	5
H63	LFLU		PPB	20.	805.	2	2
H64	BISM		PPB	5.	5.	0	1
H65	HNIT		PPB	2500.	40900.	1	1
H68	HEXO		PPB	10.	10.	0	2
I21	TRIB	Tributylphosphoric Acid	PPB	10.	10.	0	2

END OF REPORT FOR WELL# 2-E33-3

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E33-5

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	53.4	7	14
024	CS-1	Cesium-137	PCI/L	20.	7.91	0	14
034	RU-1	Ruthenium-106	PCI/L	172.5	47.6	0	14
100	PU39		PCI/L	17.	0.00263	0	2
102	PU-2		PCI/L	17.	0.0114	0	2
104	U		PCI/L	0.5	2.09	3	3
108	TRIT		PCI/L	500.	4910.	3	3
111	BETA	Gross beta	PCI/L	8.	571.	17	17
121	SR 9	Strontium-90	PCI/L	5.	0.826	0	10
181	RADI	Radium	PCI/L	1.	0.0475	0	1
191	COND	Specific conductance	UMHO	1.	345.	4	4
197	TC-9		PCI/L	15.	1980.	2	2
199	PHFI	pH		0.1	7.5	4	4
207	PH-L			0.01	8.14	5	5
212	ALPH	Gross alpha	PCI/L	4.	0.857	0	3
A01	BERY	Beryllium	PPB	5.	5.	0	1
A03	STRO	Strontium	PPB	300.	170.	0	1
A04	ZINC	Zinc	PPB	5.	5.	0	1
A05	CALC	Calcium	PPB	50.	34900.	1	1
A06	BARI	Barium	PPB	6.	35.	1	1
A07	CADM	Cadmium	PPB	2.	2.	0	1
A08	CHRO	Chromium	PPB	10.	10.	0	1
A10	SILV	Silver	PPB	10.	10.	0	1
A11	SODI	Sodium	PPB	100.	20800.	1	1
A12	NICK	Nickel	PPB	10.	10.	0	1
A13	COPP	Copper	PPB	10.	10.	0	1
A14	VANA	Vanadium	PPB	5.	22.	1	1
A15	ANTI	Antimony	PPB	100.	100.	0	1
A16	ALUM	Aluminum	PPB	150.	150.	0	1
A17	MANG	Manganese	PPB	5.	5.	0	1
A18	POTA	Potassium	PPB	100.	5210.	1	1
A19	IRON	Iron	PPB	50.	73.	1	1
A20	ARSE	Arsenic	PPB	5.	10.	1	1
A21	MERC	Mercury	PPB	0.1	0.1	0	1
A22	SELE	Selenium	PPB	5.	5.	0	1
A50	MAGN	Magnesium	PPB	0.	10500.	1	1
A51	LEAD	Lead (graphite furnace)	PPB	5.	5.	0	1
A61	TETR	Tetrachloromethane	PPB	10.	10.	0	4
A62	BENZ	Benzene	PPB	10.	10.	0	3
A63	DIOX	Dioxane	PPB	500.	500.	0	3
A64	METH	Methyl ethyl ketone	PPB	10.	10.	0	4
A65	PYRI	Pyridine	PPB	500.	500.	0	3
A66	TOLU	Toluene	PPB	10.	10.	0	3
A67	1,1,	1,1,1-trichloroethane	PPB	10.	10.	0	4
A68	1,1,	1,1,2-trichloroethane	PPB	10.	10.	0	4
A69	TRIC	Trichloroethylene	PPB	10.	10.	0	4
A70	PERC	Perchloroethylene	PPB	10.	10.	0	4
A71	OPXY	Xylene-o,p	PPB	10.	10.	0	4
A72	ACRO	Acrolein	PPB	10.	10.	0	3
A73	ACRY	Acrylonitrile	PPB	10.	10.	0	3
A74	BIST	Bis(chloromethyl) ether	PPB	10.	10.	0	3
A75	BROM	Bromoacetone	PPB	10.	10.	0	3
A76	METH	Methyl bromide	PPB	10.	10.	0	3
A77	CARB	Carbon disulfide	PPB	10.	10.	0	3
A78	CHLB	Chlorobenzene	PPB	10.	10.	0	3
A79	CHLT	2-chloroethyl vinyl ether	PPB	10.	10.	0	3
A80	CHLF	Chloroform	PPB	10.	10.	0	4
A81	METH	Methyl chloride	PPB	10.	10.	0	3

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
A82	CHMT	Chloromethyl methyl ether	PPB	10.	10.	0	3
A83	CROT	Crotonaldehyde	PPB	10.	10.	0	3
A84	DIBR	1,2-dibromo-3-chloropropane	PPB	10.	10.	0	3
A85	DIBR	1,2-dibromoethane	PPB	10.	10.	0	3
A86	DIBR	Dibromomethane	PPB	10.	10.	0	3
A87	DIBU	1,4-dichloro-2-butene	PPB	10.	10.	0	3
A88	DICD	Dichlorodifluoromethane	PPB	10.	10.	0	3
A89	1,1-	1,1-dichloroethane	PPB	10.	10.	0	3
A90	1,2-	1,2-dichloroethane	PPB	10.	10.	0	3
A91	TRAN	Trans-1,2-dichloroethene	PPB	10.	10.	0	3
A92	DICE	1,1-dichloroethylene	PPB	10.	10.	0	3
A93	METH	Methylene chloride	PPB	10.	10.	0	4
A94	DICP	1,2-dichloropropane	PPB	10.	10.	0	3
A95	DICP	1,3-dichloropropene	PPB	10.	10.	0	3
A96	NNDI	N,N-diethylhydrazine	PPB	10.	10.	0	3
A99	HYDR	Hydrogen sulfide	PPB	10.	10.	0	3
B01	IODO	Iodomethane	PPB	10.	10.	0	3
B02	METH	Methacrylonitrile	PPB	10.	10.	0	3
B03	METH	Methanethiol	PPB	10.	10.	0	3
B04	PENT	Pentachloroethane	PPB	10.	10.	0	3
B05	1112	1,1,1,2-tetrachlorethane	PPB	10.	10.	0	3
B06	1122	1,1,2,2-tetrachlorethane	PPB	10.	10.	0	3
B08	BROM	Bromoform	PPB	10.	10.	0	3
B09	TRCM	Trichloromethanethiol	PPB	10.	10.	0	3
B10	TRCM	Trichloromonofluoromethane	PPB	10.	10.	0	3
B11	TRCP	Trichloropropane	PPB	10.	10.	0	3
B12	123-	1,2,3-trichloropropane	PPB	10.	10.	0	3
B13	VINY	Vinyl chloride	PPB	10.	10.	0	3
B14	M-XY	Xylene-m	PPB	10.	10.	0	4
B15	DIET	Diethylarsine	PPB	10.	10.	0	3
B19	ACET	Acetonitrile	PPB	3000.	3000.	0	2
B20	ACET	Acetophenone	PPB	10.	10.	0	1
B21	WARF	Warfarin	PPB	10.	10.	0	1
B22	ACEF	2-acetylaminofluorene	PPB	10.	10.	0	1
B23	AMIN	4-aminobyphenyl	PPB	10.	10.	0	1
B24	AMII	5-(aminomethyl)-3-isoxazolo l	PPB	10.	10.	0	1
B25	AMIT	Amitrole	PPB	10.	10.	0	1
B26	ANIL	Aniline	PPB	10.	10.	0	1
B27	ARAM	Aramite	PPB	10.	10.	0	1
B28	AURA	Auramine	PPB	10.	10.	0	1
B29	BENZ	Benz[c]acridine	PPB	10.	10.	0	1
B30	BENZ	Benz[a]anthracene	PPB	10.	10.	0	1
B31	BEND	Benzene, dichloromethyl	PPB	10.	10.	0	1
B32	BENT	Benzenethoil	PPB	10.	10.	0	1
B33	BEND	Benzidine	PPB	10.	10.	0	1
B34	BENZ	Benzo[b]fluoranthene	PPB	10.	10.	0	1
B35	BENZ	Benzo[j]fluoranthene	PPB	10.	10.	0	1
B36	PBEN	P benzoquinone	PPB	10.	10.	0	1
B37	BENZ	Benzyl chloride	PPB	10.	10.	0	1
B38	BIS2	Bis(2-chloroethoxy) methane	PPB	10.	10.	0	1
B39	BIS2	Bis(2-chloroethyl) ether	PPB	10.	10.	0	1
B40	BIS2	Bis(2-ethylhexyl) phthalate	PPB	10.	10.	0	1
B41	BROP	4-bromophenyl phenyl ether	PPB	10.	10.	0	1
B42	BUTB	Butyl benzyl phthalate	PPB	10.	10.	0	1
B43	BUTD	2-sec-butyl-4,6-dinitrophen ol	PPB	10.	10.	0	1
B44	CHAL	Chloroalkyl ethers	PPB	10.	10.	0	1
B45	CHLA	P-chloroaniline	PPB	10.	10.	0	1
B46	CHLC	P-chloro-m-cresol	PPB	10.	10.	0	1
B47	CHLE	1-chloro-2,3-epoxypropane	PPB	10.	10.	0	1
B48	CHLN	2-chloronaphthalene	PPB	10.	10.	0	1
B49	CHLP	2-chlorophenol	PPB	10.	10.	0	1
B50	CHRY	Chrysene	PPB	10.	10.	0	1
B51	CRES	Cresols	PPB	10.	10.	0	1
B52	CYCH	2-cyclohexyl-4,6-dinitrophe nol	PPB	10.	10.	0	1

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
B53	DIBA	Dibenz[a,h]acridine	PPB	10.	10.	0	1
B54	DIBA	Dibenz[a,j]acridine	PPB	10.	10.	0	1
B55	DIBA	Dibenz[a,h]anthracene	PPB	10.	10.	0	1
B56	DIBC	7H-dibenzo[c,g]carbazole	PPB	10.	10.	0	1
B57	DIBA	Dibenzo[a,e]pyrene	PPB	10.	10.	0	1
B58	DIBA	Dibenzo[a,h]pyrene	PPB	10.	10.	0	1
B59	DIBA	Dibenzo[a,i]pyrene	PPB	10.	10.	0	1
B60	DIBP	Di-n-butyl phthalate	PPB	10.	10.	0	1
B61	12-d	1,2-dichlorobenzene	PPB	10.	10.	0	2
B62	13-d	1,3-dichlorobenzene	PPB	10.	10.	0	2
B63	14-d	1,4-dichlorobenzene	PPB	10.	10.	0	2
B64	DICH	3,3'-dichlorobenzidine	PPB	20.	20.	0	1
B65	24-d	2,4-dichlorophenol	PPB	10.	10.	0	1
B66	26-d	2,6-dichlorophenol	PPB	10.	10.	0	1
B67	DIEP	Diethyl phthalate	PPB	10.	10.	0	1
B68	DIHY	Dihydrosafrole	PPB	10.	10.	0	1
B69	DIME	3,3'-dimethoxybenzidine	PPB	10.	10.	0	1
B70	DIME	P-dimethylaminoazobenzene	PPB	10.	10.	0	1
B71	DIMB	7,12-dimethylbenz[a]anthracene	PPB	10.	10.	0	1
B72	DIME	3,3'-dimethylbenzidine	PPB	10.	10.	0	1
B73	THIO	Thiofanox	PPB	10.	10.	0	1
B74	DIMP	Alpha,alpha-dimethylphenethylamine	PPB	10.	10.	0	1
B75	DIMP	2,4-dimethylphenol	PPB	10.	10.	0	1
B76	DIMP	Dimethyl phthalate	PPB	10.	10.	0	1
B77	DINB	Dinitrobenzene	PPB	10.	10.	0	1
B78	DINC	4,6-dinitro-o-cresol and salts	PPB	10.	10.	0	1
B79	DINP	2,4-dinitrophenol	PPB	50.	50.	0	1
B80	24-d	2,4-dinitrotoluene	PPB	10.	10.	0	1
B81	26-d	2,6-dinitrotoluene	PPB	10.	10.	0	1
B82	DIOP	Di-n-octyl phthalate	PPB	10.	10.	0	1
B83	DIPH	Diphenylamine	PPB	10.	10.	0	1
B84	DIPH	1,2-diphenylhydrazine	PPB	10.	10.	0	1
B85	DIPR	Di-n-propylnitrosamine	PPB	10.	10.	0	1
B86	ETHM	Ethyleneimine	PPB	10.	10.	0	1
B87	ETHM	Ethyl methanesulfonate	PPB	10.	10.	0	1
B88	FLUO	Fluoranthene	PPB	10.	10.	0	1
B89	HEXC	Hexachlorobenzene	PPB	10.	10.	0	2
B90	HEXC	Hexachlorobutadiene	PPB	10.	10.	0	1
B91	HEXC	Hexachlorocyclopentadiene	PPB	10.	10.	0	1
B92	HEXC	Hexachloroethane	PPB	10.	10.	0	1
B93	INDE	Indeno(1,2,3-cd)pyrene	PPB	10.	10.	0	1
B94	ISOS	Isosafrole	PPB	10.	10.	0	1
B95	MALO	Malononitrile	PPB	10.	10.	0	1
B96	MELP	Melphalan	PPB	10.	10.	0	1
B97	METH	Methapyrilene	PPB	10.	10.	0	1
B98	METH	Metholonyl	PPB	10.	10.	0	1
B99	META	2-methylaziridine	PPB	10.	10.	0	1
C01	METC	3-methylcholanthrene	PPB	10.	10.	0	1
C02	METB	4,4'-methylenebis(2-chloroaniline)	PPB	10.	10.	0	1
C03	META	2-methyllactonitrile	PPB	10.	10.	0	1
C04	META	Methyl methacrylate	PPB	10.	10.	0	3
C05	METM	Methyl methanesulfonate	PPB	10.	10.	0	1
C06	METP	2-methyl-2-(methylthio) propionaldehyde-	PPB	10.	10.	0	1
C07	METH	Methylthiouracil	PPB	10.	10.	0	1
C08	NAPH	1,4-naphthoquinone	PPB	10.	10.	0	1
C09	1-na	1-naphthylamine	PPB	10.	10.	0	1
C10	2-na	2-naphthylamine	PPB	10.	10.	0	1
C11	NITR	P-nitroaniline	PPB	50.	50.	0	1
C12	NITB	Nitrobenzine	PPB	10.	10.	0	1
C13	NITP	4-nitrophenol	PPB	50.	50.	0	1
C14	NNIB	N-nitrosodi-n-butylamine	PPB	10.	10.	0	1
C15	NNID	N-nitrosodiethanolamine	PPB	10.	10.	0	1

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
C16	NNID	N-nitrosodiethylamine	PPB	10.	10.	0	1
C17	NNID	N-nitrosodimethylamine	PPB	10.	10.	0	1
C18	NNIM	N-nitrosomethylethylamine	PPB	10.	10.	0	1
C19	NNIU	N-nitroso-N-methylurethane	PPB	10.	10.	0	1
C20	NNIV	N-nitrosomethylvinylamine	PPB	10.	10.	0	1
C21	NNIM	N-nitrosomorpholine	PPB	10.	10.	0	1
C22	NNIN	N-nitrosonornicotine	PPB	10.	10.	0	1
C23	NNIP	N-nitrosopiperidine	PPB	10.	10.	0	1
C24	NITR	Nitrosopyrrolidine	PPB	10.	10.	0	1
C25	NITR	5-nitro-o-toluidine	PPB	10.	10.	0	1
C26	PENT	Pentachlorobenzene	PPB	10.	10.	0	2
C27	PENT	Pentachloronitrobenzene	PPB	10.	10.	0	1
C28	PENT	Pentachlorophenol	PPB	50.	50.	0	1
C29	PHEN	Phenacetin	PPB	10.	10.	0	1
C30	PHEN	Phenylenediamine	PPB	10.	10.	0	1
C31	PHTH	Phthalic acid esters	PPB	10.	10.	0	1
C32	PICO	2-picoline	PPB	10.	10.	0	1
C33	PRON	Pronamide	PPB	10.	10.	0	1
C34	RESE	Reserpine	PPB	10.	10.	0	1
C35	RESO	Resorcinol	PPB	10.	10.	0	1
C36	SAFR	Safrol	PPB	10.	10.	0	1
C37	TETR	1,2,4,5-tetrachlorobenzene	PPB	10.	10.	0	2
C39	TETR	2,3,4,6-tetrachlorophenol	PPB	10.	10.	0	1
C40	THIU	Thiuram	PPB	10.	10.	0	1
C41	TOLU	Toluenediamine	PPB	10.	10.	0	1
C42	OTOL	O-toluidine hydrochloride	PPB	10.	10.	0	1
C43	TRIC	1,2,4-trichlorobenzene	PPB	10.	10.	0	2
C44	245-	2,4,5-trichlorophenol	PPB	50.	50.	0	1
C45	246-	2,4,6-trichlorophenol	PPB	10.	10.	0	1
C46	TRIP	O,O,O-triethyl phosphorothioate	PPB	10.	10.	0	1
C47	SYMT	Sym-trinitrobenzene	PPB	10.	10.	0	1
C48	TRIS	Tris(2,3-dibromopropyl) phosphate	PPB	10.	10.	0	1
C49	BENZ	Benzo[a]pyrene	PPB	10.	10.	0	1
C50	CHLN	Chlornaphazine	PPB	10.	10.	0	1
C51	BIS2	Bis(2-chloroisopropyl)ether	PPB	10.	10.	0	1
C52	HEXA	Hexachloropropene	PPB	10.	10.	0	1
C54	HEXA	Hexachlorophene	PPB	10.	10.	0	2
C55	NAPH	Naphthalene	PPB	10.	10.	0	2
C56	123T	1,2,3-trichlorobenzene	PPB	10.	10.	0	2
C57	PHEN	Phenol	PPB	10.	10.	0	2
C58	135T	1,3,5-trichlorobenzene	PPB	10.	10.	0	2
C59	1234	1,2,3,4-tetrachlorobenzene	PPB	10.	10.	0	2
C60	1235	1,2,3,5-tetrachlorobenzene	PPB	10.	10.	0	2
C69	TOC	Total organic carbon	PPB	1000.	1430.	1	4
C70	CYAN	Cyanide	PPB	10.	26.4	4	4
C71	FORM	Formalin	PPB	500.	500.	0	3
C72	NITR	Nitrate	PPB	500.	37900.	4	4
C73	SULF	Sulfate	PPB	500.	41600.	4	4
C74	FLUO	Fluoride	PPB	500.	560.	2	4
C75	CHLO	Chloride	PPB	500.	6040.	4	4
C76	PHOS	Phosphate	PPB	1000.	1000.	0	4
C79	KERO	Kerosene	PPB	10000.	10000.	0	2
C80	AMMO	Ammonium ion	PPB	50.	71.	1	4
C91	STRY	Strychnine	PPB	50.	50.	0	1
C92	MALH	Maleic hydrizide	PPB	500.	500.	0	1
C93	NICO	Nicotinic acid	PPB	100.	100.	0	1
H05	ETHO	Ethylene oxide	PPB	3000.	3000.	0	2
H06	ETHM	Ethyl methacrylate	PPB	3000.	10.	0	3
H16	TC	Total carbon	PPB	-1.65E37	24500.	3	3
H18	FZIN	Zinc, filtered	PPB	5.	7.	3	4
H19	FCAL	Calcium, filtered	PPB	50.	36000.	4	4
H20	FBAR	Barium, filtered	PPB	6.	37.	4	4
H21	FCAD	Cadmium, filtered	PPB	2.	2.	0	4
H22	FCHR	Chromium, filtered	PPB	10.	11.	1	4
H23	FSIL	Silver, filtered	PPB	10.	10.	0	4

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
H24	FSOD	Sodium, filtered	PPB	100.	24900.	4	4
H25	FNIC	Nickel, filtered	PPB	10.	10.	0	4
H26	FCOP	Copper, filtered	PPB	10.	10.	0	4
H27	FVAN	Vanadium, filtered	PPB	5.	28.	4	4
H28	FALU	Aluminum, filtered	PPB	150.	150.	0	4
H29	FMAN	Manganese, filtered	PPB	5.	5.	0	4
H30	FPOT	Potassium, filtered	PPB	100.	5200.	4	4
H31	FIRO	Iron, filtered	PPB	50.	50.	0	4
H32	FMAG	Magnesium, filtered	PPB	0.	10800.	4	4
H33	FBER	Beryllium, filtered	PPB	5.	5.	0	4
H34	FOSM	Osmium, filtered	PPB	300.	300.	0	2
H35	FSTR	Strontium, filtered	PPB	300.	300.	0	4
H36	FANT	Antimony, filtered	PPB	100.	100.	0	4
H37	FARS	Arsenic, filtered	PPB	5.	9.	4	4
H38	FMER	Mercury, filtered	PPB	0.1	0.1	0	4
H39	FSEL	Selenium, filtered	PPB	5.	5.	0	4
H41	FLEA	Lead, filtered	PPB	5.	5.	0	4
H42	TOXL		PPB	20.	20.	0	4
H58	ALKA			-1.65E37	109000.	5	5
H63	LFLU		PPB	20.	430.	2	2
H64	BISM		PPB	5.	5.	0	1
H65	HNIT		PPB	2500.	33500.	1	1
H68	HEXO		PPB	10.	10.	0	2
I21	TRIB	Tributylphosphoric Acid	PPB	10.	10.	0	2

END OF REPORT FOR WELL# 2-E33-5

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E33-7

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	117.	13	13
024	CS-1	Cesium-137	PCI/L	20.	13.4	0	13
034	RU-1	Ruthenium-106	PCI/L	172.5	60.4	0	13
100	PU39		PCI/L	17.	0.	0	2
102	PU-2		PCI/L	17.	0.	0	2
104	U		PCI/L	0.5	1.5	3	3
108	TRIT		PCI/L	500.	8310.	3	3
111	BETA	Gross beta	PCI/L	8.	1010.	13	13
121	SR 9	Strontium-90	PCI/L	5.	40.3	1	10
124	U-CH	Natural uranium	UG/L	0.725	2.43	1	1
197	TC-9		PCI/L	15.	4700.	3	3
H65	HNIT		PPB	2500.	103000.	1	1

END OF REPORT FOR WELL# 2-E33-7

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E33-8

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	10.9	0	13
024	CS-1	Cesium-137	PCI/L	20.	5.51	0	13
034	RU-1	Ruthenium-106	PCI/L	172.5	59.9	0	13
100	PU39		PCI/L	17.	0.	0	2
102	PU-2		PCI/L	17.	0.	0	2
104	U		PCI/L	0.5	2.44	3	3
108	TRIT		PCI/L	500.	4990.	3	3
111	BETA	Gross beta	PCI/L	8.	184.	15	15
121	SR 9	Strontium-90	PCI/L	5.	0.657	0	10
181	RADI	Radium	PCI/L	1.	0.	0	1
191	COND	Specific conductance	UMHO	1.	255.	2	2
197	TC-9		PCI/L	15.	287.	2	2
199	PHFI	pH		0.1	7.2	2	2
207	PH-L			0.01	7.71	2	2
212	ALPH	Gross alpha	PCI/L	4.	2.38	0	2
A61	TETR	Tetrachloromethane	PPB	10.	10.	0	2
A62	BENZ	Benzene	PPB	10.	10.	0	1
A63	DIOX	Dioxane	PPB	500.	500.	0	1
A64	METH	Methyl ethyl ketone	PPB	10.	10.	0	2
A65	PYRI	Pyridine	PPB	500.	500.	0	1
A66	TOLU	Toluene	PPB	10.	10.	0	1
A67	1,1,	1,1,1-trichloroethane	PPB	10.	10.	0	2
A68	1,1,	1,1,2-trichloroethane	PPB	10.	10.	0	2
A69	TRIC	Trichloroethylene	PPB	10.	10.	0	2
A70	PERC	Perchloroethylene	PPB	10.	10.	0	2
A71	OPXY	Xylene-o,p	PPB	10.	10.	0	2
A72	ACRO	Acrolein	PPB	10.	10.	0	1
A73	ACRY	Acrylonitrile	PPB	10.	10.	0	1
A74	BIST	Bis(chloromethyl) ether	PPB	10.	10.	0	1
A75	BROM	Bromoacetone	PPB	10.	10.	0	1
A76	METH	Methyl bromide	PPB	10.	10.	0	1
A77	CARB	Carbon disulfide	PPB	10.	10.	0	1
A78	CHLB	Chlorobenzene	PPB	10.	10.	0	1
A79	CHLT	2-chloroethyl vinyl ether	PPB	10.	10.	0	1
A80	CHLF	Chloroform	PPB	10.	10.	0	2
A81	METH	Methyl chloride	PPB	10.	10.	0	1
A82	CHMT	Chloromethyl methyl ether	PPB	10.	10.	0	1
A83	CROT	Crotonaldehyde	PPB	10.	10.	0	1
A84	DIBR	1,2-dibromo-3-chloropropane	PPB	10.	10.	0	1
A85	DIBR	1,2-dibromoethane	PPB	10.	10.	0	1
A86	DIBR	Dibromomethane	PPB	10.	10.	0	1
A87	DIBU	1,4-dichloro-2-butene	PPB	10.	10.	0	1
A88	DICD	Dichlorodifluoromethane	PPB	10.	10.	0	1
A89	1,1-	1,1-dichloroethane	PPB	10.	10.	0	1
A90	1,2-	1,2-dichloroethane	PPB	10.	10.	0	1
A91	TRAN	Trans-1,2-dichloroethene	PPB	10.	10.	0	1
A92	DICE	1,1-dichloroethylene	PPB	10.	10.	0	1
A93	METH	Methylene chloride	PPB	10.	10.	0	2
A94	DICP	1,2-dichloropropane	PPB	10.	10.	0	1
A95	DICP	1,3-dichloropropene	PPB	10.	10.	0	1
A96	NNDI	N,N-diethylhydrazine	PPB	10.	10.	0	1
A99	HYDR	Hydrogen sulfide	PPB	10.	10.	0	1
B01	IODO	Iodomethane	PPB	10.	10.	0	1
B02	METH	Methacrylonitrile	PPB	10.	10.	0	1
B03	METH	Methanethiol	PPB	10.	10.	0	1
B04	PENT	Pentachloroethane	PPB	10.	10.	0	1
B05	1112	1,1,1,2-tetrachlorethane	PPB	10.	10.	0	1
B06	1122	1,1,2,2-tetrachlorethane	PPB	10.	10.	0	1

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
B08	BROM	Bromoform	PPB	10.	10.	0	1
B09	TRCM	Trichloromethanethiol	PPB	10.	10.	0	1
B10	TRCM	Trichloromonofluoromethane	PPB	10.	10.	0	1
B11	TRCP	Trichloropropane	PPB	10.	10.	0	1
B12	123-	1,2,3-trichloropropane	PPB	10.	10.	0	1
B13	VINY	Vinyl chloride	PPB	10.	10.	0	1
B14	M-XY	Xylene-m	PPB	10.	10.	0	2
B15	DIET	Diethylarsine	PPB	10.	10.	0	1
B61	12-d	1,2-dichlorobenzene	PPB	10.	10.	0	2
B62	13-d	1,3-dichlorobenzene	PPB	10.	10.	0	2
B63	14-d	1,4-dichlorobenzene	PPB	10.	10.	0	2
B89	HEXC	Hexachlorobenzene	PPB	10.	10.	0	2
C04	META	Methyl methacrylate	PPB	10.	10.	0	1
C26	PENT	Pentachlorobenzene	PPB	10.	10.	0	2
C37	TETR	1,2,4,5-tetrachlorobenzene	PPB	10.	10.	0	2
C43	TRIC	1,2,4-trichlorobenzene	PPB	10.	10.	0	2
C54	HEXA	Hexachlorophene	PPB	10.	10.	0	2
C55	NAPH	Naphthalene	PPB	10.	10.	0	2
C56	123T	1,2,3-trichlorobenzene	PPB	10.	10.	0	2
C57	PHEN	Phenol	PPB	10.	10.	0	2
C58	135T	1,3,5-trichlorobenzene	PPB	10.	10.	0	2
C59	1234	1,2,3,4-tetrachlorobenzene	PPB	10.	10.	0	2
C60	1235	1,2,3,5-tetrachlorobenzene	PPB	10.	10.	0	2
C69	TOC	Total organic carbon	PPB	1000.	493.	0	2
C70	CYAN	Cyanide	PPB	10.	10.	0	2
C71	FORM	Formalin	PPB	500.	500.	0	1
C72	NITR	Nitrate	PPB	500.	8880.	2	2
C73	SULF	Sulfate	PPB	500.	27900.	2	2
C74	FLUO	Fluoride	PPB	500.	500.	0	2
C75	CHLO	Chloride	PPB	500.	4710.	2	2
C76	PHOS	Phosphate	PPB	1000.	1000.	0	2
C79	KERO	Kerosene	PPB	10000.	10000.	0	2
C80	AMMO	Ammonium ion	PPB	50.	50.	0	2
H06	ETHM	Ethyl methacrylate	PPB	3000.	10.	0	1
H16	TC	Total carbon	PPB	-1.65E37	24000.	1	1
H18	FZIN	Zinc, filtered	PPB	5.	6.	1	2
H19	FCAL	Calcium, filtered	PPB	50.	30400.	2	2
H20	FBAR	Barium, filtered	PPB	6.	27.	2	2
H21	FCAD	Cadmium, filtered	PPB	2.	2.	0	2
H22	FCHR	Chromium, filtered	PPB	10.	10.	0	2
H23	FSIL	Silver, filtered	PPB	10.	10.	0	2
H24	FSOD	Sodium, filtered	PPB	100.	12900.	2	2
H25	FNIC	Nickel, filtered	PPB	10.	10.	0	2
H26	FCOP	Copper, filtered	PPB	10.	10.	0	2
H27	FVAN	Vanadium, filtered	PPB	5.	22.	2	2
H28	FALU	Aluminum, filtered	PPB	150.	150.	0	2
H29	FMAN	Manganese, filtered	PPB	5.	5.	0	2
H30	FPOT	Potassium, filtered	PPB	100.	5360.	2	2
H31	FIRO	Iron, filtered	PPB	50.	50.	0	2
H32	FMAG	Magnesium, filtered	PPB	0.	9530.	2	2
H33	FBER	Beryllium, filtered	PPB	5.	5.	0	2
H34	FOSM	Osmium, filtered	PPB	300.	300.	0	2
H35	FSTR	Strontium, filtered	PPB	300.	300.	0	2
H36	FANT	Antimony, filtered	PPB	100.	100.	0	2
H37	FARS	Arsenic, filtered	PPB	5.	7.	1	2
H38	FMER	Mercury, filtered	PPB	0.1	0.1	0	2
H39	FSEL	Selenium, filtered	PPB	5.	5.	0	2
H41	FLEA	Lead, filtered	PPB	5.	5.	0	2
H42	TOXL		PPB	20.	20.	0	2
H58	ALKA			-1.65E37	104000.	2	2
H63	LFLU		PPB	20.	320.	1	1
H64	BISM		PPB	5.	5.	0	1
H65	HNIT		PPB	2500.	7780.	1	1

END OF REPORT FOR WELL# 2-E33-8

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E33-9

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	54.6	1	12
024	CS-1	Cesium-137	PCI/L	20.	17.9	0	12
034	RU-1	Ruthenium-106	PCI/L	172.5	42.6	0	12
100	PU39		PCI/L	17.	0.	0	1
102	PU-2		PCI/L	17.	0.	0	1
104	U		PCI/L	0.5	1.45	1	1
108	TRIT		PCI/L	500.	4580.	8	11
111	BETA	Gross beta	PCI/L	8.	226.	11	11
115	NITR		MG/L	0.2	45.6	5	5
121	SR 9	Strontium-90	PCI/L	5.	2.01	0	11
197	TC-9		PCI/L	15.	592.	1	1
C72	NITR	Nitrate	PPB	500.	8970.	2	2
H65	HNIT		PPB	2500.	10200.	4	4

END OF REPORT FOR WELL# 2-E33-9

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E33-12

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	19.6	0	4
024	CS-1	Cesium-137	PCI/L	20.	7.26	0	4
034	RU-1	Ruthenium-106	PCI/L	172.5	111.	0	4
100	PU39		PCI/L	17.	0.00114	0	2
102	PU-2		PCI/L	17.	0.00179	0	2
104	U		PCI/L	0.5	0.236	0	3
108	TRIT		PCI/L	500.	492.	0	7
111	BETA	Gross beta	PCI/L	8.	49.3	1	1
115	NITR		MG/L	0.2	4.91	3	4
121	SR 9	Strontium-90	PCI/L	5.	0.825	0	3
197	TC-9		PCI/L	15.	132.	1	1
C72	NITR	Nitrate	PPB	500.	500.	0	1
H65	HNIT		PPB	2500.	2500.	0	2

END OF REPORT FOR WELL# 2-E33-12

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E33-14

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	20.	0	7
024	CS-1	Cesium-137	PCI/L	20.	3.66	0	2
034	RU-1	Ruthenium-106	PCI/L	172.5	0.	0	2
100	PU39		PCI/L	17.	0.	0	2
102	PU-2		PCI/L	17.	0.0162	0	2
104	U		PCI/L	0.5	1.3	3	3
108	TRIT		PCI/L	500.	2400.	4	8
116	NO3-		MG/L	0.5	43.	4	4
121	SR 9	Strontium-90	PCI/L	5.	1.67	0	3
C72	NITR	Nitrate	PPB	500.	19500.	1	1
H65	HNIT		PPB	2500.	15400.	2	2

END OF REPORT FOR WELL# 2-E33-14

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E33-18

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	6.82	0	14
024	CS-1	Cesium-137	PCI/L	20.	7.65	0	14
034	RU-1	Ruthenium-106	PCI/L	172.5	60.7	0	14
100	PU39		PCI/L	17.	0.000917	0	2
102	PU-2		PCI/L	17.	0.00615	0	2
104	U		PCI/L	0.5	1.63	3	3
108	TRIT		PCI/L	500.	4920.	2	3
111	BETA	Gross beta	PCI/L	8.	14.9	17	17
121	SR 9	Strontium-90	PCI/L	5.	2.66	0	12
181	RADI	Radium	PCI/L	1.	0.0402	0	2
191	COND	Specific conductance	UMHO	1.	277.	3	3
197	TC-9		PCI/L	15.	32.3	1	1
199	PHFI	pH		0.1	8.1	3	3
207	PH-L			0.01	7.94	3	3
212	ALPH	Gross alpha	PCI/L	4.	2.62	0	3
A61	TETR	Tetrachloromethane	PPB	10.	10.	0	3
A62	BENZ	Benzene	PPB	10.	10.	0	1
A63	DIOX	Dioxane	PPB	500.	500.	0	1
A64	METH	Methyl ethyl ketone	PPB	10.	10.	0	3
A65	PYRI	Pyridine	PPB	500.	500.	0	1
A66	TOLU	Toluene	PPB	10.	10.	0	1
A67	1,1,	1,1,1-trichloroethane	PPB	10.	10.	0	3
A68	1,1,	1,1,2-trichloroethane	PPB	10.	10.	0	3
A69	TRIC	Trichloroethylene	PPB	10.	10.	0	3
A70	PERC	Perchloroethylene	PPB	10.	10.	0	3
A71	OPXY	Xylene-o,p	PPB	10.	10.	0	3
A72	ACRO	Acrolein	PPB	10.	10.	0	1
A73	ACRY	Acrylonitrile	PPB	10.	10.	0	1
A74	BIST	Bis(chloromethyl) ether	PPB	10.	10.	0	1
A75	BROM	Bromoacetone	PPB	10.	10.	0	1
A76	METH	Methyl bromide	PPB	10.	10.	0	1
A77	CARB	Carbon disulfide	PPB	10.	10.	0	1
A78	CHLB	Chlorobenzene	PPB	10.	10.	0	1
A79	CHLT	2-chloroethyl vinyl ether	PPB	10.	10.	0	1
A80	CHLF	Chloroform	PPB	10.	10.	0	3
A81	METH	Methyl chloride	PPB	10.	10.	0	1
A82	CHMT	Chloromethyl methyl ether	PPB	10.	10.	0	1
A83	CROT	Crotonaldehyde	PPB	10.	10.	0	1
A84	DIBR	1,2-dibromo-3-chloropropane	PPB	10.	10.	0	1
A85	DIBR	1,2-dibromoethane	PPB	10.	10.	0	1
A86	DIBR	Dibromomethane	PPB	10.	10.	0	1
A87	DIBU	1,4-dichloro-2-butene	PPB	10.	10.	0	1
A88	DICD	Dichlorodifluoromethane	PPB	10.	10.	0	1
A89	1,1-	1,1-dichloroethane	PPB	10.	10.	0	1
A90	1,2-	1,2-dichloroethane	PPB	10.	10.	0	1
A91	TRAN	Trans-1,2-dichloroethene	PPB	10.	10.	0	1
A92	DICE	1,1-dichloroethylene	PPB	10.	10.	0	1
A93	METH	Methylene chloride	PPB	10.	10.	0	3
A94	DICP	1,2-dichloropropane	PPB	10.	10.	0	1
A95	DICP	1,3-dichloropropene	PPB	10.	10.	0	1
A96	NNDI	N,N-diethylhydrazine	PPB	10.	10.	0	1
A99	HYDR	Hydrogen sulfide	PPB	10.	10.	0	1
B01	IODO	Iodomethane	PPB	10.	10.	0	1
B02	METH	Methacrylonitrile	PPB	10.	10.	0	1
B03	METH	Methanethiol	PPB	10.	10.	0	1
B04	PENT	Pentachloroethane	PPB	10.	10.	0	1
B05	1112	1,1,1,2-tetrachlorethane	PPB	10.	10.	0	1
B06	1122	1,1,2,2-tetrachlorethane	PPB	10.	10.	0	1

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
B08	BROM	Bromoform	PPB	10.	10.	0	1
B09	TRCM	Trichloromethanethiol	PPB	10.	10.	0	1
B10	TRCM	Trichloromonofluoromethane	PPB	10.	10.	0	1
B11	TRCP	Trichloropropane	PPB	10.	10.	0	1
B12	123-	1,2,3-trichloropropane	PPB	10.	10.	0	1
B13	VINY	Vinyl chloride	PPB	10.	10.	0	1
B14	M-XY	Xylene-m	PPB	10.	10.	0	3
B15	DIET	Diethylarsine	PPB	10.	10.	0	1
C04	META	Methyl methacrylate	PPB	10.	10.	0	1
C69	TOC	Total organic carbon	PPB	1000.	543.	0	3
C70	CYAN	Cyanide	PPB	10.	10.	0	3
C71	FORM	Formalin	PPB	500.	500.	0	1
C72	NITR	Nitrate	PPB	500.	17200.	3	3
C73	SULF	Sulfate	PPB	500.	30300.	3	3
C74	FLUO	Fluoride	PPB	500.	500.	0	3
C75	CHLO	Chloride	PPB	500.	3560.	3	3
C76	PHOS	Phosphate	PPB	1000.	1000.	0	3
C80	AMMO	Ammonium ion	PPB	50.	59.	1	3
H06	ETHM	Ethyl methacrylate	PPB	3000.	10.	0	1
H16	TC	Total carbon	PPB	-1.65E37	22100.	1	1
H18	FZIN	Zinc, filtered	PPB	5.	6.	1	3
H19	FCAL	Calcium, filtered	PPB	50.	27700.	3	3
H20	FBAR	Barium, filtered	PPB	6.	24.	3	3
H21	FCAD	Cadmium, filtered	PPB	2.	2.	0	3
H22	FCHR	Chromium, filtered	PPB	10.	10.	0	3
H23	FSIL	Silver, filtered	PPB	10.	10.	0	3
H24	FSOD	Sodium, filtered	PPB	100.	291000.	3	3
H25	FNIC	Nickel, filtered	PPB	10.	10.	0	3
H26	FCOP	Copper, filtered	PPB	10.	10.	0	3
H27	FVAN	Vanadium, filtered	PPB	5.	27.	3	3
H28	FALU	Aluminum, filtered	PPB	150.	150.	0	3
H29	FMAN	Manganese, filtered	PPB	5.	5.	0	3
H30	FPOT	Potassium, filtered	PPB	100.	4850.	3	3
H31	FIRO	Iron, filtered	PPB	50.	50.	0	3
H32	FMAG	Magnesium, filtered	PPB	0.	9480.	3	3
H33	FBER	Beryllium, filtered	PPB	5.	5.	0	3
H34	FOSM	Osmium, filtered	PPB	300.	300.	0	3
H35	FSTR	Strontium, filtered	PPB	300.	300.	0	3
H36	FANT	Antimony, filtered	PPB	100.	100.	0	3
H37	FARS	Arsenic, filtered	PPB	5.	8.	2	3
H38	FMER	Mercury, filtered	PPB	0.1	0.1	0	3
H39	FSEL	Selenium, filtered	PPB	5.	5.	0	3
H41	FLEA	Lead, filtered	PPB	5.	5.	0	3
H42	TOXL		PPB	20.	20.	0	3
H58	ALKA			-1.65E37	96600.	3	3
H63	LFLU		PPB	20.	335.	1	1
H64	BISM		PPB	5.	5.	0	1
H65	HNIT		PPB	2500.	13700.	1	1

END OF REPORT FOR WELL# 2-E33-18

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E33-20

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	6.78	0	2
024	CS-1	Cesium-137	PCI/L	20.	1.72	0	2
034	RU-1	Ruthenium-106	PCI/L	172.5	0.	0	2
100	PU39		PCI/L	17.	0.	0	2
102	PU-2		PCI/L	17.	0.	0	2
104	U		PCI/L	0.5	2.16	3	3
108	TRIT		PCI/L	500.	5070.	2	3
111	BETA	Gross beta	PCI/L	8.	16.4	13	14
115	NITR		MG/L	0.2	76.1	6	6
121	SR 9	Strontium-90	PCI/L	5.	3.18	0	11
197	TC-9		PCI/L	15.	30.2	1	1
C72	NITR	Nitrate	PPB	500.	9730.	3	3
H65	HNIT		PPB	2500.	4850.	4	4

END OF REPORT FOR WELL# 2-E33-20

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E33-24

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	9.3	0	14
024	CS-1	Cesium-137	PCI/L	20.	8.36	0	14
034	RU-1	Ruthenium-106	PCI/L	172.5	50.2	0	14
100	PU39		PCI/L	17.	0.00259	0	2
102	PU-2		PCI/L	17.	0.	0	2
104	U		PCI/L	0.5	1.9	3	3
108	TRIT		PCI/L	500.	17600.	3	3
111	BETA	Gross beta	PCI/L	8.	391.	16	16
121	SR 9	Strontium-90	PCI/L	5.	2.6	0	10
191	COND	Specific conductance	UMHO	1.	286.	2	2
197	TC-9		PCI/L	15.	1580.	2	2
199	PHFI	pH		0.1	7.5	2	2
207	PH-L			0.01	7.74	2	2
212	ALPH	Gross alpha	PCI/L	4.	1.51	0	2
A61	TETR	Tetrachloromethane	PPB	10.	10.	0	2
A62	BENZ	Benzene	PPB	10.	10.	0	1
A63	DIOX	Dioxane	PPB	500.	500.	0	1
A64	METH	Methyl ethyl ketone	PPB	10.	10.	0	2
A65	PYRI	Pyridine	PPB	500.	500.	0	1
A66	TOLU	Toluene	PPB	10.	10.	0	1
A67	1,1,	1,1,1-trichloroethane	PPB	10.	10.	0	2
A68	1,1,	1,1,2-trichloroethane	PPB	10.	10.	0	2
A69	TRIC	Trichloroethylene	PPB	10.	10.	0	2
A70	PERC	Perchloroethylene	PPB	10.	10.	0	2
A71	OPXY	Xylene-o,p	PPB	10.	10.	0	2
A72	ACRO	Acrolein	PPB	10.	10.	0	1
A73	ACRY	Acrylonitrile	PPB	10.	10.	0	1
A74	BIST	Bis(chloromethyl) ether	PPB	10.	10.	0	1
A75	BROM	Bromoacetone	PPB	10.	10.	0	1
A76	METH	Methyl bromide	PPB	10.	10.	0	1
A77	CARB	Carbon disulfide	PPB	10.	10.	0	1
A78	CHLB	Chlorobenzene	PPB	10.	10.	0	1
A79	CHLT	2-chloroethyl vinyl ether	PPB	10.	10.	0	1
A80	CHLF	Chloroform	PPB	10.	10.	0	2
A81	METH	Methyl chloride	PPB	10.	10.	0	1
A82	CHMT	Chloromethyl methyl ether	PPB	10.	10.	0	1
A83	CROT	Crotonaldehyde	PPB	10.	10.	0	1
A84	DIBR	1,2-dibromo-3-chloropropane	PPB	10.	10.	0	1
A85	DIBR	1,2-dibromoethane	PPB	10.	10.	0	1
A86	DIBR	Dibromomethane	PPB	10.	10.	0	1
A87	DIBU	1,4-dichloro-2-butene	PPB	10.	10.	0	1
A88	DICD	Dichlorodifluoromethane	PPB	10.	10.	0	1
A89	1,1-	1,1-dichloroethane	PPB	10.	10.	0	1
A90	1,2-	1,2-dichloroethane	PPB	10.	10.	0	1
A91	TRAN	Trans-1,2-dichloroethene	PPB	10.	10.	0	1
A92	DICE	1,1-dichloroethylene	PPB	10.	10.	0	1
A93	METH	Methylene chloride	PPB	10.	10.	0	2
A94	DICP	1,2-dichloropropane	PPB	10.	10.	0	1
A95	DICP	1,3-dichloropropene	PPB	10.	10.	0	1
A96	NNDI	N,N-diethylhydrazine	PPB	10.	10.	0	1
A99	HYDR	Hydrogen sulfide	PPB	10.	10.	0	1
B01	IODO	Iodomethane	PPB	10.	10.	0	1
B02	METH	Methacrylonitrile	PPB	10.	10.	0	1
B03	METH	Methanethiol	PPB	10.	10.	0	1
B04	PENT	Pentachloroethane	PPB	10.	10.	0	1
B05	1112	1,1,1,2-tetrachlorethane	PPB	10.	10.	0	1
B06	1122	1,1,2,2-tetrachlorethane	PPB	10.	10.	0	1
B08	BROM	Bromoform	PPB	10.	10.	0	1

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
B09	TRCM	Trichloromethanethiol	PPB	10.	10.	0	1
B10	TRCM	Trichloromonofluoromethane	PPB	10.	10.	0	1
B11	TRCP	Trichloropropane	PPB	10.	10.	0	1
B12	123-	1,2,3-trichloropropane	PPB	10.	10.	0	1
B13	VINY	Vinyl chloride	PPB	10.	10.	0	1
B14	M-XY	Xylene-m	PPB	10.	10.	0	2
B15	DIET	Diethylarsine	PPB	10.	10.	0	1
C04	META	Methyl methacrylate	PPB	10.	10.	0	1
C69	TOC	Total organic carbon	PPB	1000.	558.	0	2
C70	CYAN	Cyanide	PPB	10.	10.	0	2
C71	FORM	Formalin	PPB	500.	500.	0	1
C72	NITR	Nitrate	PPB	500.	18000.	2	2
C73	SULF	Sulfate	PPB	500.	33400.	2	2
C74	FLUO	Fluoride	PPB	500.	500.	0	2
C75	CHLO	Chloride	PPB	500.	4860.	2	2
C76	PHOS	Phosphate	PPB	1000.	1000.	0	2
C80	AMMO	Ammonium ion	PPB	50.	64.	1	2
H06	ETHM	Ethyl methacrylate	PPB	3000.	10.	0	1
H16	TC	Total carbon	PPB	-1.65E37	23100.	1	1
H18	FZIN	Zinc, filtered	PPB	5.	5.	0	2
H19	FCAL	Calcium, filtered	PPB	50.	28200.	2	2
H20	FBAR	Barium, filtered	PPB	6.	32.	2	2
H21	FCAD	Cadmium, filtered	PPB	2.	2.	0	2
H22	FCHR	Chromium, filtered	PPB	10.	10.	0	2
H23	FSIL	Silver, filtered	PPB	10.	10.	0	2
H24	FSOD	Sodium, filtered	PPB	100.	16900.	2	2
H25	FNIC	Nickel, filtered	PPB	10.	10.	0	2
H26	FCOP	Copper, filtered	PPB	10.	10.	0	2
H27	FVAN	Vanadium, filtered	PPB	5.	24.	2	2
H28	FALU	Aluminum, filtered	PPB	150.	150.	0	2
H29	FMAN	Manganese, filtered	PPB	5.	5.	0	2
H30	FPOT	Potassium, filtered	PPB	100.	5160.	2	2
H31	FIRO	Iron, filtered	PPB	50.	50.	0	2
H32	FMAG	Magnesium, filtered	PPB	0.	8940.	2	2
H33	FBER	Beryllium, filtered	PPB	5.	5.	0	2
H34	FOSM	Osmium, filtered	PPB	300.	300.	0	2
H35	FSTR	Strontium, filtered	PPB	300.	300.	0	2
H36	FANT	Antimony, filtered	PPB	100.	100.	0	2
H37	FARS	Arsenic, filtered	PPB	5.	6.	1	2
H38	FMER	Mercury, filtered	PPB	0.1	0.1	0	2
H39	FSEL	Selenium, filtered	PPB	5.	5.	0	2
H41	FLEA	Lead, filtered	PPB	5.	5.	0	2
H42	TOXL		PPB	20.	20.	0	2
H58	ALKA			-1.65E37	98400.	2	2
H63	LFLU		PPB	20.	375.	1	1
H64	BISM		PPB	5.	5.	0	1
H65	HNIT		PPB	2500.	13500.	1	1

END OF REPORT FOR WELL# 2-E33-24

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 2-E33-26

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	22.6	1	13
024	CS-1	Cesium-137	PCI/L	20.	6.55	0	13
034	RU-1	Ruthenium-106	PCI/L	172.5	67.9	0	13
111	BETA	Gross beta	PCI/L	8.	271.	12	13
121	SR 9	Strontium-90	PCI/L	5.	0.691	0	10
197	TC-9		PCI/L	15.	1420.	1	1
212	ALPH	Gross alpha	PCI/L	4.	4.68	1	3

END OF REPORT FOR WELL# 2-E33-26

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 6-49-55A

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	228.	13	14
024	CS-1	Cesium-137	PCI/L	20.	4.	0	7
034	RU-1	Ruthenium-106	PCI/L	172.5	34.9	0	7
081	I-12		PCI/L	15.	0.047732	0	1
104	U		PCI/L	0.5	3.83	5	5
108	TRIT		PCI/L	500.	17800.	15	15
111	BETA	Gross beta	PCI/L	8.	1550.	9	9
116	NO3-		MG/L	0.5	260.	6	6
121	SR 9	Strontium-90	PCI/L	5.	0.635	0	3
191	COND	Specific conductance	UMHO	1.	850.	3	3
197	TC-9		PCI/L	15.	12500.	1	1
199	PHFI	pH		0.1	7.7	3	3
207	PH-L			0.01	8.29	4	4
212	ALPH	Gross alpha	PCI/L	4.	5.62	2	8
281	I-12		PCI/L	1.	0.0224	0	1
A61	TETR	Tetrachloromethane	PPB	10.	10.	0	6
A62	BENZ	Benzene	PPB	10.	10.	0	4
A63	DIOX	Dioxane	PPB	500.	500.	0	4
A64	METH	Methyl ethyl ketone	PPB	10.	10.	0	6
A65	PYRI	Pyridine	PPB	500.	500.	0	4
A66	TOLU	Toluene	PPB	10.	5.	0	4
A67	1,1,	1,1,1-trichloroethane	PPB	10.	10.	0	6
A68	1,1,	1,1,2-trichloroethane	PPB	10.	10.	0	6
A69	TRIC	Trichloroethylene	PPB	10.	10.	0	6
A70	PERC	Perchloroethylene	PPB	10.	10.	0	6
A71	OPXY	Xylene-o,p	PPB	10.	10.	0	6
A72	ACRO	Acrolein	PPB	10.	10.	0	4
A73	ACRY	Acrylonitrile	PPB	10.	10.	0	4
A74	BIST	Bis(chloromethyl) ether	PPB	10.	10.	0	4
A75	BROM	Bromoacetone	PPB	10.	10.	0	4
A76	METH	Methyl bromide	PPB	10.	10.	0	4
A77	CARB	Carbon disulfide	PPB	10.	10.	0	4
A78	CHLB	Chlorobenzene	PPB	10.	10.	0	4
A79	CHLT	2-chloroethyl vinyl ether	PPB	10.	10.	0	4
A80	CHLF	Chloroform	PPB	10.	10.	0	6
A81	METH	Methyl chloride	PPB	10.	10.	0	4
A82	CHMT	Chloromethyl methyl ether	PPB	10.	10.	0	4
A83	CROT	Crotonaldehyde	PPB	10.	10.	0	4
A84	DIBR	1,2-dibromo-3-chloropropane	PPB	10.	10.	0	4
A85	DIBR	1,2-dibromoethane	PPB	10.	10.	0	4
A86	DIBR	Dibromomethane	PPB	10.	10.	0	4
A87	DIBU	1,4-dichloro-2-butene	PPB	10.	10.	0	4
A88	DICD	Dichlorodifluoromethane	PPB	10.	10.	0	4
A89	1,1-	1,1-dichloroethane	PPB	10.	10.	0	4
A90	1,2-	1,2-dichloroethane	PPB	10.	10.	0	4
A91	TRAN	Trans-1,2-dichloroethene	PPB	10.	10.	0	4
A92	DICE	1,1-dichloroethylene	PPB	10.	10.	0	4
A93	METH	Methylene chloride	PPB	10.	10.	0	6
A94	DICP	1,2-dichloropropane	PPB	10.	10.	0	4
A95	DICP	1,3-dichloropropene	PPB	10.	10.	0	4
A96	NNDI	N,N-diethylhydrazine	PPB	10.	10.	0	4
A99	HYDR	Hydrogen sulfide	PPB	10.	10.	0	4
B01	IODO	Iodomethane	PPB	10.	10.	0	4
B02	METH	Methacrylonitrile	PPB	10.	10.	0	4
B03	METH	Methanethiol	PPB	10.	10.	0	4
B04	PENT	Pentachloroethane	PPB	10.	10.	0	4
B05	1112	1,1,1,2-tetrachlorethane	PPB	10.	10.	0	4
B06	1122	1,1,2,2-tetrachlorethane	PPB	10.	10.	0	4

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
B08	BROM	Bromoform	PPB	10.	10.	0	4
B09	TRCM	Trichloromethanethiol	PPB	10.	10.	0	4
B10	TRCM	Trichloromonofluoromethane	PPB	10.	10.	0	4
B11	TRCP	Trichloropropane	PPB	10.	10.	0	4
B12	123-	1,2,3-trichloropropane	PPB	10.	10.	0	4
B13	VINY	Vinyl chloride	PPB	10.	10.	0	4
B14	M-XY	Xylene-m	PPB	10.	10.	0	6
B15	DIET	Diethylarsine	PPB	10.	10.	0	4
B19	ACET	Acetonitrile	PPB	3000.	3000.	0	3
B61	12-d	1,2-dichlorobenzene	PPB	10.	10.	0	4
B62	13-d	1,3-dichlorobenzene	PPB	10.	10.	0	4
B63	14-d	1,4-dichlorobenzene	PPB	10.	10.	0	4
B89	HEXC	Hexachlorobenzene	PPB	10.	10.	0	4
C04	META	Methyl methacrylate	PPB	10.	10.	0	4
C26	PENT	Pentachlorobenzene	PPB	10.	10.	0	4
C37	TETR	1,2,4,5-tetrachlorobenzene	PPB	10.	10.	0	4
C43	TRIC	1,2,4-trichlorobenzene	PPB	10.	10.	0	4
C54	HEXA	Hexachlorophene	PPB	10.	10.	0	4
C55	NAPH	Naphthalene	PPB	10.	10.	0	4
C56	123T	1,2,3-trichlorobenzene	PPB	10.	10.	0	4
C57	PHEN	Phenol	PPB	10.	10.	0	4
C58	135T	1,3,5-trichlorobenzene	PPB	10.	10.	0	4
C59	1234	1,2,3,4-tetrachlorobenzene	PPB	10.	10.	0	4
C60	1235	1,2,3,5-tetrachlorobenzene	PPB	10.	10.	0	4
C69	TOC	Total organic carbon	PPB	1000.	480.	0	4
C70	CYAN	Cyanide	PPB	10.	342.	7	8
C71	FORM	Formalin	PPB	500.	500.	0	4
C72	NITR	Nitrate	PPB	500.	253000.	12	12
C73	SULF	Sulfate	PPB	500.	158000.	8	8
C74	FLUO	Fluoride	PPB	500.	777.	3	8
C75	CHLO	Chloride	PPB	500.	16200.	8	8
C76	PHOS	Phosphate	PPB	1000.	1000.	0	8
C79	KERO	Kerosene	PPB	10000.	10000.	0	4
C80	AMMO	Ammonium ion	PPB	50.	1490.	10	10
H05	ETHO	Ethylene oxide	PPB	3000.	3000.	0	3
H06	ETHM	Ethyl methacrylate	PPB	3000.	10.	0	4
H16	TC	Total carbon	PPB	-1.65E37	23100.	4	4
H18	FZIN	Zinc, filtered	PPB	5.	5.	0	8
H19	FCAL	Calcium, filtered	PPB	50.	99200.	8	8
H20	FBAR	Barium, filtered	PPB	6.	52.	8	8
H21	FCAD	Cadmium, filtered	PPB	2.	2.	0	8
H22	FCHR	Chromium, filtered	PPB	10.	10.	0	8
H23	FSIL	Silver, filtered	PPB	10.	10.	0	8
H24	FSOD	Sodium, filtered	PPB	100.	48200.	8	8
H25	FNIC	Nickel, filtered	PPB	10.	10.	0	8
H26	FCOP	Copper, filtered	PPB	10.	10.	0	8
H27	FVAN	Vanadium, filtered	PPB	5.	11.	8	8
H28	FALU	Aluminum, filtered	PPB	150.	150.	0	8
H29	FMAN	Manganese, filtered	PPB	5.	25.	8	8
H30	FPOT	Potassium, filtered	PPB	100.	13100.	8	8
H31	FIRO	Iron, filtered	PPB	50.	234.	8	8
H32	FMAG	Magnesium, filtered	PPB	0.	26800.	8	8
H33	FBER	Beryllium, filtered	PPB	5.	5.	0	8
H34	FOSM	Osmium, filtered	PPB	300.	300.	0	1
H35	FSTR	Strontium, filtered	PPB	300.	487.	8	8
H36	FANT	Antimony, filtered	PPB	100.	100.	0	8
H37	FARS	Arsenic, filtered	PPB	5.	9.	3	8
H38	FMER	Mercury, filtered	PPB	0.1	0.1	0	4
H39	FSEL	Selenium, filtered	PPB	5.	6.	1	8
H41	FLEA	Lead, filtered	PPB	5.	5.	0	8
H42	TOXL		PPB	20.	6.7	0	4
H58	ALKA			-1.65E37	102000.	6	6
H62	LHYD		PPB	30.	30.	0	1
H63	LFLU		PPB	20.	460.	8	8
H64	BISM		PPB	5.	5.	0	1
H65	HNIT		PPB	2500.	242000.	2	2
H68	HEXO		PPB	10.	10.	0	5

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
I01	ACET	Acetone	PPB	-1.65E37	28.	1	1
I21	TRIB	Tributylphosphoric Acid	PPB	10.	10.	0	3

END OF REPORT FOR WELL# 6-49-55A

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 6-49-55B

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	0.	0	1
024	CS-1	Cesium-137	PCI/L	20.	0.	0	1
034	RU-1	Ruthenium-106	PCI/L	172.5	0.	0	1
108	TRIT		PCI/L	500.	170.	0	6
111	BETA	Gross beta	PCI/L	8.	6.7	0	3
115	NITR		MG/L	0.2	2.16	3	3
121	SR 9	Strontium-90	PCI/L	5.	0.147	0	2
197	TC-9		PCI/L	15.	0.486	0	1
212	ALPH	Gross alpha	PCI/L	4.	2.48	0	3
C72	NITR	Nitrate	PPB	500.	500.	0	2
H65	HNIT		PPB	2500.	2500.	0	1

END OF REPORT FOR WELL# 6-49-55B

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 6-49-57

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	90.	10	14
024	CS-1	Cesium-137	PCI/L	20.	24.	1	7
034	RU-1	Ruthenium-106	PCI/L	172.5	51.5	0	6
081	I-12		PCI/L	15.	0.20088	0	1
104	U		PCI/L	0.5	1.45	2	2
108	TRIT		PCI/L	500.	8100.	14	14
109	COLI	Coliform bacteria	MPN	2.2	3.	2	3
111	BETA	Gross beta	PCI/L	8.	400.	15	15
116	NO3-		MG/L	0.5	184.	6	6
121	SR 9	Strontium-90	PCI/L	5.	0.257	0	3
181	RADI	Radium	PCI/L	1.	0.202	0	5
191	COND	Specific conductance	UMHO	1.	600.	10	10
193	C 14		PCI/L	-1.65E37	6.89	2	2
197	TC-9		PCI/L	15.	1330.	1	1
199	PHFI	pH		0.1	8.7	9	9
207	PH-L			0.01	8.07	7	7
212	ALPH	Gross alpha	PCI/L	4.	2.26	0	13
281	I-12		PCI/L	1.	0.34	0	1
A01	BERY	Beryllium	PPB	5.	5.	0	3
A02	OSMI	Osmium	PPB	300.	300.	0	3
A03	STRO	Strontium	PPB	300.	300.	0	3
A04	ZINC	Zinc	PPB	5.	46.	2	3
A05	CALC	Calcium	PPB	50.	34600.	3	3
A06	BARI	Barium	PPB	6.	28.	3	3
A07	CADM	Cadmium	PPB	2.	2.	0	3
A08	CHRO	Chromium	PPB	10.	20.	1	3
A09	LEAD		PPB	30.	30.	0	1
A10	SILV	Silver	PPB	10.	10.	0	3
A11	SODI	Sodium	PPB	100.	66700.	3	3
A12	NICK	Nickel	PPB	10.	10.	0	3
A13	COPP	Copper	PPB	10.	10.	0	3
A14	VANA	Vanadium	PPB	5.	32.	3	3
A15	ANTI	Antimony	PPB	100.	100.	0	3
A16	ALUM	Aluminum	PPB	150.	150.	0	3
A17	MANG	Manganese	PPB	5.	5.	0	3
A18	POTA	Potassium	PPB	100.	6920.	3	3
A19	IRON	Iron	PPB	50.	146.	2	3
A20	ARSE	Arsenic	PPB	5.	8.3	2	3
A21	MERC	Mercury	PPB	0.1	0.23	3	3
A22	SELE	Selenium	PPB	5.	5.	0	3
A33	ENDR	Endrin	PPB	1.	1.	0	3
A34	METH	Methoxychlor	PPB	3.	1.	0	3
A35	TOXA	Toxaphene	PPB	1.	1.	0	3
A36	a-BH	Alpha-BHC	PPB	1.	1.	0	3
A37	b-BH	Beta-BHC	PPB	1.	1.	0	3
A38	g-BH	Gamma-BHC	PPB	1.	1.	0	3
A39	d-BH	Delta-BHC	PPB	1.	1.	0	3
A50	MAGN	Magnesium	PPB	0.	6730.	1	1
A51	LEAD	Lead (graphite furnace)	PPB	5.	10.	1	2
A54	AR10	Arochlor 1016	PPB	1.	1.	0	2
A55	AR12	Arochlor 1221	PPB	1.	1.	0	2
A56	AR12	Arochlor 1232	PPB	1.	1.	0	2
A57	AR12	Arochlor 1242	PPB	1.	1.	0	2
A58	AR12	Arochlor 1248	PPB	1.	1.	0	2
A59	AR12	Arochlor 1254	PPB	1.	1.	0	2
A60	AR12	Arochlor 1260	PPB	1.	1.	0	2
A61	TETR	Tetrachloromethane	PPB	10.	10.	0	10
A62	BENZ	Benzene	PPB	10.	10.	0	5

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
A63	DIOX	Dioxane	PPB	500.	500.	0	5
A64	METH	Methyl ethyl ketone	PPB	10.	10.	0	10
A65	PYRI	Pyridine	PPB	500.	500.	0	5
A66	TOLU	Toluene	PPB	10.	10.	0	5
A67	1,1,	1,1,1-trichloroethane	PPB	10.	10.	0	10
A68	1,1,	1,1,2-trichloroethane	PPB	10.	10.	0	10
A69	TRIC	Trichloroethylene	PPB	10.	10.	0	10
A70	PERC	Perchloroethylene	PPB	10.	10.	0	10
A71	OPXY	Xylene-o,p	PPB	10.	10.	0	10
A72	ACRO	Acrolein	PPB	10.	10.	0	4
A73	ACRY	Acrylonitrile	PPB	10.	10.	0	4
A74	BIST	Bis(chloromethyl) ether	PPB	10.	10.	0	4
A75	BROM	Bromoacetone	PPB	10.	10.	0	4
A76	METH	Methyl bromide	PPB	10.	10.	0	4
A77	CARB	Carbon disulfide	PPB	10.	10.	0	4
A78	CHLB	Chlorobenzene	PPB	10.	10.	0	4
A79	CHLT	2-chloroethyl vinyl ether	PPB	10.	10.	0	4
A80	CHLF	Chloroform	PPB	10.	10.	0	9
A81	METH	Methyl chloride	PPB	10.	10.	0	4
A82	CHMT	Chloromethyl methyl ether	PPB	10.	10.	0	4
A83	CROT	Crotonaldehyde	PPB	10.	10.	0	4
A84	DIBR	1,2-dibromo-3-chloropropane	PPB	10.	10.	0	4
A85	DIBR	1,2-dibromoethane	PPB	10.	10.	0	4
A86	DIBR	Dibromomethane	PPB	10.	10.	0	4
A87	DIBU	1,4-dichloro-2-butene	PPB	10.	10.	0	4
A88	DICD	Dichlorodifluoromethane	PPB	10.	10.	0	4
A89	1,1-	1,1-dichloroethane	PPB	10.	10.	0	4
A90	1,2-	1,2-dichloroethane	PPB	10.	10.	0	4
A91	TRAN	Trans-1,2-dichloroethene	PPB	10.	10.	0	4
A92	DICE	1,1-dichloroethylene	PPB	10.	10.	0	4
A93	METH	Methylene chloride	PPB	10.	10.	0	9
A94	DICP	1,2-dichloropropane	PPB	10.	10.	0	4
A95	DICP	1,3-dichloropropene	PPB	10.	10.	0	4
A96	NNDI	N,N-diethylhydrazine	PPB	10.	10.	0	4
A97	1,1-	1,1-dimethylhydrazine	PPB	3000.	3000.	0	2
A98	1,2-	1,2-dimethylhydrazine	PPB	3000.	3000.	0	2
A99	HYDR	Hydrogen sulfide	PPB	10.	10.	0	4
B01	IODO	Iodomethane	PPB	10.	10.	0	4
B02	METH	Methacrylonitrile	PPB	10.	10.	0	4
B03	METH	Methanethiol	PPB	10.	10.	0	4
B04	PENT	Pentachloroethane	PPB	10.	10.	0	4
B05	1112	1,1,1,2-tetrachlorethane	PPB	10.	10.	0	4
B06	1122	1,1,2,2-tetrachlorethane	PPB	10.	10.	0	4
B08	BROM	Bromoform	PPB	10.	10.	0	4
B09	TRCM	Trichloromethanethiol	PPB	10.	10.	0	4
B10	TRCM	Trichloromonofluoromethane	PPB	10.	10.	0	4
B11	TRCP	Trichloropropane	PPB	10.	10.	0	4
B12	123-	1,2,3-trichloropropane	PPB	10.	10.	0	4
B13	VINY	Vinyl chloride	PPB	10.	10.	0	4
B14	M-XY	Xylene-m	PPB	10.	10.	0	10
B15	DIET	Diethylarsine	PPB	10.	10.	0	4
B19	ACET	Acetonitrile	PPB	3000.	3000.	0	5
B61	12-d	1,2-dichlorobenzene	PPB	10.	10.	0	8
B62	13-d	1,3-dichlorobenzene	PPB	10.	10.	0	8
B63	14-d	1,4-dichlorobenzene	PPB	10.	10.	0	8
B89	HEXC	Hexachlorobenzene	PPB	10.	10.	0	8
C04	META	Methyl methacrylate	PPB	10.	10.	0	4
C26	PENT	Pentachlorobenzene	PPB	10.	10.	0	8
C37	TETR	1,2,4,5-tetrachlorobenzene	PPB	10.	10.	0	8
C43	TRIC	1,2,4-trichlorobenzene	PPB	10.	10.	0	8
C52	HEXA	Hexachloropropene	PPB	10.	10.	0	1
C53	HYDR	Hydrazine	PPB	3000.	3000.	0	2
C54	HEXA	Hexachlorophene	PPB	10.	10.	0	8
C55	NAPH	Naphthalene	PPB	10.	10.	0	8
C56	123T	1,2,3-trichlorobenzene	PPB	10.	10.	0	8
C57	PHEN	Phenol	PPB	10.	10.	0	8
C58	135T	1,3,5-trichlorobenzene	PPB	10.	10.	0	8

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
C59	1234	1,2,3,4-tetrachlorobenzene	PPB	10.	10.	0	8
C60	1235	1,2,3,5-tetrachlorobenzene	PPB	10.	10.	0	8
C62	CHLL	Chlorobenzilate	PPB	100.	100.	0	1
C68	TOX	Total organic halogen	PPB	100.	52.	0	3
C69	TOC	Total organic carbon	PPB	1000.	808.	0	9
C70	CYAN	Cyanide	PPB	10.	61.9	12	12
C71	FORM	Formalin	PPB	500.	500.	0	5
C72	NITR	Nitrate	PPB	500.	114000.	16	16
C73	SULF	Sulfate	PPB	500.	52700.	13	13
C74	FLUO	Fluoride	PPB	500.	1670.	13	13
C75	CHLO	Chloride	PPB	500.	5280.	13	13
C76	PHOS	Phosphate	PPB	1000.	1000.	0	13
C79	KERO	Kerosene	PPB	10000.	10000.	0	8
C80	AMMO	Ammonium ion	PPB	50.	170.	2	13
C88	CYAN	Cyanogen bromide	PPB	3000.	3000.	0	2
C89	CYAN	Cyanogen chloride	PPB	3000.	3000.	0	2
C90	PARA	Paraldegyde	PPB	3000.	3000.	0	2
C91	STRY	Strychnine	PPB	50.	50.	0	1
C92	MALH	Maleic hydrizide	PPB	500.	500.	0	1
C93	NICO	Nicotinic acid	PPB	100.	100.	0	1
C94	ACRY	Acrylamide	PPB	10000.	3000.	0	2
C95	ALLY	Allyl alcohol	PPB	3000.	3000.	0	2
C96	CHLO	Chloral	PPB	3000.	3000.	0	2
C97	CHLA	Chloroacetaldehyde	PPB	16000.	3000.	0	2
C98	CHLP	3-chloropropionitrile	PPB	4000.	3000.	0	2
C99	CYAN	Cyanogen	PPB	3000.	3000.	0	2
H01	DICP	Dichloropropanol	PPB	3000.	3000.	0	2
H03	ETHC	Ethyl carbamate	PPB	5000.	3000.	0	2
H04	ETHC	Ethyl cyanide	PPB	3000.	3000.	0	2
H05	ETHO	Ethylene oxide	PPB	3000.	3000.	0	5
H06	ETHM	Ethyl methacrylate	PPB	3000.	10.	0	4
H07	FLUO	Fluoroacetic acid	PPB	3000.	3000.	0	2
H08	GLYC	Glycidylaldehyde	PPB	3000.	3000.	0	2
H09	ISOB	Isobutyl alcohol	PPB	3000.	3000.	0	2
H10	METZ	Methyl hydrazine	PPB	3000.	3000.	0	2
H11	PROP	N-propylamine	PPB	10000.	3000.	0	2
H12	PROP	2-propyn-1-ol	PPB	8000.	3000.	0	2
H13	2,4-	2,4-D	PPB	2.	1.	0	3
H14	2,4,	2,4,5-TP silvex	PPB	2.	1.	0	3
H16	TC	Total carbon	PPB	-1.65E37	26100.	5	5
H18	FZIN	Zinc, filtered	PPB	5.	8.	2	12
H19	FCAL	Calcium, filtered	PPB	50.	26200.	12	12
H20	FBAR	Barium, filtered	PPB	6.	29.	12	12
H21	FCAD	Cadmium, filtered	PPB	2.	2.	0	12
H22	FCHR	Chromium, filtered	PPB	10.	11.	6	12
H23	FSIL	Silver, filtered	PPB	10.	10.	0	12
H24	FSOD	Sodium, filtered	PPB	100.	51200.	12	12
H25	FNIC	Nickel, filtered	PPB	10.	10.	0	12
H26	FCOP	Copper, filtered	PPB	10.	10.	0	12
H27	FVAN	Vanadium, filtered	PPB	5.	38.	12	12
H28	FALU	Aluminum, filtered	PPB	150.	150.	0	12
H29	FMAN	Manganese, filtered	PPB	5.	5.	0	12
H30	FPOT	Potassium, filtered	PPB	100.	6210.	12	12
H31	FIRO	Iron, filtered	PPB	50.	50.	0	12
H32	FMAG	Magnesium, filtered	PPB	0.	8390.	12	12
H33	FBER	Beryllium, filtered	PPB	5.	5.	0	12
H34	FOSM	Osmium, filtered	PPB	300.	300.	0	3
H35	FSTR	Strontium, filtered	PPB	300.	300.	0	12
H36	FANT	Antimony, filtered	PPB	100.	100.	0	12
H37	FARS	Arsenic, filtered	PPB	5.	13.	12	12
H38	FMER	Mercury, filtered	PPB	0.1	0.17	4	12
H39	FSEL	Selenium, filtered	PPB	5.	5.	0	12
H41	FLEA	Lead, filtered	PPB	5.	5.	0	12
H42	TOXL		PPB	20.	20.	0	6
H58	ALKA			-1.65E37	110000.	6	6
H63	LFLU		PPB	20.	1090.	10	10
H64	BISM		PPB	5.	5.	0	1

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
H65	HNIT		PPB	2500.	50300.	2	2
H68	HEXO		PPB	10.	10.	0	5
I21	TRIB	Tributylphosphoric Acid	PPB	10.	10.	0	3

END OF REPORT FOR WELL# 6-49-57

AREA 200-BP-1 OPERABLE UNIT

WELL NUMBER 6-50-53

DATA COLLECTED BETWEEN 1985 AND JUNE 1988

DOE-RL 88-32 DRAFT

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
010	CO-6	Cobalt-60	PCI/L	22.5	487.	13	15
024	CS-1	Cesium-137	PCI/L	20.	5.63	0	7
034	RU-1	Ruthenium-106	PCI/L	172.5	85.7	0	7
081	I-12		PCI/L	15.	0.043709	0	2
108	TRIT		PCI/L	500.	3470.	11	15
109	COLI	Coliform bacteria	MPN	2.2	3.	2	3
111	BETA	Gross beta	PCI/L	8.	3020.	18	18
116	NO3-		MG/L	0.5	270.	6	6
121	SR 9	Strontium-90	PCI/L	5.	0.473	0	4
181	RADI	Radium	PCI/L	1.	0.265	0	3
191	COND	Specific conductance	UMHO	1.	1588.	10	10
193	C 14		PCI/L	-1.65E37	1.28	2	2
197	TC-9		PCI/L	15.	29100.	4	4
199	PHFI	pH		0.1	8.2	9	9
207	PH-L			0.01	7.92	7	7
212	ALPH	Gross alpha	PCI/L	4.	8.05	6	18
281	I-12		PCI/L	1.	0.268	0	1
A01	BERY	Beryllium	PPB	5.	5.	0	3
A02	OSMI	Osmium	PPB	300.	300.	0	3
A03	STRO	Strontium	PPB	300.	723.	3	3
A04	ZINC	Zinc	PPB	5.	19.	3	3
A05	CALC	Calcium	PPB	50.	152000.	3	3
A06	BARI	Barium	PPB	6.	54.	3	3
A07	CADM	Cadmium	PPB	2.	2.	0	3
A08	CHRO	Chromium	PPB	10.	10.	0	3
A09	LEAD		PPB	30.	37.	1	1
A10	SILV	Silver	PPB	10.	10.	0	3
A11	SODI	Sodium	PPB	100.	48700.	3	3
A12	NICK	Nickel	PPB	10.	10.	0	3
A13	COPP	Copper	PPB	10.	21.	1	3
A14	VANA	Vanadium	PPB	5.	22.	3	3
A15	ANTI	Antimony	PPB	100.	100.	0	3
A16	ALUM	Aluminum	PPB	150.	150.	0	3
A17	MANG	Manganese	PPB	5.	5.	0	3
A18	POTA	Potassium	PPB	100.	12900.	3	3
A19	IRON	Iron	PPB	50.	614.	3	3
A20	ARSE	Arsenic	PPB	5.	5.	0	3
A21	MERC	Mercury	PPB	0.1	0.1	0	3
A22	SELE	Selenium	PPB	5.	13.3	1	3
A33	ENDR	Endrin	PPB	1.	1.	0	3
A34	METH	Methoxychlor	PPB	3.	1.	0	3
A35	TOXA	Toxaphene	PPB	1.	1.	0	3
A36	a-BH	Alpha-BHC	PPB	1.	1.	0	3
A37	b-BH	Beta-BHC	PPB	1.	1.	0	3
A38	g-BH	Gamma-BHC	PPB	1.	1.	0	3
A39	d-BH	Delta-BHC	PPB	1.	1.	0	3
A50	MAGN	Magnesium	PPB	0.	43700.	1	1
A51	LEAD	Lead (graphite furnace)	PPB	5.	5.	0	2
A54	AR10	Arochlor 1016	PPB	1.	1.	0	2
A55	AR12	Arochlor 1221	PPB	1.	1.	0	2
A56	AR12	Arochlor 1232	PPB	1.	1.	0	2
A57	AR12	Arochlor 1242	PPB	1.	1.	0	2
A58	AR12	Arochlor 1248	PPB	1.	1.	0	2
A59	AR12	Arochlor 1254	PPB	1.	1.	0	2
A60	AR12	Arochlor 1260	PPB	1.	1.	0	2
A61	TETR	Tetrachloromethane	PPB	10.	10.	0	10
A62	BENZ	Benzene	PPB	10.	10.	0	5
A63	DIOX	Dioxane	PPB	500.	500.	0	5

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
A64	METH	Methyl ethyl ketone	PPB	10.	10.	0	10
A65	PYRI	Pyridine	PPB	500.	500.	0	5
A66	TOLU	Toluene	PPB	10.	10.	0	5
A67	1,1,	1,1,1-trichloroethane	PPB	10.	10.	0	10
A68	1,1,	1,1,2-trichloroethane	PPB	10.	10.	0	10
A69	TRIC	Trichloroethylene	PPB	10.	10.	0	10
A70	PERC	Perchloroethylene	PPB	10.	10.	0	10
A71	OPXY	Xylene-o,p	PPB	10.	10.	0	10
A72	ACRO	Acrolein	PPB	10.	10.	0	4
A73	ACRY	Acrylonitrile	PPB	10.	10.	0	4
A74	BIST	Bis(chloromethyl) ether	PPB	10.	10.	0	4
A75	BROM	Bromoacetone	PPB	10.	10.	0	4
A76	METH	Methyl bromide	PPB	10.	10.	0	4
A77	CARB	Carbon disulfide	PPB	10.	10.	0	4
A78	CHLB	Chlorobenzene	PPB	10.	10.	0	4
A79	CHLT	2-chloroethyl vinyl ether	PPB	10.	10.	0	4
A80	CHLF	Chloroform	PPB	10.	10.	0	9
A81	METH	Methyl chloride	PPB	10.	10.	0	4
A82	CHMT	Chloromethyl methyl ether	PPB	10.	10.	0	4
A83	CROT	Crotonaldehyde	PPB	10.	10.	0	4
A84	DIBR	1,2-dibromo-3-chloropropane	PPB	10.	10.	0	4
A85	DIBR	1,2-dibromoethane	PPB	10.	10.	0	4
A86	DIBR	Dibromomethane	PPB	10.	10.	0	4
A87	DIBU	1,4-dichloro-2-butene	PPB	10.	10.	0	4
A88	DICD	Dichlorodifluoromethane	PPB	10.	10.	0	4
A89	1,1-	1,1-dichloroethane	PPB	10.	10.	0	4
A90	1,2-	1,2-dichloroethane	PPB	10.	10.	0	4
A91	TRAN	Trans-1,2-dichloroethene	PPB	10.	10.	0	4
A92	DICE	1,1-dichloroethylene	PPB	10.	10.	0	4
A93	METH	Methylene chloride	PPB	10.	22300.	1	9
A94	DICP	1,2-dichloropropane	PPB	10.	10.	0	4
A95	DICP	1,3-dichloropropene	PPB	10.	10.	0	4
A96	NNDI	N,N-diethylhydrazine	PPB	10.	10.	0	4
A99	HYDR	Hydrogen sulfide	PPB	10.	10.	0	4
B01	IODO	Iodomethane	PPB	10.	10.	0	4
B02	METH	Methacrylonitrile	PPB	10.	10.	0	4
B03	METH	Methanethiol	PPB	10.	10.	0	4
B04	PENT	Pentachloroethane	PPB	10.	10.	0	4
B05	1112	1,1,1,2-tetrachlorethane	PPB	10.	10.	0	4
B06	1122	1,1,2,2-tetrachlorethane	PPB	10.	10.	0	4
B08	BROM	Bromoform	PPB	10.	10.	0	4
B09	TRCM	Trichloromethanethiol	PPB	10.	10.	0	4
B10	TRCM	Trichloromonofluoromethane	PPB	10.	10.	0	4
B11	TRCP	Trichloropropane	PPB	10.	10.	0	4
B12	123-	1,2,3-trichloropropane	PPB	10.	10.	0	4
B13	VINY	Vinyl chloride	PPB	10.	10.	0	4
B14	M-XY	Xylene-m	PPB	10.	10.	0	10
B15	DIET	Diethylarsine	PPB	10.	10.	0	4
B19	ACET	Acetonitrile	PPB	3000.	3000.	0	3
B61	12-d	1,2-dichlorobenzene	PPB	10.	10.	0	7
B62	13-d	1,3-dichlorobenzene	PPB	10.	10.	0	7
B63	14-d	1,4-dichlorobenzene	PPB	10.	10.	0	7
B89	HEXC	Hexachlorobenzene	PPB	10.	10.	0	7
C04	META	Methyl methacrylate	PPB	10.	10.	0	4
C26	PENT	Pentachlorobenzene	PPB	10.	10.	0	7
C37	TETR	1,2,4,5-tetrachlorobenzene	PPB	10.	10.	0	7
C43	TRIC	1,2,4-trichlorobenzene	PPB	10.	10.	0	7
C52	HEXA	Hexachloropropene	PPB	10.	10.	0	1
C54	HEXA	Hexachlorophene	PPB	10.	10.	0	7
C55	NAPH	Naphthalene	PPB	10.	10.	0	7
C56	123T	1,2,3-trichlorobenzene	PPB	10.	10.	0	7
C57	PHEN	Phenol	PPB	10.	10.	0	7
C58	135T	1,3,5-trichlorobenzene	PPB	10.	10.	0	7
C59	1234	1,2,3,4-tetrachlorobenzene	PPB	10.	10.	0	7
C60	1235	1,2,3,5-tetrachlorobenzene	PPB	10.	10.	0	7
C62	CHLL	Chlorobenzilate	PPB	100.	100.	0	1
C68	TOX	Total organic halogen	PPB	100.	9.8	0	3

CODE#	CODENAME	LONG NAME	UNITS	DETECTION LIMIT	MAXIMUM VALUE	NUMBER DETECT	NUMBER ANALYSIS
C69	TOC	Total organic carbon	PPB	1000.	2010.	4	9
C70	CYAN	Cyanide	PPB	10.	1690.	12	12
C71	FORM	Formalin	PPB	500.	500.	0	5
C72	NITR	Nitrate	PPB	500.	559000.	18	18
C73	SULF	Sulfate	PPB	500.	474000.	15	15
C74	FLUO	Fluoride	PPB	500.	1130.	8	15
C75	CHLO	Chloride	PPB	500.	113000.	15	15
C76	PHOS	Phosphate	PPB	1000.	1000.	0	15
C79	KERO	Kerosene	PPB	10000.	10000.	0	7
C80	AMMO	Ammonium ion	PPB	50.	185.	6	11
C91	STRY	Strychnine	PPB	50.	50.	0	1
C92	MALH	Maleic hydrizide	PPB	500.	500.	0	1
C93	NICO	Nicotinic acid	PPB	100.	100.	0	1
H05	ETHO	Ethylene oxide	PPB	3000.	3000.	0	3
H06	ETHM	Ethyl methacrylate	PPB	3000.	10.	0	4
H13	2,4-	2,4-D	PPB	2.	1.	0	3
H14	2,4,	2,4,5-TP silvex	PPB	2.	1.	0	3
H16	TC	Total carbon	PPB	-1.65E37	19700.	5	5
H18	FZIN	Zinc, filtered	PPB	5.	25.	12	12
H19	FCAL	Calcium, filtered	PPB	50.	245000.	12	12
H20	FBAR	Barium, filtered	PPB	6.	77.	12	12
H21	FCAD	Cadmium, filtered	PPB	2.	2.	0	12
H22	FCHR	Chromium, filtered	PPB	10.	10.	0	12
H23	FSIL	Silver, filtered	PPB	10.	10.	0	12
H24	FSOD	Sodium, filtered	PPB	100.	65900.	12	12
H25	FNIC	Nickel, filtered	PPB	10.	10.	0	12
H26	FCOP	Copper, filtered	PPB	10.	10.	0	12
H27	FVAN	Vanadium, filtered	PPB	5.	14.	5	12
H28	FALU	Aluminum, filtered	PPB	150.	150.	0	12
H29	FMAN	Manganese, filtered	PPB	5.	5.	0	12
H30	FPOT	Potassium, filtered	PPB	100.	15400.	12	12
H31	FIRO	Iron, filtered	PPB	50.	318.	12	12
H32	FMAG	Magnesium, filtered	PPB	0.	70300.	12	12
H33	FBER	Beryllium, filtered	PPB	5.	5.	0	12
H34	FOSM	Osmium, filtered	PPB	300.	300.	0	3
H35	FSTR	Strontium, filtered	PPB	300.	1050.	11	12
H36	FANT	Antimony, filtered	PPB	100.	100.	0	12
H37	FARS	Arsenic, filtered	PPB	5.	5.	0	12
H38	FMER	Mercury, filtered	PPB	0.1	0.1	0	8
H39	FSEL	Selenium, filtered	PPB	5.	27.	11	12
H41	FLEA	Lead, filtered	PPB	5.	5.	0	12
H42	TOXL		PPB	20.	21200.	1	6
H58	ALKA			-1.65E37	75000.	8	8
H63	LFLU		PPB	20.	310.	10	10
H64	BISM		PPB	5.	5.	0	1
H65	HNIT		PPB	2500.	531000.	2	2
H68	HEXO		PPB	10.	10.	0	5
I21	TRIB	Tributylphosphoric Acid	PPB	10.	10.	0	3

END OF REPORT FOR WELL# 6-50-53

APPENDIX F

SURFACE WATER MONITORING RESULTS

(Elder, R.E., G.W. Egert, A.R. Johnson, and W.L. Osborne, 1988. Westinghouse Hanford Company Environmental Surveillance Annual Report 200/600 Areas, WHC-EP-0145, prepared by Westinghouse Hanford Company, Richland, WA, for U.S. Department of Energy.)

Key

→ Pointer indicates monitoring results for West Lake

Site number	Sampling site	Total beta		Total alpha		Cs-137		Sr-90	
		Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
RM 3	216-T-4-2 Ditch	0.336	<DL	0.007	<DL	0.189	0.027	<0.030	<DL
RM18	216-B-63 Ditch	<0.098	<DL	<0.004	<DL	0.170	<DL	<0.028	<DL
RM20	216-A-29 Ditch	0.027	<DL	0.011	<DL	<0.127	<DL	<0.030	<DL
RM21	216-B-3-3 Ditch	0.155	<DL	0.052	<DL	<0.055	<DL	<0.040	<DL
RM22	216-B-3 Pond N	<0.044	<DL	0.010	<DL	<0.060	<DL	<0.042	<DL
RM23	216-B-3 Pond S	<0.108	<DL	<0.030	<DL	0.143	<DL	<0.043	<DL
RM24	216-A-25 Pond inlet (Gable Mountain Pond)	0.059	<DL	<0.013	<DL	<0.080	0.038	<0.110	<DL
RM25	216-A-25 Pond outfall (Gable Mountain Pond)	0.260	0.045	<0.011	<DL	0.140	<DL	0.045	<DL
RM26	216-B-3 Pond overflow	0.030	<DL	0.010	<DL	<0.087	<DL	<0.030	<DL
RM27	Powerhouse Pond	0.064	<DL	0.031	<DL	<0.057	<DL	0.119	<DL
RM28	216-S-10 Ditch	<0.037	<DL	<0.007	<DL	<0.088	<DL	<0.115	<DL
RM29	216-B-3 Pond 3rd overflow	<0.059	<DL	<0.014	<DL	<0.057	<DL	<0.040	<DL
RM53	Westlake	0.578	0.320	0.132	0.039	<0.044	<DL	<0.020	<DL
	Detection limit	0.1		0.04		0.2		0.1	
	Derived concentration guideline (a)	1.0 (b)		3.0 (c)		3.0		1.0	

NOTE: <DL = less than detection limit.
(a) DOE 1986b.
(b) Using Sr-90 DCG for comparison.
(c) Using Pu-239 DCG for comparison.

Reference: Elder et al, 1988

883-1611/12695

Figure F-1. Radiological Parameters in Surface Water at Ponds and Ditches for 1987 (pCi/mL)

Site number	Sampling site	pH			Nitrate (NO3) (ppm).		
		Maximum	Minimum	Average	Maximum	Minimum	Average
RM 3	216-T-4-2 Ditch	8.3	5.7	7.1	2.7	<DL	<DL
RM18	216-B-63 Ditch	9.3	6.6	7.6	1.6	<DL	<DL
RM20	216-A-29 Ditch	10.8	6.5	7.8	0.6	<DL	<DL
RM21	216-B-3-3 Ditch	8.9	6.9	7.8	<DL	<DL	<DL
RM22	216-B-3 Pond N	9.7	6.8	8.1	<DL	<DL	<DL
RM23	216-B-3 Pond S	9.9	6.8	8.2	<DL	<DL	<DL
RM24	216-A-25 Pond inlet (Gable Mountain Pond)	9.7	7.2	7.9	<DL	<DL	<DL
RM25	216-A-25 Pond outfall (Gable Mountain Pond)	9.9	6.8	8.0	<DL	<DL	<DL
RM26	216-B-3 Pond overflow	9.4	6.8	8.2	<DL	<DL	<DL
RM27	Powerhouse Pond	10.0	7.2	9.0	<DL	<DL	<DL
RM28	216-S-10 Ditch	8.4	6.8	7.6	<DL	<DL	<DL
RM29	216-B-3 Pond 3rd overflow	9.7	6.9	8.3	<DL	<DL	<DL
RM53	Westlake	9.9	7.6	9.5	<DL	<DL	<DL

NOTE: pH maximum and minimum are from weekly samples.
<DL = less than detection limit (~1.2 ppm).

Reference: Elder et al, 1988

883-1611/12696

Figure F-2. Nonradiological Parameters in Water at the Ponds and Ditches for 1987

Sample site	Co-60 (pCi/g)	Sr-90 (pCi/g)	Nb-95 (pCi/g)	Zr-95 (pCi/g)	RuRh-106 (pCi/g)	Cd-109 (pCi/g)	Cs-134 (pCi/g)	Cs-137 (pCi/g)	CePr-144 (pCi/g)	Eu-154 (pCi/g)	Eu-155 (pCi/g)	Bi-214 (pCi/g)	Pu-239 (pCi/g)	U (g/g)
216-A-25 Pond Inlet	<DL	3.0	0.8	0.7	27	76	0.6	30	147	4.0	9.0	<DL	1.6	1.39E-06
216-A-25 Pond N	<DL	0.5	<DL	<DL	<DL	<DL	<DL	23	<DL	<DL	<DL	1.0	0.2	7.49E-07
216-A-29 Ditch	<DL	0.6	<DL	<DL	<DL	<DL	<DL	2.0	<DL	<DL	<DL	<DL	1.8	2.20E-06
216-B-2-3 Ditch	<DL	2.2	0.2	<DL	11	<DL	<DL	11	<DL	<DL	<DL	<DL	8.2	1.83E-06
216-B-3 Pond 1st Overflow	<DL	< 1.0	<DL	<DL	7.0	<DL	<DL	9.0	<DL	<DL	<DL	<DL	0.5	1.16E-06
216-B-3 Pond N	<DL	0.5	<DL	<DL	<DL	<DL	<DL	2.2	<DL	<DL	<DL	0.8	3.2	5.36E-07
216-B-3 Pond S	<DL	1.0	<DL	<DL	<DL	<DL	<DL	95	<DL	<DL	<DL	<DL	1.8	1.34E-06
216-B-3-3 Ditch	<DL	2.1	1.0	0.6	25	<DL	0.8	134	167	1.0	2.5	2.0	1.6	1.05E-06
216-B-63 Ditch	<DL	1.7	<DL	<DL	<DL	<DL	<DL	9.3	<DL	<DL	<DL	<DL	0.2	5.80E-07
216-T-4 Ditch	2.1	2.6	<DL	<DL	<DL	<DL	<DL	172	<DL	<DL	<DL	<DL	0.9	1.10E-06
West Lake	<DL	0.3	<DL	<DL	<DL	<DL	<DL	0.3	<DL	<DL	<DL	<DL	0.5	2.43E-06
200 Area soil standards (a)	300	400						400		200	200		60	

Note: No standard deviation is available.
<DL = less than detection limit.
(a) Boothe 1987.

Reference: Elder et al, 1988

883-1611/12697

Figure F-3. Radionuclide Concentrations in Sediment Samples from Separations Area Pond and Ditches for 1987

Sample site	Cs-137 (pCi/g)	Sr-90 (pCi/g)	Pu-239 (pCi/g)	U (g/g)
216-A-25 Pond Inlet	3.4	0.78	0.40	2.18E-07
216-A-25 Pond N	15.0	0.61	< 1	4.39E-07
216-A-29 Ditch	4.5	2.29	2.06	1.68E-06
216-B-2-3 Ditch	21.0	0.65	0.29	1.08E-06
216-B-3 Pond 1st Overflow	9.0	1.12	< 1	5.20E-07
216-B-3 Pond N	4.3	0.65	1.52	3.78E-07
216-B-3 Pond S	4.6	< 0.39	2.95	1.12E-07
216-B-3-3 Ditch	17.0	17.58	a	9.61E-07
216-B-63 Ditch	20.0	1.04	1.00	2.58E-07
216-T-4 Ditch	8.0	6.18	< 1	1.37E-07
West Lake	3.9	< 0.60	0.46	1.13E-07

Note: No standard deviation is available.
(a) Sample lost.

Reference: Elder et al, 1988

883-1611/12698

Figure F-4. Radionuclides in Aquatic Vegetation Samples Taken from the Separations Area Pond and Ditches for 1987

APPENDIX G

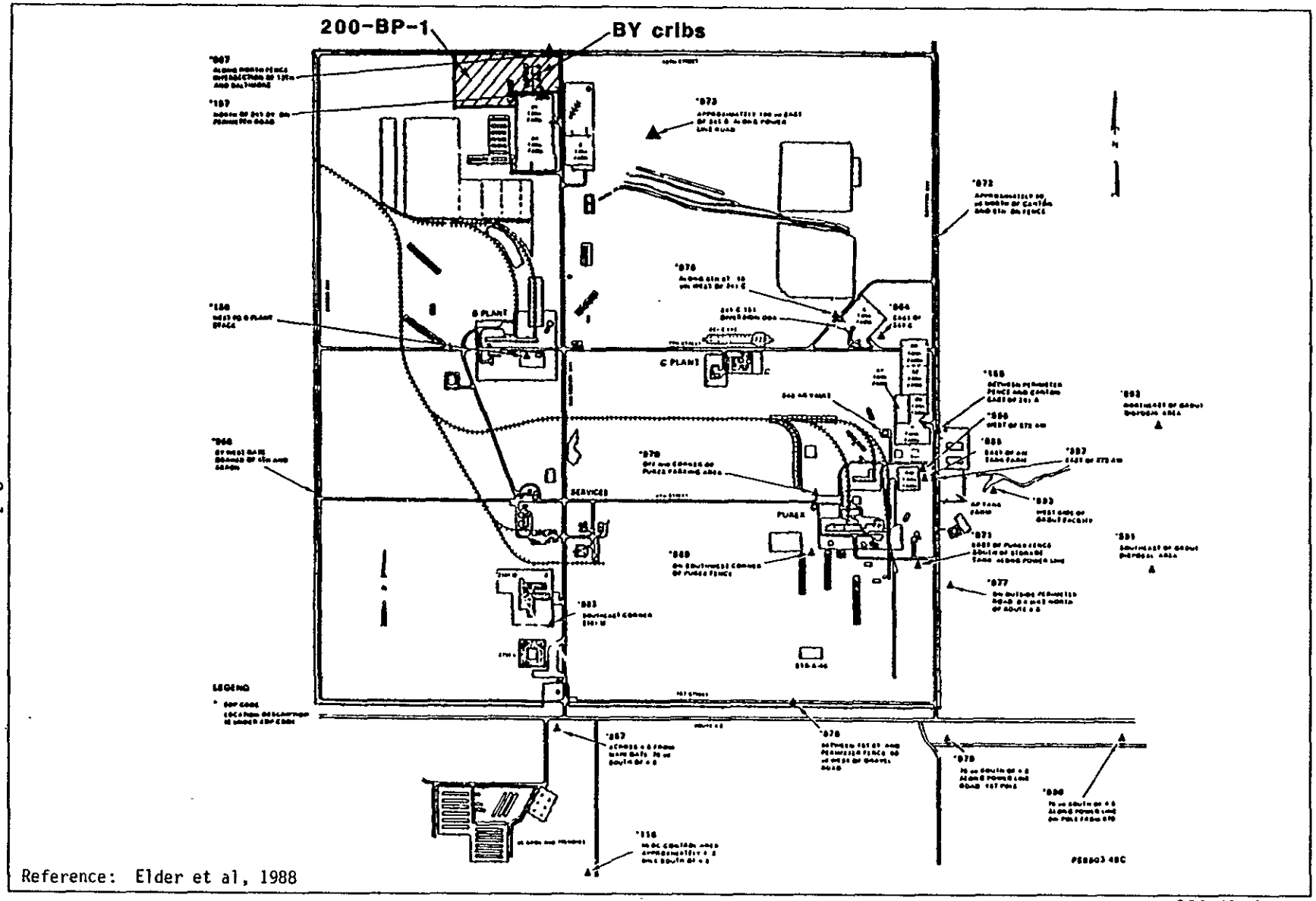
AMBIENT AIR MONITORING RESULTS

(Elder, R.E., G.W. Egert, A.R. Johnson, and W.L. Osborne, 1988. Westinghouse Hanford Company Environmental Surveillance Annual Report 200/600 Areas, WHC-EP-0145, prepared by Westinghouse Hanford Company, Richland, WA, for U.S. Department of Energy.)

9 0 1 1 7 1 1 1 5 9

Key

→ Pointer indicates monitoring results for sampling stations near 200-BP-1



883-1611/12699

Figure G-1. The 200 East Area Showing Locations of Air Samplers

Map location	Site	Quarters sampled	^{90}Sr			^{137}Cs		
			Quarter maximum	Quarter minimum	Annual Average ± 2SD*	Quarter maximum	Quarter minimum	Annual Average ± 2SD*
N116	N of BC Cribs	1, 2, 3, 4	4.42 E-04	2.73 E-04	3.33 E-04 ± 1.52 E-04	2.35 E-04	1.59 E-04	4.00 E-06 ± 3.97 E-04
N153	241-TX Tank Farm	1, 2, 3, 4	3.36 E-04	1.92 E-04	2.47 E-04 ± 1.35 E-04	9.42 E-03	2.87 E-03	5.34 E-03 ± 5.69 E-03
N155	241-U Tank Farm	1, 2, 3, 4	1.50 E-04	1.13 E-05	6.46 E-05 ± 1.38 E-04	7.79 E-04	2.34 E-04	3.14 E-04 ± 9.36 E-04
N060	Replicate to site N158	1, 2, 3, 4	1.53 E-04	3.94 E-06	8.39 E-05 ± 1.50 E-04	6.63 E-04	2.04 E-04	3.47 E-04 ± 8.06 E-04
N157	241-BY Tank Farm	1, 2, 3, 4	2.45 E-04	4.06 E-06	1.35 E-04 ± 1.79 E-04	5.00 E-03	2.75 E-03	3.81 E-03 ± 2.09 E-03
N158	241-AX Tank Farm	1, 2, 3, 4	5.44 E-04	1.49 E-04	3.55 E-04 ± 3.44 E-04	3.16 E-03	2.81 E-04	1.64 E-03 ± 2.36 E-03
N159	B Plant	1, 2, 3, 4	3.85 E-04	3.70 E-05	1.46 E-04 ± 3.26 E-04	2.62 E-02	9.69 E-04	7.60 E-03 ± 2.48 E-02
N161	T Plant	1, 2, 3, 4	5.75 E-05	3.93 E-05	4.63 E-05 ± 1.71 E-05	5.47 E-04	4.02 E-05	2.75 E-04 ± 5.77 E-04
N165	216-Z-19 Ditch (covered)	1, 2, 3, 4	7.34 E-05	1.88 E-05	3.53 E-05 ± 9.15 E-05	1.10 E-03	2.98 E-04	3.45 E-04 ± 1.39 E-03
N168	U Plant	1, 2, 3, 4	1.27 E-04	1.31 E-05	5.75 E-05 ± 9.75 E-05	1.29 E-03	-1.00 E-04	3.48 E-04 ± 1.31 E-03
N177	Laundry	1, 2, 3, 4	2.22 E-04	7.48 E-05	1.49 E-04 ± 1.31 E-04	7.24 E-04	1.58 E-04	3.90 E-04 ± 5.27 E-04
N956	E of 241-S and SX Tank Farm	1, 2, 3, 4	2.03 E-04	9.74 E-06	1.40 E-04 ± 9.61 E-06	2.54 E-03	4.02 E-04	1.46 E-03 ± 2.58 E-03
N957	BC Cribs	1, 2, 3, 4	3.17 E-04	3.96 E-05	1.21 E-04 ± 2.64 E-04	4.22 E-04	0.00 E+00	1.77 E-04 ± 4.02 E-04
N962	SE corner W-48	1, 2, 3, 4	1.06 E-02	1.82 E-04	3.57 E-03 ± 9.71 E-03	1.08 E-03	4.58 E-04	7.33 E-04 ± 5.05 E-04
N963	SE of REDOX	1, 2, 3, 4	1.07 E-04	9.31 E-06	5.99 E-05 ± 8.30 E-05	2.37 E-04	4.12 E-04	1.15 E-04 ± 6.70 E-04
N964	W of W-48	1, 2, 3, 4	1.77 E-04	1.08 E-06	7.43 E-06 ± 1.43 E-04	5.68 E-04	0.00 E+00	2.04 E-04 ± 5.65 E-04
N965	NE corner 200 West Area	1, 2, 3, 4	7.06 E-05	2.92 E-05	4.48 E-06 ± 3.89 E-05	5.34 E-04	4.35 E-06	2.24 E-05 ± 8.08 E-04
N966	S of 200 West Area Main Gate	1, 2, 3, 4	3.96 E-04	9.10 E-06	1.41 E-04 ± 3.52 E-04	7.06 E-04	3.43 E-04	9.92 E-05 ± 8.93 E-04
N967	N of 241-B and BY Tank Farm	1, 2, 3, 4	1.10 E-04	2.14 E-05	5.96 E-05 ± 8.57 E-05	9.25 E-04	2.64 E-04	5.34 E-04 ± 5.59 E-04
N968	W gate 200 East Area	1, 2, 3, 4	9.28 E-05	1.14 E-06	4.53 E-05 ± 7.48 E-05	3.02 E-04	1.83 E-04	1.49 E-04 ± 2.74 E-04
N969	SW of PUREX Plant	1, 2, 3, 4	2.73 E-04	1.28 E-05	9.22 E-06 ± 2.45 E-04	5.06 E-05	4.33 E-04	2.56 E-04 ± 3.31 E-04
N970	NW of PUREX Plant	1, 2, 3, 4	2.60 E-04	2.26 E-05	8.74 E-05 ± 2.74 E-04	3.82 E-04	0.00 E+00	1.60 E-04 ± 3.41 E-04
N971	SE of PUREX Plant	1, 2, 3, 4	4.20 E-04	2.30 E-05	1.35 E-04 ± 3.82 E-04	4.94 E-04	2.35 E-04	5.43 E-04 ± 4.16 E-04
N972	NE of 241-C Tank Farm	1, 2, 3, 4	2.72 E-04	1.39 E-04	1.91 E-04 ± 1.19 E-04	1.08 E-03	1.34 E-04	5.61 E-04 ± 7.82 E-04
N973	E of B Tank Farm	1, 2, 3, 4	1.99 E-04	7.89 E-05	1.37 E-04 ± 1.02 E-04	2.09 E-03	2.56 E-04	9.92 E-04 ± 1.57 E-03
N974	N of T Plant	1, 2, 3, 4	1.17 E-04	1.14 E-05	3.75 E-05 ± 1.20 E-04	3.00 E-04	2.80 E-04	1.55 E-04 ± 2.92 E-04
N975	E of Z Plant	1, 2, 3, 4	1.14 E-04	3.27 E-05	7.81 E-05 ± 6.81 E-05	2.33 E-04	1.34 E-04	1.91 E-04 ± 1.02 E-04
N976	2E17, 241-C Tank Farm	1, 2, 3, 4	2.98 E-04	1.48 E-04	2.51 E-04 ± 1.41 E-04	5.54 E-04	2.06 E-04	4.07 E-04 ± 3.02 E-04
N977	Grid Site 2E30	1, 2, 3, 4	2.90 E-04	3.62 E-06	1.23 E-04 ± 2.28 E-04	7.03 E-04	2.91 E-04	5.51 E-04 ± 2.57 E-04
N978	Grids Site 2E35	1, 2, 3, 4	1.97 E-04	2.73 E-05	7.97 E-06 ± 2.04 E-04	5.88 E-04	5.28 E-05	2.65 E-04 ± 5.58 E-04
N979	Grids Site 2E36	1, 2, 3, 4	8.12 E-04	7.06 E-06	2.87 E-04 ± 7.87 E-04	4.44 E-04	3.01 E-06	2.41 E-04 ± 3.98 E-04
N980	Grid Site 2EA	1, 2, 3, 4	9.50 E-06	2.50 E-05	7.34 E-06 ± 6.60 E-05	5.29 E-04	2.19 E-04	1.23 E-04 ± 6.25 E-04
N983	SE of 2101-M	1, 2, 3, 4	5.51 E-06	6.53 E-06	2.78 E-06 ± 4.29 E-06	4.82 E-06	3.68 E-04	4.19 E-06 ± 4.39 E-04
N984	SE 241-C Tank Farm	1, 2, 3, 4	7.98 E-03	1.18 E-04	2.11 E-03 ± 7.79 E-03	3.12 E-03	4.48 E-04	1.58 E-03 ± 2.23 E-03
N985	E of 241-AW Tank Farm	1, 2, 3, 4	5.48 E-04	1.43 E-04	3.19 E-04 ± 3.43 E-04	4.08 E-04	3.02 E-04	4.85 E-06 ± 7.43 E-04
N986	241-TY Tank Farm SE	1, 2, 3, 4	2.15 E-04	2.66 E-06	8.36 E-06 ± 2.00 E-04	1.15 E-03	0.00 E+00	5.87 E-04 ± 9.48 E-04
N987	241-TY Tank Farm NE	1, 2, 3, 4	1.06 E-04	4.22 E-05	7.85 E-05 ± 3.52 E-05	7.11 E-04	1.85 E-04	1.62 E-04 ± 8.37 E-04
N991	Grout SE	1, 2, 3, 4	1.06 E-04	4.84 E-06	5.31 E-05 ± 9.64 E-05	4.58 E-04	1.13 E-06	2.55 E-04 ± 3.91 E-04
N992	Grout NE	1, 2, 3, 4	1.33 E-04	3.79 E-06	4.52 E-05 ± 8.78 E-05	8.88 E-04	7.54 E-04	1.87 E-04 ± 1.64 E-03
N993	Grout NW	1, 2, 3, 4	1.66 E-04	4.28 E-05	1.02 E-04 ± 1.19 E-04	1.28 E-03	4.92 E-05	4.65 E-04 ± 1.23 E-03
N994	Old NW Corner 200 West	1, 2, 3, 4	8.61 E-05	7.60 E-06	4.33 E-06 ± 8.44 E-05	5.62 E-06	6.29 E-04	7.95 E-04 ± 6.35 E-04
N996	W Air Intake 272-AW	1, 2, 3, 4	8.43 E-04	1.89 E-05	2.72 E-04 ± 7.67 E-04	4.64 E-04	3.25 E-04	9.02 E-05 ± 8.03 E-04
N997	E Air Intake 272-AW	1, 2, 3, 4	7.17 E-04	4.77 E-06	2.51 E-04 ± 4.25 E-04	1.23 E-03	2.64 E-04	3.31 E-04 ± 1.30 E-03
N981	Yakima Barricade	1, 2, 3, 4	7.43 E-06	4.16 E-06	5.62 E-06 ± 3.08 E-05	3.45 E-04	-4.69 E-04	3.90 E-06 ± 7.06 E-04
N981	Wye Barricade	1, 2, 3, 4	7.21 E-06	2.19 E-06	4.29 E-06 ± 4.80 E-06	1.78 E-04	1.58 E-04	2.93 E-06 ± 3.23 E-04
N982	Hanford Towards	1, 2, 3, 4	1.14 E-04	5.94 E-06	8.66 E-06 ± 5.49 E-06	5.88 E-04	-1.81 E-04	2.00 E-04 ± 8.27 E-04
N960	Quality Assurance Blank	1, 2, 3, 4	2.02 E-04	3.42 E-06	7.41 E-06 ± 1.76 E-04	6.87 E-04	-7.64 E-06	2.00 E-04 ± 7.18 E-04
N961	Quality Assurance Blank	1, 2, 3, 4	6.13 E-06	-4.57 E-06	2.66 E-06 ± 3.70 E-06	3.02 E-04	2.18 E-04	-6.06 E-06 ± 4.86 E-04
	Derived concentration guides*				9.00 E+06			4.00 E+02

Reference: Elder et al, 1988

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Figure G-2. Air Sampling Results for 1987 (pCi/m3)

Map location	Site	Quarters sampled	^{239}Pu			Uranium (total)		
			Quarter maximum	Quarter minimum	Annual Average ± 2SD[a]	Quarter maximum	Quarter minimum	Annual Average ± 2SD[a]
N116	N of BC Crib	1, 2, 3, 4	5.75 E-06	-3.96 E-06	2.27 E-06 ± 4.93 E-06	2.06 E-06	4.25 E-06	1.34 E-05 ± 1.37 E-05
N153	241-TX Tank Farm	1, 2, 3, 4	8.28 E-06	3.80 E-06	3.72 E-05 ± 6.66 E-05	4.65 E-06	1.54 E-05	3.00 E-05 ± 3.01 E-05
N155	241-U Tank Farm	1, 2, 3, 4	3.60 E-06	1.48 E-05	2.40 E-05 ± 2.09 E-05	3.46 E-06	2.04 E-05	2.74 E-05 ± 1.39 E-05
N900	Replicate to site N156	1, 2, 3, 4	7.06 E-05	1.59 E-05	3.77 E-05 ± 4.82 E-05	4.02 E-05	1.02 E-05	2.59 E-05 ± 2.89 E-05
N157	241-BY Tank Farm	1, 2, 3, 4	1.28 E-05	1.07 E-06	7.72 E-06 ± 1.05 E-05	2.32 E-05	2.07 E-06	1.36 E-05 ± 2.02 E-05
N158	241-AX Tank Farm	1, 2, 3, 4	1.21 E-06	3.56 E-06	6.56 E-06 ± 7.66 E-06	3.50 E-05	1.94 E-05	2.62 E-05 ± 1.31 E-05
N159	B Plant	1, 2, 3, 4	4.00 E-05	3.10 E-06	1.89 E-05 ± 3.53 E-05	1.43 E-05	2.13 E-06	9.11 E-06 ± 1.32 E-05
N161	T Plant	1, 2, 3, 4	2.67 E-06	9.73 E-06	1.62 E-05 ± 1.45 E-05	1.88 E-05	2.54 E-06	1.00 E-05 ± 1.87 E-05
N165	216-Z-19 Ditch (covered)	1, 2, 3, 4	3.41 E-04	6.49 E-05	1.96 E-04 ± 2.96 E-04	3.20 E-05	9.05 E-06	1.86 E-05 ± 1.93 E-05
N168	U Plant	1, 2, 3, 4	2.67 E-05	6.25 E-06	1.42 E-05 ± 1.88 E-05	3.25 E-04	8.64 E-05	1.70 E-04 ± 2.15 E-04
N177	Laundry	1, 2, 3, 4	6.48 E-05	1.22 E-06	3.08 E-05 ± 5.29 E-05	9.80 E-06	6.35 E-05	7.83 E-05 ± 3.21 E-05
N956	E of 241-S and SX Tank Farm	1, 2, 3, 4	8.77 E-06	3.12 E-06	5.29 E-06 ± 4.96 E-06	2.47 E-05	1.38 E-06	1.05 E-05 ± 2.51 E-05
N957	BC Crib-1	1, 2, 3, 4	3.31 E-06	1.10 E-06	2.03 E-06 ± 1.85 E-06	3.18 E-05	9.49 E-06	1.85 E-05 ± 1.93 E-05
N962	SE corner W-4B	1, 2, 3, 4	1.24 E-04	3.02 E-05	6.75 E-05 ± 8.04 E-05	5.40 E-06	1.57 E-05	2.90 E-05 ± 3.47 E-05
N963	SE of REDOX	1, 2, 3, 4	3.82 E-05	6.38 E-06	2.01 E-05 ± 2.83 E-05	4.93 E-05	1.67 E-06	3.33 E-05 ± 4.43 E-05
N964	W of W-4B	1, 2, 3, 4	1.08 E-04	4.45 E-06	4.10 E-05 ± 9.44 E-05	3.60 E-05	1.02 E-05	2.35 E-05 ± 2.22 E-05
N965	NE corner 200 West Area	1, 2, 3, 4	8.39 E-06	2.20 E-06	4.33 E-06 ± 5.77 E-06	1.84 E-06	-2.72 E-06	4.44 E-06 ± 1.91 E-05
N966	S of 200 West Area Main Gate	1, 2, 3, 4	1.04 E-05	7.13 E-06	8.93 E-06 ± 3.34 E-06	4.03 E-06	6.96 E-06	2.22 E-05 ± 2.90 E-05
N967	N of 241-B and BY Tank Farm	1, 2, 3, 4	6.68 E-06	1.12 E-06	4.55 E-06 ± 4.95 E-06	4.67 E-05	3.50 E-06	1.75 E-05 ± 4.51 E-05
N968	W gate 200 East Area	1, 2, 3, 4	3.12 E-05	5.31 E-07	1.69 E-05 ± 2.93 E-05	4.99 E-05	2.03 E-05	3.21 E-05 ± 2.62 E-05
N969	SW of PUREX Plant	1, 2, 3, 4	9.10 E-06	6.29 E-07	4.82 E-06 ± 7.19 E-06	3.69 E-05	4.37 E-06	2.47 E-05 ± 2.86 E-05
N970	NW of PUREX Plant	1, 2, 3, 4	1.25 E-05	3.04 E-06	7.70 E-06 ± 8.68 E-06	4.08 E-05	1.07 E-05	2.28 E-05 ± 2.72 E-05
N971	SE of PUREX Plant	1, 2, 3, 4	1.35 E-05	2.57 E-06	6.54 E-06 ± 9.45 E-06	3.02 E-05	1.03 E-05	2.01 E-05 ± 1.66 E-05
N972	NE of 241-C Tank Farm	1, 2, 3, 4	5.15 E-06	3.89 E-06	4.57 E-06 ± 1.05 E-06	9.11 E-05	2.97 E-05	5.81 E-05 ± 5.29 E-05
N973	E of B Tank Farm	1, 2, 3, 4	1.01 E-05	5.86 E-07	4.81 E-06 ± 9.77 E-06	3.46 E-05	1.18 E-06	1.74 E-05 ± 2.74 E-05
N974	N of T Plant	1, 2, 3, 4	2.66 E-06	2.23 E-06	1.03 E-06 ± 3.27 E-06	1.08 E-05	2.60 E-06	4.87 E-06 ± 1.16 E-05
N975	E of Z Plant	1, 2, 3, 4	2.10 E-05	9.06 E-06	1.30 E-05 ± 1.11 E-05	4.18 E-05	2.17 E-05	3.08 E-05 ± 1.90 E-05
N976	2E17, 241-C Tank Farm	1, 2, 3, 4	4.83 E-06	1.90 E-06	3.88 E-06 ± 4.21 E-06	6.01 E-05	1.45 E-05	3.29 E-05 ± 3.71 E-05
N977	Grid Site 2E30	1, 2, 3, 4	7.66 E-06	5.31 E-07	3.56 E-06 ± 7.39 E-06	4.27 E-05	1.03 E-05	2.41 E-05 ± 2.95 E-05
N978	Grids Site 2E35	1, 2, 3, 4	3.80 E-06	5.31 E-07	1.38 E-06 ± 3.59 E-06	3.53 E-05	5.48 E-06	1.87 E-05 ± 2.47 E-05
N979	Grids Site 2E36	1, 2, 3, 4	3.81 E-06	5.31 E-07	2.18 E-06 ± 4.03 E-06	2.72 E-06	1.25 E-05	1.83 E-05 ± 1.25 E-05
N980	Grid Site 2EA	1, 2, 3, 4	4.99 E-06	5.31 E-07	1.89 E-06 ± 4.63 E-06	3.08 E-06	7.14 E-06	1.59 E-05 ± 2.09 E-05
N983	SE of 2101-M	1, 2, 3, 4	4.58 E-06	5.31 E-07	1.46 E-06 ± 4.35 E-06	2.62 E-06	3.46 E-06	1.54 E-05 ± 1.92 E-05
N984	SE 241-C Tank Farm	1, 2, 3, 4	3.43 E-06	4.78 E-07	2.12 E-06 ± 2.44 E-06	1.51 E-05	6.76 E-06	1.11 E-05 ± 7.09 E-06
N985	E of 241-AW Tank Farm	1, 2, 3, 4	5.25 E-06	9.41 E-07	3.15 E-06 ± 3.63 E-06	3.14 E-06	1.34 E-05	2.32 E-05 ± 1.48 E-05
N986	241-TY Tank Farm SE	1, 2, 3, 4	9.03 E-05	7.24 E-06	4.40 E-05 ± 6.88 E-05	2.11 E-05	1.09 E-06	1.19 E-05 ± 1.97 E-05
N987	241-TY Tank Farm NE	1, 2, 3, 4	2.34 E-05	5.31 E-07	7.08 E-06 ± 2.24 E-05	1.94 E-05	1.68 E-06	1.16 E-05 ± 1.54 E-05
N991	Grout SE	1, 2, 3, 4	2.64 E-06	4.66 E-08	1.62 E-06 ± 3.02 E-06	2.84 E-06	1.23 E-06	1.35 E-05 ± 2.24 E-05
N992	Grout NE	1, 2, 3, 4	3.65 E-06	7.38 E-07	2.10 E-06 ± 2.64 E-06	2.06 E-05	1.77 E-05	8.62 E-06 ± 3.57 E-05
N993	Grout NW	1, 2, 3, 4	7.48 E-06	3.05 E-06	5.48 E-06 ± 4.53 E-06	1.42 E-04	2.46 E-05	6.05 E-05 ± 1.10 E-04
N994	Old NW Corner 200 West	1, 2, 3, 4	5.31 E-06	2.17 E-07	3.03 E-06 ± 4.23 E-06	2.04 E-06	8.65 E-06	1.57 E-05 ± 1.00 E-05
N996	W Air Intake 272-AW	1, 2, 3, 4	1.96 E-05	1.98 E-06	7.26 E-06 ± 1.66 E-05	7.40 E-05	2.45 E-05	4.14 E-05 ± 4.58 E-05
N997	E Air Intake 272-AW	1, 2, 3, 4	3.70 E-05	1.44 E-06	1.47 E-06 ± 3.22 E-05	2.51 E-05	2.04 E-06	1.31 E-05 ± 2.10 E-05
N981	Yakima Barricade	1, 2, 3, 4	2.81 E-05	3.00 E-07	8.46 E-06 ± 2.63 E-05	1.62 E-06	5.38 E-07	7.18 E-06 ± 1.38 E-05
N981	Wye Barricade	1, 2, 3, 4	3.11 E-06	5.31 E-08	8.64 E-07 ± 3.08 E-06	1.54 E-05	7.84 E-07	6.56 E-06 ± 1.49 E-05
N982	Hanford Townsite	1, 2, 3, 4	3.12 E-06	2.46 E-08	1.37 E-06 ± 2.57 E-06	3.48 E-06	4.33 E-06	1.44 E-05 ± 2.69 E-05
N960	Quality Assurance Blank	1, 2, 3, 4	6.71 E-06	-5.31 E-07	2.24 E-06 ± 6.44 E-06	9.25 E-06	-1.50 E-05	2.45 E-06 ± 1.99 E-05
N961	Quality Assurance Blank	1, 2, 3, 4	2.24 E-06	-6.31 E-07	6.96 E-07 ± 2.30 E-06	7.28 E-06	1.46 E-05	-3.42 E-06 ± 1.79 E-05
	Derived concentration guides[b]				2.00 E-02			3.00 E+00

[a]Standard deviation of the mean of quarterly composites. Does not reflect analytical error.

[b]Beetle 1987.

Reference: Elder et al, 1988

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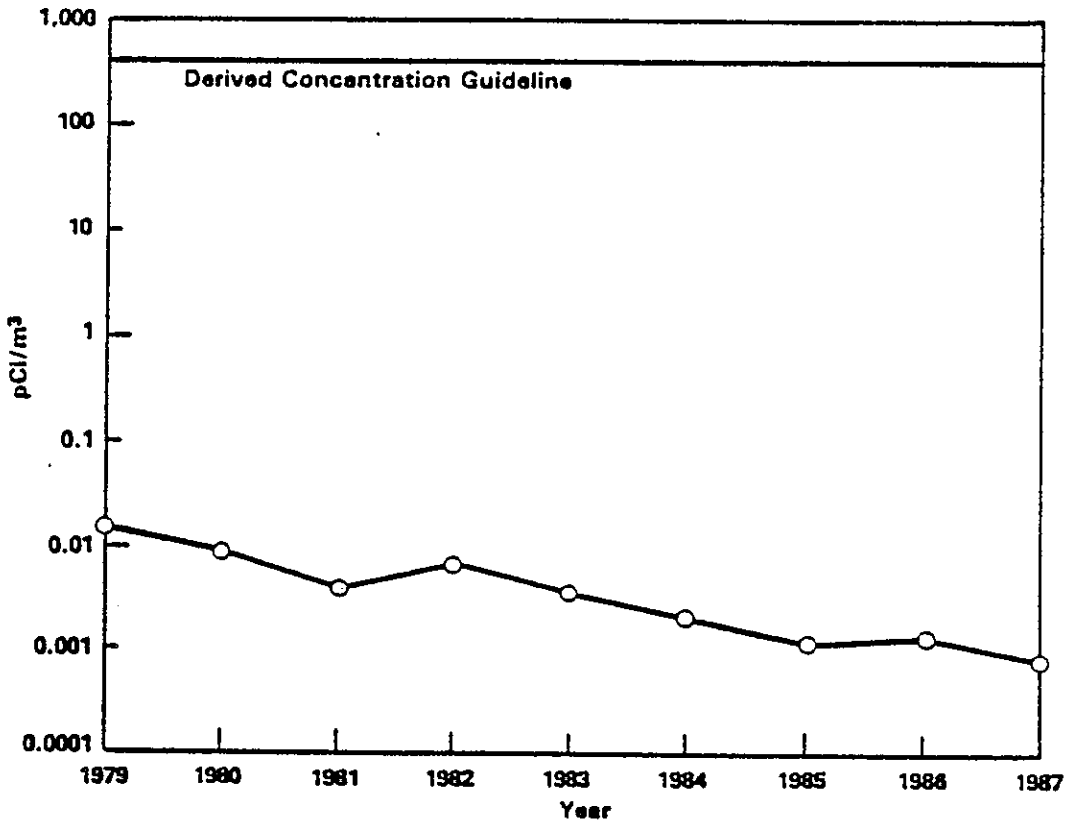
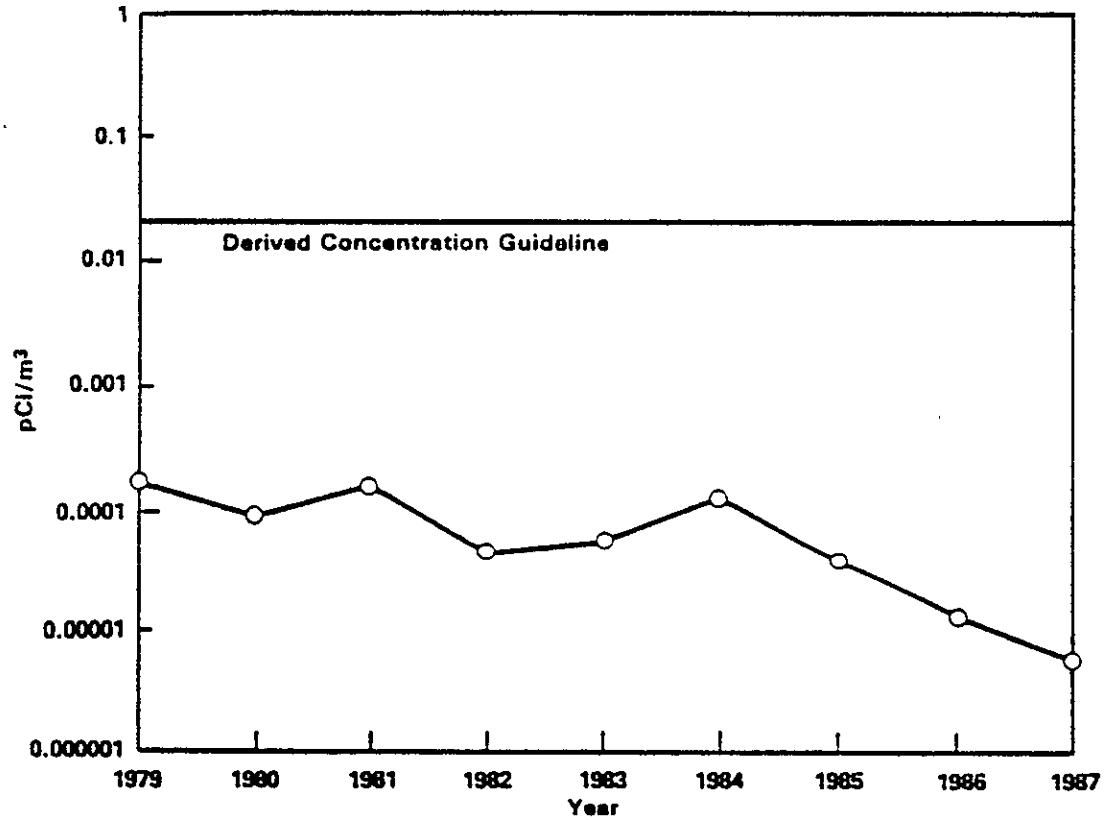
Figure G-2 (cont.). Air Sampling Results for 1987 (pCi/m3)



Reference: Elder et al, 1988

883-1611/12702

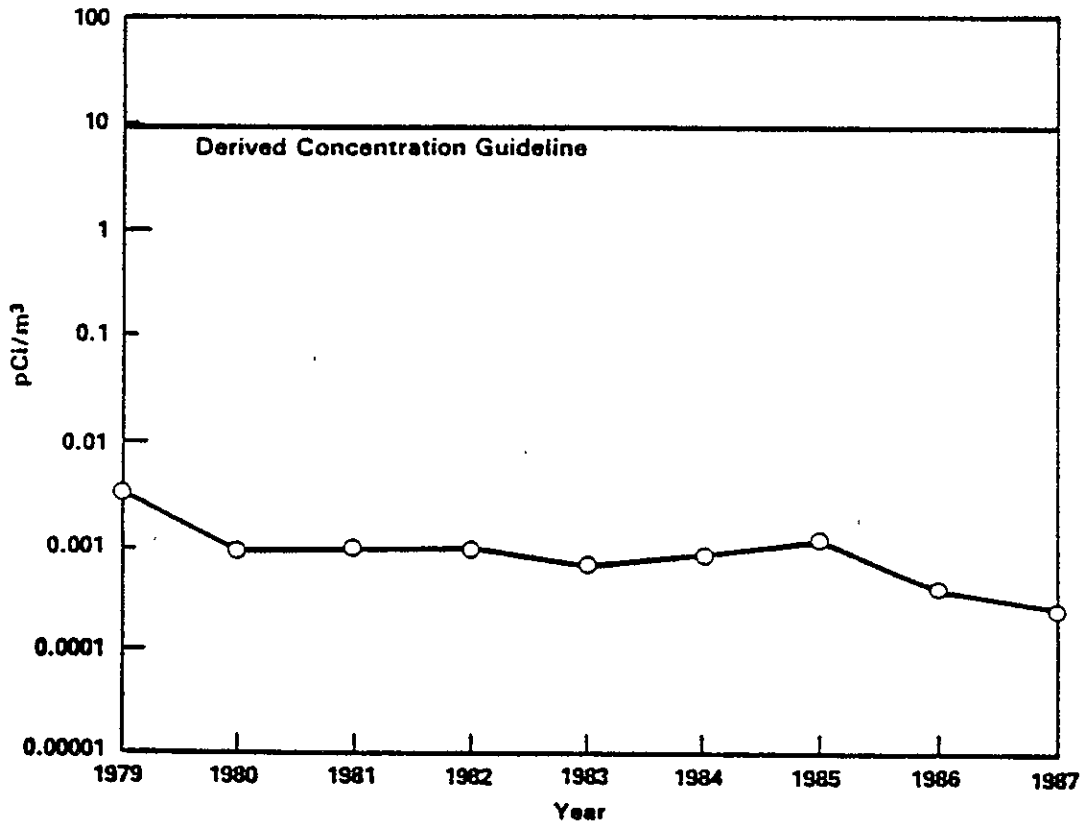
Figure G-3. The ^{137}Cs in the Air, 200 East Area



Reference: Elder et al, 1988

883-1611/12703

Figure G-4. The ^{239}Pu in the Air, 200 East Area



Reference: Elder et al, 1988

883-1611/12704

Figure G-5. The ^{90}Sr in the Air, 200 East Area

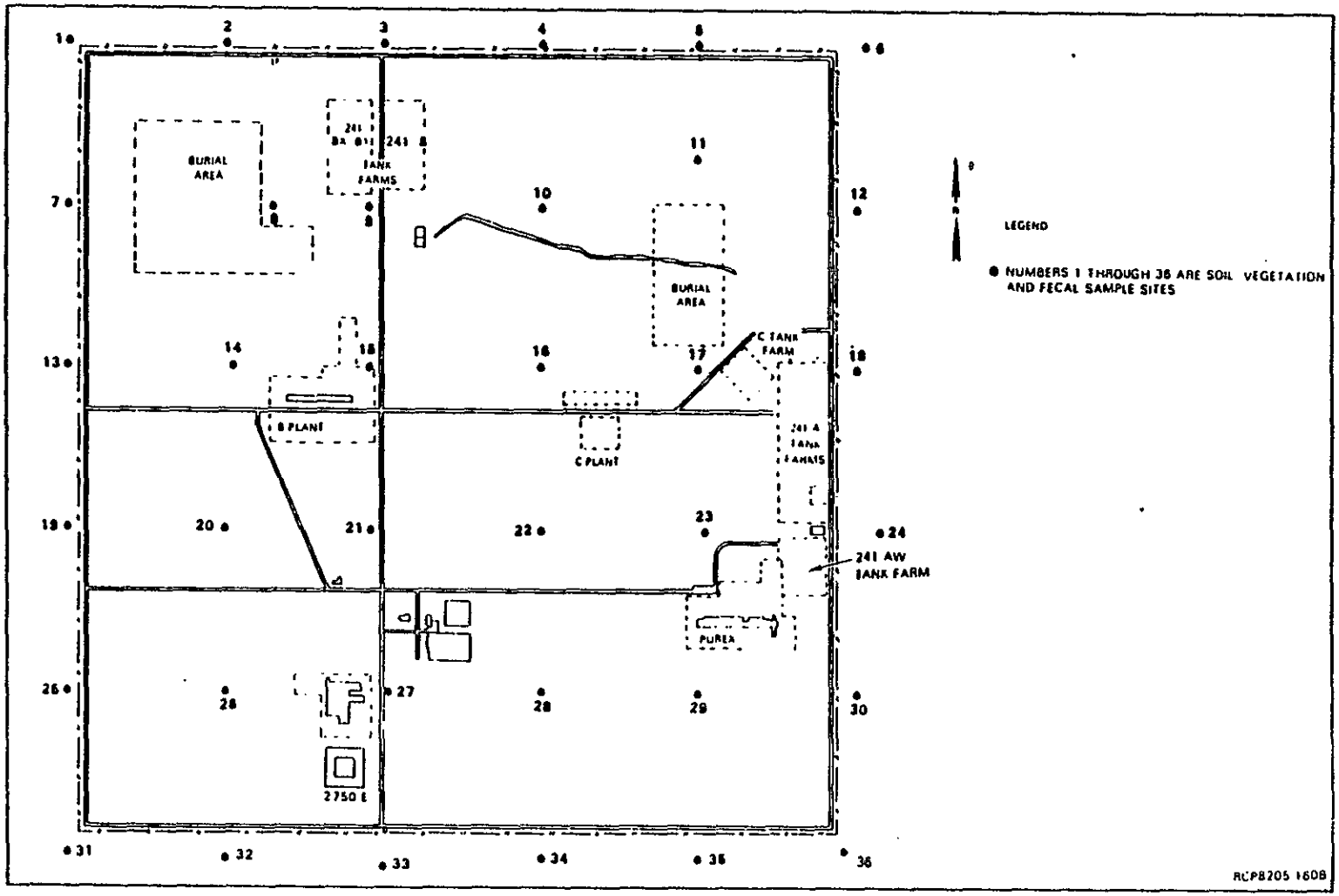
APPENDIX H

VEGETATION MONITORING RESULTS

(Elder, R.E., G.W. Egert, A.R. Johnson, and W.L. Osborne, 1988. Westinghouse Hanford Company Environmental Surveillance Annual Report 200/600 Areas, WHC-EP-0145, prepared by Westinghouse Hanford Company, Richland, WA, for U.S. Department of Energy.)

Key

→ Pointer indicates monitoring results for sampling stations near 200-BP-1



Reference: Elder et al, 1988

883-1726/9847

Figure H-1. The 200 East Area Grid Sampling Sites

Location	Co-60 ± Error	Sr-90 ± Error	Nb-95 ± Error	Zr-95 ± Error	Tc-99 ± Error	Ru-106 ± Error	I-129 ± Error
2E 1	< -7.3E-3 ± 1.6E-2	a	3.0E-2 ± 1.9E-2	< -1.3E-2 ± 3.0E-2	a	b	a
2E 3	< 1.3E-2 ± 1.4E-2	a	< -2.7E-2 ± 1.9E-2	< -4.0E-3 ± 2.5E-2	a	b	a
2E 4	< 6.0E-3 ± 1.3E-2	1.2E-1 ± 3.1E-2	< 7.8E-3 ± 2.0E-2	3.5E-2 ± 2.3E-2	a	b	a
2E 4B	< 9.5E-3 ± 1.5E-2	1.2E-1 ± 3.2E-2	< 3.1E-3 ± 1.9E-2	< -4.7E-2 ± 3.3E-2	a	b	a
2E 6	< -7.7E-3 ± 1.5E-2	a	< 3.3E-3 ± 1.9E-2	4.0E-2 ± 2.6E-2	a	b	a
2E10	2.8E-2 ± 1.4E-2	9.5E-1 ± 2.4E-1	< -1.9E-2 ± 2.3E-2	< 1.1E-2 ± 2.9E-2	1.1E+0 ± 8.8E-1	b	< -8.5E-1 ± 4.5E-1
2E12	1.8E-2 ± 1.5E-2	a	< 1.4E-2 ± 2.1E-2	< 1.7E-2 ± 2.9E-2	a	b	a
2E14	< -4.2E-3 ± 1.4E-2	a	< -1.9E-2 ± 2.4E-2	3.7E-2 ± 2.5E-2	< 3.1E-1 ± 8.5E-1	b	< -5.8E-2 ± 3.2E-1
2E14B	< -4.4E-3 ± 1.8E-2	a	< -2.2E-2 ± 2.7E-2	< 1.9E-2 ± 3.0E-2	< 1.5E-1 ± 8.4E-1	b	3.6E-1 ± 2.3E-1
2E16	2.5E-2 ± 2.2E-2	a	< -2.0E-2 ± 3.0E-2	< -4.4E-2 ± 4.5E-2	a	b	a
2E17	1.7E-2 ± 1.3E-2	1.0E+1 ± 2.4E+0	< -1.2E-2 ± 2.3E-2	< 1.7E-2 ± 2.8E-2	a	b	a
2E18	< 4.3E-3 ± 2.1E-2	2.1E-1 ± 5.4E-2	< 1.0E-2 ± 2.9E-2	5.6E-2 ± 4.3E-2	a	b	a
2E19	< 7.3E-3 ± 1.7E-2	a	< -1.3E-2 ± 2.7E-2	< 2.7E-2 ± 3.3E-2	a	b	a
2E23	< -1.7E-2 ± 2.3E-2	3.5E-2 ± 1.2E-2	< -3.4E-3 ± 3.6E-2	< -5.2E-3 ± 4.9E-2	a	b	a
2E24	< 3.9E-3 ± 1.4E-2	3.8E-1 ± 9.7E-2	< -6.6E-3 ± 2.0E-2	< -1.8E-2 ± 2.7E-2	< 2.0E-1 ± 8.4E-1	b	< -3.9E-1 ± 4.1E-1
2E28	< -1.2E-3 ± 1.7E-2	a	< -4.3E-3 ± 2.9E-2	< -7.1E-2 ± 4.1E-2	a	b	a
2E28B	< -1.0E-2 ± 1.8E-2	a	< 2.2E-2 ± 3.3E-2	< -2.0E-2 ± 4.4E-2	a	b	a
2E34	1.9E-2 ± 1.8E-2	a	< -2.4E-2 ± 2.6E-2	< -3.5E-3 ± 3.4E-2	a	b	a
2E35	< 1.6E-3 ± 1.4E-2	1.4E+0 ± 3.6E-1	< -2.2E-2 ± 2.5E-2	< -6.1E-3 ± 3.2E-2	a	b	a
2EA	< 1.3E-2 ± 1.4E-2	a	< 9.3E-3 ± 2.4E-2	< -4.6E-3 ± 2.9E-2	a	b	a
2EB	< 1.1E-2 ± 1.5E-2	a	< 6.5E-3 ± 2.3E-2	< -1.5E-2 ± 3.4E-2	a	4.3E-1 ± 1.7E-1	a
2EC	< 0.0E+0 ± 1.8E-2	a	< -2.2E-3 ± 2.6E-2	< -2.3E-2 ± 3.5E-2	a	b	a
2ED	1.9E-2 ± 1.8E-2	3.7E-1 ± 9.4E-2	< -2.3E-2 ± 3.3E-2	< 4.9E-3 ± 3.9E-2	< 3.8E-1 ± 8.5E-1	b	< -2.8E-1 ± 3.1E-1
2EDB	< 1.4E-2 ± 1.6E-2	3.3E-1 ± 8.4E-2	< 1.8E-2 ± 2.9E-2	< 8.9E-3 ± 3.9E-2	9.6E-1 ± 8.8E-1	b	< -1.4E-1 ± 3.7E-1
GRT1	< 5.5E-3 ± 1.7E-2	2.2E-1 ± 5.7E-2	< -1.1E-2 ± 2.8E-2	< 1.4E-2 ± 4.2E-2	a	b	< -3.5E-1 ± 3.0E-1
GRT2	3.4E-2 ± 2.5E-2	3.6E-1 ± 9.0E-2	< 7.0E-3 ± 2.5E-2	< -1.3E-3 ± 3.7E-2	4.7E+0 ± 1.1E+0	b	< -1.1E-1 ± 2.2E-1
GRT4	< 1.5E-2 ± 1.8E-2	3.4E-1 ± 8.5E-2	< 2.6E-3 ± 3.2E-2	< -3.6E-2 ± 4.1E-2	< 2.3E-1 ± 8.4E-1	b	< 4.6E-2 ± 2.8E-1
GRT5	< 9.7E-3 ± 1.5E-2	1.4E-1 ± 3.7E-2	< 1.1E-2 ± 2.1E-2	< -3.9E-3 ± 2.9E-2	< 2.1E-2 ± 8.3E-1	b	< -1.0E-1 ± 2.8E-1
GRT6	< 1.1E-2 ± 1.5E-2	2.4E-1 ± 6.0E-2	< 1.9E-2 ± 2.8E-2	3.7E-2 ± 3.3E-2	< 6.4E-1 ± 8.6E-1	b	< 1.7E-1 ± 3.7E-1
Maximum	3.4E-2	1.0E+1	3.0E-2	5.6E-2	4.7E+0	4.3E-1	3.6E-1
Minimum	-1.7E-2	3.5E-2	-2.7E-2	-7.1E-2	2.1E-2	4.3E-1	-8.5E-1
Mean	8.0E-3	1.0E+0	-2.2E-3	2.8E-4	8.6E-1	4.3E-1	-1.6E-1
Background (c)		4.8E-2					

Reference: Elder et al, 1988

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Figure H-2. Grid Site Vegetation Results for 200 East Area for 1987 (pCi/g dry weight)
(Sheet 1 of 2)

Location	Cs-134 ± Error	Cs-137 ± Error	Eu-152 ± Error	Eu-154 ± Error	Eu-155 ± Error	Pu-238 ± Error	Pu-239 ± Error
2E 1	4.3E-2 ± 1.6E-2	1.6E-1 ± 2.6E-2	< 4.2E-2 ± 6.5E-2	< 8.2E-3 ± 4.8E-2	< 9.6E-3 ± 3.5E-2	a	a
2E 3	b	4.2E-1 ± 5.1E-2	< -3.3E-2 ± 6.1E-2	< -3.8E-2 ± 4.7E-2	< 1.8E-2 ± 3.1E-2	a	a
2E 4	b	3.4E-1 ± 4.4E-2	< -3.2E-2 ± 6.9E-2	< 3.1E-2 ± 4.4E-2	< 2.0E-2 ± 3.0E-2	2.9E-4 ± 2.4E-4	1.4E-3 ± 5.4E-4
2E 4B	6.9E-2 ± 1.9E-2	3.3E-1 ± 4.4E-2	< -6.6E-2 ± 7.0E-2	< -2.8E-2 ± 5.1E-2	< 2.5E-2 ± 3.7E-2	3.3E-4 ± 2.0E-4	2.7E-3 ± 6.4E-4
2E 6	3.3E-2 ± 1.7E-2	2.6E-1 ± 3.6E-2	1.0E-1 ± 5.8E-2	< -3.6E-2 ± 5.6E-2	< -4.1E-2 ± 3.7E-2	a	a
2E10	5.4E-2 ± 1.7E-2	3.7E+0 ± 3.7E-1	< -2.7E-2 ± 6.7E-2	< -1.9E-2 ± 4.8E-2	< -1.4E-3 ± 4.2E-2	< 2.3E-4 ± 2.8E-4	4.9E-3 ± 1.2E-3
2E12	3.2E-2 ± 1.8E-2	2.7E-1 ± 3.7E-2	< 5.3E-2 ± 5.8E-2	< 2.0E-3 ± 4.9E-2	< -3.2E-2 ± 4.3E-2	a	a
2E14	b	8.2E-1 ± 9.3E-2	< 2.4E-2 ± 7.3E-2	< 1.2E-2 ± 4.3E-2	< 1.9E-3 ± 4.0E-2	a	a
2E14B	b	1.0E+1 ± 1.0E+0	< -4.3E-3 ± 7.5E-2	< -2.6E-2 ± 5.7E-2	8.1E-2 ± 6.7E-2	a	a
2E16	1.0E-1 ± 2.7E-2	2.8E-1 ± 4.2E-2	< 2.5E-2 ± 7.8E-2	< 1.6E-2 ± 5.9E-2	< -6.9E-3 ± 5.0E-2	a	a
2E17	4.2E-2 ± 1.8E-2	5.4E-1 ± 6.4E-2	< 2.8E-2 ± 6.3E-2	< -2.4E-2 ± 5.1E-2	< 4.0E-2 ± 5.0E-2	3.3E-4 ± 2.1E-4	2.1E-3 ± 5.7E-4
2E18	7.6E-2 ± 2.8E-2	9.1E-1 ± 1.1E-1	< 2.6E-2 ± 9.1E-2	< -3.5E-2 ± 6.9E-2	< 3.7E-2 ± 6.1E-2	4.5E-4 ± 2.7E-4	1.9E-3 ± 5.7E-4
2E19	b	1.1E-1 ± 2.5E-2	< -2.2E-2 ± 7.3E-2	5.8E-2 ± 5.1E-2	< 9.7E-3 ± 4.0E-2	a	a
2E23	b	1.1E-1 ± 3.3E-2	< -8.7E-2 ± 9.7E-2	< -3.8E-3 ± 7.0E-2	< -1.7E-2 ± 6.3E-2	< 8.6E-5 ± 1.7E-4	2.9E-3 ± 1.1E-3
2E24	5.5E-2 ± 1.8E-2	1.5E+0 ± 1.6E-1	< 1.3E-2 ± 6.7E-2	5.1E-2 ± 4.7E-2	< -3.3E-2 ± 4.0E-2	< 7.8E-5 ± 1.6E-4	5.9E-3 ± 1.2E-3
2E28	b	1.8E-1 ± 3.2E-2	< 5.9E-3 ± 7.6E-2	< 1.9E-2 ± 5.8E-2	< 1.8E-3 ± 4.9E-2	a	a
2E28B	7.2E-2 ± 2.3E-2	2.2E-1 ± 3.4E-2	< -2.4E-2 ± 8.0E-2	< 1.1E-2 ± 5.8E-2	< -2.9E-4 ± 3.7E-2	a	a
2E34	5.3E-2 ± 2.6E-2	2.6E-1 ± 4.0E-2	< -2.9E-2 ± 7.4E-2	< 6.4E-3 ± 5.0E-2	< -1.4E-2 ± 5.1E-2	a	a
2E35	7.7E-2 ± 2.0E-2	3.9E-1 ± 4.9E-2	7.4E-2 ± 5.4E-2	< -1.1E-2 ± 5.0E-2	< 2.7E-2 ± 3.8E-2	4.5E-4 ± 3.1E-4	6.8E-3 ± 1.4E-3
2EA	5.6E-2 ± 1.9E-2	2.4E-1 ± 3.4E-2	< -1.8E-3 ± 7.6E-2	< -7.8E-3 ± 4.8E-2	< -2.8E-2 ± 4.6E-2	a	a
2EB	4.0E-2 ± 2.0E-2	1.4E-1 ± 2.8E-2	< -7.2E-2 ± 8.2E-2	< -3.1E-3 ± 5.5E-2	< -2.2E-2 ± 4.3E-2	a	a
2EC	8.4E-2 ± 2.2E-2	6.5E-1 ± 7.5E-2	< -5.7E-2 ± 7.5E-2	< -4.5E-2 ± 5.7E-2	< -1.4E-2 ± 3.9E-2	a	a
2ED	6.8E-2 ± 2.4E-2	3.0E-1 ± 4.4E-2	< 0.0E+0 ± 8.4E-2	< -1.9E-2 ± 6.0E-2	< 1.4E-3 ± 4.5E-2	< 3.1E-5 ± 6.5E-5	8.0E-3 ± 1.3E-3
2EDB	5.2E-2 ± 2.1E-2	2.8E-1 ± 3.9E-2	< 4.8E-2 ± 6.4E-2	< -2.9E-2 ± 4.9E-2	< 1.4E-2 ± 3.8E-2	< 8.9E-5 ± 1.3E-4	8.0E-3 ± 1.5E-3
GRT1	6.1E-2 ± 2.2E-2	3.6E-1 ± 4.9E-2	6.9E-2 ± 6.7E-2	< -5.8E-2 ± 5.9E-2	< -2.5E-2 ± 4.3E-2	3.2E-4 ± 2.6E-4	6.0E-3 ± 1.3E-3
GRT2	8.3E-2 ± 3.0E-2	3.6E-1 ± 5.0E-2	< 7.5E-2 ± 9.2E-2	< 2.7E-2 ± 7.7E-2	< 2.0E-2 ± 6.1E-2	< 1.9E-4 ± 2.7E-4	2.9E-3 ± 1.1E-3
GRT4	5.0E-2 ± 2.2E-2	4.8E-1 ± 6.1E-2	< 2.9E-2 ± 7.7E-2	< 4.3E-2 ± 5.3E-2	< -2.4E-2 ± 5.0E-2	< 9.9E-5 ± 1.4E-4	7.3E-3 ± 1.5E-3
GRT5	8.5E-2 ± 1.9E-2	4.6E-1 ± 5.6E-2	< -8.2E-3 ± 7.0E-2	< -3.3E-2 ± 5.0E-2	< -3.2E-2 ± 4.3E-2	< 8.3E-5 ± 9.8E-5	4.0E-3 ± 7.9E-4
GRT6	8.0E-2 ± 2.1E-2	4.9E-1 ± 5.9E-2	< 1.0E-2 ± 7.1E-2	< -3.7E-2 ± 5.4E-2	< 0.0E+0 ± 3.8E-2	< -1.5E-6 ± 8.1E-4	9.4E-3 ± 3.5E-3
Maximum	1.0E-1	1.0E+1	1.0E-1	5.8E-2	8.1E-2	4.5E-4	9.4E-3
Minimum	3.2E-2	1.1E-1	-8.7E-2	-5.8E-2	-4.1E-2	-1.5E-6	1.4E-3
Mean	6.2E-2	8.5E-1	5.4E-3	-5.8E-3	5.1E-4	2.0E-4	4.9E-3
Background (c)		5.1E-2					2.1E-4

Reference: Elder et al, 1988

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Figure H-2. Grid Site Vegetation Results for 200 East Area for 1987 (pCi/g dry weight)
(Sheet 2 of 2)

Site	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2E1	2.5E-1 ± 1.1E-1	1.0E-1 ± 6.2E-2	-4.9E-4 ± 1.2E-1	7.2E-3 ± 4.4E-1	-9.3E-2 ± 2.6E-1	b	b	1.6E-2 ± 1.1E-2	b	1.6E-1 ± 2.6E-2
2E2	2.8E+0 ± 2.8E-1	1.1E+0 ± 1.5E-1	2.6E-1 ± 1.6E-1	7.8E-2 ± 3.6E-1	-6.3E-1 ± 6.3E-1	b	b	1.6E-1 ± 2.5E-2	1.8E-1 ± 5.1E-2	b
2E3	6.3E+0 ± 4.4E-1	2.1E+0 ± 1.8E-1	1.2E-1 ± 1.1E-1	8.0E-1 ± 6.1E-1	-2.8E-1 ± 4.0E-1	b	8.6E-1 ± 1.1E-1	5.1E-1 ± 5.5E-2	b	4.2E-1 ± 5.1E-2
2E4	5.2E+0 ± 3.8E-1	2.0E+0 ± 2.1E-1	b	1.4E+0 ± 7.6E-1	5.2E-1 ± 7.1E-1	b	3.6E-1 ± 8.5E-2	4.5E-1 ± 4.1E-2	2.9E+0 ± 3.1E-1	3.4E-1 ± 4.4E-2
2E5	b	1.1E+0 ± 1.4E-1	1.1E-1 ± 1.2E-1	4.8E-1 ± 3.3E-1	-5.9E-1 ± 7.2E-1	1.8E-1 ± 1.6E-1	2.3E-1 ± 7.1E-2	2.3E-1 ± 2.8E-2	5.3E-1 ± 8.5E-2	b
2E6	b	2.1E-1 ± 7.5E-2	b	1.0E-1 ± 4.8E-1	4.8E-2 ± 2.2E-1	b	4.8E-1 ± 9.3E-2	1.4E-1 ± 2.8E-2	b	2.6E-1 ± 3.6E-2
2E7	b	1.4E-1 ± 7.9E-2	1.0E-1 ± 1.4E-1	-1.2E-2 ± 4.6E-1	-6.4E-2 ± 2.7E-1	b	1.7E-1 ± 6.7E-2	2.4E-2 ± 2.4E-2	b	b
2E8	8.3E-1 ± 1.6E-1	9.8E-1 ± 1.4E-1	b	4.4E-1 ± 3.6E-1	1.1E+0 ± 9.2E-1	b	1.4E-1 ± 6.9E-2	2.9E-2 ± 2.1E-2	3.7E-1 ± 5.8E-2	b
2E9	3.2E+0 ± 2.8E-1	1.4E+0 ± 1.6E-1	b	3.0E-1 ± 4.3E-1	6.9E-1 ± 9.3E-1	b	9.0E-1 ± 1.1E-1	2.2E-1 ± 4.3E-2	2.2E-1 ± 4.7E-2	b
2E10	1.2E+1 ± 5.7E-1	8.4E-1 ± 1.1E-1	1.6E+0 ± 2.7E-1	1.1E+0 ± 2.4E-1	7.9E-2 ± 1.3E-1	2.2E-1 ± 8.0E-2	3.6E-1 ± 6.8E-2	1.9E-1 ± 2.9E-2	7.6E-1 ± 1.2E-1	3.7E+0 ± 3.7E-1
2E11	2.5E+0 ± 2.7E-1	1.9E-1 ± 6.8E-2	b	1.9E-1 ± 3.4E-1	5.2E-1 ± 7.8E-1	1.1E-1 ± 8.4E-2	1.8E-1 ± 6.2E-2	3.2E-1 ± 3.1E-2	3.9E-1 ± 6.7E-2	b
2E12	9.2E-1 ± 1.6E-1	4.9E-1 ± 1.1E-1	b	1.5E-1 ± 4.6E-1	2.0E-1 ± 9.4E-2	b	1.7E-1 ± 7.5E-2	3.3E-1 ± 3.5E-2	4.3E-1 ± 6.5E-2	2.7E-1 ± 3.7E-2
2E13	b	2.7E-1 ± 8.5E-2	5.9E-2 ± 1.2E-1	2.0E-1 ± 4.6E-1	6.7E-2 ± 2.3E-1	1.3E-1 ± 8.9E-2	b	3.4E-2 ± 1.2E-2	2.6E-1 ± 4.4E-2	b
2E14	b	1.8E+0 ± 1.6E-1	b	3.0E-1 ± 7.9E-1	0.0E+0 ± 3.4E-1	1.4E-1 ± 1.3E-1	6.5E-1 ± 1.4E-1	6.0E-1 ± 6.0E-2	9.5E-2 ± 3.0E-2	8.2E-1 ± 9.3E-2
2E15	b	2.5E-1 ± 7.1E-2	b	-7.7E-2 ± 4.5E-1	-1.8E+0 ± 1.2E+0	b	b	2.0E-1 ± 3.3E-2	1.1E-1 ± 4.9E-2	b
2E16	6.2E-1 ± 1.9E-1	5.4E-1 ± 9.6E-2	5.1E-1 ± 1.9E-1	1.2E-2 ± 4.6E-1	1.3E+0 ± 6.4E-1	b	4.7E-1 ± 8.2E-2	1.1E-1 ± 1.6E-2	8.1E-1 ± 1.1E-1	2.8E-1 ± 4.2E-2
2E17	b	3.6E-1 ± 9.7E-2	5.4E-1 ± 2.0E-1	4.7E-1 ± 4.3E-1	3.0E-1 ± 4.1E-1	2.4E-1 ± 1.7E-1	4.7E-1 ± 7.9E-2	1.2E+0 ± 7.9E-2	1.0E+0 ± 1.3E-1	5.4E-1 ± 6.4E-2
2E18	4.6E+0 ± 4.4E-1	2.6E+0 ± 2.1E-1	6.3E-1 ± 2.0E-1	8.1E-1 ± 3.9E-1	1.8E-1 ± 1.5E-1	1.1E-1 ± 9.4E-2	6.6E-1 ± 1.1E-1	5.3E-1 ± 4.2E-2	1.9E+0 ± 2.1E-1	9.1E-1 ± 1.1E-1
2E19	b	1.0E-1 ± 6.4E-2	1.1E-1 ± 1.5E-1	3.8E-1 ± 1.9E-1	-7.6E-1 ± 6.8E-1	b	b	7.8E-2 ± 2.7E-2	b	1.1E-1 ± 2.5E-2
2E20	b	2.4E+0 ± 2.2E-1	1.1E-1 ± 1.2E-1	1.4E-1 ± 3.3E-1	2.6E-1 ± 8.6E-1	b	b	6.6E-2 ± 1.9E-2	8.2E-1 ± 1.4E-1	b
2E21	b	5.0E-1 ± 9.8E-2	5.7E-2 ± 1.3E-1	1.8E-2 ± 5.3E-1	2.5E-1 ± 1.6E-1	b	1.1E-1 ± 5.3E-2	9.1E-2 ± 1.3E-2	b	b
2E22	b	1.2E-1 ± 6.4E-2	2.3E-1 ± 1.3E-1	2.7E-2 ± 4.7E-1	-3.9E-1 ± 4.5E+0	2.0E-1 ± 1.5E-1	b	1.1E-1 ± 1.1E-2	7.7E-1 ± 1.1E-1	b
2E23	3.9E-1 ± 1.1E-1	9.7E-2 ± 6.5E-2	b	1.7E-1 ± 4.1E-1	7.4E-1 ± 4.0E-1	b	5.1E-1 ± 6.8E-2	1.5E-1 ± 3.0E-2	2.0E-1 ± 4.2E-2	1.1E-1 ± 3.3E-2
2E24	2.2E+0 ± 2.1E-1	1.9E+0 ± 2.1E-1	1.4E+0 ± 3.8E-1	1.3E+0 ± 3.9E-1	3.5E-1 ± 1.3E-1	4.6E-1 ± 1.5E-1	6.9E-1 ± 1.1E-1	3.5E-1 ± 7.7E-2	1.2E+0 ± 1.4E-1	1.5E+0 ± 1.6E-1
2E25	b	3.9E-1 ± 9.7E-2	-1.6E-2 ± 1.3E-1	2.4E-1 ± 6.4E-1	1.1E+0 ± 7.8E-1	b	b	9.3E-2 ± 4.0E-2	b	b
2E26	b	2.2E-1 ± 7.5E-2	-3.1E-2 ± 1.1E-1	5.9E-3 ± 4.1E-1	4.1E-2 ± 7.8E-1	b	b	b	b	b
2E27	b	5.0E-3 ± 4.7E-2	b	6.0E-1 ± 5.6E-1	9.2E-1 ± 4.8E-1	b	1.7E-1 ± 6.6E-2	2.7E-1 ± 7.9E-2	6.9E-2 ± 3.0E-2	b
2E28	b	4.8E-1 ± 1.1E-1	1.1E-1 ± 1.3E-1	1.4E-1 ± 4.2E-1	1.2E-1 ± 5.6E-1	1.6E-1 ± 1.4E-1	b	1.3E-1 ± 4.5E-2	b	1.8E-1 ± 3.2E-2
2E29	b	1.3E-1 ± 7.0E-2	b	5.8E-1 ± 5.5E-1	6.5E-1 ± 4.9E-1	b	3.2E-1 ± 7.7E-2	2.8E-2 ± 6.2E-2	2.5E-1 ± 4.8E-2	b
2E30	b	6.4E-1 ± 1.2E-1	2.1E-1 ± 1.3E-1	3.2E-1 ± 3.6E-1	3.9E-1 ± 3.8E-1	b	1.1E-1 ± 5.5E-2	b	b	b
2E31	b	2.0E-1 ± 8.6E-2	2.8E-1 ± 2.0E-1	4.1E-1 ± 6.0E-1	4.7E-1 ± 3.1E-1	b	b	7.6E-2 ± 3.9E-2	4.7E-1 ± 7.2E-2	b
2E32	b	7.4E-2 ± 5.3E-2	-2.3E-2 ± 1.8E-1	3.8E-2 ± 2.3E-1	-5.1E-2 ± 1.3E-1	b	1.9E-1 ± 4.9E-2	6.9E-2 ± 3.8E-2	5.6E-1 ± 9.4E-2	b
2E33	b	1.1E-1 ± 6.6E-2	b	1.8E-1 ± 4.4E-1	3.4E-1 ± 6.1E-1	b	b	6.9E-2 ± 3.0E-2	b	b
2E34	b	-3.5E-2 ± 5.3E-2	9.6E-2 ± 1.1E-1	-1.1E-3 ± 4.7E-1	-3.2E-2 ± 2.7E-1	b	8.2E-2 ± 5.9E-2	1.2E-1 ± 4.4E-2	6.6E-1 ± 1.2E-1	2.6E-1 ± 4.0E-2
2E35	b	2.3E-1 ± 7.6E-2	-2.9E-2 ± 1.1E-1	1.4E-2 ± 4.0E-1	1.5E-2 ± 1.5E-1	b	1.5E-1 ± 4.6E-2	3.9E-2 ± 7.1E-2	b	3.9E-1 ± 4.9E-2
2E36	b	1.9E-1 ± 7.5E-2	8.7E-2 ± 1.3E-1	9.0E-3 ± 3.5E-1	1.4E-1 ± 3.4E-1	b	2.0E-1 ± 8.5E-2	3.8E-1 ± 1.1E-1	6.0E-1 ± 9.1E-2	b
2EA	2.8E-1 ± 1.5E-1	1.1E-1 ± 6.2E-2	8.0E-2 ± 1.4E-1	-1.1E-1 ± 4.9E-1	1.2E-1 ± 4.0E-1	2.3E-1 ± 2.1E-1	1.2E-1 ± 6.9E-2	7.2E-2 ± 5.6E-2	6.4E-1 ± 1.0E-1	2.4E-1 ± 3.4E-2
2EB	b	1.5E-1 ± 6.2E-2	1.8E-2 ± 1.3E-1	1.2E-1 ± 3.1E-1	-2.6E-2 ± 4.7E-1	1.4E-1 ± 1.1E-1	1.5E-1 ± 5.0E-2	6.5E-2 ± 4.4E-2	2.5E-1 ± 4.3E-2	1.4E-1 ± 2.8E-2
2EC	b	3.6E-1 ± 9.6E-2	2.8E-1 ± 1.5E-1	9.6E-2 ± 3.5E-1	1.8E-1 ± 2.9E-1	b	1.8E-1 ± 6.5E-2	2.8E-1 ± 5.9E-2	4.5E-1 ± 8.6E-2	6.5E-1 ± 7.5E-2
2ED	b	1.1E+0 ± 1.6E-1	8.4E-1 ± 2.6E-1	2.3E+0 ± 6.4E-1	1.3E-1 ± 3.2E-1	1.6E-1 ± 8.4E-2	4.0E-1 ± 9.0E-2	2.4E-1 ± 7.1E-2	2.0E+0 ± 2.3E-1	3.0E-1 ± 4.4E-2
Mean (a)	3.0E+0 ± 1.7E+0	6.4E-1 ± 2.3E-1	2.7E-1 ± 1.5E-1	3.4E-1 ± 1.6E-1	1.6E-1 ± 2.8E-1	1.9E-1 ± 5.6E-2	3.4E-1 ± 9.1E-2	2.1E-1 ± 7.2E-2	6.7E-1 ± 2.4E-1	5.8E-1 ± 3.6E-1

Reference: Elder et al, 1988

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Figure H-3. The 137Cs Concentations in Vegetation, 1978 through 1987 (pCi/g dry weight)

APPENDIX I

COMPARISON OF AVAILABLE CODES FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY

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APPENDIX I

COMPARISON OF AVAILABLE CODES FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY

1.0 PURPOSE

Computer models and codes provide a framework to incorporate the processes that are active at a waste disposal site, thereby permitting assessment and evaluation of various waste management options for a given site. The time frames, ranging from decades to thousands of years, associated with evaluation of waste isolation potential for a given site also necessitate the use of models and codes.

Because of the importance of the computer models relative to the performance assessment and risk assessment of a waste disposal site, a process to compare these codes has been developed. The codes must be compared to determine the limitations of theories and reliability of supporting empirical relations and laboratory tests used for evaluation of long-term waste isolation potential.

The purpose of this section is to provide a comparison of a variety of codes that are possible candidates for use in the remedial investigation/feasibility study (RI/FS) of a given site. The groundwater, air, biotic, direct contact, and surface-water pathways are considered for transport of contaminants. Such a comparison can be used to function in the following manners:

- Provide a screening mechanism (i.e., to determine which codes are applicable to a specific requirement at a given site)
- Indicate potential deficiencies of the codes
- Evaluate the necessity of additional codes that do not currently exist but might be required in the future for an RI/FS
- Provide a basis for gathering additional field data during site characterization.

2.0 SCOPE OF WORK

The codes compared in this report were selected as part of a two-step process. The first step in comparing the codes was to assemble the list of relevant codes that can potentially be used in an RI/FS. The second step was to prepare a table describing the important features of selected codes. As

part of the second step, a detailed comparison of the selected codes was performed and a comparison table was developed.

The criteria used in assembling the list of codes may be summarized as follows.

- Codes developed and used by the U.S. Department of Energy (DOE), U.S. Nuclear Regulatory Commission (NRC), and U.S. Environmental Protection Agency (EPA) should be selected.
- These codes should be:
  - Unclassified
  - Off-the-shelf
  - Documented sufficiently to make preparation of an evaluation feasible.
- If codes are available in several versions, the most recent should be used.
- The total number of codes reviewed must be consistent with schedule and manhours available.

Furthermore, the comparison process should address the following:

- Stage of development of the code
- Verification and benchmark status
- Validation status
- Availability of users' manual
- Acceptance by regulatory agencies (i.e., code usage by the DOE, NRC, and EPA)
- Acceptance by the scientific community (i.e., availability of peer-reviewed journal articles incorporating code description and verification and benchmark results)
- Operational readiness status of the code at the Hanford Site
- Cost of using the code
- Strengths of the code
- Limitations
- Input data required

- Availability of preprocessors and postprocessors for a code
- Ability (or inability) to model Hanford Site conditions; in particular, ability to model the dry, heterogeneous vadose zone soils at the Hanford Site
- Hardware requirements for a code
- Expertise required to use a code
- Marginal advantage of one code over another.

The comparisons are based on available publications and documentation of the codes, supplemented in some cases by the experience of members of the Environmental Technology Group. The comparisons are not comprehensive; rather, the goal was to indicate how the codes might be used in RI/FS analysis and point out the deficiencies in the codes. These comparisons, therefore, represent a first step in the screening process for using a code for a given site.

Table I-1 provides a comparison table for integrated transport codes. Table I-2 describes several groundwater pathway codes. Table I-3 describes transport codes for the air, biotic, and direct-contact pathways.

Table I-1. Integrated Models for All Pathways. (sheet 1 of 2)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
RAPS/ MEPAS (model to simulate contaminant transport from a waste disposal site and to evaluate human exposure)	Fully developed	Verified and benchmarked (Whelan et al. 1987)	Not validated	Yes (Whelan et al. 1986)	U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA)	Unknown	Available on site Pacific Northwest Laboratory (PNL)	Low	Minimum knowledge of risk assessment and a minimum amount of input data; considers groundwater, overland, surface water, and atmospheric pathways	Can be used to rank or prioritize sites; but cannot be used in a predictive mode to simulate actual risks at a particular site from the release of contaminants	Dispersion coefficients, hydraulic conductivities, degradation rates, modes of exposure, and dose response information	No	Unknown	Micro/mini-computer	Familiarity with users' manual	Can be applied to rank or prioritize sites; includes simplified models for risk assessments to important receptors
PATHRAE (simulates transport from groundwater, surface water, atmospheric, and occupational pathways)	Fully developed	Unknown	Not validated	Yes (Rogers and Hung 1987)	DOE/U.S. Nuclear Regulatory Commission (NRC)	Unknown	Available on site (PNL)	Low	Minimum user knowledge of risk assessment and a minimum amount of input data; considers complex processes migration, degradation, transformation, transfer between media (air, water, etc.) and biological uptake	Can be used to rank or prioritize sites, but cannot be used in a predictive mode to simulate actual risks at a particular site from the release of contaminants	Dispersion coefficients, hydraulic conductivities, degradation rates, modes of exposure, and dose response information	No	Unknown	Micro/mini-computer	Familiarity with users' manual	Can be applied to rank or prioritize sites; includes simplified models for risk assessments to important receptors

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Table I-1. Integrated Models for All Pathways. (sheet 2 of 2)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
GEMS (EPA library of codes to model each potential transport pathway)	Fully developed	Unknown	Unknown	Yes (GSC 1982)	EPA	Unknown	Not currently available on site	Medium to high	Unknown	Unknown	Dispersion coefficients, hydraulic, conductivities, degradation rates, modes of exposure, and dose response information	Yes	Unknown	Terminal and modem to access GEMS	Limited modeling experience and familiarity with users' manual	EPA model

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Table I-2. Available Groundwater Pathway Computer Codes for Remedial Investigation/Feasibility Study. (sheet 1 of 4)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
CHAINT (2D transport code for saturated and unsaturated media; includes radionuclide decay and adsorption for contaminants)	Fully developed	Partially verified and benchmarked	Not validated	Yes	DOE	Unknown	Available on PRIME 750	Medium	Low cost for vadose zone flow simulation, two-dimensional transport	One-dimensional, vertical, steady-state unit gradient model for vadose zone, does not allow for source/sink terms	Soil moisture characteristics for various layers	Yes	Applied to 200 Areas solid waste disposal sites	Mini/ mainframe computers	Familiarity with users' manual, theory description	Low cost of simulation, Westinghouse Hanford Company personnel familiarity with codes, less data requirements
MAGNUM (2D code for simulated groundwater flow in saturated aquifers)	Fully developed	Verified and benchmarked	Not validated	Yes	DOE	Unknown	Available on PRIME 750	Medium	Two-dimensional flow simulations	Does not allow for source/sink terms within aquifers	Hydraulic characteristics for various zones with aquifers	Yes	Extensively applied to Hanford Site basalt aquifers (flow tops and dense interiors)	Mini/ mainframe computers	Familiarity with users' manual, theory description	Low cost of simulation, Westinghouse Hanford Company personnel familiarity with code. MAGNUM was especially developed for modeling flow in basalt environment
FEMWATER/ FEMWASTE	Fully developed	Verified and benchmarked (Yeh et al. 1987)	Not validated	Yes	DOE		Not available on site	High	Two-dimensional flow and transport includes sources/ sinks	Long execution times, inability to model heterogeneous vadose zone soils	Moisture characteristic curves for various vadose zone layers	No	Unknown	Mini/ mainframe computers	High degree of familiarity with theory and users' manuals	Integrated saturated/ unsaturated zone modeling flow including sources/ sinks for unconfined aquifer

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Table I-2. Available Groundwater Pathway Computer Codes for Remedial Investigation/Feasibility Study. (sheet 2 of 4)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available ?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
VAM2D/ SATURN (2D flow and transport code for saturated/ unsaturated media; includes decay and adsorption)	Fully developed	Verified and benchmarked (Huyakorn et al. 1984)	Not validated	Yes	U.S. Department of Energy (DOE) U.S. Nuclear Regulatory Commission (NRC)	Huyakorn et al. 1984, 1985, 1987		Medium	Includes a simplified option for modeling vadose zone; includes option sources/ sinks for aquifers	Long execution times, for the full saturated/ unsaturated flow and transport modeling	Hydraulic characteristics for various vadose zone layers and unconfined aquifers	No	Capable of modeling heterogeneous layered media (such as those existing at Hanford Site)	Mini/ mainframe computers	High degree of familiarity with theory and users' manuals	Simplified option for vadose zone modeling; option for including sources/ sinks for unconfined aquifer; integrated modeling of saturated/ unsaturated media
TRACR3D (3D code for modeling flow and transport of multiphase organics in vadose zone)	Fully developed	Currently being verified and benchmarked at Pacific Northwest Laboratory (PNL) for the Hanford Site grout program	Not validated	Yes, (Travis 1984)	DOE, NRC	Unknown	Available at PNL	High	Multi-dimensional modeling of flow and transport of organics	Does not include flow and transport in unconfined aquifer; limited ability to model heterogeneous vadose zone properties	Relative permeability versus saturation relationships for various multiphase organics	No	Has difficulty in simulating flow through heterogeneous layered media (such as those existing at Hanford Site)	Mini/ mainframe computers	High degree of familiarity with theory and users' manuals	Ability to model multi-dimensional, multiphase flow and transport in vadose zone
PORFLO (3D code for simulating flow, heat transport and mass transport saturated porous media)	Fully developed	(Eyler and Budden 1984)	Not validated	Yes, (Kline et al. 1983)	DOE	Unknown	Available onsite	Medium	Three-dimensional simulations possible; allows for sources/ sinks in unconfined aquifers	Vadose zone simulation capabilities not available but are currently being incorporated	Hydraulic properties of various heterogeneities in the saturated aquifer	Yes	Extensively applied to model flow and transport through Hanford Site basalts	Mini/ mainframe computers	High degree of familiarity with theory and users' manuals	Ability to model three-dimensional flow and transport in saturated media, Westinghouse Hanford Company familiarity with code
MODFLO (3D code for simulating flow in saturated porous media)	Fully developed	(McDonald and Harbaugh 1984)	Not validated	Yes	U.S. Geological Survey	Unknown	Not available onsite	Medium	Modular structure of various submodels	Vadose zone simulation capabilities not available	Hydraulic properties of saturated confined and unconfined aquifers	No	Unknown	Mini/ mainframe computers	Familiarity with users' manual	Ability to model three-dimensional flow in saturated media

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Table I-2. Available Groundwater Pathway Computer Codes for Remedial Investigation/Feasibility Study. (sheet 3 of 4)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available ?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
VAM3D (3D flow and transport code for modeling flow and transport through saturated/ unsaturated media; includes decay and adsorption)	Fully developed	Verified and benchmarked (Huyakorn et al. 1985)	Not validated	Yes	DOE	Unknown	Not available on site	Verify high	Includes a simplified option for modeling vadose zone; includes option for incorporating source/ sink terms in aquifers	Very long execution times for modeling the full, 3D, saturated/ unsaturated media	Hydraulic properties for various vadose zone layers and unconfined aquifers	No	Capable of modeling heterogeneous layered media (such as those existing at Hanford Site)	Mainframe computer	Very high degree of familiarity with theory and users manuals	Ability to the fill, 3D flow and transport in an integrated saturated/ unsaturated media, with sources/ sinks in unconfined aquifers
UNSAT2	Fully developed	Verified and benchmarked	Not validated	Yes	DOE/NRC	(Neuman 1973)	Available at PNL	Medium	Two-dimensional vadose zone and unconfined aquifer simulations with sources/ sinks present in unconfined aquifer	Vadose zone flow simulation capabilities limited to simpler, smaller flow domains; does not include contaminant transport modeling option	Hydraulic properties for various vadose zone layers and unconfined aquifers	No	Has difficulty in simulating flow through heterogeneous, layered media (such as those existing at Hanford Site)	Mini/ mainframe computer	High degree of familiarity with theory and users manuals	Ability to model 2D in integrated saturated/ unsaturated media, with sources/ sinks in unconfined aquifers
UNSAT-H (1D model for simulating flow through vadose zone)	Fully developed	Verified and benchmarked	Not validated	Yes, (Fayer 1987)	DOE	Unknown	Available at PNL	Low	Developed specifically for Hanford Site conditions, includes a water balance subroutine	One-dimensional model, limited applicability to multi-dimensional, heterogeneous layered media	Soil properties, plant data for ET calculations	Unknown	Capable of simulating flow in heterogeneous layered media	Mini/ mainframe computer	Familiarity with users manual	Has been applied to Hanford Site conditions

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Table I-2. Available Groundwater Pathway Computer Codes for Remedial Investigation/Feasibility Study. (sheet 4 of 4)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
RITZ (simulates movement fate of hazardous chemicals during land treatment of oily wastes)	Fully developed	Unknown	Not validated	Yes, (Nofziger and Williams 1988)	U.S. Environmental Protection Agency (EPA)	Unknown	Available onsite	Low	Simple model with few data requirements; can be applied in case of organics	Assumptions are highly simplistic and may not be valid in nature; cannot be used to simulate actual risks at a site	Input data on soil, pollutant, oil, environmental, and operational parameters for land treatment sites	Yes	Unknown	Microcomputer	Familiarity with users' manual	Can be applied to obtain preliminary data on transport and fate of organics in the vadose zone
SESOIL (unsaturated zone transport model)	Fully developed	Unknown	Not validated	Yes, (Bonazountas and Wagner, 1981)	EPA	Unknown	Available through GEMS	Low - Medium	Models organic and inorganic species; accounts for adsorption, volatilization, degradation, and biodegradation	Only handles up to three soil layers	Hydrologic and meteorologic data, contaminant information	Yes	Unknown	Terminal and modem access to GEMS	Familiarity with users' manual	Versatile, easy to use, EPA acceptance
HELP (1-D unsaturated flow and transport model)	Fully developed	Unknown	Not validated		EPA	Unknown	Available onsite	Low	Simple model for rough calculations, models organic and inorganic species	Simple 1-D approach may not be adequate at some sites	Hydrologic and meteorologic data, contaminant information	No	Yes	IBM-PC or equivalent	Familiarity with users' manual	Easy to use, EPA acceptance

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Table I-3. Transport Codes for the Air, Biotic, and Direct Contact Pathways. (sheet 1 of 3)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
AIR PATHWAY																
TOXBOX (basic box model)	Fully developed	Unknown	Unknown	(GSC 1982)	U.S. Environmental Protection Agency (EPA)	Unknown	Not currently accessible at Hanford Site	Low-Medium	Can represent vertical dispersion; areal source; available through GEMS	Simplified box model	Unknown	Yes	No site-specific limitations	Terminal and modem to access GEMS	Limited modeling experience	Ease of use and EPA acceptance
INDUSTRIAL SOURCE COMPLEX (Gaussian dispersion model)	Fully developed	Unknown	Unknown	(GSC 1982)	EPA	Unknown	Not currently accessible at Hanford Site	Low-Medium	Long- and short term simulations; settling and dry deposition of particles; multiple point sources; limited terrain adjustments	Unknown	Meteorological and source data	Yes	No site-specific limitations	Terminal and modem to access GEMS; mini/ mainframe computer	Limited modeling experience	Rigorous approach and EPA acceptance
SEE ALSO PATHRAE AND RAPS/ MEPAS																

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Table I-3. Transport Codes for the Air, Biotic, and Direct Contact Pathways. (sheet 2 of 3)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
BIOTIC PATHWAY																
BIOPORT/ MAXI 1 (Radiation dose due to plants and animals	Fully developed	Planned for FY 1989	Planned for FY 1989	(McKenzie et al. 1985)	NRC	Unknown	Available at Hanford Site	Low	Radiation dose calculated for ingestion, inhalation, and direct exposure; intrusion and active physical transport are considered	Does not consider hazardous chemicals	Agricultural and water-usage practices; wildlife information	No	No site-specific limitations	Mini/ mainframe computer	Limited modeling experience	Developed at Hanford Site
SEE ALSO PATHRAE AND RAPS/ MEPAS																
DIRECT-CONTACT PATHWAY																
ONSITE/ MAXI 1 (Radiation dose due to direct intrusion)	Fully developed	Unknown	Unknown	(Kennedy et al. 1986, 1987)	NRC	Unknown	Available at Hanford Site	Low	Radiation dose calculated for direct exposure and ingestion (food and water)	Does not consider hazardous chemicals	Agricultural and water-usage practices; lifestyle characteristics of intruder/ resident	No	No site-specific limitations	Micro/mini/ mainframe computer	Limited modeling experience	Developed at Hanford Site
SEE ALSO PATHRAE AND RAPS/ MEPAS																

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Table I-3. Transport Codes for the Air, Biotic, and Direct Contact Pathways. (sheet 3 of 3)

Computer code name	Stage of development	Verification/ benchmarking status	Validation status	Users' manual available?	Acceptance by regulatory agencies	Acceptance by scientific community	Operational readiness	Cost of utilization	Strengths	Limitations	Input data required	Pre/post processors available?	Ability to model Hanford Site conditions	Hardware requirements	Expertise required	Marginal advantage of one model/ another
SURFACE WATER PATHWAY																
EXPOSURE ANALYSIS MODELING SYSTEM (3-D compartmental model for freshwater, nontidal systems)	Fully developed	Unknown	Unknown	(Burns et al. 1982) (GSD 1982)	EPA	Unknown	Not currently accessible at Hanford	Medium-High		Unknown	Unknown	Yes	No site-specific requirements	Mini/ mainframe computer	Understanding of transport process and modeling experience	Rigorous approach and EPA acceptance
WATER QUALITY ASSESSMENT METHODOLOGY (1-D Model for lakes, rivers, and streams)	Fully developed	Unknown	Unknown	(Mills et al. 1982)	EPA	Unknown	Not currently accessible at Hanford	Low	Easy to use with desk calculator	Very simple approach	Limited data requirements	No	No site-specific requirements	Calculator	Limited modeling experience	Ease of use and EPA acceptance
SEE ALSO RAPS/ MEPAS AND PATHRAE																

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ATTACHMENT 1

SAMPLING AND ANALYSIS PLAN

CONTENTS

PHASE I

SAMPLING AND ANALYSIS PLAN

1.0 Introduction At1-1
1.1 Background At1-1
1.2 Purpose and Objective At1-1
1.3 Content At1-1

Part I Phase I Field Sampling Plan (FSP)

Part II Phase I Quality Assurance Project Plan (QAPP)

LIST OF TABLES

Table 1-1. Environmental Investigation Instructions (EII) in Process to be Cleared for Public Release At1-3

1.0 INTRODUCTION

1.1 BACKGROUND

Pursuant to CERCLA, the 200 Area has been divided into operable units for the purpose of focusing and managing the needed environmental investigations, studies, and actions. The 200-BP-1 Operable Unit is located with the northwestern portion of the 200 East Area and has been designated for CERCLA action.

The 200-BP-1 Operable Unit includes nine inactive cribs which received waste from U-Plant uranium reclamation operations and waste storage tank condensate from the adjacent 241-BY Tank Farm, as well as three unplanned releases (UPRs) which were the result of tank farm operations. A tenth crib designated 216-B-61 was constructed but was reportedly never used or known to have received wastes. All but two of the cribs have been inactive since the mid-1950's. The remaining two were operated into the early 1970's. Eight of the sites within this operable unit individually received Hazard Ranking System (HRS) scores greater than 28.5. The Operable Unit encompasses a total area of 25 acres, although the majority of the sites are concentrated in a four acre region at the eastern end of the 200-BP-1.

1.2 PURPOSE AND OBJECTIVE

This Sampling and Analysis (S&A) Plan is an attachment to the 200-BP-1 Operable Unit Remedial Investigation/Feasibility Study (RI/FS) Work Plan and presents details for Phase I Remedial Investigation (RI) at the 200-BP-1 Operable Unit. The purpose of this S&A Plan is for guidance during field investigation and laboratory activities in which environmental sampling, measurement and analysis will be performed. Information on site background, site conditions, waste inventories, physical environment and previous or on-going environmental monitoring results are presented in the 200-BP-1 Operable Unit RI/FS Work Plan. This S&A Plan is intended to be used in conjunction with the RI/FS Work Plan and other project plans including the 200-BP-1 Operable Unit Health and Safety Plan, Radiation Work Permit(s), Excavation Permit, Welding and Cutting Permit, Cultural Resource Review, and WDOE WAC 173-160 start cards for all wells over 10 feet deep for 200-BP-1 RI activities (to be obtained), the Project Management Plan, Data Management Plan, and Community Relations Plan for Hanford.

1.3 CONTENT

The Sampling and Analysis Plan contains two parts:

Part 1 - Field Sampling Plan (FSP)
Part 2 - Quality Assurance Project Plan (QAPP)

The FSP describes the activities to be performed during Phase I Remedial Investigation, defines sample designation and identifies sample analysis to be performed. The QAPP establishes data quality objectives, defines analytical methods and procedures, documentation requirements, and provides established technical procedures to be used for field sampling and measurement. The QAPP

details all quality assurance/quality control procedures to be followed to ensure that usable and defensible data are collected during the Phase I Remedial Investigation. Table 1-1 provides a listing of the WHC Environmental Investigation Instructions that will be used during this investigation. The FSP and the QAPP each conform with U.S. EPA guidance (EPA, 1988) with respect to content and format.

Table 1-1. Environmental Investigation Instructions (EII) in Process to be Cleared for Public Release

Number	Procedure title/topic	Anticipated issue date
EII 1.2	Preparation and revision of environmental investigation instructions	Completed
EII 1.4	Deviation from environmental investigation instructions	Completed
EII 1.5	Field logbooks	02/28/89
EII 1.6	Records management	02/28/89
EII 1.7	Indoctrination, training, and qualification	02/28/89
EII 2.1	Preparation of health and safety plans	Completed
EII 2.2	Dosimetry	Completed
EII 3.1	User calibration of measurement and test equipment (health and safety)	02/28/89
EII 4.1	Nonradioactive hazardous waste disposal	3/31/89
EII 5.1	Chain of custody	Completed
EII 5.2	Soil and sediment sampling	Completed
EII 5.3	Biotic sampling	03/31/89
EII 5.4	Field decontamination of drilling equipment	Completed
EII 5.5	Decontamination of equipment for RCRA/CERCLA sampling	Completed
EII 5.6	Gross gamma geophysical logging	02/28/89
EII 5.7	Hanford geotechnical library control (sample archiving)	03/28/89
EII 6.2	Groundwater monitoring well technical inspection	02/15/89
EII 6.3	Preparation of groundwater monitor well construction specifications	03/31/89
EII 9.1	Geologic logging	Completed
EII 10.1	Aquifer testing	02/28/89
EII 10.2	Groundwater-level monitoring	03/31/89
EII 10.3	Disposal of well construction development waters (purgewater disposal)	02/28/89

ATTACHMENT 1a

FIELD SAMPLING PLAN

PART 1
PHASE I FIELD SAMPLING PLAN
FOR PHASE I REMEDIAL INVESTIGATION
OF THE 200-BP-1 OPERABLE UNIT

REVISION -0-

Westinghouse Hanford Company
Environmental Engineering and Technology Function
Richland, Washington

Approved by:

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1.0 INTRODUCTION

This Field Sampling Plan (FSP) is intended as a guide during field investigations where environmental samples or field measurements will be obtained. Information on site background, site conditions, waste inventories, physical environment and previous or on-going environmental monitoring results was presented in the 200-BP-1 Operable Unit Remedial Investigation/Feasibility Study (RI/FS) work plan. The Sampling and Analysis Plan, in which this FSP is Part 1, is intended to be used in conjunction with the RI/FS work plan and other associated project plans.

The FSP describes the tasks and activities identified in Phase I Remedial Investigation (RI) of the RI/FS work plan in which environmental samples and measurements will be obtained. The rationale and justification for the Phase I RI tasks are provided in the 200-BP-1 RI/FS work plan. Because there is uncertainty in the scope of work, the FSP does not include tasks or activities that may need to be performed during Phase II Remedial Investigation of 200-BP-1. A FSP will need to be established once Phase II RI tasks and activities are identified and prior to implementation of Phase II RI.

Section 2 describes the purpose, sampling location, and frequency for each task. Wherever references are made to applicable sampling, chain of custody, analytical, and other supporting procedures, they are as defined by the unit-specified QAPP.

Section 3 describes decontamination procedures and requirements during remedial investigation activities for both health and safety and sample quality.

2.0 PHASE I REMEDIAL INVESTIGATION TASKS

This section organizes and describes tasks to be performed during Phase I RI of the 200-BP-1 Operable Unit. The purpose of conducting Phase I is to gather data primarily for characterizing site conditions, conducting the baseline risk assessment and evaluating remedial alternatives.

The tasks identified and described for Phase I RI are as follows:

- Task 1 - Project Management
- Task 2 - Source Sampling and Analysis
- Task 3 - Surface and Near Surface Soil Sampling and Analysis
- Task 4 - Vadose Zone Soil Sampling and Analysis
- Task 5 - Seismic Refraction Survey
- Task 6 - Installation of Monitoring Wells
- Task 7 - Groundwater Sampling and Analysis
- Task 8 - Site Topographic Map
- Task 9 - Biota Survey
- Task 10 - Column Leach Tests
- Task 11 - Hydraulic Pump Tests
- Task 12 - Sorption Tests
- Task 13 - Baseline Risk Assessment
- Task 14 - Data Evaluation and Phase I Remedial Investigation Report

Parameters of interest have been identified in the work plan and are presented in Table 2-1. These parameters have been identified because site characterizations, baseline risk assessment, and evaluation of remedial alternatives will depend on their presence, toxicity, mobility and persistence. Throughout the FSP, references will be made to analyses for these parameters of interest.

Prior to beginning activities a dose rate calculation needs to be prepared for the 200-BP-1 Operable Unit to address ALARA (as low as reasonably achievable) considerations. This will provide the Field Team Leader an indication of the amount of contamination control needed to prevent an environmental release. This must be done for hazardous constituents as well as radionuclides.

The FSP outlines procedures for conducting tasks that are necessary for the Remedial Investigation of 200-BP-1 Operable Unit as presented in the 200-BP-1 Work Plan. If modifications or changes to the method, extent or equipment proposed are appropriate and approved (i.e., type of drilling method, number and location of seismic refraction survey lines, number and location of new monitoring wells, etc.) for the implementation of the work plan, the FSP will be revised accordingly before implementation of the modified or changed task.

2.1 TASK 1 - PROJECT MANAGEMENT

Task 1 includes management activities necessary for conducting the RI/FS at the Hanford Site. Environmental samples or measurement data will not be obtained in this task. Project management activities will be performed in accordance with the Project Management Plan (Attachment 3).

2.2 TASK 2 - SOURCE SAMPLING AND ANALYSIS

2.2.1 Purpose

The purpose for sampling source materials is to verify the identification and remaining concentration of waste constituents within the cribs. Analyses will be undertaken for all CERCLA-Target Compound List (TCL) and major radionuclides (including total alpha and beta) to determine whether other constituents need to be included or considered as parameters of interest for the 200-BP-1 Operable Unit investigation. Analysis of source materials for the CERCLA-TCL chemicals and radionuclides together with the existing analytical results for groundwater from wells in and around 200-BP-1 should eliminate uncertainty with estimates of past disposal effluent constituents. In addition, the analytical results will be useful for evaluating the variability among source materials in cribs that received waste effluent from similar processes. Prior to beginning this activity on-site laboratory capabilities will have to be expanded to enable analyses for the TCL substances on samples with radioactivity in excess of 5 mrem/hour. Actions have been initiated to provide these capabilities by January 1990.

Table 2-1. Parameters of Interest for the RI/FS of the 200-BP-1 Operable Unit

Radionuclides
Total gross alpha
Total gross beta
Tritium
Strontium-90
Cesium-137
Technetium-99
Cobalt-60
Ruthenium-106
Total uranium
Plutonium-238
Plutonium-238/239
Metals
Selenium
Anions
Nitrate
Total cyanide
Free cyanide
Ferrocyanide
Sulfate

2.2.2 Activities

The activities comprising this task include:

(1) preparation
(2) drilling and soil sampling
(3) sample and waste handling, inspection, storage and transfer or disposal
(4) chemical analysis
(5) geophysical borehole logging
(6) geodetic survey
(7) borehole abandonment.

2.2.3 Preparation

Preparation includes all activities that must be conducting prior to beginning the field work. These activities for Task 2 include the following:

- coordination between team members (see Project Management Plan, Figure 2-6)
- coordination with support services (i.e., drillers, laboratory, radiation control facility, borehole geophysics contractors, surveyors, etc.)
- obtain Radiation Work Permit
- obtain and test field monitoring and sampling equipment.

2.2.4 Sampling Locations and Frequencies

Three borings will be drilled through each crib to about 3 meters (10 feet) below the gravel infiltration layer, to obtain soil samples for analyses. The three borings within cribs 216-B-43 through 50 will be in a triangular array as shown in Figure 2-1 so as not to disrupt the existing piping and structure. The three borings within crib 216-B-57 will be in a linear array, as shown in Figure 2-2, because of the difference in construction of this crib. One boring will be drilled in crib 216-B-61 at the head end to verify it was never used. Three additional 5-meter deep borings will be drilled at a designated zone in the 600 Area at least 100 meters north of crib 216-B-61 (not in a possible surface drainage channel) for determining area background concentrations.

Initial borings through cribs 216-B-43 through 50 will be to about 8 meters (25 feet), 3 meters (10 feet) below the bottom of the gravel infiltration bed. Depth of borings for the 216-B-57 and 61 cribs are anticipated to be at least 6 meters (20 feet) to penetrate 3 meters (10 feet) below infiltration gravels. Samples will be continuously cored from each boring. Borings will subsequently be extended to the water table in three of the cribs as described in Task 4. Rationale for sampling locations and frequency is provided in Section 5.1.2 of the work plan.

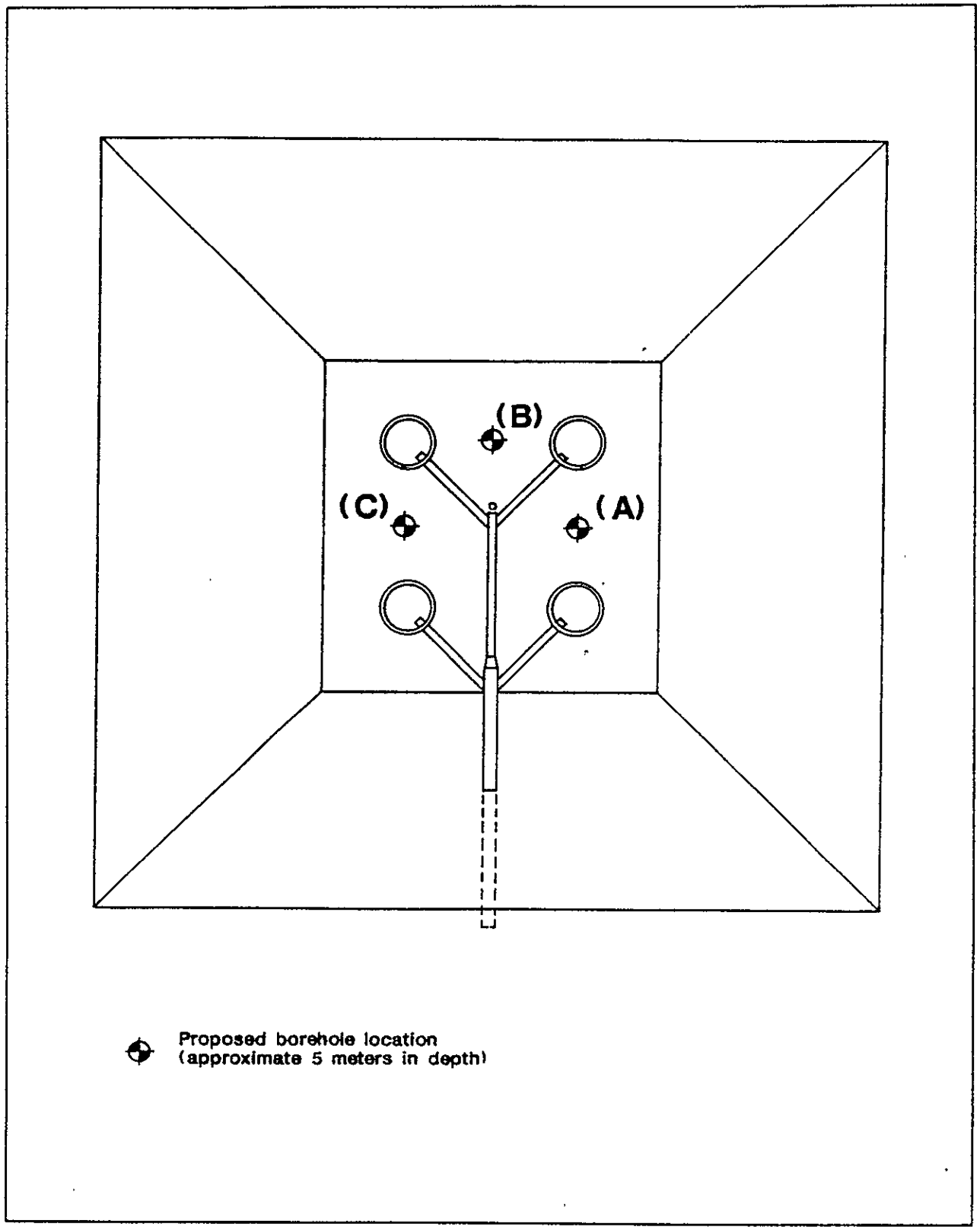

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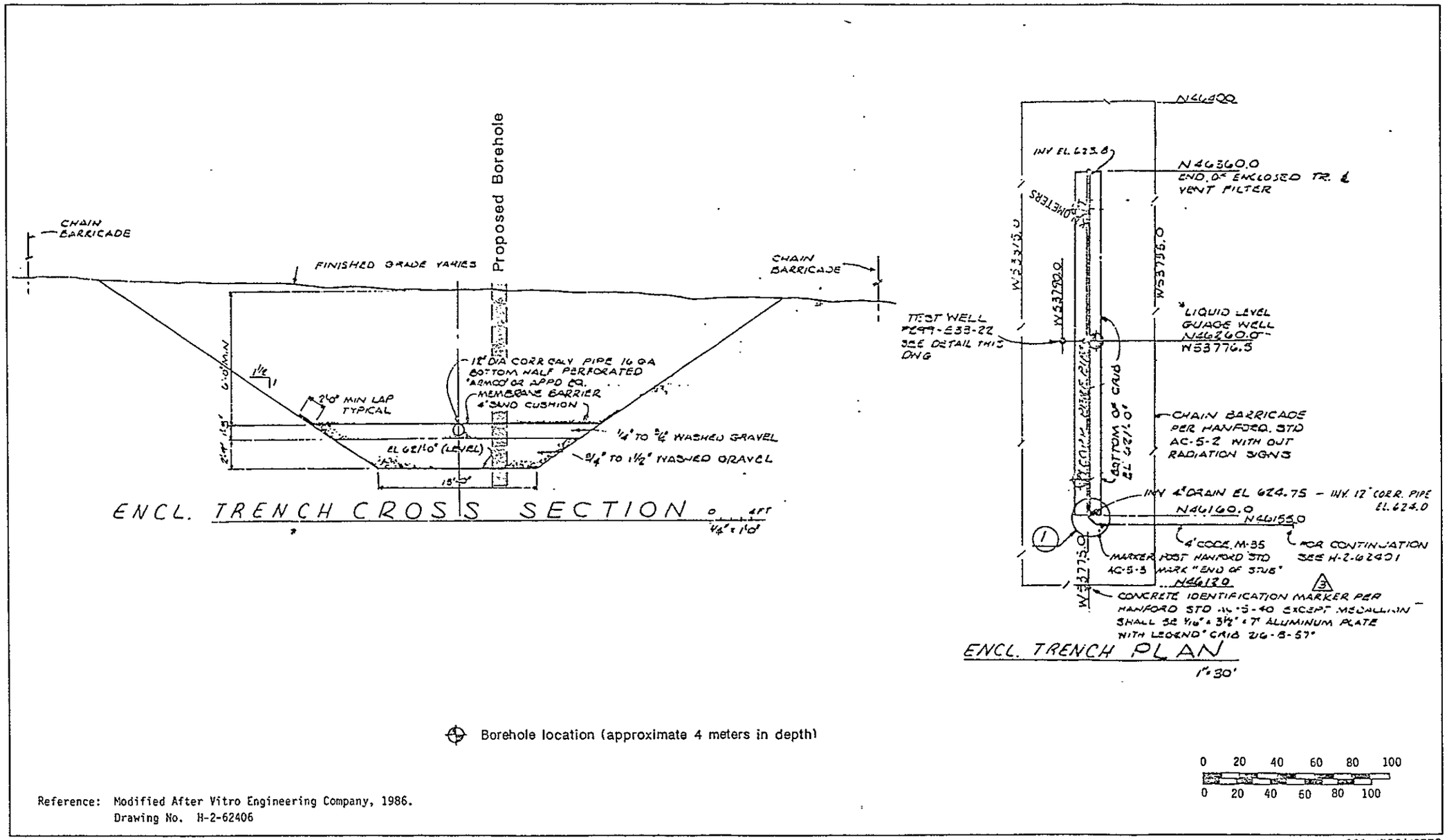
Figure 2-1. Task 2 Borehole Locations for Source Sampling in Cribs 216-B-43 Through 50



Reference: Modified After Vitro Engineering Company, 1986.
Drawing No. H-2-62406

883-1726/12772

Figure 2-2. Task 2 Borehole Locations for Source Sampling in Crib 216-B-57

2.2.5 Sampling Equipment and Procedures

Details on the sampling equipment and procedures are provided in Westinghouse Hanford soil and sediment sampling procedures. Drilling will be with dual-wall cable tool techniques primarily for contamination control. The nominal diameter of the outer wall shall be either 25 or 30 centimeters (10 or 12 inches). Samples will be obtained from the inner core barrel of the dual-wall. The dual wall cores will be transferred to an appropriate controlled facility where the soil sample will be extracted, scanned by scintillation detector, geologically logged and described according to material type, color, etc in accordance with procedure for geologic logging.

The borings will be capped and sealed with the outer wall remaining in place, in accordance with procedures on preparation of groundwater monitoring well construction specifications for future use in subsequent tasks as necessary. Each boring will be geodetically surveyed for elevation and N-S/E-W coordinates as described in Task 8. Eventually, the borings will be properly abandoned in accordance with WAC 173-160 by removing the outer wall and grouting the entire borehole annulus to land surface.

Each borehole will be geophysically logged prior to pulling the casing using downhole probes for gamma-gamma, neutron-epithermal-neutron and gamma. Procedures will be provided by participant contractors or subcontractors as described in the QAPP (Part 2).

Upon completion of all activities in Task 4, each borehole will be properly abandoned. All steel casing will be removed and the entire annulus grouted to land surface as required by WAC 173-160. Steel removed from the borehole will be transferred to an appropriate controlled decontamination facility.

2.2.6 Borehole and Sample Designation

Boreholes will be given designations that relate to the crib through which they are drilled. For example, the three boreholes through the 216-B-43 crib will be given designations of:

- 216-B-43-A
- 216-B-43-B
- 216-B-43-C

Dual-wall cores will be subdivided into 0.3 meter (1-foot) samples. Individual samples from each borehole will be labelled according to the materials used in engineering the system. The material designations will represent:

- Cover soils (CS - depth in feet)
- Interface of the cover soils and infiltration gravel bed (SG - depth in feet)
- Interface of infiltration gravel bed and underlying native soils to 0.76 meter (2.5) feet (GS - depth in feet)

- Soils from about 2 to 3 meters (7.5 to 10 feet) below the gravel bed (SS - depth in feet)

The designation of samples for the 216-B-43-A borehole will be the following:

- 216-B-43-A (CS - depth in feet)
- 216-B-43-A (SG - depth in feet)
- 216-B-43-A (GS - depth in feet)
- 216-B-43-A (SS - depth in feet)

The background boreholes will be designated:

- 699-B-BB-A (depth in feet)
- 699-B-BB-B (depth in feet)
- 699-B-BB-C (depth in feet)

Selected soils samples will be composited within controlled Westinghouse facilities. Compositing will be for soil samples from the same crib and same soil horizon but from different boreholes (designated A, B or C). Composited soil samples will be designated by the crib in which they originated, the borehole (ABC) from which they were obtained and the soil horizon they represent. An example of a composited sample designation for the 216-B-43 crib representing the first 0.3-meter (1-foot) depth in interval is:

- 216-B-43-ABC (CS-1)

2.2.7 Sample Handling and Analysis

Laboratory soil samples (with the exception of background samples) will be extracted within an appropriate controlled facility, scanned with scintillation detectors, geologically logged and described according to matrix type. Soil samples for each borehole and the three 600 Area background borings will be made to represent the surface soils (uppermost 0.3 meter [1-foot]), soil cover above the gravel infiltration bed (1.5 to 2 meter [5 to 6.5 feet] depth interval), the interface of the bottom of the gravel bed and soils 0.75 meter (2.5 feet) below the gravel bed, and soils from about 2 to 3 meters (7.5 to 10 feet) below the gravel bed as illustrated in Figure 2-3. The samples are expected to have radioactivity in excess of 5 mrem/hour and will be sent to a qualified Westinghouse Hanford laboratory for analysis. A portion of each sample will be individually analyzed for volatile organics (EPA Method 8240) (1986), cyanide, sulfate, sodium and total beta and alpha activity. The reminder of the samples for analysis will be composited within the laboratory together for each crib and for each material layer as described above (total of four composites for each crib). Composited samples representing the interface of the gravel bed and underlying soils from each crib will be analyzed for CERCLA-TCL constituents (except volatile organics which were analyzed on individual samples) and parameters of interest except cyanide (see Table 2-2). The other composited samples for each crib will be analyzed for parameters of interest and other constituents discovered during the full CERCLA-TCL analyses. Level IV Routine Analytical Services (RAS) will be conducted on all sample analysis. Level V Special Analytical Services (SAS) may be required for analysis of cyanide. If soils from the

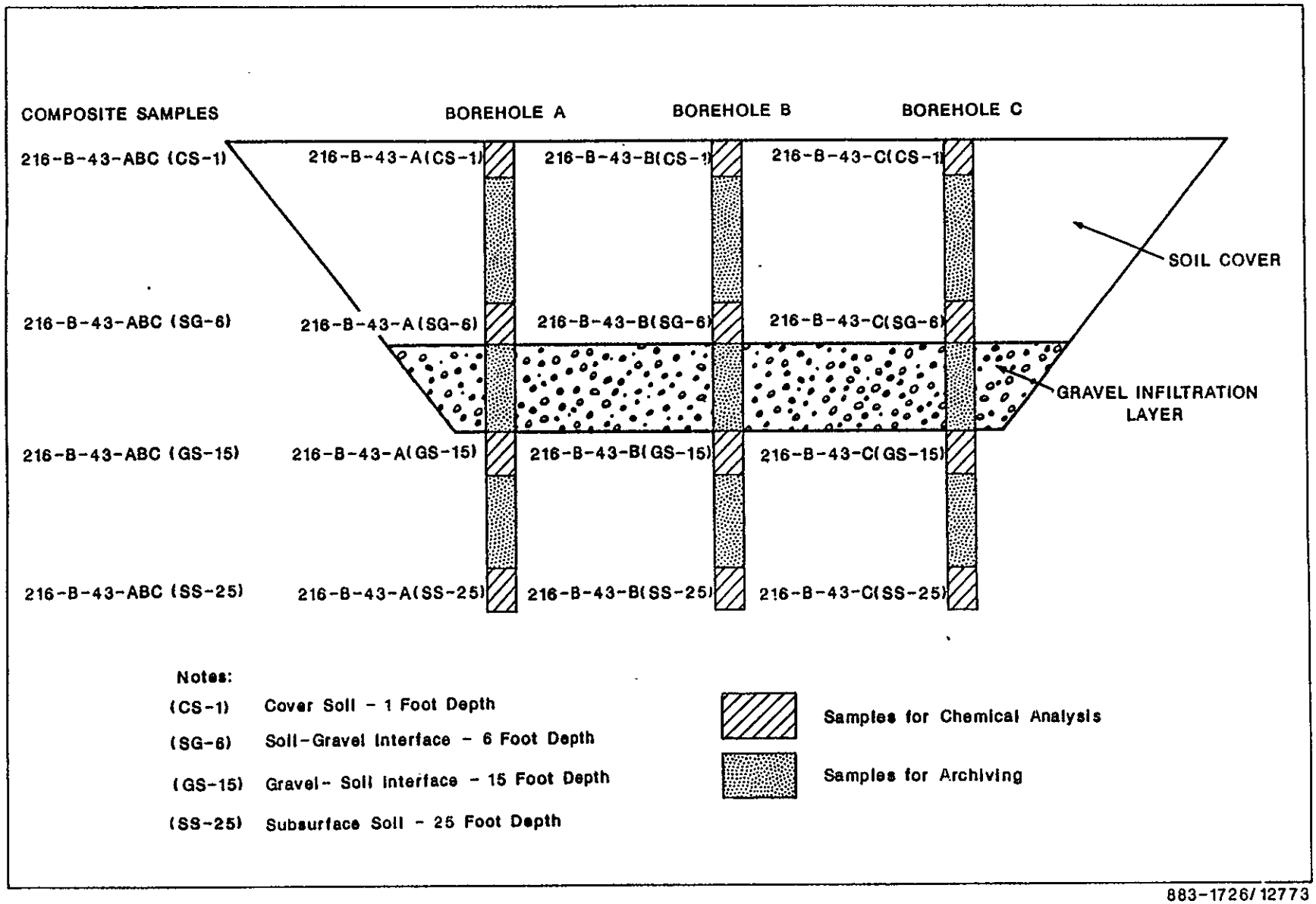


Figure 2-3. Schematic Diagram for Task 2 - Source Sampling and Analysis

216-B-61 crib do not indicate the presence of contamination, the resulting analyses will be evaluated as possible background concentration of soils and crib construction materials. Table 2-2 summarizes the analysis to be conducted on the samples.

Information on the type and size of sample containers, container preparation, sample handling and preservation, and maximum holding time for analysis is provided in procedures on soil and sediments sampling.

Quality control samples will include, as a minimum, two duplicates of a "GS" composited sample and one duplicate of "CS" and "SS" composited samples. The samples are identified in Table 2-2. In addition, two field blanks and one travel blank of pure silica sand will be established for analysis as presented in Table 2-2.

The remaining soil materials from the dual well cores that were not sent to the laboratory for chemical analysis will be segregated by borehole and material type (i.e., cover soils interface between gravel bed and underlying or overlying soils, gravel bed, and underlying soils). The segregated materials will be placed in appropriate containers, labeled and archived in an appropriate controlled facility in accordance with Hanford geotechnical library control procedure(s). The archived samples may be used in subsequent Tasks 9 and 11, and Phase II RI (Treatability Tasks).

2.3 TASK 3 - SURFACE AND NEAR-SURFACE SOIL SAMPLING AND ANALYSIS

2.3.1 Purpose

The purpose of this task is to investigate contamination of soils at or near the surface. Three unplanned releases (UN-200-E-9, 63 and 110) are associated with 200-BP-1, but the location, extent and concentration of contaminants are uncertain. In addition, the possibility exists that underground distribution lines could have leaked. This task will attempt to locate and delineate contamination existing in the near surface soils for site characterization and risk assessment.

2.3.2 Activities

This task involves the following activities:

(1) Preparation.

(2) Radiation survey of land surface (Level I analyses).

(3) Evaluation, testing and implementation of leak detection technologies for underground effluent distribution lines.

(4) Subsurface soil survey using soil probes and scintillation detectors (Level I analyses). This task is anticipated to be conducted in stages.

Table 2-2. Samples and Laboratory Analysis for Task 2 (Sheet 1 of 3)

Composite Sample Designation	Additional Major Radionuclides (Level III	TCL Constituents[a] Semivolatile Organics (Level IV - RAS)	TCL Constituents[a] Metals	Parameters of Interest[a] (Table 2-1) (Level III and V)
216-B-43-ABC (CS-1)		Extraction only		●
216-B-43-ABC (CS-6)		Extraction only		●
216-B-43-ABC (GS-15)	●	●	●	●
216-B-43-ABC (SS-25)	●	●	●	●
216-B-44-ABC (CS-1)		Extraction only		●
216-B-44-ABC (CS-6)		Extraction only		●
216-B-44-ABC (GS-15)	●	●	●	●
216-B-44-ABC (SS-25)	●	●	●	●
216-B-44-ABC (SS-25) Duplicate	●	●	●	●
216-B-45-ABC (CS-1)		Extraction only		●
216-B-45-ABC (CS-6)		Extraction only		●
216-B-45-ABC (GS-15)	●	●	●	●
216-B-45-ABC (SS-25)	●	●	●	●
216-B-46-ABC (CS-1)		Extraction only		●
216-B-46-ABC (CS-6)		Extraction only		●
216-B-46-ABC (GS-15) Duplicate	●	●	●	●
216-B-46-ABC (GS-15)	●	●	●	●
216-B-46-ABC (SS-25)	●	●	●	●
216-B-47-ABC (CS-1		Extraction only		●
216-B-47-ABC (CS-6)		Extraction only		●
216-B-47-ABC (GS-15)	●	●	●	●
216-B-47-ABC (GS-25)	●	●	●	●
216-B-48-ABC (CS-1)		Extraction only		●

Table 2-2. Samples and Laboratory Analysis for Task 2 (Sheet 2 of 3)

Composite Sample Designation	Additional Major Radionuclides (Level III	TCL Constituents[a] Semivolatile Organics (Level IV - RAS)	TCL Constituents[a] Metals	Parameters of Interest[a] (Table 2-1) (Level III and V)
216-B-48-ABC (CS-6)		Extraction only		•
216-B-48-ABC (GS-15)	•	•	•	•
216-B-48-ABC (SS-25)	•	•	•	•
216-B-49-ABC (CS-1)		Extraction only		•
216-B-49-ABC (CS-6)		Extraction only		•
216-B-49-ABC (GS-15)	•	•	•	•
216-B-49-ABC (GS-15) Duplicate	•		•	•
216-B-49-ABC (SS-25)	•	•	•	•
216-B-50-ABC (CS-1)		Extraction only		•
216-B-50-ABC (CS-6)		Extraction only		•
216-B-50-ABC (GS-15)	•	•	•	•
216-B-50-ABC (SS-25)	•	•	•	•
216-B-57-ABC (CS-1)		Extraction only		•
216-B-57-ABC (CS-6)		Extraction only		•
216-B-57-ABC (CS-6) Duplicate		Extraction only		•
216-B-57-ABC (GS-10)	•	•	•	•
216-B-57-ABC (SS-20)	•	•	•	•
216-B-61 A (GS-1)		Extraction Only		•
216-B-61 A (GS-6)		Extraction Only		•
216-B-61 A (GS-10)	•	•	•	•
216-B-61 A (SS-20)	•	•	•	•

Table 2-2. Samples and Laboratory Analysis for Task 2 (Sheet 3 of 3)

Composite Sample Designation	Additional Major Radionuclides (Level III	TCL Constituents[a] Semivolatile Organics (Level IV - RAS)	TCL Constituents[a] Metals	Parameters of Interest[a] (Table 2-1) (Level III and V)
699-B-BB-ABC (SS-1)		Extraction only		•
699-B-BB-ABC (SS-1)		Extraction only		•
699-B-BB-ABC (SS-15)	•		•	••
699-B-BB-ABC (SS-25	•		•	••
Field Blank	•		•	••
Field Blank	•		•	••
Travel Blank	•		•	••

(a) TCL volatile organics, cyanide, sulfate, sodium, and total beta and alpha activity will be analyzed on aliquots of the individual samples (before compositing) that were used to make the composites in this table.

(5) Sampling and analysis of surface and near surface soils that have elevated radioactivity.

(6) Geodetic control and survey.

2.3.3 Preparation

Preparation activities necessary prior to beginning field work for Task 3 include:

- Coordination with team members (see Project Management Plan Figure 2-3 and 2-5).
- Coordination with support services (i.e., laboratory surveyors, etc.)
- Develop test control procedures for evaluation, testing and implementation of leak detection methods for underground distribution lines.
- Develop procedures for installation and monitoring of soil probes.
- Obtain radiation work permit.
- Obtain and test field monitoring and sampling equipment.

2.3.4 Sampling Locations and Frequencies

The ground surface (not including the cribs) will be surveyed by passing tractor-mounted radiation detection equipment over the site for beta/gamma and alpha (Level I analysis). This will provide virtually 100 percent coverage of the surveyed area. Background radiation will be established by surveying 10 random land surfaces north of the 200-BP-1 boundary in the designated background zone in the 600 Area used for background evaluations in Task 2. Areas within 200-BP-1 with either alpha or beta/gamma radiation statistically greater (99 percent confidence of the mean) than area background will be identified for more detailed inspection.

Subsurface soils below locations identified by the land surface scintillation survey as having elevated levels of radionuclides, locations suspected to have unplanned releases, and locations containing underground distribution lines, will be surveyed using soil probes. The subsurface soil survey will be conducted in stages. Within the remaining areas (excluding cribs), subsurface soils will be investigated through random sampling on a grid pattern using the soil probes. Figure 2-4 shows the location and the minimum number of subsurface soil probes for Stage I. The actual number of soil samples will depend on the results of the surface and subsurface surveys. Soil samples will be obtained and screened (Level I) using scintillation detectors for alpha and beta/gamma. At most two soil samples containing the highest radiation levels from each anomaly will be sent to a qualified laboratory for analysis of parameters of interest (including additional compounds discovered during Task 2). One for the highest alpha reading and/or one for the highest beta/gamma reading.

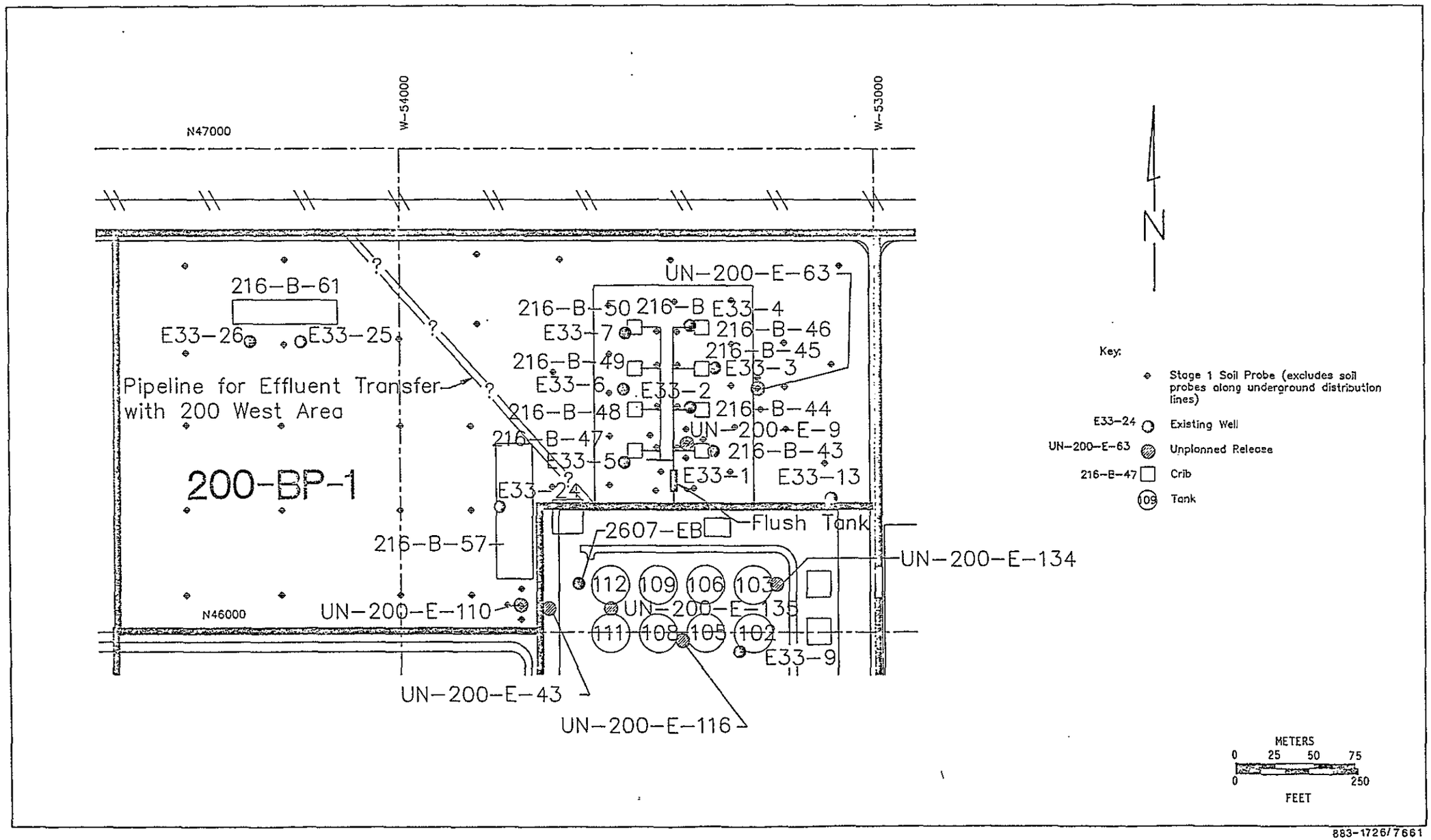


Figure 2-4. Task 3 Proposed Soil Probe Locations in the 200-BP-1 Operable Unit

2.3.5 Sampling Equipment and Procedures

Radiation Land Survey

Land surface surveys will be conducted using tractor mounted radiation detection equipment in accordance with standard operating proceeding for alpha and beta/gamma. The land surface survey will be conducted over the entire area of 200-BP-1.

Underground Distribution System Leak Detection

An evaluation of leak detection techniques for underground waste effluent distribution lines will be conducted. Locating leaking areas directly is the most efficient manner of characterizing uncontrolled discharges to subsurface soils. Initially, the piping system construction and installation systems drawings (as builts) will be reviewed. Particular attention will be given to the possibility of isolating (from air tight valves) and pressurizing the system or sections of the system for determining the possibility of leaks.

Four distribution systems exist in 200-BP-1 and are:

(1) Effluent transfer lines to cribs 216-B-43 through 216-B-50.
(2) Effluent transfer line to crib 216-B-57.
(3) Effluent transfer line connecting 200 East with 200 West Areas.
(4) Effluent transfer line to crib 216-B-61 (location is uncertain).

If the evaluation indicates a distribution system or sections of a system can be isolated and pressurized with existing values or with retrofited values, a technical procedure will be developed and made part of this SAP. The distribution system will be pressure tested with air for determining the possibility of leaks. Systems or sections of a system that indicate the potential for leaks (pressure reduction with time) will be pressure tested using an appropriate tracer gas. An evaluation of appropriate tracer gases needs to be made prior to implementing the tracer gas test. Tracer gases should be relatively inexpensive, inert (stable) to suspected residual effluents in the lines and soil environment, nontoxic, easily detectable.

Once a suitable tracer gas has been selected, a technical procedure will be developed for implementing the tracer gas test. Soil gas probes (extending 2 to 2.5 meters (6 to 8 feet) will be installed along the pressurized system lines every 3 meters (10 feet). The system or isolated section of the system will be pressurized with sufficiently high concentrations of the tracer gas. Soil gas samples will be collected and analyzed (preferably onsite) for the presence of the tracer gas. Sampling points where tracer gas in encountered will be noted as being locations where effluent leakage could have occurred. These locations will be targeted for further soil characterization.

Soil Survey

Soil probes will be driven into soils to depths of approximately 2 to 2.5 meters (6 to 8 feet). A beta/gamma scintillation detector will be lowered through the probe to measure radiation levels with depth. The Stage 2 subsurface soil survey will more accurately delineate radioactive anomalies identified in the Stage 1 survey. Area-specific background radiation will be

determined from subsurface soil probes located in an area designated for background measurements, north of the 216-B-61 crib.

Techniques for driving soil probes 2 to 2.5 meters (6 to 8 foot depths) will need to be tested. A rotating drive hammer or vibracore used in conjunction with a casing hammer has a good possibility of being able to drive steel tube to depths of 2. to 2.5 meters (6 to 8 feet) in soils expected in 200-BP-1. Procedures will be provided by participant contractors or subcontractors as described in the QAPP. If driving techniques fail to penetrate to desired depth, soils could be directly sampled using hollow stem augering methods and field screened with scintillation detectors.

Soil Sampling

Surface soils 0.6 meters (2 feet) will be sampled using stainless steel trowels/shovels while subsurface soils will be sampled either directly with a vibracore, with hollow-stem augers using a split tube samplers, or with backhoes using trowels. Details on the soil sampling and handling procedures are provided in procedures on soil and sediment sampling.

Geodetic Control

Each pit, borehole and soil probe will be staked and flagged for subsequent geodetic surveying for N-S/E-W coordinates. The geodetic survey will be conducted to "third order" precision and accuracy.

2.3.6 Measurement and Sample Designation

Soil probes, auger borings and test pits will be given designations 2BP1-SP-1 through X, 2BP1-AB-1 through X and 2BP1-TP-1 through X (where X = total number). Soil samples obtained within 200-BP-1 for chemical analysis will be designated 2BP1-SS-1 through X (where X = total number of samples taken) with the depth in which the sample was obtained included [i.e., 2BP1-SS-1 (4 foot)]. Background area surface recordings, soil probes, auger borings or test pits will be designed 699-SS-1 through X, with depths identified for each sample.

2.3.7 Sample Handling and Analysis

Soil samples will be initially screened for radiation in the field before extraction. If significant radiation is present (as determined by the RPT) the samples will be immediately sent to an appropriate controlled facility for extraction and classification. If low radiation is present (as determined by the RPT) the samples can be extracted in the field, scanned for alpha and beta/gamma and placed in labeled containers.

Soil samples with the highest level of alpha and beta/gamma for each identified anomaly will be analyzed for the parameters of interest using Level III and V (for cyanide speciation) analytical methods and procedures. An on-site laboratory will analyze samples exceeding 5 mrem/hour, whereas samples less than 5 mrem/hour may be sent to a qualified off-site laboratory for analysis.

Information on the type and size of sample containers (for analysis), container preparation, sample handling and preservation, and maximum holding time for analysis is provided in soil and sediment sampling procedures.

Field quality control samples will include:

- procedural blanks (final rinse for decontamination of distilled/ deionized water from samples)
- travel blanks (pure silica sand)
- method blanks (pure silica sand)
- duplicates.

The field quality control samples will be established randomly through the soil sampling activities. Travel method blanks and procedural blanks will each total a minimum of 5 percent of the total number of soil samples, whereas duplicates will total a minimum of 10 percent of the soil samples. Additional field quality control samples will be established as warranted based on sampling events and circumstances.

2.4 TASK 4 - VADOSE ZONE SOIL SAMPLING AND ANALYSIS

2.4.1 Purpose

The purposes of sampling vadose zone soils below the cribs are as follows:

(1) To obtain detailed geologic stratigraphic information to assess the possibility of infiltrating effluent water becoming perched and migrating laterally.

(2) To obtain concentration profiles of parameters of interest to evaluate the vertical migration of each constituent and assess the future impact to the groundwater.

(3) To obtain representative vadose zone soils for laboratory testing studies such as: (1) leach tests using simulated rainwater for assessing future impacts to the groundwater; (2) physical property tests for evaluation of remedial alternatives; (3) potential bench scale treatment tests (flushing with lixiviants, chemical stabilization, etc.) as may become necessary for evaluation of remedial alternatives.

2.4.2 Activities

The activities anticipated for this task include:

(1) preparation
(2) drilling and soil sampling

(3) sample and waste handling, inspection, storage, and transfer or disposal
(4) borehole geophysics
(5) geodetic Survey
(6) chemical analysis
(7) borehole abandonment.

2.4.3 Preparation

Preparation activities necessary prior to beginning field work for Task 4 include:

- Coordination with team members (see Project Management Plan - Figure 2-6).
- Coordination with support services (i.e., driller, laboratory, radiation control facility, surveyors, borehole geophysics support, etc).
- Evaluation of drilling techniques.
- Obtain Radiation Work Permit.
- Obtain and test field monitoring and sampling equipment.

2.4.4 Sampling Locations and Frequency

Existing boreholes constructed during Task 2, which were drilled through cribs 216-B-43, 216-B-49 and 216-B-57 will be deepened to the water table ~ 70 meters (230 feet). Drilling will be conducted in accordance with the requirements of WAC 173-160 "Minimum Standards for Construction and Maintenance of Wells." It is anticipated that boring through vadose zone soils below these cribs will be adequate to represent soils below the other cribs that received waste effluents. Crib 216-B-57 received ITS condensate and is assumed representative of crib 216-B-50, while all other cribs received TBP process supernatant effluents. Comparison of vadose zone concentration profiles in the vadose zone below cribs 216-B-43 and 49 should provide information on the validity of this assumption. Soil samples will be collected continuously with depth during the first boring than at every 0.75 meter (2.5 foot) depth interval in each subsequent boring unless a stratigraphic change is noted by the driller or geologist, at which time additional samples will be collected. Background samples will not be collected during this task because they will be obtained from boreholes in the 600 Area during Task 6, Installation of Monitoring Wells.

2.4.5 Sampling Equipment and Procedures

Prior to conducting this activity, drilling procedures will be evaluated to determine the best method for obtaining samples while maintaining acceptable levels of contamination control. Cable-tool drilling techniques are currently proposed for each boring. Each boring will be drilled through an existing surface casing (nominal 25 to 30 centimeters [10-12 inches]

diameter) left in place from Task 2. The dual wall cable tool system will be employed until radiation levels are low enough to use conventional cable tool system, whereupon a nominal 20 centimeters (8 inch) casing will be drilled through the larger diameter casing. If drilling through cribs cannot be continued in a safe manner, drilling, and vadose zone soil sampling will be conducted immediately adjacent to the cribs, or other drilling techniques evaluated. Drill cuttings will be captured in appropriate containers and properly disposed in accordance with approved Westinghouse procedures.

Samples will either be obtained in the inner wall of the dual wall system as a continuous core or sampled with a 0.6-meter (2-foot) long, split-barrel drive tube at least 6 centimeters (2.5 inches) ID with internal stainless steel core. Samples will be obtained every 0.6-meter (2-foot) depth interval in the first boring, then at every 0.75-meter (2.5-foot) depth interval in the subsequent borings. Drive tube samples of undisturbed soil below the drive casing will be taken after the drive casing has been bailed clean to drive shoe depth. Records will be kept on the penetration rate of the sampler, force of the hammer and blow counts for estimating in situ density. Details on soil drilling and sampling and on geologic descriptions and logging of soil samples are contained in Westinghouse Hanford procedures.

2.4.6 Borehole and Sample Designation

Borehole will be given the same designation as in Task 2. The proposed boreholes to be advanced during Task 4 will be designated as follows:

- 216-B-43-A, B or C
- 216-B-49-A, B or C
- 216-B-57-A, B or C

Samples obtained during drilling will be designated by noting the depth in which they were obtained. For example:

- 216-B-43-A, B or C (depth in feet)

2.4.7 Sample Handling and Analyses

Dual wall cores will be transferred directly to appropriate controlled facilities. Within the controlled facilities, the dual wall samples will be extracted, scanned by scintillation detector, geologically logged and described according to material type, color given a scintillation scan, etc. Dual wall samples will be subdivided into 0.75 meter depth intervals transferred to 3.7 liter wide mouth polyethylene bottles and labeled. Samples for chemical analysis will be sent to either an on-site laboratory for chemical analysis, or to a qualified off-site laboratory for chemical analysis. Samples not sent for chemical analysis will be sent to a designated controlled onsite facility for archiving in accordance with Westinghouse Hanford procedures on geotechnical library control (sample archiving).

Samples obtained using split-tube drive samplers will have the inner core barrel removed and scanned on site by the RPT before extraction. The RPT will determine whether the samples can be extracted from the core barrel in the field or transferred to an appropriate controlled facility for extraction.

Field extracted samples will again be scanned and geologically logged. All sample material will be bottled. Samples for chemical analysis will be transferred directly to sample containers and labeled for sample analysis, while remaining samples or portions will be transferred to 3.7-liter (1-gallon) wide mouth polyethylene bottles and labeled. Samples in 3.7-liter (1-gallon) bottles will be sent to a designated controlled onsite facility for archiving in accordance with Westinghouse Hanford geotechnical library control (sample archiving) procedures.

Samples obtained at 8 meters (25 feet) depth intervals will be analyzed for the parameters of interest (including any additional analytes identified during Task 2). Additional samples will also be analyzed for parameters of interest if scintillation reading appear anomalously high relative to other soils. If a stratum which could perch infiltrating effluents is identified by the hydrogeologist, the sample representing soils at the interface of the confining stratum and overlying soils will be sent for analysis for parameters of interest. The remainder of samples will be archived for use in subsequent tasks. All chemical analyses for parameters of interest will be Level III and V methods and procedures. Analyses of samples will be at either an on-site laboratory if they exceed 5 mrem/hour or at a qualified off-site laboratory if they are less than 5 mrem/hour.

Information on the type and size sample containers (for analysis), container preparation, sample handling and preservation, and maximum holding time for analyses is contained in Westinghouse Hanford procedures on soil and sediment sampling.

Field quality control samples will include one random field duplicate from each boring, two field blanks, and a travel blank of pure silica sand. Two procedural blanks will be established by collecting final rinse distilled/deionized water after decontamination of the split-tube drive sampler and internal core barrel. Field quality control blanks will be established at random. Additional field quality control can be established as sampling conditions and circumstances warrant. Analyses of field quality control duplicates and blanks will be for the parameters of interest.

2.4.8 Borehole Geophysics and Geodetic Survey

Following completion of the borings to final depth, each borehole will be geodetically surveyed (elevation and coordinates) to "third order" precision and accuracy and geophysically logged using techniques such as neutron-epithermal-neutron, gross gamma, gamma-gamma and high resolution spectral gamma probes. These logs will help provide data for use in geologic stratigraphic interpretations and density (porosity) estimates of vadose zone soils, and the type and distribution of radionuclides in the vadose zone. The logs will also be compared with gross gamma data from existing wells in 200-BP-1 to assess the change in gamma radiation with lateral distance away from the cribs. Details on the equipment and procedures for conducting borehole geophysics will be provided by Westinghouse or the participant contractor as described in the QAPP (Part 2).

2.4.9 Borehole Abandonment

Upon completion of all activities in this task, each borehole will be properly abandoned. All steel casing will be removed and the entire annulus grouted to land surface as required by WAC 173-160. Steel removed from the borehole will be transferred to an appropriate controlled decontamination facility.

2.5 TASK 5 - SEISMIC REFRACTION SURVEY

2.5.1 Purpose

The purpose of the seismic refraction survey is to more accurately define the surface elevations of the uppermost basalt stratum. From catastrophic paleo flooding events, the surface of the Elephant Mountain basalt has been either completely or partially eroded. Wells at the 53-55 location encountered basalt at an elevation of 76 meters (250 feet) above msl, although borings at well locations 55-57, 54-57, 50-53, 49-57 and 49-55 basalts were encountered at elevations between 117 and 122 meters (380 and 400 feet) above msl. This suggests the possibility of eroded paleo channels in the surface of the basalt which could influence the migration of contaminant plumes emanating from 200-BP-1. In areas where the Elephant Mountain basalt is completely eroded, the Rattlesnake Ridge aquifer is in hydraulic communication with the unconfined aquifer.

The proposed locations for installing monitoring wells (Task 6) will be reevaluated based on the results of the seismic refraction survey. The seismic survey proposed for the RI of the 200-BP-1 Operable Unit will also be useful for RI's for other operable units in the northern portion of the 200 East Area.

2.5.2 Activities

The activities necessary for completing the seismic refraction survey include:

(1) Literature Review, Initial Testing and Survey Design (Decision point for assessing if further action is necessary)

(2) Preparation

(3) Geodetic Control

(4) Field Reconnaissance

(5) Data Reduction and Interpretation

2.5.3 Measurement Locations

Figure 2-5 shows the approximate location of the seismic refraction survey lines and the general area of coverage. Area of coverage and location of survey lines will be refined based on the review of previous studies in the area. The proposed seismic survey lines will allow maximum use of existing wells for vertical control and calibration during data reduction and interpretation. The geophone spacing is anticipated to be approximately 8 to 15 meters (25 to 50 feet) with individual spreads between 200 and 400 meters (600 and 1300 feet). Actual geophone spacing and spreads will depend on the depth to basalt and the contrast in seismic wave velocity between the basalt and the overburden materials. The seismic survey will be designed to not compromise the integrity of the single shell tanks in the 241-BY Tank Farm.

2.5.4 Measurement Equipment and Procedures

A 24-channel seismograph, equipped with 24 geophones, will be used during the seismic survey. Kinepak two-component explosives will be used for promulgating seismic waves. Details on the equipment, explosives and procedures for conducting the seismic survey, instrument calibration, and data collection, reduction and interpretation will be provided by the participant contractor or subcontractor as described in the QAPP (Part 2).

2.6 TASK 6 - INSTALLATION OF MONITORING WELLS

2.6.1 Purpose

The purpose of installing additional groundwater monitoring wells is for site characterization. The functions of the proposed wells can be categorized as follows:

1) Delineation of the contaminant plumes in the unconfined aquifer associated with sources in 200-BP-1.

2) Determination of the potential future direction and extent of plumes emanating from 200-BP-1.

3) Determination of the types of chemicals and their concentrations, migrating into the 200-BP-1 Operable Unit via the unconfined aquifer.

4) Evaluation of the impacts or potential impacts to the Rattlesnake Ridge aquifer due to contaminants released from 200-BP-1.

5) Establish cluster wells that monitor both the unconfined and confined aquifers for evaluating the hydraulic interconnectivity of these aquifers.

6) Determination of the geologic stratigraphy.

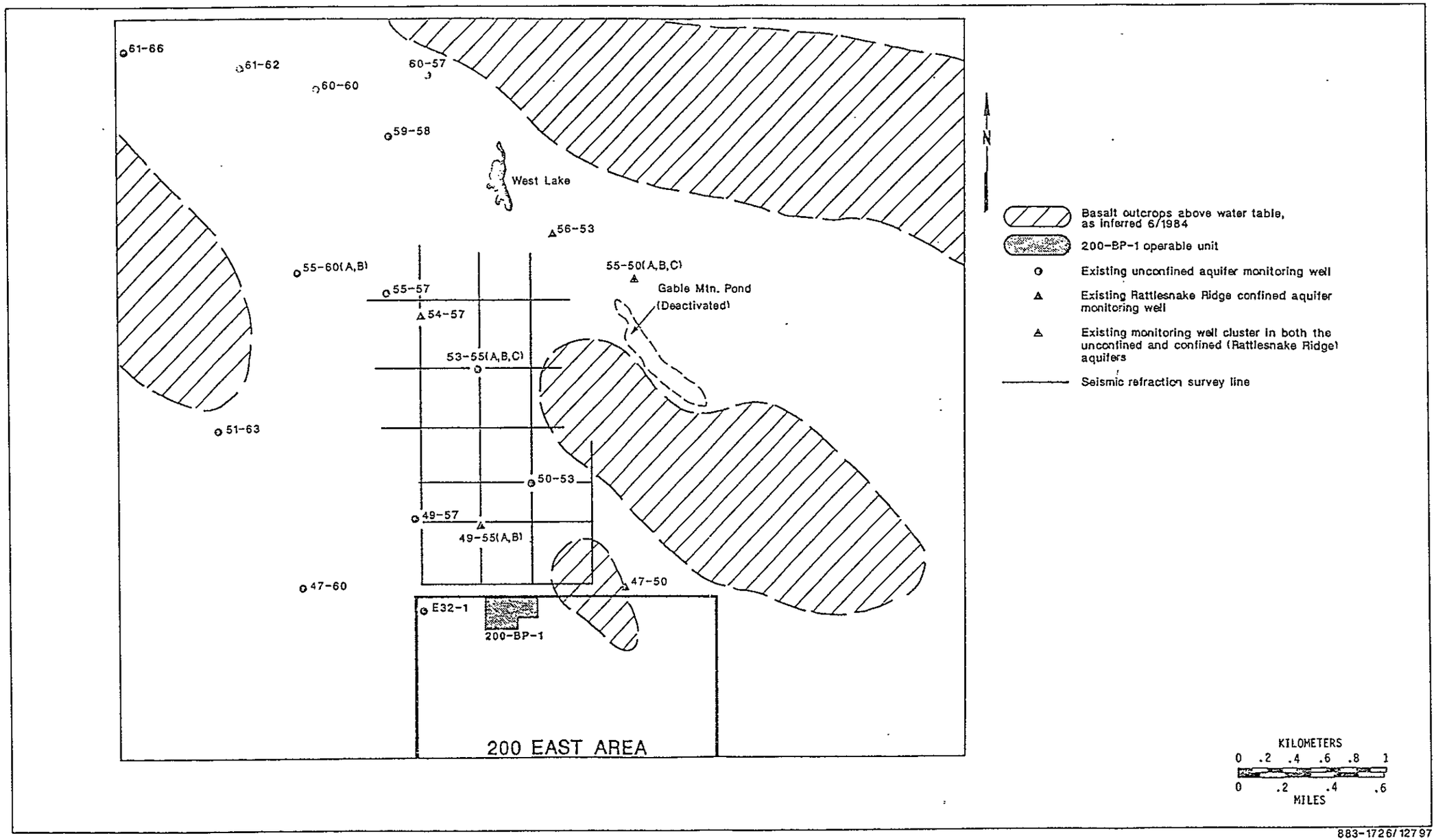


Figure 2-5. Location of Proposed Seismic Refraction Survey Lines

2.6.2 Activities

This task will be conducted in stages. In Stage 1, eight monitoring wells will be installed in an attempt to adequately satisfy the above objectives. However, due to the uncertainty in hydrogeologic investigations, some additional field activities may be required under Stage 2, depending on the information collected during Stage 1.

The major activities anticipated for this task include:

1) Review and evaluation of data from Task 5 - Seismic Survey, and Task 7 - Groundwater Analysis (1st sampling period).

2) Preparation for field program.

3) Stage 1 - drilling and installation of monitoring wells.

4) Evaluation of data from Task 6 - Stage 1 and Task 7 (2nd sampling period).

5) Stage 2 - drilling and installation of monitoring wells (optional).

6) Geophysical logging of boreholes

7) Geodetic survey.

Initially, data collected and interpreted from Task 5 - Seismic Refraction Survey and the latest sampling period for Task 7 - Groundwater Sampling and Analysis will be evaluated to refine the conceptual model of the hydrogeology presented in Section 3, and to estimate the extent of the current contaminant plumes associated with 200-BP-1. Based upon this, the well locations may be revised from those presently envisioned, and/or additional well locations may be considered necessary.

2.6.3 Preparation

Preparation activities for Task 6 include:

- Coordination with team members (see Project Management Plan - Figure 2-7).
- Coordination with support services (i.e., drillers, laboratory, surveyors, geophysical logging support etc.)
- Evaluation of drilling techniques.

2.6.4 Sampling Locations

Tentative locations of eight new wells to be installed are illustrated in Figures 2-6 and 2-7. It is anticipated that the monitoring wells installed for this investigation will also be useful for remedial investigations of other operable units. The anticipated total depths for each monitoring well is also presented in Table 2-3. Soil samples will be obtained at every 1.5-meter (5-foot) depth intervals or major stratigraphic change during the drilling and advancement of each borehole.

2.6.5 Equipment and Procedures

Conventional cable tool techniques are planned for drilling and installation of monitoring wells in Stage 1. Prior to implementation of drilling activities, new and tested drilling techniques or modifications to conventional techniques will be evaluated for applications to this task. All wells will be completed in accordance with the requirements of WAC 173-160. A surface casing, 30 centimeters (12 inches) nominal diameter will be drilled to 20 feet depth. The remainder of drilled depth will be with 25 centimeters (10-inch) nominal diameter driving casing to the top of the Elephant Mountain basalt. For wells monitoring the Rattlesnake Ridge aquifer, 25 centimeters (10-inch) nominal diameter drive casing will be extended about 2 meters (6 feet) into the Elephant Mountain basalt. This casing will be sealed from within the basalt to at least 10 feet into the overlying unconfined aquifer. Drilling will continue through the basalt with 20 centimeters (8-inch) nominal borehole. Details on drilling using conventional cable tool techniques are provided in a Westinghouse Hanford procedure on groundwater monitor well specifications. Groundwater levels will be measured at the beginning of each day before drilling activities begin in accordance with Westinghouse Hanford groundwater level monitoring procedures.

Soil samples will be obtained at every 1.5-meter (5-foot) depth interval using a split tube drive sampler (minimum 6 centimeters nominal ID with internal stainless steel core). Drive tube samples of undisturbed unconsolidated soils will be obtained ahead of the drive casing after the drive casing has been bailed clean to the depth of the drive shoe. Samples from the basalt will be obtained from drill cuttings for geologic interpretation. Records will be kept on the penetration rate, force of the hammer, and blow counts for in situ density estimates.

Drill cuttings will be captured in appropriate containers and scanned for radioactivity. Drill cuttings that do not indicate radioactivity above background will be disposed to the ground in adjacent areas. Drill cuttings that indicate radioactivity above background will be properly disposed in accordance with approved Westinghouse Hanford procedures.

Borehole geophysical logging using neutron-epithermal-neutron, gamma-gamma, and gamma probes will be conducted in boreholes before wells are installed. The geophysical logs will provide geologic information and will be compared with other geophysical well logs within 200-BP-1 for evaluation of geologic strata and the lateral migration of contaminants (potentially by perched infiltrating effluents) within the vadose zone. Technical procedures for borehole geophysical logging will be supplied by the participatory contractor.

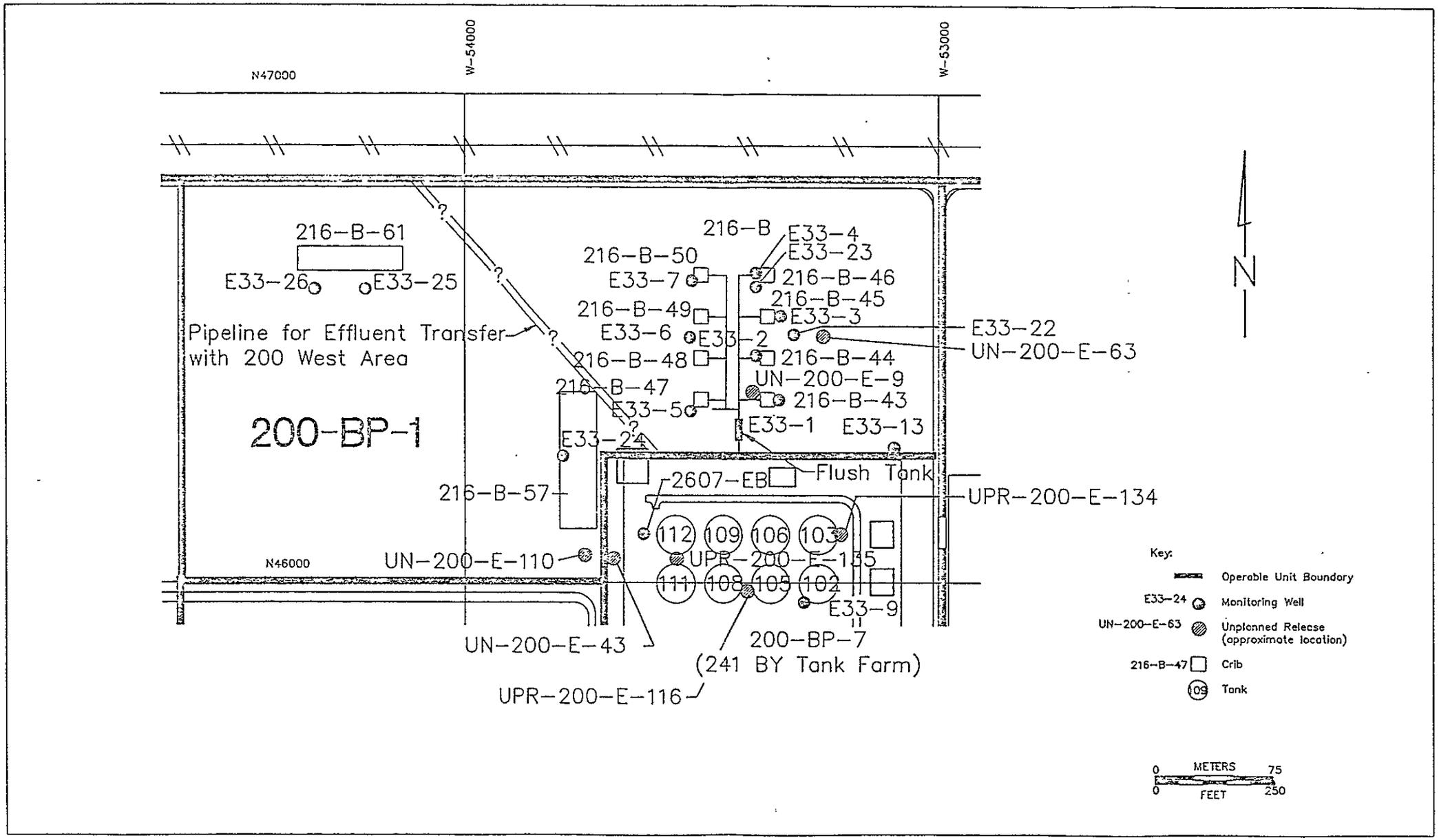


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Figure 2-6. Site Map of the 200-BP-1 Operable Unit

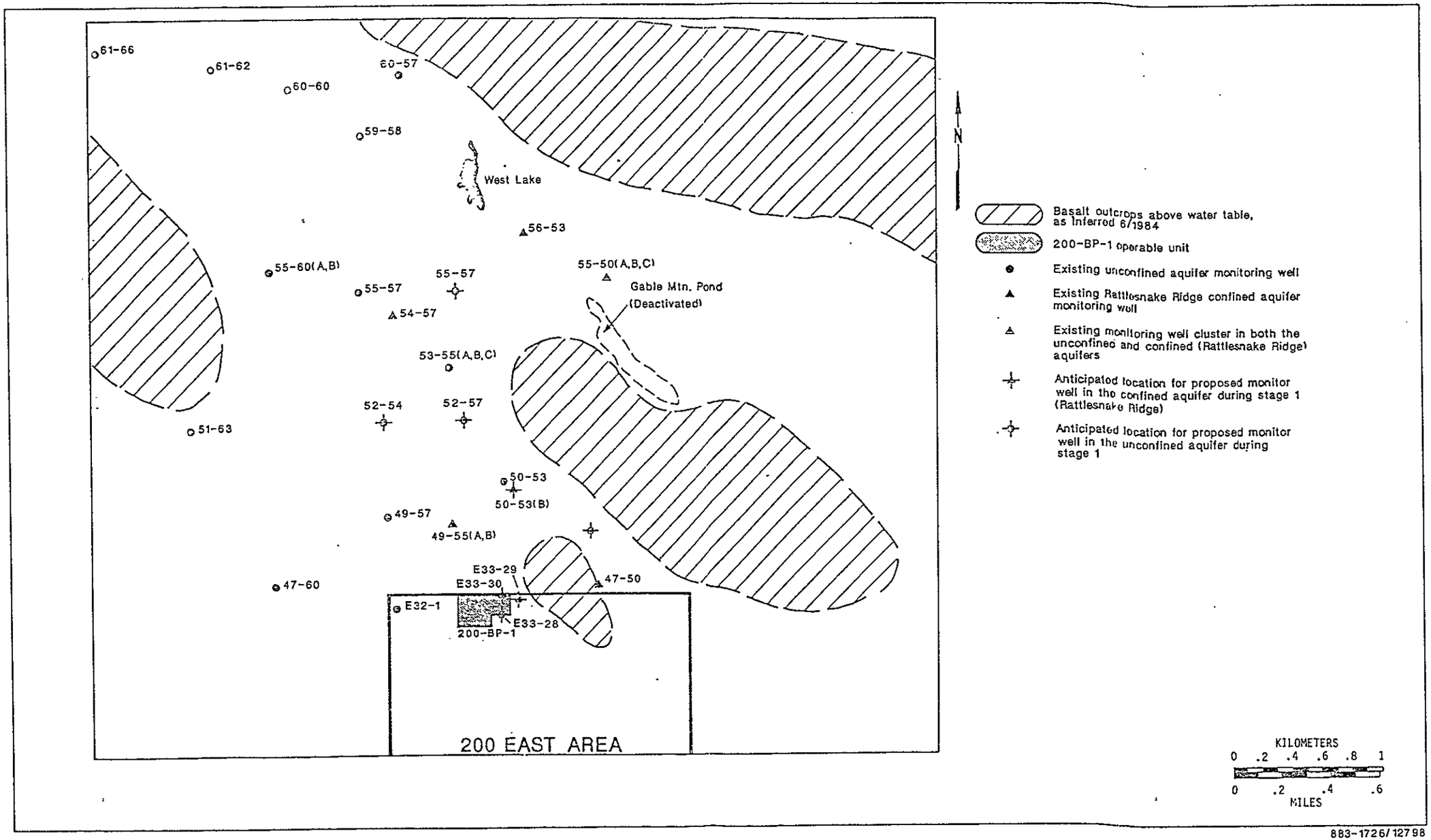

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Figure 2-7. Location Map for Proposed Monitoring Wells During Task 6 Stage 1 of Phase 1

9 0 1 1 7 4 1 1 2 4

Table 2-3. Anticipated Monitoring Well Depths

Proposed Stage 1 Well	Anticipated Total Depth of Completed Well
E33-31	75 meters (240 feet)
E33-32	75 meters (240 feet)
E33-33	100 meters (330 feet)
48-50	70 meters (230 feet)
50-53(B)	75 meters (240 feet)
52-54	55 meters (180 feet)
52-57	50 meters (170 feet)
55-55	45 meters (150 feet)

9 0 1 1 7 1 1 2 2 5

One monitoring well will be installed in each borehole. The general construction of the monitor wells are provided in Figure 2-8. If boreholes are advanced beyond the intended screen interval, they will be backfilled to the desired depth with bentonitic grout. Wells will be 15 centimeters (6 inches) in the unconfined aquifer and 10-centimeter (4-inch) nominal diameter in the Rattlesnake Ridge. Screens will be made of stainless steel. Slot size of the screen may be modified depending on formation grain size encountered for the monitored interval. Riser casing will be stainless steel to land surface. Well sorted coarse sand or pea gravel (no carbonate content) based on formation grain size will fill the borehole annulus around the screen to 1 to 2 meters (3 to 6 feet) above the screen. One meter of bentonite pellets will be added and then the remainder of the borehole annulus will be sealed with bentonitic grout to within 1.5 meter (5 feet) of land surface. All steel drive casing will be removed. A protective (lockable) steel well monument and internal pump support will be cemented in place. Details on well installation, well construction materials, and construction inspections are contained Westinghouse Hanford procedures on preparation of groundwater monitor well construction specifications and groundwater monitoring well technical inspection.

Well screens will extend no more than 6 meters (20 feet) below the surface of the unconfined aquifer or to the top of the basalt, whichever is less and extend five feet above the static water level. Well screens in the Rattlesnake Ridge confined aquifer will be placed approximately 1.5 meters (5 feet) into the overlying basalt and extend into the interbed. The length of the screen that extends into the interbed will not be greater than 15 feet, but may be less depending on the encountered stratigraphy.

Each well will be developed by bailing until groundwater has a turbidity less than 5 N.T.U. Purged groundwater will be captured and properly disposed depending on its quality in accordance with Westinghouse Hanford procedures on disposal of well construction development water (purgewater disposal). All wells will be geodetically surveyed for elevation and N-S/E-W coordinates. A dedicated pump system that is capable of purging and sampling will be installed within each well.

Results of Task 7 - Groundwater Sampling and Analyses (latest sampling period) will be reviewed and evaluated to assess whether the objectives listed have been adequately satisfied or whether additional monitoring locations are needed in either the unconfined aquifer or Rattlesnake Ridge confined aquifer for implementation of Stage 2. For schedule planning (Section 6 of the work plan), it is assumed that three additional monitoring wells in the unconfined aquifer, and one additional monitoring well in the Rattlesnake Ridge aquifer will be necessary.

2.6.6 Monitoring Well and Sample Designation

Monitoring wells and associated boreholes in the 600 Area will be designated by the North/South coordinate - East/West Coordinate rounded off to the nearest by 1,000 to conform to the Hanford well numbering system. For example, a well located within N55000 and W52000 quadrant will have the designation of 699-55-52. If more than one well is located within 1,000 feet of another, then letters will be used such as 699-55-52 (A, B, C, etc.) for

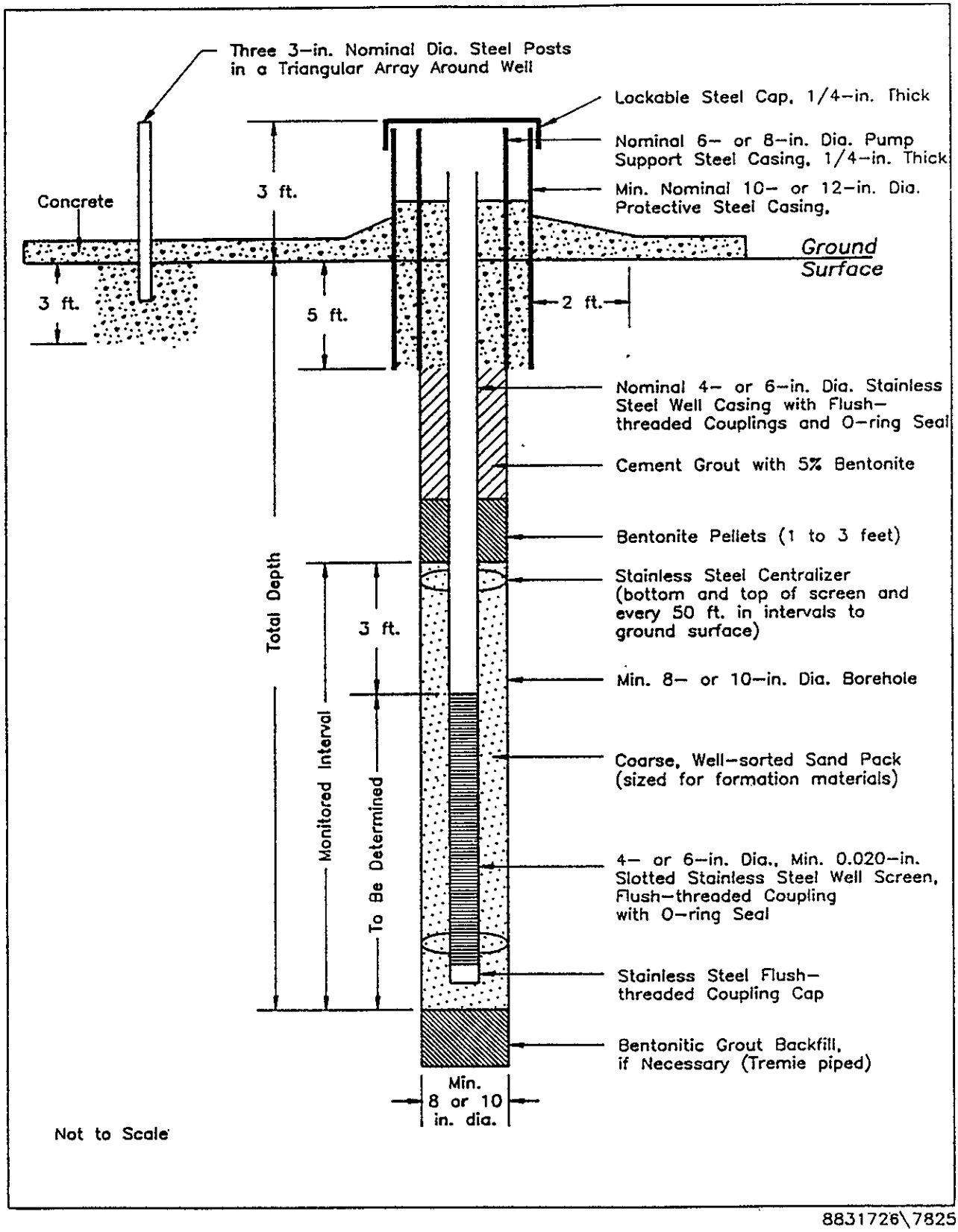

Figure 2-8. Generalized Schematic Diagram of Completed Single Monitoring Well Construction

distinction. Wells located within the 200 East Area will be numbered consecutively using the existing numbering system (i.e., 299-E33-31 through 33).

Soil samples obtained during drilling will be designated by borehole and depth. For example:

699-55-52 (depth in feet)

2.6.7 Sample Handling and Analysis

Samples obtained using split-tube drive samplers will have the inner core barrel removed and be scanned on site by the RPT before extraction. The RPT will determine whether the samples can be extracted from the core barrel in the field or transferred to an appropriate controlled facility for extraction. Extracted samples will again be scanned and geologically logged. All sample material will be placed in appropriate jars. Samples for chemical analysis will be transferred directly to sample containers and labelled for sample analysis, while remaining samples or portions will be transferred to 3.7 liter (1 gallon) wide mouth polyethylene bottles and labelled. Samples for chemical analysis will be sent to an on-site laboratory or a qualified off-site laboratory for analysis. Samples (3.7 liter bottles) to be archived will be sent to a predesignated Hanford Site facility in accordance with Westinghouse Hanford geotechnical library control (sample archiving) procedures.

Soil samples from E33-31, E33-33, 52-57, and 55-55 that represent corresponding soil horizons as analyzed during Task 4 (at 8-meter depth intervals) will be sent to a qualified laboratory for analysis for the parameters of interest (Level III methods and procedures). The purpose of analyzing soil samples from E33-31 and E33-33 is to understand the potential lateral migration of effluents from 200-BP-1 cribs. Particular attention will be given to identifying horizon(s) within E33-31 or E33-33 where soil samples indicate previously perched conditions for infiltrating effluents from the cribs. The purpose of analyzing soils from 52-57 and 55-55 is to obtain background concentrations of parameters of interest within soils in the vadose zone for comparison with vadose zone samples within 200-BP-1. Two wells were chosen for better representation of background levels.

From each borehole in the 600 Area, analyses (Level III) will be performed for total organic carbon on three randomly selected soil samples from each aquifer. Total organic carbon in the aquifer matrix is required for retardation estimates of organic solution in groundwater flow system. Even if organic compounds are not a contaminant of concern at the 200-BP-1, this information may be useful for contaminants from other operable units.

Information on the type and size sample container (for analysis), container preparation, sample handling and preservation, and maximum holding time for analyses is contained in Westinghouse Hanford soil and sediment sampling procedures.

Field quality control samples will include one random field duplicate from each boring (E33-31, E33-33, 52-57 and 55-55), two field blanks of pure sand and a travel blank of pure sand. Two procedural blanks will be

established by collecting final rinse distilled/deionized water after decontamination of the split-tube drive samples and internal core barrel. Field quality control blanks will be established at random. Analyses of field quality control duplicates and blanks will be for parameters of interest (Level III).

2.7 TASK 7 - GROUNDWATER SAMPLING AND ANALYSIS

2.7.1 Purpose

Groundwater in existing wells and installed wells will be sampled semi-annually for quality determinations, trend evaluations and plume migration estimates. Construction details of existing wells will be evaluated to determine whether they are acceptable. Groundwater has been and will continue to be monitored in many wells in the 200 East Area and 600 Area. Schedules exist for sampling groundwater from an established network of wells for calendar year 1988. Parameters are also identified for analysis from each well. Since the RI/FS is not expected to begin until calendar year 1989, this task was developed independent of anticipated groundwater monitoring efforts being planned for calendar year 1989. The wells and analyses should be integrated into the schedule for monitoring groundwater quality.

2.7.2 Activities

The activities included in this task are:

(1) Development of Level V Special Analytical Services (SAS) methods and procedures for analysis of cyanide species, obtaining lower detection limits for ruthenium-106, and obtaining representative redox potentials for groundwater.

(2) Review construction details and/or conduct field tests of existing wells to determine whether the wells are acceptable for continued monitoring for this investigation.

(3) Semi-annual groundwater sampling and analysis of monitoring wells pertinent for characterizing plumes emanating from 200-BP-1.

2.7.3 Development of Level V Special Analytical Services (SAS)

Initial tests will be conducted to develop methods appropriate for analyses of two parameters of interest (cyanide and ruthenium-106) and an additional analysis (redox potential) that is important for evaluation of groundwater data. The tests will be conducted prior to implementing the regular semi-annual sampling periods. A summary of tasks are provided below.

Cyanide

The environmental fate and toxicity of cyanide in aqueous systems can vary widely (PHS, 1988). This is in part due to the dependence of cyanide on pH. Furthermore, speciation of cyanide in ground or surface waters will also

depend on available cation species which can form simple alkali metal salts or complex metallocyanide compounds. The metals salts which may form are very soluble in water and consequently form CN and HCN with their dissociation (Cossinelli, 1986). Metallocyanide complexes can have a wide range of solubilities and variability in water. For example, cyanide complexes of zinc and cadmium are weakly complexed and should easily dissociate. Complexes of nickel and copper are moderately stable and complexes of gold, iron and cobalt exhibit a fairly inert behavior in water and are expected to remain complexed (Nonomura, 1987).

The relatively insoluble forms of cyanide, such as $Fe(CN)_6^{-3}$ or $Co(CN)_6^{-3}$ will likely sorb onto sediments or soils and could be available for bioaccumulation in aquatic organisms or biological degradation. Biodegradation of cyanide is expected to play a major role in the environmental fate in natural water systems and a number of microorganisms have been observed to breakdown cyanide at low concentration, under both aerobic and anaerobic conditions (PHS, 1988).

Since inorganic cyanides are present in both simple and complexed forms, several methods have been established to quantitate free, complexed, and total cyanide in water. Determination of free cyanide according to U.S. EPA Method 335.2 will assay soluble metal salts of cyanide, such as NaCN, or KCN, as well as CN and HCN. Method 9010, determines cyanide susceptible to chemical oxidation through chlorination (EPA, 1986). This method measures all simple cyanides as well as cyanide complexes with the exception of iron cyanide complexes. It should be noted that total cyanide determinations by EPA Method 335.2 (1986), will quantitate all cyanide forms including insoluble complexes.

Established methodologies for cyanide in water rely typically on the determination of cyanide in solution. Although pretreatment may vary, such as chlorination with hypochlorite, these methods employ bulk steam distillation of the sample at a reduced pH, with ultimate collection of HCN in a caustic trap. The trap is then analyzed by either calorimetric, titrimetric, or electrochemical techniques for cyanide ion.

All methods suffer from potential interferences. Some of these method interferences can be reduced with addition of chemical reagents. For a brief summary of analytical methodologies, Table 2-4 lists common techniques used for cyanide determination in water.

In a recent study, method sensitivity and accuracy with the common calorimetric, and electrochemical techniques were evaluated. This study found the calorimetric techniques, specifically, the pyridine-barbituric acid method, to be preferred. Both calorimetric techniques were found to have better statistical accuracy than the electrochemical methods. The accuracy of the two common calorimetric methods studies (EPA Methods 335.2 [1986]) were found to be equivalent (PHS, 1988).

A recently developed technique involving ion chromatography (IC) with amperometric detection has shown promise for the determination of CN and CN complexes in water. This technique is free of most interferences associated with distillation techniques or specific electrode electrochemical and calorimetric detection. The IC techniques involve direct injection of the water sample onto the IC with electrochemical detection. Detectable limits of 2 p/b for CN were achieved (Nonomura, 1987).

Table 2-4. Analytical methods for the determination of cyanide in water

METHOD	SAMPLE PREPARATION	DETECTION	SPECIES	DETECTION LIMITS
1	Sample acidified refluxed-distilled, HCN sorbed onto NaOH	Spectrophoto (EPA Method 335.2)	Total Cyanide	20 p/b
2	Sample Chlorinated w/ HCLO @ pH 11-12 Residual sample acidified as w/ Method 335.2	Spectrophoto (EPA Method 335.2 Method 9010, cyanide amenable to chlorination)	Simple and some complexes, will not determine iron and cobalt complexes	---
3	Sample acidified and refluxed-distilled as 335.2, absorbing solution titrated w/AgNO3	Titration (Method 335.2)	Total Cyanide	1000 p/b
4	None	Ion/Chromo/ampero-	Free and complexed	2 p/b

Test for cyanide on groundwater samples obtained from wells 49-57, 49-55(a) and 50-53 are proposed to be conducted. These tests will include duplicates, spikes (of known free cyanide and complexed cyanide including cobalt complexes) and blanks. The method(s) that produces the most accurate, precise and reproducible results will be chosen for use in subsequent analysis during regularly scheduled sampling periods. Procedures will be established for the chosen methods(s).

Ruthenium-106

The normally achievable detection limit obtained from the 222S laboratory and U.S. Testing Laboratory is 172 pCi/L for water. Risk assessments may require analytical detections of 3 pCi/L, which is the equivalent of 0.1 times (to account for the "Unity rule") MCL for ruthenium-106 in drinking water. Analytical techniques will be tested on groundwater from wells 49-57, 49-55(A), and 50-53 including duplicates, spikes and blanks for obtaining consistent detection concentration of 3 pCi/L. The results will be evaluated and assessed whether analytical techniques (capable of 3 pCi/L detection) should be regularly implemented on groundwater samples during the 200-BP-1 Remedial Investigations. Procedures and equipment specifications will be established for the preferred method.

Redox Potential

Aqueous chemical speciation, oxidation state of many transition metals and Actinium and Lanthanum series ions, and solubility indices are important for solute transport and fate analysis and are dependent on the oxidation-reduction (Redox) potential of the aqueous solution. The Redox potential in aqueous systems is highly unstable and may be difficult to characterize. Contact with the atmosphere and metal well screens will also influence the Redox potential. An initial test is proposed to evaluate whether the Redox potential can be characterized using field analytical methods and to assess the most appropriate method.

Normally, if dissolved oxygen is detectable and quantifiable in groundwater, the Redox potential can be adequately estimated. Another method for estimating Redox is by electrical potential (eH) using platinum electrodes. This method requires sufficient concentration of ionic redox couples (i.e., iron ions, manganese ions) for representation and is subject to "poisoning" of the platinum electrode that results in misrepresentation of actual redox condition. Another method is to measure Redox couples directly by ion chromatography in a laboratory. Ion chromograph analyhsis of redox couples such as iron +2/+3 ion, manganese +2/+4 ions, NO_2^-/NO_3^- ions and $SO_4^=/S^=$ ions, could be used as a validity check for the above more portable field techniques. The above techniques will be tested on purged groundwater form wells 49-57, 49-55(A) and 50-53. Results will be evaluated and an assessment will be made whether Redox should be analyzed regularly in the field and the method to be used. Procedures will be established if Redox potential is to be included during regularly scheduled groundwater sampling.

2.7.4 Review of Existing Wells

Existing wells will be evaluated to determine whether they are adequate for water level measurements, water quality sampling, and hydraulic pump tests. Borehole drilling, well construction, installation and field verification records will be reviewed if available. Information on depth of the well, screened interval, and construction materials will be evaluated to assess whether the wells are adequate for some or all of these uses. Field testing or verification may be required if sufficient information is not available and the location of the well is important to the RI objectives identified in Section 5.1.6 of the work plan. Verification may include sounding the depth of wells, caliper and/or geophysical well logging, temperature profiling, flow monitoring and possibly downhole television recording of the interior of the wells.

2.7.5 Sampling and Analysis Program

2.7.5.1 Sampling Locations and Frequency. The existing monitoring wells included for 200-BP-1 groundwater sampling and anticipated function for monitoring are listed in Table 2-5. New monitoring wells completed during Task 6-Well Installation, will be sampled within one week after well development and installation of the dedicated pump, then will be included in the regular monitoring periods. Each monitoring well listed in Table 2-5 will be sampled and analyzed quarterly for one year. The quarterly sampling of existing wells will start at the beginning of the RI for 200-BP-1 and the quarterly sampling for the installed wells (Task 6) will start after each stage of installation. After one year of quarterly monitoring wells will be sampled and analyzed for groundwater quality on a semiannual basis until completion of the FS.

2.7.5.2 Sampling Equipment and Procedures. During each sampling period, groundwater samples will be collected according to standard PNL procedures on groundwater sample collection. Monitoring wells are equipped with dedicated pump systems. Temperature, pH, turbidity and electrical conductance will be monitored during purging of each well. Wells will be purged a minimum of three well and sand pack storage volumes or until all parameters have stabilized (temperature $\pm$ 0.1°C, pH $\pm$ 0.1, turbidity (<5 NTU) and electrical conductance $\pm$ 10 percent), whichever criteria is greatest. Purged groundwater will be captured and properly disposed depending on its quality in accordance with PNL procedures on groundwater sample collection. Samples for inorganic and radionuclide analyses will be filtered through 0.45 micron filter prior to bottling and preservation.

2.7.5.3 Sample Designation. Groundwater samples will be given the same designations as have been used during ongoing monitoring. Samples will be identified by the well designation and the date in which each sample is obtained. For example, the designation for well 50-53 will be:

- 50-53 (date)

Table 2-5. List of Monitoring Wells for Semi-annual Groundwater Sampling and Monitoring Function

WELL	AQUIFER MONITORED	MONITORING FUNCTION
Existing Wells		
E32-1	Unconfined	
E33-1	Unconfined	200-BP-1 source and 200-BP-7 contributions
E33-3	Unconfined	200-BP-1 source contribution
E33-4	Unconfined	200-BP-1 source contribution
E33-5	Unconfined	200-BP-1 source and 200-BP-7 contributions
E33-7	Unconfined	200-BP-1 source contribution
E33-8	Unconfined	200-BP-3 contribution
E33-9	Unconfined	200-BP-7 contribution
E33-11	Unconfined	200-BP-4 and 200-BP-7 contributions
E33-12	Rattlesnake Ridge	Impacts near 200 BP-1
E33-13	Unconfined	200-BP-7 and 200-BP-4 contributions
E33-14	Unconfined	200-BP-4 contribution
E33-15	Unconfined	200-BP-7 contribution
E33-18	Unconfined	200-BP-7 contribution
E33-20	Unconfined	200-BP-7 contribution
E33-24	Unconfined	200-BP-1 source and 200-BP-3 contributions
E33-26	Unconfined	200-BP-10 and 600 Area contributions
E33-28	Unconfined	200-BP-3 contribution
E34-1	Unconfined	200-PD-6 contribution
49-57	Unconfined	200-BP-1 plume delineation
49-55A	Unconfined	200-BP-1 plume delineation
49-55B	Rattlesnake Ridge	Potential impacts from 200-BP-1
50-53	Unconfined	200-BP-1 plume delineation
53-55B	Unconfined	200-BP-1 plume delineation
53-55C	Unconfined (?)	200-BP-1 plume delineation
54-57	Rattlesnake Ridge	Potential impacts from 200-BP-1
55-57	Unconfined	200-BP-1 plume delineation
Tentatively Proposed Wells		
E33-31	Unconfined	200-BP-4 and 200-BP-7 contributions
E33-32	Unconfined	200-BP-7 contribution
E33-33	Rattlesnake Ridge	Potential impacts from 200-BP-1
48-50	Unconfined	B-pond and 200 PO-6 contributions
50-53(B)	Rattlesnake Ridge	Potential impacts from 200-BP-1
52-54	Unconfined	200-BP-1 plume delineation
52-57	Unconfined	200-BP-1 plume delineation
52-55	Unconfined	200-BP-1 plume delineation

2.7.5.4 Sample Handling and Analysis. During each sampling and analysis period, groundwater from the wells listed in Table 2-5 will be analyzed for the parameters of interest including additional constituents assessed important from the results of Task 2 Source Sampling. Groundwater analyses for parameters of interest will be by Level III analytical methods and procedures (Level V - SAS methods for, cyanide species and Ruthenium-106 as determined). Samples will be collected directly into sample containers after sufficient water has been purged. Purgewater will be disposed of in accordance with the PNL procedures on groundwater sample collection. Samples will be sent to a qualified laboratory. During sampling in the field, unstable water quality parameters will be analyzed (Level I Analytical Methods and Procedures) continuously (in-line) during purging of well water or immediately after sample acquisition. These include pH, temperature, electrical conductance, dissolved oxygen and Redox potential (depending on the result of initial testing of methods for Redox). In addition, groundwater from the wells will be analyzed (Level III Analytical Methods and Procedures) for major cation-anion concentrations (listed below) for remedial alternative evaluations and engineering design and for evaluating the ratio between nitrates and nitrites.

- Calcium
- Magnesium
- Sodium
- Potassium
- Iron
- Manganese
- Chloride
- Alkalinity
- Fluoride
- Silicon oxide
- Aluminum
- Total dissolved solids
- Nitrite

Information on the type and size of sample containers (for analysis), container preparation, sample handling and preservation, and maximum holding time of samples for analysis is contained in PNL procedures on groundwater sample collection.

Quality control field samples which will be established during sampling include the following along with minimum frequency (expressed as a percentage of the total wells sampled each period):

- Duplicates (10 percent)
- Travel blanks (5 percent)
- Procedural blanks (5 percent)
- Method blanks (5 percent)
- Duplicate spikes with CN species, NO_3 and SO_4 (5 percent)

Quality control field samples will be selected randomly throughout the duration of the sampling period.

2.8 TASK 8 - SITE TOPOGRAPHIC MAP

2.8.1 Purpose

A site map of the 200-BP-1 Operable Unit will be established to be used during site characterization, evaluation of remedial alternatives and engineering design. Geodetic surveys for elevation and north-south (N-S) and

east-west (E-W) coordinates are necessary for vertical and horizontal control of RI activities and data.

2.8.2 Activities

The activities anticipated in this task include:

1) Development of site topographic map for 200-BP-1 Operable Unit.

2) Geodetic survey in Task 2 borings for elevation and N-S/E-W coordinates.

3) Geodetic survey in Task 3 soil probes and test pits for N-S/E-W coordinates.

4) Geodetic survey in Task 4 borings for elevation and N-S/E-W coordinates.

5) Geodetic control in Task 5 seismic refraction survey lines within the N-S/E-W coordinate system.

6) Geodetic survey in Task 6 monitoring wells for elevation and N-S/E-W coordinates.

2.8.3 Requirements for Surveys and Maps

The site topographic map will show elevation contours at 0.5-meter (2-foot) intervals. Site features such as the 200-BP-1 boundary, fence lines, gates, buildings, restricted areas, and pipelines will be included. The site map will extend 100 meters (330 feet) beyond the boundary of 200-BP-1 and include the designated area-specific background zone. The site map will be prepared so as to be compatible with the N-S/E-W coordinate system used for the existing maps of the 200 East Area. Third-order precision and accuracy will be used for the development of the site map.

Third-order plane surveys and horizontal angular measurements should be made with a 20-second or better transit. Angles should be doubled, with the mean of the doubled angle within 10 seconds at the first angle. Distance measurements should be made with a calibrated tape corrected for temperature and tension or with a calibrated electronic distance measuring instrument (EDMI). When using EDMI, the manufacturer's parts per million (p/m) error continues to be applied as well as corrections for curvature and refraction.

Surveys are to be completed by a surveyor who is licensed and registered in the State of Washington. Vertical control will be referenced to a U.S.G.S. Datum obtained from a permanent bench mark.

Monitoring well locations are surveyed only after the installation of a tamper-proof locking well cap casing cover, which is set in concrete. The horizontal plane survey accuracy is ± 0.3 meter (1 foot) and is measured at any point on the well casing cover. The vertical plane survey must be accurate to ± 0.003 meter (0.01 foot). Three elevations are measured, included the following:

- top of the inner well casing (on the lip)
- top of the outer protective casing (on the lip, not the cap)
- permanent survey mark attached to the outer protective well casing.

The point at which the elevation was measured should be scribed so that water level measurements may be taken at the same location.

2.8.4 Equipment and Procedures

Complete details of equipment instrument calibration, and procedures will be provided by participant contractors or subcontractors as described in the QAPP. Major equipment includes the following:

- automatic differential level (self-leveling) (25-30 power magnification and resolving power of approximately 1 minute)
- electronic total station (distance meter and optical theodolite)
- leveling rod(s) (Philadelphia type) with graduations in hundredths of a foot
- rod level
- tape measure.

2.8.5 Data Collection, Reduction, and Interpretation

All measurements shall be recorded in field notebooks or field report forms and all measured marker points shall be plotted on topographic maps.

A base map will be prepared from the data collected including; site features, elevation contours at 0.5 meters (2 feet) intervals, elevations and locations for Task 2 borings, Task 4 borings and Task 6 monitoring wells. Locations of Task 3 soil probes and test pits and Task 5 seismic refraction survey lines will also be included.

Data and maps will also be prepared so as to be compatible for input into the existing data base for the 200 East Area.

2.9 TASK 9 - BIOTA EVALUATION

A visual reconnaissance effort will be conducted at these sites by qualified personnel to locate and evaluate any evidence of uptake of toxic substances by plants or animals. Any evidence of weakened, necrotic, or chlorotic plants will be documented by species. Observations would also be made of evidence of small mammals and bird species, and animal burrowing activities. Where possible, at least two soil samples from burrowing animal mounds will be collected at each site and analyzed for parameters of interest. A threatened or endangered species survey will also be conducted as part of the biotic reconnaissance effort. For comparison purposes, at least one control site (preferably similarly disturbed) located nearby (within

approximately 3.2 kilometers [2 miles]) would also be examined in the same way.

2.10 TASK 10 - COLUMN LEACH TESTS

2.10.1 Purpose

The purpose of conducting column leach tests is to investigate the mobility of contaminants in the vadose zone due to infiltrating meteoric water. This test will determine the solubilization of contaminants with infiltrating water. Past studies undertaken at the site indicate the recharge (water flux) to the aquifer could be zero or as high as 8 cm/yr (Isaacson et al., 1974, Jones, 1978, Gee and Heller, 1985, and Gee, 1987). Tests to determine recharge fluxes of infiltrating meteoric water are difficult and time consuming. They will, therefore, be undertaken independently of the RI so that they may be applied to other operable units within the Separation Area. The concentrations obtained through these proposed column leach tests with the estimated recharge flux of infiltrating meteoric water will be used to estimate contaminant flux to groundwater. The contaminant flux to groundwater together with observed trends in groundwater contaminant concentrations (Task 7) will be used to evaluate the potential for future contaminant impacts. Data from these leach tests will be useful for evaluation and design of capping technologies, such as partial infiltration instead of zero infiltration covers.

2.10.2 Activities

The activities for conducting column leach tests include:

1) fabrication of leach columns with appropriate soil samples
2) synthesizing simulated rainwater
3) conducting the leach tests
4) chemical analysis of leach solutions.

2.10.3 Test Equipment and Procedures

The column leach test will be conducted in a qualified onsite laboratory on soil samples obtained during Task 2 and Task 4 of Phase I Remedial Investigation. Soil samples will be stacked within a column to represent the field conditions. Simulated rainwater will be allowed to percolate through the column as shown in Figure 2-9. A reservoir equipped with a septum will be installed between sample intervals for degassing (if necessary), or sampling infiltrating water (if possible) between sample intervals through a syringe.

The leach columns will be established for leaching vadose zone soil samples that were obtained from each borehole during Task 4. Source samples from Task 2 corresponding to each borehole will also be used. A total of nine columns will be established (3 for materials from each borehole). The three leach tests for each borehole sample will be conducted with different infiltration rates to gain information on the dependence of leachate concentration with infiltration rate. Application rates should be less than

the rate which would cause ponding. Preliminary infiltration tests on similar materials will need to be conducted to establish the most appropriate application rates for conducting the leach tests.

Effluents collected periodically at the bottom of the leaching column will be analyzed for the parameters of interest. The rate and amount of water applied and collected will be monitored for each test. Details on the test procedures and equipment for the column leach tests will be provided by the participant contractor or subcontractor as described in the QAPP (Part 2).

2.10.4 Test and Sample Designation

Column leach tests will be designated by the borehole in which the soils were obtained and by the infiltration rate. Effluent leach solutions collected for analysis will have an additional identifier distinguishing the time interval between the start of the test and when the sample was collected.

2.10.5 Sample Handling and Analysis

Effluent leach solutions will be collected periodically at the bottom catch-basin of the leaching column and analyzed for the parameters of interest (Level III analytical methods and procedures). A sample of the initial leach effluent from each test column shall be collected and analyzed. Tests should be conducted for a period of one month after the first leach effluent sample is collected. Additional samples of leach effluent shall be obtained at one week, two weeks and one month time periods after the first effluent leach sample has been acquired. Percolation of simulated rainwater will be discontinued and the leaching column will be allowed to drain. The system will not be disassembled until the analytical results on all effluent leach samples are obtained and evaluated.

Effluent leach solution samples will be either analyzed in a qualified onsite or offsite laboratory for analysis depending on whether the samples are exceed 5 mrem/hr of radioactive materials.

Information on the test procedures and equipment for the column leach tests will be provided by the participant contractor or subcontractor as described in the QAPP.

2.11 TASK 11 - HYDRAULIC PUMP TESTS

2.11.1 Purpose

The purpose of conducting aquifer tests is to obtain information on the hydraulic properties of the unconfined and Rattlesnake Ridge Aquifer. This information will be used for site characterization (contaminant velocities and fluxes), baseline risk assessment (resource evaluation and contaminant concentrations and variations with time at surface water discharge points) and preliminary screening of remedial alternatives (i.e., hydraulic barrier systems, flushing, etc.).

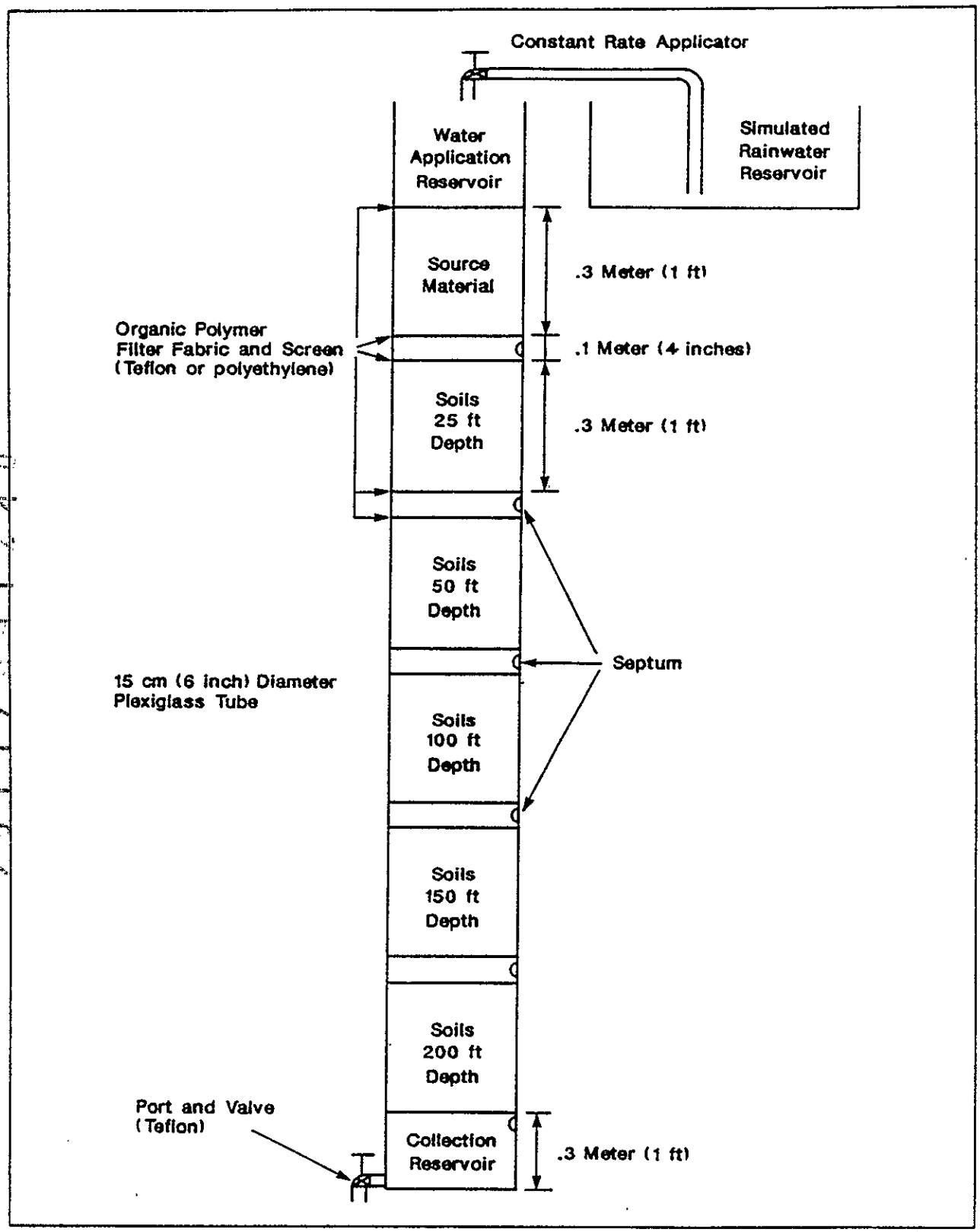

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Figure 2-9. Schematic Diagram of Column Leach Test

2.11.2 Activities

Slug testing will be conducted on all wells which are to be hydraulically tested. Slug tests are only accurate within an "order-of-magnitude". The anticipated hydraulic conductivity and transmissivity of the aquifers may be too high to conduct adequate slug tests. Drawdown/recovery testing, which is the preferred hydraulic test method, will be performed only on wells where groundwater can be discharged directly to adjacent ground (outside the zone of influence of the test) for infiltration, since these tests will produce large quantities of water. Prior to testing, the current groundwater quality will be evaluated and a determination will be made whether drawdown/recovery of hydraulic tests are appropriate for the well.

The baseline risk assessment or preliminary screening of alternatives may necessitate having more accurate hydraulic properties of the aquifer in specific areas. If this is required, drawdown/recovery test(s) will be performed during Phase II Remedial Investigation. Phase II RI hydraulic aquifer tests could be conducted for extended time (≈/month or greater) with observation wells for more representative hydraulic parameters and possibly hydraulic boundary analysis. Large quantities of groundwater may require capture and treatment before discharge. Such tests could be performed in conjunction with a treatability test for groundwater treatment technologies for remedial alternative evaluations and remedial design.

2.11.3 Testing Locations

The only well within the study area that has been hydraulically tested in previous studies (Graham et al., 1984; and Graham, 1981) is E33-12 (Rattlesnake Ridge aquifer). The wells that are proposed for hydraulic testing in order to develop a spatial representation of the unconfined aquifer properties are:

Existing	Proposed
E33-1	52-57
E33-4	52-54
E33-5	55-55
E33-7	
E33-24	
49-57	
49-55(A)	
50-53	
53-55(B)	
53-55(C)	
65-67	
60-60	

Wells that are proposed for hydraulic testing for the Rattlesnake Ridge aquifer are:

Existing	Proposed
49-55(B)	E-33-33
54-57	50-53(B)

2.11.4 Testing Equipment and Procedures

Before each slug test, water levels will be monitored and recorded for a minimum 0.5 hour to determine antecedent trends in water levels. Slug tests will be performed by removing an instantaneous slug of water (by displacement) and measuring water level recovery (rising head slug tests) by down hole pressure transducers with a surface automatic data acquisition system. Wells that are receiving water from confined aquifers can have an instantaneous slug introduced and recording water level recovery with time (falling head slug test). This system will provide water level readings as frequent as will be necessary to accommodate anticipated rapid recovery rates. Each test will be performed in duplicate for comparison of results. Dedicated sampling pumps will need to be removed by a work over rig prior to conducting slug tests.

Before performing drawdown/recovery tests, the wells will be tested for well efficiency and antecedent trends in water levels. Well efficiency will be evaluated by using the step drawdown technique which will be conducted at three discharge rates. Each discharge rate will be pumped for a period of one to four hours as determined by the hydrogeologist. Estimates of well efficiency and transmissivity will be made and the optimal constant pumping rate for the longer term drawdown/recovery test will be determined. For evaluation of antecedent trends, water levels will be monitored and recorded for a period of about the anticipated pumping and recovery time. In addition, well barometric efficiency will need to be estimated for wells that are connected to the confined aquifer. Barometric efficiency can be determined before or after the pump test.

The dedicated sampling pumps will probably not have the capacity to pump at a rate sufficient to stress the aquifer. In this case, the sampling pumps will be removed using a well service rig and a temporary pump will be installed with a larger capacity. A hydrogeologist will determine the pump capacity requirements for each well and decide whether the existing pump is adequate for conducting the drawdown/recovery test.

During the drawdown/recovery test, the well will be pumped at a constant discharge rate for a minimum of one day. The total length of the test will be determined by a hydrogeologist and will depend on the observed changes in water level with time. Drawdown will be monitored and recorded with time. The pump discharge rate will be monitored and regulated if the discharge rate changes. After the pump is turned off, the recovery of water levels in the well will be monitored and recorded with time until water levels reach at least 95 percent estimated static conditions. If other wells exist in the near vicinity [<100 meters (328 feet) for unconfined aquifer pumping, or 1000 meters (3300 feet) for wells in the confined aquifer during confined aquifer pumping], their water levels will be monitored during the entire test. For wells receiving water from the confined Rattlesnake Ridge aquifer, barometric pressure will be monitored and recorded throughout the test period.

Details on the testing procedures, equipment and calibration requirements, and data monitoring and recording frequencies, are provided in Westinghouse Hanford procedures on aquifer testing and groundwater level monitoring.

2.12 TASK 12 - SORPTION TESTS

2.12.1 Purpose

Sorption tests are proposed as an optional activity dependent on the adequacy of existing data. The purpose of conducting sorption tests is to gain information on the partitioning of contaminants between the aquifer matrix and the water phase. This information will be used to estimate the migration velocity of plumes relative to the velocity of groundwater in the flow system, the attenuation of contaminants in the aquifer and the potential impacts to surface waters. A review will be conducted of sorption tests that have been conducted on radionuclides for Hanford soils to determine whether additional information is needed.

Most sorption coefficients for geological material are obtained experimentally by equilibrating the material with a solute/radionuclide containing aqueous solution for a specified period of time. Sorption of the radionuclide on the geological material is usually determined by measuring the decrease in the solute/radionuclide concentration (i.e., activity in the solution) over this period of time. Corrections for removal of the solutes from solution by processes other than sorption on the geological surface - either by sorption on the walls of the container or by precipitation or colloid formation - may or may not be made, depending on the sophistication of the experimental approach (Vandergraaf, 1982).

Sorption coefficients can be determined during the desorption as well as during the sorption step. In the desorption step the geological material with the sorbed solute/radionuclide is contacted with a solution containing no solute/radionuclide of interest, and the degree of desorption determined from the increase in the activity of the solution.

The coefficients obtained during the sorption and desorption steps are not necessarily the same. Irreversible processes such as precipitation and incorporation of solute/radionuclides into the crystal lattice of the minerals during the "sorption" step may make new nuclides unavailable for subsequent desorption.

2.12.2 Test Equipment and Procedures

Sorption tests will be conducted on samples of aquifer soils obtained during Task 6-Installation of monitoring wells. Unconfined aquifer soils from the same borehole will be composited. Sorption tests will be run in triplicate for composited soils. The boreholes in which unconfined aquifer soils will be tested include:

- E33-31
- E33-33
- 50-53
- 52-54
- 55-55
- 52-57

Sorption tests will be conducted using actual groundwater collected from the unconfined aquifer. Two types of groundwaters will be used:

1) Groundwater not containing detectable parameters of interest. Groundwater sampling and analysis during Task 7-Groundwater Sampling and Analysis will define which well should be used for this groundwater type.

2) Groundwater containing relatively high concentrations of parameters of interest (possibly from well 50-53).

Initially, test soils will be flushed with distilled and deionized water. The purpose of soil flushing is to flush existing groundwater and desorp existing contaminants from the aquifer soil matrix. Distilled and deionized water will be flushed through the test soils. The volume of distilled and deionized water shall be 10 times the volume of soils. Samples of flush water will be screened (Level I) regularly for alpha and beta/gamma radiation using scintillation detectors, pH, and nitrate using ion specific electrodes. After flushing the test soils will be drained then analyzed for the parameters of interest (level III analytical methods and procedures) to establish baseline/residual concentration prior to the sorption test.

Sorption tests will next be conducted using the "contaminated" groundwater type. Test soils will be transferred to 1-L test vials, which are glass and equipped with airtight septum caps. The ratio of test soil and groundwater will be 1.0 for each test. The test vial will be filled with groundwater and not contain entrained air. The test materials in the vials will be continuously agitated for the duration of each test. Contaminated water will be regularly screened using ion specific electrodes and scintillation detectors (Level I Analysis) and periodically sampled and analyzed for parameters of interest (Level III Analytical Methods and Procedures). The desorption step will be performed on all test soils after draining the "contaminated" water (distilled water flush should not be conducted). The desorption step will be conducted in the same manner as the sorption step except "clean" groundwater will be used instead of "contaminated" groundwater. The desorption step will determine whether irreversible processes exist.

Figure 2-10 is an illustration of the test procedure. Between each sorption/desorption step, the geological material is transferred and the vial itself is analyzed for radionuclide sorption on the vial wall and corrections are applied to the calculation of the sorption/desorption coefficient. Nitric acid solution (pH < 2) shall be used to extract absorbed metals and radionuclides from the vial for analysis.

Details on the test procedures, equipment and calibration requirements, analytical methods will be provided by the participant contractor or subcontractor as described in the QAPP.

The sorption coefficient (K_d) will be estimated from the following:

$$K_d(\text{mL/g}) = \frac{\text{Activity sorbed/g material}}{\text{Activity in solution/mL solution}}$$

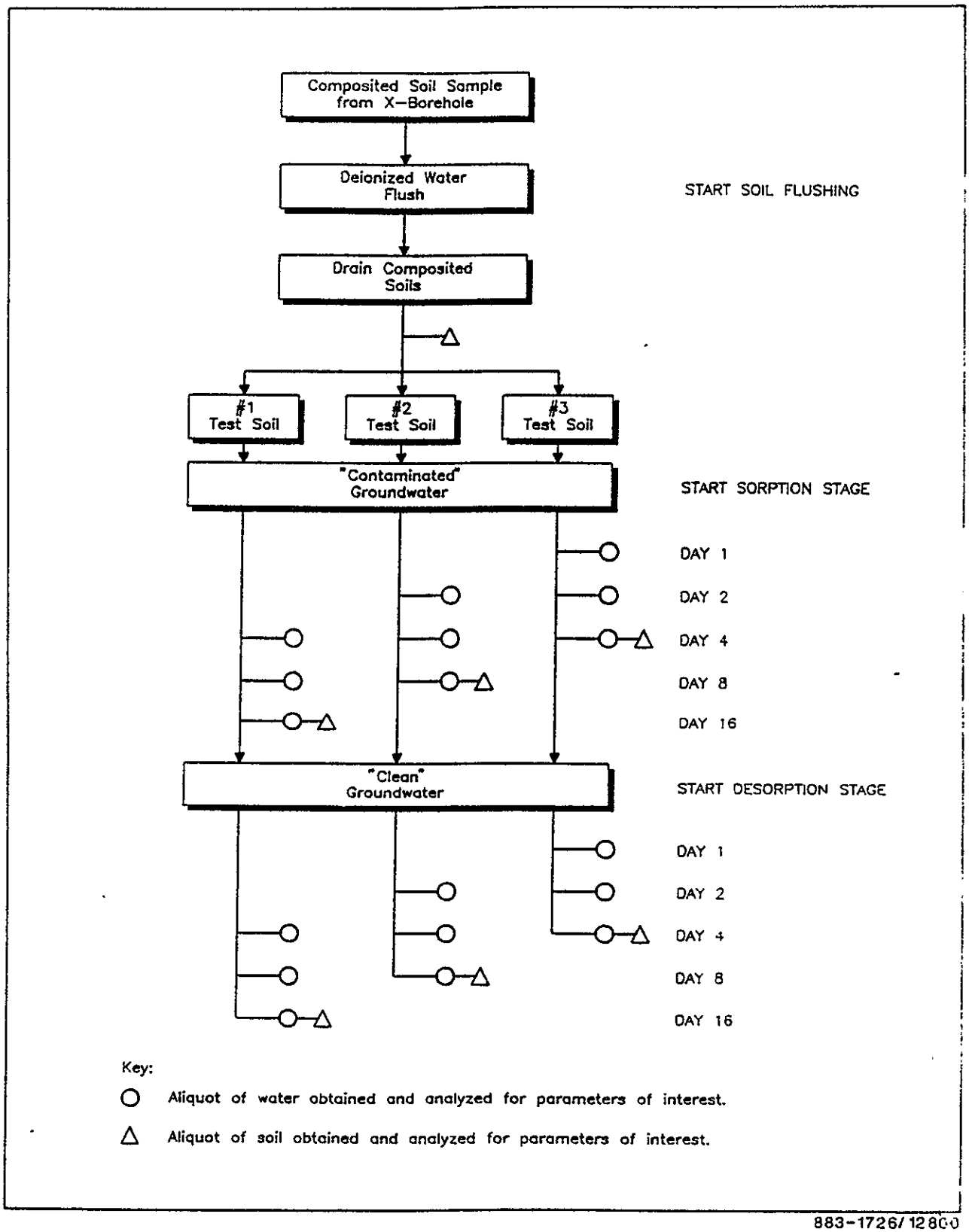

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Figure 2-10. Illustration of the Sorption Test Procedure for Aquifer Soils from Borings

2.13 TASK 13 - BASELINE RISK ASSESSMENT

Baseline risk assessments provide an evaluation of the potential threat to human health and the environment in the absence of any remedial action. They provide the basis for determining whether or not remedial action is necessary and the justification for performing remedial actions. The risk assessment will not obtain environmental samples or measurement data, but will utilize data obtained during other tasks.

2.14 TASK 14 - EVALUATION AND REPORT

This task summarizes and presents conclusions and evaluations from Phase I Remedial Investigation. Environmental samples or measurement data will not be obtained as part of this task.

3.0 DECONTAMINATION EQUIPMENT AND PROCEDURES

All drilling rigs and equipment will be decontaminated prior to commencement of drilling activities, relocation to a new boring, or demobilization. Drilling equipment will be steam cleaned in a designated decontamination area within close proximity to the drill site. This decontamination area will be overlain with an impermeable cover. Any waste water resulting from decontamination will be collected and stored in steel drums (or equivalent) and disposed of properly. Decontamination for drilling equipment will be in accordance with Westinghouse Hanford procedures on field decontamination of drilling equipment. Additional radiological decontamination procedures will be instituted and directed by the Radiation Protection Technologist as required.

All site personnel will be required to wear protective clothing as designated in the Health and Safety Plan. A decontamination station will be set up at the boundary of the designated working area. All personnel entering the designated working area will be required to remove all protective gear. Wash and rinse basins, equipped with brushes, will be provided for cleaning boots and other reusable protective gear. Facilities will also be provided for the collection of all disposable protective gear.

All nondedicated sampling equipment which comes into contact with samples (e.g., split tube sampler, catch pans, etc.) will be decontaminated prior to and between collection of samples. Decontamination solutions will be captured and stored in steel drums (or equivalent) and disposed of properly. Decontamination will be conducted in accordance with Westinghouse Hanford procedures on decontamination of equipment for RCRA/CERCLA sampling. All decontaminated sampling equipment will be dried and stored in accordance with this procedure to prevent further contamination. Clean protective gloves will be worn by all personnel when handling sampling equipment which comes in contact with the collected sample.

4.0 REFERENCES

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ATTACHMENT 1b

QUALITY ASSURANCE PROJECT PLAN

9 0 1 1 7 1 1 1 2 4 3

QUALITY ASSURANCE PROJECT PLAN FOR PHASE 1 ENVIRONMENTAL INVESTIGATIONS IN THE 200-BP-1 OPERABLE UNIT

Revision -0-

Westinghouse Hanford Company
Environmental Engineering and Technology Function
Richland, Washington

9 0 1 1 7 1 1 2 4 9

Approved by:

US EPA Unit Manager_____ Date:_____

US EPA QA Officer_____ Date:_____

State of Washington Department of
Ecology Unit Manager_____ Date:_____

State of Washington Department of
Ecology QA Officer_____ Date:_____

US DOE Unit Manager_____ Date:_____

US DOE QA Officer_____ Date:_____

WHC/EE&T Function Manager:_____ Date:_____

WHC/EE&T Technical Lead:_____ Date:_____

WHC QA Officer: _____ Date:_____

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1.0 PROJECT DESCRIPTION

1.1 PROJECT OBJECTIVE

The primary objective of the environmental investigations in the 200-BP-1 Operable Unit is to further define the extent and location of sources of radioactive contamination and other inorganic and volatile and nonvolatile organic contaminants in the vadose zone and underlying aquifers. Data resulting from this investigation will be evaluated to determine the most feasible options for remediation or closure.

1.2 BACKGROUND INFORMATION

The 200-BP-1 Operable Unit covers approximately 10 hectares (25 acres) located within the 200 East Area of the Hanford Site, as shown on Figure 1-1. Detailed background information regarding the history and present use of the unit is provided in Section 2.0 of the 200-BP-1 Operable Unit work plan.

1.3 QA PROJECT PLAN APPLICABILITY AND RELATIONSHIP TO WESTINGHOUSE HANFORD QA PROGRAM

This quality assurance project plan (QAPP) applies specifically to the Phase 1 field activities and laboratory analyses performed as part of environmental investigations in the 200-BP-1 Operable Unit. It is an element of the Sampling and Analysis Plan (SAP) prepared specifically for this unit investigation, and is prepared in compliance with Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Draft) (EPA, 1988b) and the overall quality program requirements of the Westinghouse Hanford Company as discussed in Section 1.4 of the work plan. Distribution and revision control of the QAPP will be performed in compliance with standard Westinghouse Hanford procedures. QAPP distribution shall routinely include all review/approved personnel and all other individuals designated by the Westinghouse Hanford Technical Lead. All other plans or procedures referenced in the QAPP are available for regulatory review upon request by the direction of the Technical Lead.

1.4 SCHEDULE OF ACTIVITIES

The investigations that will be conducted in the 200-BP-1 Operable Unit will be subdivided into two or more discrete phases and a number of individual tasks. Since the results of the task activity in an individual phase may significantly affect the technical activities planned for subsequent phases, this QAPP shall undergo mandatory review after completion of each phase and be updated or modified as to accommodate any required revisions in the scope of work. This version of the QAPP applies specifically to Phase 1 of the Remedial Investigation (RI).

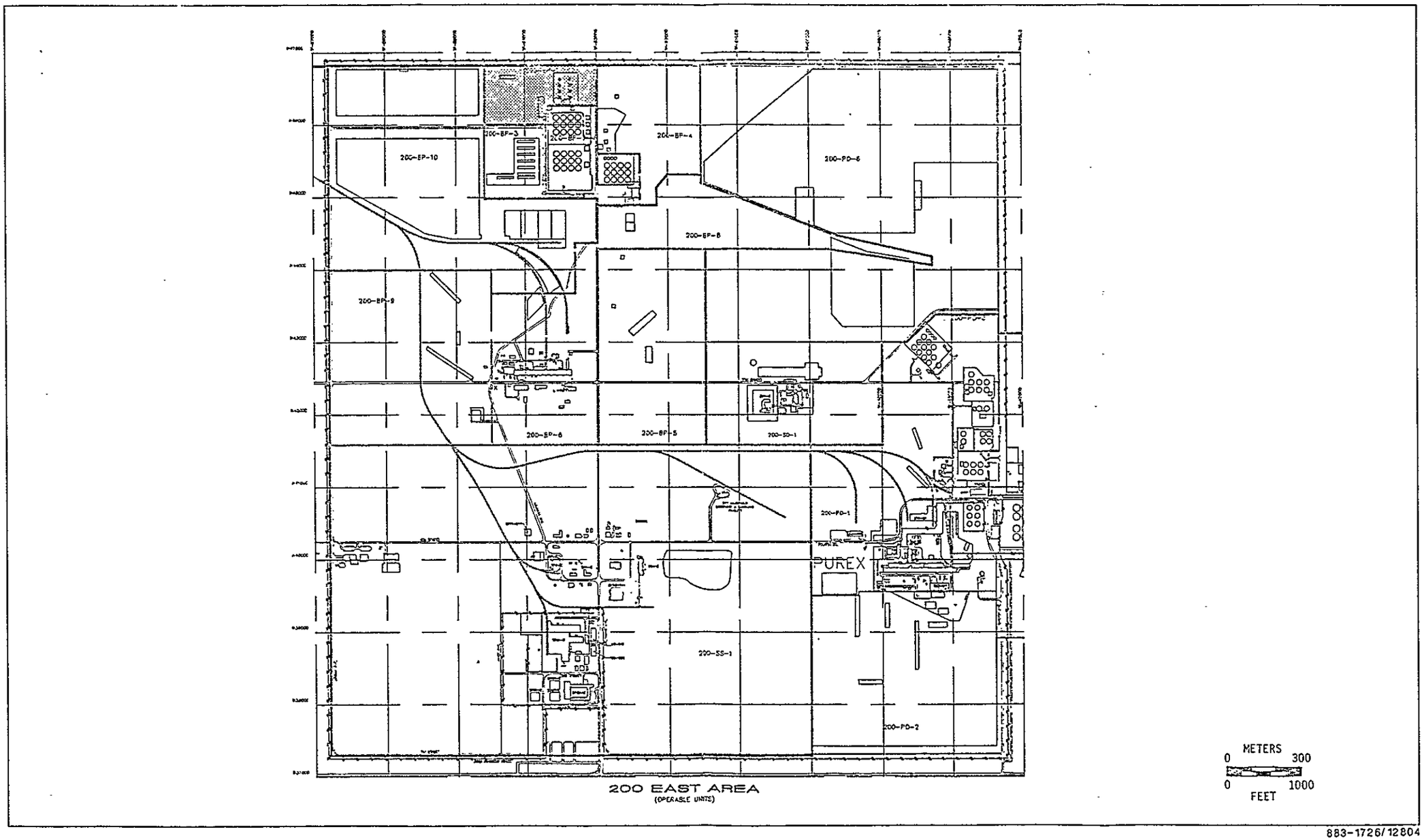

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Figure 1-1. Location of 200-BP-1 Operable Unit

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Individual task scopes for Phase 1 are listed and briefly described below; more detailed discussions are contained in Section 5.1 of the work plan. Procedures applicable to the tasks described here are discussed in Section 4.0 and Table 4-1. All sample analyses will be conducted as described in Section 3.0, Table 3-1, and Section 7.0.

Task 1: Project Management Task 1 consists of Phase I management activities, including schedule preparation, cost control, and coordination of activities with subcontractors, participant contractors, EPA, Ecology, and DOE.

Task 2: Source Sampling and Analysis Task 2 is a soil sampling, geophysical borehole logging, and surveying program that will be completed in the more contaminated crib areas.

Task 3: Surface and Near-Surface Soil Sampling and Analysis; Task 3 involves surface and subsurface scintillation surveying, evaluation and testing of leak detection techniques, surface and subsurface soil sampling, soil sample analysis, and geodetic surveying.

Task 4: Vadose Zone Sampling and Analysis; Task 4 is a soil sampling and analysis program conducted in the vadose zone. Archive samples will be retained for potential testing under Phase II. Task activity will include geophysical borehole logging and soil sample analysis.

Task 5: Seismic Refraction Survey At the direction of the Technical Lead, a seismic refraction survey will be performed by an approved subcontractor or participating contractor.

Task 6: Installation of Monitoring Wells Several new monitoring wells will be designed and installed at various horizons within the underlying aquifer; new wells will be surveyed and geophysically logged.

Task 7: Groundwater Sampling and Analysis Task 7 is a groundwater sampling program using existing and newly installed wells; special analytical methods will be developed for cyanide, ruthenium-106, and redox potential.

Task 8: Site Topographic Map A geodetic survey shall be performed by an approved participant contractor or subcontractor. The information obtained from the survey will be used to update existing site maps in the areas investigated.

Task 9: Biota Evaluation At the direction of the Technical Lead, an evaluation of biota will be conducted by an experienced biologist, qualified in accordance with appropriate Environmental Investigations Instructions (EII) requirements, and recommendations made for optional biotic sampling activities.

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Task 10: Column Leach Test At the option of the Technical Lead, column leach test procedures will be prepared and testing performed to determine the relative mobility of analytes in the vadose zone due to meteoric water infiltration.

Task 11: Hydraulic Pump Tests Slug tests and drawdown and recovery pump tests will be conducted at selected wells.

Task 12: Sorption Tests At the option of the Technical Lead, sorption test procedures will be developed and testing performed to obtain additional information regarding the partitioning of analytes between the aquifer matrix and the water phase.

Task 13: Baseline Risk Assessment A study will be completed that identifies and assesses the risks associated with potential remedial measures.

Task 14: Data Evaluation and Phase I Remedial Investigation Report A report will be prepared that analyzes the results of Phase I investigations, summarizes the results from the baseline risk assessment, and provides recommendations for any additional (Phase II) investigations prior to undertaking remediation.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 TECHNICAL LEAD RESPONSIBILITIES

The Environmental Engineering and Technology (EE&T) Function of Westinghouse Hanford has primary responsibilities for conducting this investigation. Organizational charts are included in the Project Management Plan for this operable unit which define personnel assignments and individual Westinghouse Hanford Field Team structures applicable to the various types of tasks included in Phase I.

External participant contractors or subcontractors shall be evaluated and selected for certain portions of task activities at the direction of the Technical Lead in compliance with standard Westinghouse Hanford procedures for supplier evaluation and procurement. Major participant contractor and subcontractor resources are listed in Figure 2-2 of the Project Management Plan. All contractor plans and procedures shall be approved prior to use, and shall be available for regulatory review after Westinghouse Hanford approval. All analytical procedures shall be reviewed and approved by the Westinghouse Hanford Analytical Laboratories organization.

2.2 ANALYTICAL LABORATORIES

The appropriate Westinghouse Hanford field sampling team will be responsible for screening all samples for gross alpha and, beta/gamma radioactivity, and for separating samples into two groups for further analysis. Samples with activity greater than or equal to 200 counts per minute are expected to be confined to soil samples except in the most unusual cases; they will be routed to an appropriately equipped Westinghouse Hanford or other Hanford Site participant contractor laboratory which will perform

chemical analysis to the extent of its capabilities. Extensive facility upgrades are planned for FY89, and as additional analytical capabilities for both radioactive and nonradioactive hazardous samples are developed and approved, analytical laboratory procedures will be prepared and updated in compliance with standard Westinghouse Hanford procedural controls. Samples with activity below 200 counts per minute shall be routed to an approved participant contractor or subcontractor. All analyses shall be performed in compliance with Westinghouse Hanford-approved laboratory QA plans and analytical procedures, subject to standard internal and external quality auditing and surveillance controls. For subcontractors or participant contractors, applicable quality requirements shall be invoked as part of the approved procurement documentation or participation agreement. Services of alternate qualified laboratories may be procured for the performance of split sample analysis at the Technical Lead's option (see Section 9.1) in compliance with standard Westinghouse Hanford procurement control procedures. If such an option is selected, the laboratory QA plan and applicable analytical procedures must be approved prior to their use.

2.3 OTHER SUPPORT CONTRACTORS

Procurements of all other contracted field activities shall be in compliance with procedure reference requirements as discussed in 2.1 and 2.2 above. All work shall be performed in compliance with Westinghouse Hanford-approved QA plans and/or procedures, subject to standard internal and external quality auditing and surveillance controls. Applicable quality requirements shall be invoked as part of the approved procurement documentation or work order.

3.0 OBJECTIVES FOR MEASUREMENTS

Data quality objectives for the 200-BP-1 operable unit are summarized in Table 4-1 of the Work Plan. Additional analytical data based on soil and groundwater sampling activities will be obtained and evaluated in order to further characterize the nature and extent of radioactive and hazardous contamination, and to determine the most feasible options for remediation. The analytes of interest for this operable unit include radionuclides, ions, inorganic metals, volatile organic compounds, and extractable organic compounds. Analytical data will be obtained at several different levels, based on the criteria provided in Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process (EPA, 1987a), and are described as follows:

Level V: Nonstandard methods will be required for the analysis of ruthenium 106 and cyanide compounds. Analyses will be performed onsite by a suitably equipped and qualified Westinghouse Hanford or participant contractor laboratory. Laboratories may or may not be Contract Laboratory Program (CLP) qualified, and new or modified analytical methods will be required. Detection limits, precision, and accuracy will be specific to individual methods, which must be prepared, reviewed, and approved prior to use in compliance with the standard Westinghouse Hanford procurement control and/or procedure control procedures. The method developed or modified for ruthenium 106 must be capable of

detection limits at or below Minimum Concentration Limit (MCL) standards for drinking water as defined in 40 CFR 141.

Level IV: CLP Routine Analytical Services (RAS) methods are acceptable for all analyses of inorganic metallic, volatile organic, and extractable organic compounds. All such analyses shall be performed onsite or offsite by a CLP-qualified laboratory, based on the results of Level I radiation screening as described below. Participant contractor or subcontractor services shall be controlled through applicable Westinghouse Hanford procurement and work control procedures.

Level III: Level III analyses will be acceptable for ions and radionuclides. All such analyses shall be performed onsite or offsite by appropriately equipped Westinghouse Hanford, participant contractor, or subcontractor laboratories, based on the results of Level I radiation screening as described below. Analytical detection limits, precision, and accuracy shall be specified in the analytical method, which shall be reviewed and approved prior to use in compliance with standard Westinghouse Hanford procurement control and/or procedure control procedures.

Level I: Soil samples shall undergo field screening to determine gross alpha and beta/gamma radiation. Samples exhibiting radioactivity greater than 200 counts per minute will be automatically routed to an appropriately equipped and qualified onsite Westinghouse Hanford or participant contractor laboratory for analysis. Screening shall be performed by qualified Westinghouse Hanford Radiation Protection Technologists as specified in governing procedures.

As noted in Section 4.6 of Data Quality Objectives for Remedial Response Activities: Volume I, Development Process (EPA, 1987a), universal goals for precision, accuracy, representativeness, completeness, and comparability (PARCC parameters) cannot be practically established at the outset of an investigation. Historical data are available, however, that may be used as minimum guidelines for selection or preparation of analytical methods appropriate for this investigation. Table 3-1 provides general guidelines and reference sources for method detection limits, precision, and accuracy as available for each analyte of interest. Once individual laboratory statements of work are negotiated, and procedures are developed and approved in compliance with standard Westinghouse Hanford procurement control procedures. Table 3-1 shall be revised to reference approved detection limit, precision, and accuracy criteria as project requirements.

Goals for data representativeness are addressed qualitatively by the specification of sampling locations and intervals within the Field Sampling Plan (FSP) for this operable unit. Objectives for completeness for this investigation shall require that contractually or procedurally established requirements for precision and accuracy be met for at least 80 percent of the total number of requested determinations. Failure to meet this criterion shall be documented as a nonconformance, subject to corrective action as required by applicable Westinghouse Hanford procedures. Approved analytical procedures shall require that use of standard reporting techniques and units wherever possible to facilitate the comparability of data sets in terms of precision and accuracy.

Table 3-1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 200-BP-1 Operable Unit (sheet 1 of 8)

Category of Analysis	Analyte of Interest	Analytical Level(1)	Analytical Method	MDC(2)	Precision (soil)	Accuracy (soil)	MDL(3)	Precision (water)	Accuracy (water)	Comments
Radiation Screening	Gross Alpha	I	(4)	N/A	N/A	N/A	N/A	N/A	N/A	(6)
	Gross Beta/Gamma	I	(4)	N/A	N/A	N/A	N/A	N/A	N/A	(6)
Radionuclide Analysis	STRONTIUM 90	III	(4)	(5)	(5)	(5)	N/A	N/A	N/A	(6)
	TRITIUM	III	(4)	(5)	(5)	(5)	N/A	N/A	N/A	(6)
	URANIUM	III	(4)	(5)	(5)	(5)	N/A	N/A	N/A	(6)
	PLUTONIUM	III	(4)	(5)	(5)	(5)	N/A	N/A	N/A	(6)
	COBALT 60	III	(4)	(5)	(5)	(5)	N/A	N/A	N/A	(6)
	RUTHENIUM 106	V	(4)	(5)(7)	(5)	(5)	N/A	N/A	N/A	(6)
	TECHNETIUM 99	III	(4)	(5)	(5)	(5)	N/A	N/A	N/A	(6)
Inorganic Analysis	ALUMINUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	ANTIMONY	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	BARIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	BERYLLIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	BORON	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	CADMIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	CALCIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	CHROMIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	COBALT	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	COPPER	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	IRON	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	LITHIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	MAGNESIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	MANGANESE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	MOLYBDENUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	NICKEL	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)

Table 3-1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 200-BP-1 Operable Unit (sheet 2 of 8)

Category of Analysis	Analyte of Interest	Analytical Level(1)	Analytical Method	MDC(2)	Precision (soil)	Accuracy (soil)	MDL(3)	Precision (water)	Accuracy (water)	Comments
Inorganic Analysis (continued)	POTASSIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	SILICON	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	SILVER	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	TITANIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	SODIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	STRONTIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	TIN	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	VANADIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	ZINC	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	ZIRCONIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	ARSENIC	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	LEAD	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	MERCURY	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	SELENIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	THALLIUM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
	FERRICYANIDE	V	(4)	(5)	(5)	(5)	(5)	(5)	(5)	(6)
	FERROCYANIDE	V	(4)	(5)	(5)	(5)	(5)	(5)	(5)	(6)
	FREE CYANIDE	V	(4)	(5)	(5)	(5)	(5)	(5)	(5)	(6)
	NITRATE	IV	CLP(8)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	SULFATE	IV	CLP(8)	(8)	(8)	(8)	(8)	(8)	(8)	(6)

Table 3-1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 200-BP-1 Operable Unit (sheet 3 of 8)

Category of Analysis	Analyte of Interest	Analytical Level(1)	Analytical Method	MDC(2)	Precision (soil)	Accuracy (soil)	MDL(3)	Precision (water)	Accuracy (water)	Comments
Volatile Organic Analysis (continued)	BENZENE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	CARBON TETRACHLORIDE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	CHLOROFORM	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	P-DICHLOROBENZENE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,1 DICHLOROETHANE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,2 DICHLOROETHANE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	TRANS-1,2 DICHLOROETHYLENE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	METHYL ISOBUTYL KETONE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	METHYLETHYL KETONE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	METHYLENE CHLORIDE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	TETRACHLOROETHYLENE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	TOLUENE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,1,1-TRICHLOROETHANE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,1,2-TRICHLOROETHANE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	TRICHLOROETHYLENE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	VINYL CHLORIDE	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	XYLENE (TOTAL)	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	acetonitrile (9)	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	acrolein	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	acrylonitrile	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	allyl chloride	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	bis (chloromethyl) ether	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	bromoacetone	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	bromodichloromethane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	bromoform	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	carbon disulfide	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	chlorobenzene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)

Table 3-1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 200-BP-1 Operable Unit (sheet 4 of 8)

Category of Analysis	Analyte of Interest	Analytical Level(1)	Analytical Method	MDC(2)	Precision (soil)	Accuracy (soil)	MDL(3)	Precision (water)	Accuracy (water)	Comments
Volatile Organic Analysis (continued)	chloroethane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2-chlorethyl vinyl ether	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	chloromethyl methyl ether	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	crotonaldehyde	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	dibromochloromethane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,2-dibromo-3-chloropropane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,2-dibromomethane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	dibromomethane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,4-dichloro-2-butene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	dichlorodiflouromethane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,2-dichloropropane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,3-dichloropropene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,2-dimethylhydrazine	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,1-Dimethylhydrazine	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,4-dioxane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	ethyl benzene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	ethylene oxide	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	ethyl methacrylate	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	formaldehyde	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2-hexanone	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	iodomethane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	methacrylonitrile	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	methanethiol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	methyl chloride	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	methyl bromide	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	methylene chloride	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	n,n-diethylhydrazine	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)

Table 3-1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 200-BP-1 Operable Unit (sheet 5 of 8)

Category of Analysis	Analyte of Interest	Analytical Level(1)	Analytical Method	MDC(2)	Precision (soil)	Accuracy (soil)	MDL(3)	Precision (water)	Accuracy (water)	Comments
Volatile Organic Analysis (continued)	pentachloroethane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	propionitrile	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	pyridine	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,1,1,2-tetrachlorethane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,1,2,2-tetrachlorethane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	trans-1,2-dichloroethene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	trichloromethanethiol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	trichloromonoflouromethane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,2,3-trichloropropane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	styrene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	vinyl acetate	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
Extractable Organics Analysis	N-Nitrosodimethylamine	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Phenol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Aniline	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	bis (2-Chloroethyl) Ether	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2-Chlorophenol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,3-Dichlorobenzene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,4-Dichlorobenzene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Benzyl Alcohol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,2-Dichlorobenzene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2-Methylphenol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	bis (2-Chloroisopropyl) Ether	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	4-Methylphenol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	N-Nitroso-dipropylamine	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Hexachlorethane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Nitrobenzene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)

Table 3-1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 200-BP-1 Operable Unit (sheet 6 of 8)

Category of Analysis	Analyte of Interest	Analytical Level(1)	Analytical Method	MDC(2)	Precision (soil)	Accuracy (soil)	MDL(3)	Precision (water)	Accuracy (water)	Comments
Extractable Organic Analysis (continued)	Isophorone	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2-Nitrophenol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2,4-Dimethylphenol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Benzoic Acid	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	bis(2-Chloroethoxy)methane	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2,4-Dichlorophenol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	1,2,4-Trichlorobenzene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Naphthalene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	4-Chloronaline	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Hexachlorobutadiene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	4-Chloro-3-methylphenol (para-chloro-meta-cresol)	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2-Methylaphthalene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Hexachlorocyclopentadiene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2,4,6-Trichlorophenol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2,4,5-Trichlorophenol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2-Chloronaphthalene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2-Nitroanaline	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Dimethyl Phthalate	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Acenaphthylene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	3-Nitroaniline	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Acenaphthene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2,4-Dinitrophenol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	4-Nitrophenol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Dibenzofuran	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2,4-Dinitrotoluene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	2,6-Dinitrotoluene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)

Table 3-1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 200-BP-1 Operable Unit (sheet 7 of 8)

Category of Analysis	Analyte of Interest	Analytical Level(1)	Analytical Method	MDC(2)	Precision (soil)	Accuracy (soil)	MDL(3)	Precision (water)	Accuracy (water)	Comments
Extractable Organic Analysis (continued)	Diethylphthalate	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	4-Chlorophenyl Phenyl Ether	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Flourene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	4-Nitroaniline	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	4,6-Dinitro-2-methylphenol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	N-nitrodiphenylamine	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	4-Bromophenyl Phenyl Ether	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Hexachlorobenzene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Pentachlorophenol	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Phenathrene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Anthracene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Di-n-butylphthalate	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Fluoranthene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Benzidine	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Pyrene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Butyl Benzyl Phthalate	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	3,3'-Dichlorobenzidine	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Benzo(a)anthracene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	bis(2-Ethylhexyl)phthalate	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Chrysene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Di-n-octyl Phthalate	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Benzo(b)Fluoranthene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Benzo(k)Fluoranthene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Benzo(a)pyrene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Indenol(1,2,3-cd)pyrene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	DiBenz(a,h)anthracene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)
	Benzo(g,h,i)perylene	IV	CLP(8)(4)	(8)	(8)	(8)	(8)	(8)	(8)	(6)

Table 3-1. Analytical Level, Method Selection, Detection Limit, Precision, and Accuracy Guidelines for the 200-BP-1 Operable Unit (sheet 8 of 8)

Category of Analysis	Analyte of Interest	Analytical Level(1)	Analytical Method	MDC(2)	Precision (soil)	Accuracy (soil)	MDL(3)	Precision (water)	Accuracy (water)	Comments
Ion Analysis	CHLORIDE	III	ASTM-D-4327(4)	1 µg/g	per 4327	per 4327	500 µg/L	per 4327	per 4327	(6)
	FLUORIDE	III	ASTM-D-4327(4)	1 µg/g	per 4327	per 4327	500 µg/l	per 4327	per 4327	(6)
	PHOSPHATE	III	ASTM-D-4327(4)	1 MG/G	per 4327	per 4327	500 µg/l	per 4327	per 4327	(6)
	AMMONIUM	III	ASTM-D-4327(4)	1 µg/g	per 4327	per 4327	500 µg/l	per 4327	per 4327	(6)

(1) Analytical levels are as defined in Section 4.3.1 of Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process (EPA, 1987a) and Table 4-1 of the Work Plan for this operable unit.

(2) MDC refers to minimum detectable concentration in soil.

(3) MDL refers to minimum detection limit in water.

(4) Analytical methods shall be in compliance with approved WHC or WHC-approved participant contractor or subcontractor procedures. All procedures shall be reviewed and approved in compliance with applicable Westinghouse Hanford procedure control or procurement procedures.

(5) Minimum requirements for method detection levels, precision, and accuracy will be method-specific, and shall be negotiated and established in the procedure review and approval process.

(6) Analyses shall be performed by an approved WHC, participant contractor, or subcontractor laboratory; approvals shall address the analytical indicated level.

(7) Minimum detection limits shall be at or below MCL standards for drinking water as defined in 40 CFR 141.

(8) For all Level IV analyses, type of CLP RAS method and historically derived values for detection limits, accuracy, and precision are contained within Appendix F of Data Quality Objectives for Remedial Response Activities; Volume 1, Development Process (EPA, 1987a).

(9) Lower case indicates additional targeted constituents; identification and quantification shall be accomplished by forward search techniques using the EPA/NIH Mass Spectial Data Base.

4.0 SAMPLING PROCEDURES

4.1 PROCEDURE APPROVALS AND CONTROL

All procedures required for Phase I activities shall be approved in compliance with applicable Westinghouse Hanford procedures. Where Westinghouse Hanford Environmental Investigation Instructions (EIIs) are referenced, they shall be the latest approved versions. Where Westinghouse Hanford analytical laboratory procedures are referenced, they shall be the latest approved version defined within procedures manuals for the applicable facilities, reviewed and approved in compliance with standard procedures. Participating contractor or subcontractor QA plans and procedures shall be reviewed, approved and maintained as project quality records. All approved procedures are available for regulatory review on request by direction of the Westinghouse Hanford Technical Lead.

4.2 SAMPLING PROCEDURES

4.2.1 Soil Sampling

All soil sampling shall be performed in accordance with the EII for soil and sediment sampling. All boreholes shall be logged in compliance with the EII for geologic logging. Test pit sampling shall be in accordance with the auger or grab sample techniques described in the soil sampling EII. Sample numbers, types, location, and other site specific considerations shall be as defined by the Field Sampling Plan (FSP) prepared for this operable unit. Documentation requirements are contained within individual EIIs and the Data Management Plan (DMP). All procedures related to soil sampling are identified in Table 4-1 as applicable to individual tasks.

4.2.2 Groundwater Sampling

All groundwater sampling shall be performed by PNL under the supervision of the Westinghouse Hanford Field Team Leader in compliance with Westinghouse Hanford-approved procedures. The EII for chain of custody shall be invoked as procurement QA requirements in accordance with governing procurement control procedures. Documentation requirements shall be defined within approved PNL procedures and the DMP. All procedures related to groundwater sampling are identified in Table 4-1 as applicable to individual tasks.

4.2.3 Sample Container Selection

Sample container types and preservation requirements for Phase 1 of this investigation shall be specified by the FSP; sample container types, container preparation codes, preparation requirements, and special handling requirements are defined the EII for soil and sediment sampling. Similar requirements for groundwater sampling shall be contained within approved PNL procedures.

Table 4-1. Sampling and Investigative Procedures for Phase I Investigations in the 200-BP-1 Operable Unit
(Sheet 1 of 2)

Procedure Subject(1)	Task 2 Source Sampling and Analysis	Task 3 Surface Soil Sampling and Analysis	Task 4 Vadose Zone Sampling and Analysis	Task 5 Seismic Refraction Survey	Task 6 Installation of Monitoring Wells	Task 7 Groundwater Sampling and Analysis	Task 8 Site Topographic Map	Task 9 Biota Evaluation	Task 10 Hydraulic Pump Test	Task 11 Leach Test	Task 12 Sorption Test
Field Logbooks	X	X	X	X	X			X	X	X	X
Records Management	X	X	X	X	X	X	X	X	X	X	X
Preparation of Health and Safety Plans	X	X	X	X	X						
Chain of Custody	X	X	X		X			X		X	X
Soil and Sediment Sampling	X	X	X		X						
Biotic Sampling								X			
Field Decontamination of Drilling Equipment	X		X		X						
Decontamination of Equipment for RCRA/CERCLA Sampling	X	X	X		X						
Gross Gamma Geophysical Logging	X		X		X						
Hanford Geotechnical Library Control Sample Archiving)	X		X		X	X					
Activity Reports of Field Operations	X		X		X						
Groundwater Monitoring Well Maintenance					X						
Preparation of Groundwater Monitor Well Construction Specifications					X						
Groundwater Monitoring Well Maintenance					X						
Geologic Logging	X		X		X						
Aquifer Testing									X		
Groundwater Level Monitoring					X				X		
Disposal of Well Construction Development Waters					X				X		
Groundwater Sample Collection Procedures (see note 2)						X					
Borehole/Site Reclamation and Verification	X		X								
Borehole/Site Reclamation Activity Reports	X		X								

Table 4-1. Sampling and Investigative Procedures for Phase I Investigations in the 200-BP-1 Operable Unit (Sheet 2 of 2)

Procedure Subject(1)	Task 2 Source Sampling and Analysis	Task 3 Surface Soil Sampling and Analysis	Task 4 Vadose Zone Sampling and Analysis	Task 5 Seismic Refraction Survey	Task 6 Installation of Monitoring Wells	Task 7 Groundwater Sampling and Analysis	Task 8 Site Topographic Map	Task 9 Biota Evaluation	Task 10 Hydraulic Pump Test	Task 11 Leach Test	Task 12 Sorption Test
Surveying (Kaiser procedures, see note 2)	X	X	X	X	X		X				
Laboratory Analysis (WHC or U.S. Testing procedures; see note 2)	X	X	X		X	X		X		X	X
Seismic Refraction Procedure (3)				X							
Leach Test Procedure (3)										X	
Sorption Test Procedure (3)											X
Underground Utility Location (3)	X	X									
Underground Pipe Leak Detection (3)		X									
Soil Probe Installation and Monitoring (3)		X									
Additional Geophysical Logging Procedures (3) - neutron-epithermal-neutron - gamma-gamma - high resolution spectral gamma			X		X						

Notes:

(1) Procedures are WHC Environmental Investigations Instructions (EIIs) unless participant contractor or subcontractor procedures are indicated. All procedures listed are directly applicable to the performance or documentation of task activities. Other administrative EIIs that are applicable to all tasks address the following subjects:

- o preparation of EIIs
- o desk instruction preparation
- o deviations from EIIs
- o dosimetry
- o lock and tag requirements
- o pest control

(2) All participant contractor and subcontractor procedures shall be reviewed and approved by WHC prior to use; approved procedures are retained in project quality records and are available for regulatory review upon request at the direction of the technical lead. Laboratory analytical procedures are further defined in Section 3.0, Section 7.0, and Table 7-1.

(3) Procedures will be developed by WHC participating organizations, participant contractors, or subcontractors in compliance with the procurement control, procedure control, and test control requirements promulgated by Westinghouse Hanford. All procedures will be reviewed and approved by WHC prior to use, and shall be available upon request at the direction of the WHC Technical Lead.

(4) Analytical Level I radiation screening procedures shall be as specified by standard Westinghouse Hanford radiological protection operating procedures.

4.3 OTHER PROCEDURES

Other procedures that will be required specifically for this phase of the investigation are identified in Table 4-1 for each individual task. Documentation requirements shall be addressed within individual procedures and/or the DMP as appropriate. Analytical procedures are discussed in detail in Section 7.0 and are listed in Table 3-1.

4.4 PROCEDURE CHANGES

Should deviations from established EIIs be required to accommodate unforseen field situations, they may be authorized by the Field Team Leader in accordance with the requirements of the EII prepared to control deviation from EII requirements. Documentation, review, and disposition of instruction change authorization forms are defined within the EII. Other types of procedure change requests shall be documented as required by the Westinghouse Hanford procedures governing their preparation.

5.0 SAMPLE CUSTODY

5.1 CHAIN OF CUSTODY PROCEDURES

All samples obtained during the course of this investigation shall be controlled as required by the chain of custody EII from the point of origin to the analytical laboratory. Laboratory chain of custody procedures shall be reviewed and approved as required by Westinghouse Hanford procurement control procedures, and shall ensure the maintenance of sample integrity and identification throughout the analytical process. At the direction of the Technical Lead, requirements for return of residual sample materials after completion of analysis shall be defined in accordance with procedures defined in the procurement documentation to subcontractor or participant contractor laboratories. Chain of custody forms shall be initiated for returned residual sample as required by the approved procedures applicable within the participating laboratory. Results of analyses shall be traceable to original samples through the unique code or identifier specified in the FSP. All results of analyses shall be controlled as permanent project quality records as required by standard Westinghouse Hanford procedures and the Data Management Plan (DMP).

5.2 SAMPLE FLOW PROCESS

Sample flow activity applicable to this investigation will be coordinated with the Westinghouse Hanford office of Sample Management, and is shown schematically in Figure 5-1. All soil and water samples shall be screened for gamma/beta, and total alpha radiation in compliance with approved radiological protection and operational health physics procedures. If samples are retrieved using the dual wall core barrel method and borehole gamma scans by the Radiation Protection Technologist indicate elevated radiation levels, the inner core barrels will be sealed on site and delivered to an appropriate controlled facility for sample extraction in a hot cell or other appropriate

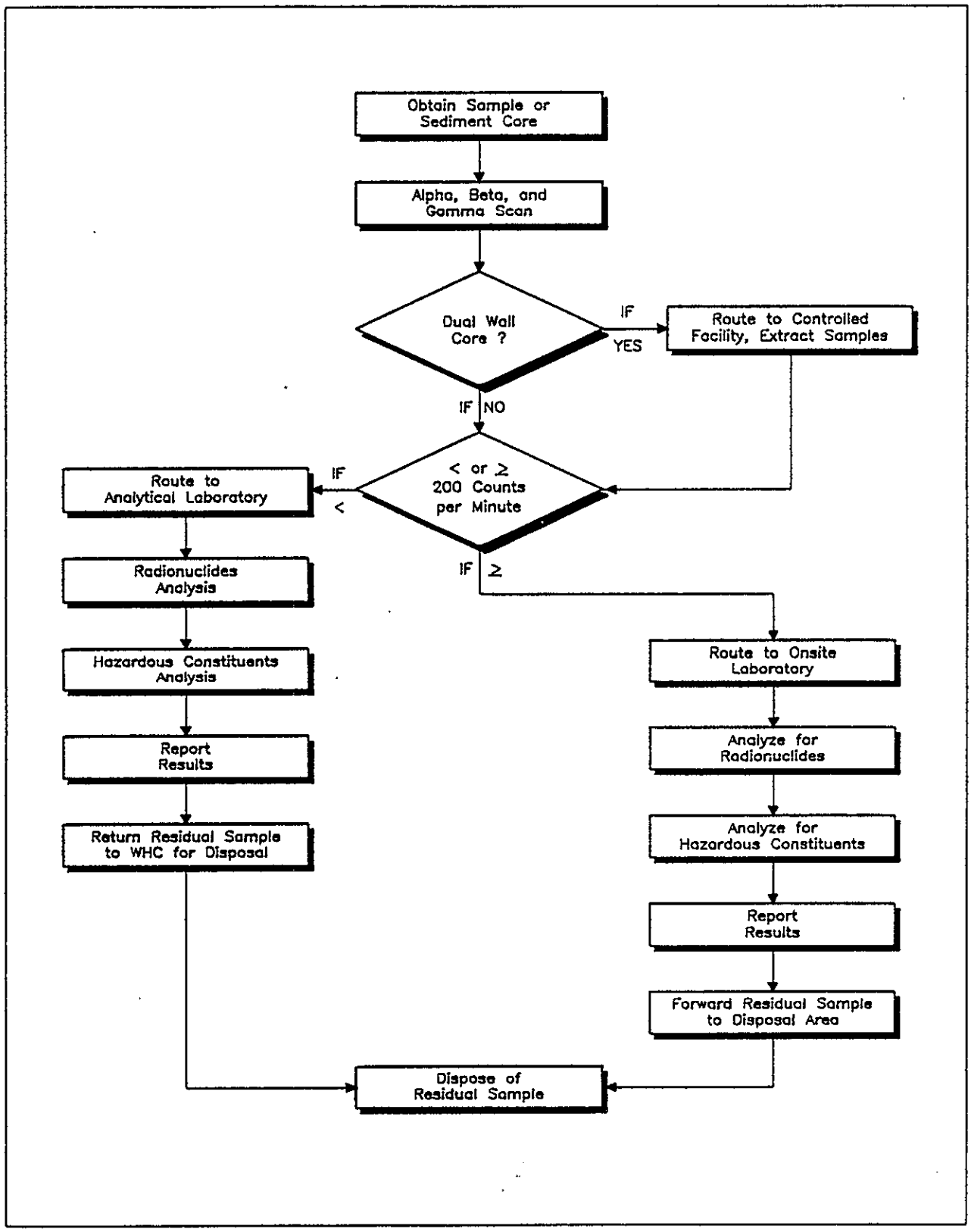

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Figure 5-1. 200-BP-1 Sample Flow Process

controlled facility. All samples with activity greater than or equal to 200 counts per minute will be analyzed by an appropriately equipped Westinghouse Hanford onsite participant contractor laboratory for radionuclide and hazardous constituents as described by Section 3.0, Table 3-1, and Section 7.0. Samples with activity greater than or equal to 200 counts per minute are expected to be confined to soil samples except in the most unusual cases. Samples with activity less than 200 counts per minute may be transported to approved subcontractors or participant contractors for full radionuclide and hazardous constituent analysis as described by Section 3.0, Table 3-1, and Section 7.0. All analyses shall be performed in compliance with Westinghouse Hanford-approved laboratory QA plans and analytical procedures, subject to standard Westinghouse Hanford internal and external quality auditing and surveillance procedures. Applicable quality requirements shall be invoked as part of the approved procurement documentation or participation agreement.

6.0 CALIBRATION PROCEDURES

Calibration of all Westinghouse Hanford measuring and test equipment, whether in existing inventory or purchased for this investigation, shall be controlled as required by Westinghouse Hanford calibration programs in compliance with the requirements of applicable Westinghouse Hanford procedures. Equipment that requires user calibration or field adjustment shall be calibrated as required by standard procedures for user calibration.

All calibration of Westinghouse Hanford or contractor laboratory measuring and test equipment shall meet the minimum requirements of Section II of Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses (EPA, 1988c) and Section III of Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses (EPA, 1988a). Such requirements shall be invoked through Westinghouse Hanford procurement control procedures.

7.0 ANALYTICAL PROCEDURES

Analytical methods or procedures for each analytical level identified in Table 3-1 of the work plan and Section 3.0 above shall be selected or developed and approved prior to use in compliance with appropriate Westinghouse Hanford procedure and/or procurement control requirements. As noted in Section 4.6 of Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process (EPA, 1987a), universal goals for precision, accuracy, representativeness, completeness, and comparability (PARCC parameters) cannot be practically specified at the outset of an investigation. Historical data for precision and accuracy are available for many analytes of interest, however, and shall be used as minimum guidelines for selection or preparation of analytical methods appropriate for this investigation. Table 3-1 provides general guidelines and reference sources for method detection limits, precision, and accuracy, as available for each analyte of interest and sorted by the required analytical level. Where guidelines are not available, statistical guidelines appropriate for determining precision and accuracy shall be developed, included in procedures, and submitted for Westinghouse Hanford review and approval. The guidance

provided in Appendix B, "Recommended Statistical Methods for Assessing Precision, Accuracy, and Completeness" may be used in such situations as appropriate for the development of procedural guidelines. Once individual laboratory statements of work are negotiated, and procedures are approved in compliance with appropriate Westinghouse Hanford requirements, Table 3-1 shall be revised to include actual method references, approved detection limit, precision, and accuracy criteria as project requirements.

All analytical procedures approved for use in this investigation shall require the use of standard reporting techniques and units wherever possible to facilitate the comparability of data sets in terms of precision and accuracy. All approved procedures shall be retained in the project QA records, and shall be available for regulatory review upon request by the direction the Westinghouse Hanford Technical Lead.

8.0 DATA REDUCTION, VALIDATION AND REPORTING

Analytical data from sampling activities will be used primarily to determine the presence and amounts of analytes of interest in the sampled locations or intervals. Analytical laboratories shall be responsible for the examination and validation of analytical results to the extent appropriate for each analytical level. The requirements discussed in this section shall be invoked, as appropriate, in procurement documentation prepared in compliance with standard Westinghouse Hanford procedures. Results from all Level III, IV and V analyses shall be summarized in a validation report and supported by recovery percentages, quality control checks, equipment calibration data, chromatograms, spectrograms, and other validation data. Specific validation criteria for Level III and V methods shall be as defined in the individual method. Requirements to be checked as part of the validation of Level IV analyses of volatile or semivolatile organic compounds shall meet the minimum requirements of Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses (EPA, 1988a) and are listed below:

- sample holding times
- gas chromatograph/mass spectrometer tuning or adjustment requirements
- initial and continuing calibration requirements
- blank sample requirements
- surrogate recovery requirements
- matrix spike/matrix spike duplicate requirements
- field duplicate requirements
- internal standards performance requirements
- target Compound List (TCL) compound identification requirements
- compound quantitation requirements and reported detection limits

- tentatively Identified Compounds (TIC) library search and assessment requirements
- system performance assessment requirements
- overall data assessment requirements.

Requirements to be checked as part of the validation of Level IV analyses of inorganic compounds shall meet the minimum requirements of Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses (EPA, 1988c) and are listed below:

- sample holding times
- calibration requirements
- blank sample requirements
- interference Check Sample (ICS) requirements
- laboratory Control Sample (LCS) requirements
- duplicate sample analysis
- matrix spike sample requirements
- furnace atomic absorption quality control requirements
- inductively coupled plasma (ICP) serial dilution requirements
- sample result verification requirements
- field duplicate sample requirements
- overall data assessment requirements.

All validation reports and supporting data shall be subjected to a detailed technical review by a qualified reviewer designated by the Westinghouse Hanford Technical Lead. All validation reports, technical reviews, and supporting data shall be retained as permanent project QA records in compliance with referenced procedures and the DMP.

9.0 INTERNAL QUALITY CONTROL

The quality of analytical samples shall be subject to in process quality control checks in the field and the laboratory; minimum requirements are defined as follows.

Unless otherwise specified in the Field Sampling Plan (FSP), minimum field quality control checks for sample activities shall include:

- Duplicate samples; a minimum of 10 percent of the total collected samples shall be duplicated.

- Split samples; at the Technical Lead's option, up to 50 percent of the total duplicate samples may be split and sent to an alternate laboratory as a check on the methods, precision, and accuracy of the primary laboratory.

- Method blank samples; the minimum number of blank samples shall be equivalent to 5 percent of the total number of collected samples. Blank sampling shall be evenly distributed throughout the entire sampling period.

Internal quality control checks performed by the analytical laboratories shall be in compliance with approved analytical procedure requirements or, for Level IV inorganic and organic analyses, the minimum requirements of Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses (EPA, 1988c) and Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses (EPA, 1988a), respectively. Should conflicts arise, the more stringent requirement shall apply. Where Level III or V analytical procedures are used, minimum laboratory quality control check requirements shall be established in procurement documentation or Work Orders through the control standard Westinghouse Hanford procedures. Minimum laboratory quality control checks shall be as follows:

- Duplicate samples; at least 5 percent of all received samples should be separated into aliquots for separate analysis.

- Spike samples; spike samples require the addition of a known quantity of a known compound to the sample as a test of analytical precision and as a measure of the recovery percentage. Spike quantities, compounds, and concentrations shall be at the laboratory's option, and shall be included in analytical procedures subject to Westinghouse Hanford review and approval.

10.0 PERFORMANCE AND SYSTEM AUDITS

Acceptable performance for this project is defined as compliance with the requirements of this QAPP, its implementing procedures and appendices, and associated plans such as the Field Sampling Plan, Data Management Plan, and other applicable Westinghouse Hanford quality assurance program plans. All activities addressed by this QAPP are subject to planned audits of project performance and systems adequacy at the onset of project activity, and near completion of each phase. Audits may be scheduled more often at the request of the Quality Coordinator or Technical Lead. Audits shall be conducted in accordance with appropriate Westinghouse Hanford procedures. Audit planning shall consider specific Westinghouse Hanford quality assurance program plan requirements, this QAPP, and all applicable Westinghouse Hanford, subcontractor, or participating contractor or subcontractor procedures.

After completion of initial system and performance audits, the activities addressed by this QAPP may be subjected to periodic surveillance in accordance with appropriate Westinghouse Hanford procedures. Surveillances shall be

scheduled at the discretion of the Quality Coordinator or Technical Lead. Discrepancies observed during surveillance that cannot be immediately corrected within the allowances of surveillance procedures shall be documented as nonconformances and dispositioned as required by applicable nonconformance control procedures. When unpredicted field situations require a deviation in EII provisions, they shall be authorized in compliance with the appropriate deviation request EII. Failure to repeat the technical activity when instruction change authorizations have been disapproved shall be automatically considered a nonconformance, subject to the reporting and corrective action controls described above.

11.0 PREVENTIVE MAINTENANCE

All measurement and testing equipment used in the field and laboratory that directly affects the quality of the analytical data shall be subject to preventive maintenance measures that ensure minimization of measurement system downtime. For this investigation, such measures are confined to laboratory equipment, since all field measurements are related either to the measurement of the sample interval or to the determination of radiological or other health and safety hazards. Laboratories shall be responsible for performing or managing the maintenance of their analytical equipment; maintenance requirements, spare parts lists, and instructions shall be included in individual methods or in laboratory QA plans, subject to Westinghouse Hanford review and approval.

12.0 DATA ASSESSMENT PROCEDURES

As discussed in Section 8.0 above, a data validation report shall be prepared by the analytical laboratory that summarizes the precision, accuracy, and completeness of the analysis; the report shall compare actual analytical results with the objectives stated in Section 3.0 above. If the stated objectives for a particular parameter are not met, the situation shall be analyzed, and limitations or restrictions on the uses of such data shall be established. The validation report shall be reviewed and approved by the Technical Lead, who may direct additional sampling activities if data quality objectives have not been met. The approved report shall be routed to the project quality records and included within the reports that will be prepared for submittal to the regulatory agencies at the completion of Phase I activities.

13.0 CORRECTIVE ACTION

Corrective action requests required as a result of surveillance reports, nonconformance reports, or audit activity shall be documented and dispositioned as required by standard Westinghouse Hanford corrective action procedures. Primary responsibilities for corrective action resolution are assigned to the Technical Lead and the QA Coordinator.

Other measurement system, procedures, or plan corrections that may be required as a result of routine review processes, shall be resolved as required by governing procedures or shall be referred to the Technical Lead for resolution. Copies of all surveillance, nonconformance, audit, and corrective action documentation shall be routed to the project QA records upon completion or closure.

14.0 QUALITY ASSURANCE REPORTS

As previously stated in Sections 10.0 and 13.0, project performance shall be regularly assessed by auditing and surveillance processes. Surveillance, nonconformance, audit, and corrective action documentation shall be routed to the project records upon completion or closure of the activity. A report summarizing all audit, surveillance, and instruction change authorization activity (see Section 4.4 above), as well as any associated corrective actions, shall be prepared by the QA Coordinator at the completion of Phase 1 or once annually, whichever is sooner. The report(s) shall be submitted to the Technical Lead for incorporation into the final report prepared at the end of Phase 1 of the investigation. The final report shall include an assessment of the overall adequacy of the total measurement system with regard to the data quality objectives of the investigation.

APPENDIX A:

GLOSSARY

Accuracy: For the purposes of environmental investigations, accuracy may be interpreted as the measure of the bias in a system. Accuracy is the degree of agreement of a measurement (or the average of a set of measurements with identical parameters) with an accepted reference or true value. Accuracy may be expressed as: 1) the difference between the measurement (X) with the reference value (T), i.e., X-T; or 2) the difference between the two values as a percentage of the reference value, i.e., 100(X-T)/T; or simply as the ratio X/T.

Comparability: For the purposes of environmental investigations, comparability is an expression of the relative confidence with which one data set may be compared with another.

Completeness: For the purposes of environmental investigations, completeness may be interpreted as a measure of the amount of data actually obtained from a measurement system against the amount that would be expected under correct normal conditions.

Deviation: For the purpose of environmental investigations, deviation refers to a planned departure from established criteria that may be required as a result of unforeseen field situations or that may be required to correct ambiguities in procedures that may arise in practical applications.

Nonconformance: A nonconformance is a deficiency in characteristic, documentation or procedure which renders the quality of material, equipment, services, or activities unacceptable or indeterminate. When the deficiency is of a minor nature, does not effect a permanent or significant change in quality if it is not corrected, and can be brought into conformance with immediate corrective action, it shall not be categorized as a nonconformance. However, if the nature of the condition is such that it cannot be immediately and satisfactorily corrected, it shall be documented in compliance with approved procedures and brought to the attention of management for disposition and appropriate corrective action.

Precision: For the purposes of environmental investigations, precision may be interpreted as a measure of relative agreement between individual measurements made with a common set of parameters or conditions. Precision is normally expressed in terms of the standard deviation.

Quality Assurance: For the purposes of environmental investigations, Quality Assurance (QA) refers to the total integrated quality planning, quality control, quality assessment, and corrective action activities that collectively ensure that the data from monitoring and analysis meets all end user requirements.

Quality Assurance Project Plan: The Quality Assurance Project Plan (QAPP) is an orderly assembly of management policies, project objectives, methods, and procedures that defines how data of known quality will be produced for a particular project or investigation.

Quality Control: For the purposes of environmental investigations, Quality Control (QC) refers to the routine application of procedures and defined methods to the performance of sampling, measurement, and analytical processes.

Representativeness: For the purposes of environmental investigations, representativeness may be interpreted as the degree to which data accurately and precisely expresses the actual characteristics of the environmental conditions at the sampled interval.

Validation: For the purposes of environmental investigations, validation refers to a systematic process of reviewing a body of data against a set of criteria to provide assurance that the data are acceptable for their intended use. Validation methods may include review of verification activities, editing, screening, cross-checking or technical review.

Verification: For the purposes of environmental investigations, verification refers to the process of determining whether procedures, processes, data, or documentation conform to specified requirements. Verification activities may include inspections, audits, surveillances, or technical review.

APPENDIX B

RECOMMENDED STATISTICAL METHODS FOR ASSESSING PRECISION, ACCURACY, AND COMPLETENESS

1.0 SCOPE

This attachment discusses various statistical methods and standard formulae suitable for inclusion in Westinghouse Hanford, participant contractor, or subcontractor laboratory analytical procedures for environmental investigations. Such methods are routinely used to assess the precision, accuracy, and completeness of measurement data within individual analytical procedures. The information provided by this attachment is intended for guidance only; all methods selected or proposed by an individual analytical laboratory for the assessment of data precision, accuracy, and completeness are subject to review and approval prior to use.

2.0 STATISTICAL METHODS AND FORMULAE

2.1 CENTRAL TENDENCY AND DISPERSION

Methods for determining central tendencies and dispersion of data may include determination of various statistical values, The **arithmetic mean** is the average of the sum of a set of n values divided by n;

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n} \qquad \text{(EPA, 1979)}$$

Range simply refers to the difference between the highest and lowest values reported for a sample (EPA, 1979). The **standard deviation** is the square root of the variance of the population;

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N} X_i^2 - \left(\sum_{i=1}^{N} X_i\right)^2 / N}{N}} \qquad \text{(EPA, 1979)}$$

The **standard deviation estimate** is the most widely used measure to describe the dispersion of a set of data, and is expressed as follows;

$$S = \sqrt{\frac{\sum_{i=1}^{n} X_i^2 - \left(\sum_{i=1}^{n} X_i\right)^2 / n}{n-1}} \qquad \text{(EPA, 1979)}$$

The **relative standard deviation** is the ratio of the standard deviation S of a set of numbers to their mean $\bar{X}$, expressed as a percentage; it relates the standard deviation (or precision) of a set of data to the size of the numbers;

$$\text{CV} = \text{RD (percent)} = 100\frac{S}{\bar{X}} \qquad \text{(EPA, 1979)}$$

Skewness is a measure of the asymmetry of a frequency distribution;

$$K = \frac{(X_i - \bar{X})^3}{n\sigma^3} \qquad \text{(EPA, 1979)}$$

The **geometric mean** is a measure of central tendency for data from a positively skewed distribution (log normal);

$$\bar{X}_g = \sqrt[n]{(X_1)(X_2)\ldots(X_n)}$$

$$\bar{X}_g = \text{antilog}\,\frac{\sum_{i=1}^{n} \log X_i}{n} \qquad \text{(EPA, 1979)}$$

2.2 ASSESSMENT OF DATA QUALITY

Accuracy may be interpreted as the measure of the **bias** in a measurement system; bias is a systematic error due to the experimental method that causes measured values to deviate from true values. Accuracy is the degree of agreement of a measurement (or the average of a set of measurements with identical parameters) with an accepted reference or true value. Accuracy may be expressed as: 1) the difference between the measurement (X) with the reference value (T), i.e., X-T; or 2) the difference between the two values as a percentage of the reference value, i.e., 100(X-Y)/Y; or simply as the ratio X/T. For the purposes of environmental investigations, **precision** may be interpreted as a measure of relative agreement or reproducibility between individual measurements made with a common set of parameters or conditions. Precision is normally expressed in terms of the **standard deviation**, but may also be expressed as the **relative standard deviation** (coefficent of variation)

individual measurements made with a common set of parameters or conditions. Precision is normally expressed in terms of the **standard deviation**, but may also be expressed as the **relative standard deviation** (coefficent of variation) or **range** (maximimum value minus minimum value; see the discussion in item 2.1 above). **Relative error** refers to the mean error of a series of measured data values as a percentage of the true value X_t;

$$\text{RE (percent)} = 100 \frac{|X - \bar{X}|}{X_t} \qquad \text{(EPA, 1979)}$$

For the purposes of environmental investigations, **comparability** is an expression of the relative confidence with which one data set may be compared with another; see item 2.4 below for a discussion of **confidence limits**. **Completeness** may be interpreted as a measure of the amount of data actually obtained from a measurement system against the amount that would be expected under correct normal conditions, and is expressed as follows;

$$\text{Completeness (\%)} = \frac{\text{Number of valid analyses (for each parameter)}}{\text{Number of samples analyzed (for each parameter)}} \; 100$$

For the purposes of environmental investigations on the Hanford Site, completeness is defined as an objective of meeting established requirements for precision and accuracy for at least 80 percent of the requested determinations.

2.3 SIGNIFICANCE TESTS

Significance testing refers to the various statistical means of checking distribution hypotheses. Such tests include the **Student-t test**, the **chi-squared test**, the **paired t-test**, and the **F-test**, and should be selected to suit the type of hypotheses. Detailed discussions of these types of tests may be found in standard statistics texts such as Probability and Statistics in Modern Engineering (Lapin, 1983) or Probability and Statistics for Engineers (Miller and Freund, 1965).

2.4 CONFIDENCE LIMITS

Confidence limits refer to the boundaries of a value interval with a designated probability (the **confidence coefficient**) of including some defined parameter of the sample population. The **confidence coefficient** is the probability that the value interval has of including the sample population values. The confidence coefficient is normally expressed as a percentage; for a given sample size, the distance between the confidence limits increases as the coefficient increases. The guidelines, tables, formulae, and figures of Appendix E, "Estimation Procedures", from Quality Assurance Handbook for Air

2.5 TESTING FOR OUTLIERS

Statistical tests are recommended for the screening of data sets for unusually large or small data values for elimination prior to the analysis or processing of data. The guidelines, tables, formulae, and figures of Appendix F, "Outliers", from Quality Assurance Handbook for Air Pollution Measurement Systems (EPA, 1987b) are recommended for selection of appropriate methods.

3.0 MATHEMATICAL TERMS

Mathematical terms used in the formulae discussed above are as follows (EPA, 1979:

K = skewness

N = population size (if finite) or lot size

n = number of items in the sample or test

S = standard deviation estimate

$\bar{X}$ = arithemtic mean

$\bar{X}_g$ = geometric mean of sample measurements

X_i = ith measurement, or the ith smallest measurement of a set of measurements arranged in ascending order

σ = population standard deviation

APPENDIX C

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ATTACHMENT 2

HEALTH AND SAFETY PLAN

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1.0 GENERAL CONSIDERATIONS AND REQUIREMENTS

1.1 INTRODUCTION

The purpose of this Health and Safety Plan (HASP) is to establish standard health and safety procedures for Westinghouse Hanford employees and contractors engaged in remedial investigation activities at the 200-BP-1 Operable Unit. These activities will include excavating and collecting soil samples from test pits, drilling and sampling approximately 40 shallow boreholes, and installing three deep (220-230 feet) boreholes in areas of known chemical and radiological contamination.

A brief pre-job safety plan (PJSP) as described in the Preparation of Health and Safety Plans EII will be prepared for each work site (e.g., crib, ditch, etc.) which will reiterate the following information for that specific site and task(s):

1. Inventory of suspected chemical and/or radiological hazards.
2. Discussion of existing and potential physical hazards.
3. Methods for mitigating known and potential site specific hazards.
4. Discuss and have employees sign their understanding of procedures and Job Safety Analysis (JSA).

Each PJSP will be reviewed by the Geotechnical Engineering Unit (GEU), Industrial Safety and Fire Protection (ISFP) and Engineering Field Services (EFS) prior to start up, and will serve as the agenda for a mandatory weekly "tail-gate" safety meeting.

The levels of protection and procedures specified in this plan are based on the best available information and represent the minimum health and safety requirements to be observed at all times by Westinghouse Hanford employees and their contractors while engaged in tasks associated with this project. Unknown conditions undoubtedly exist, and existing conditions may change. Should any situation arise which is obviously beyond the scope of the monitoring, personal protection, and decontamination procedures specified herein, work activities shall be halted pending discussion with the Westinghouse Hanford health and safety officer and Westinghouse Hanford management, and revision of specified health and safety procedures.

All Westinghouse Hanford employees and contractors engaged in onsite activities in the 200-BP-1 Operable Unit must read this document. Employees are encouraged to bring any questions or lingering concerns to the attention of the Field Team Leader or the Health and Safety Officer.

- Read this document carefully.
- Follow all specified health and safety procedures.
- Do not lose sight of the "everyday" hazards associated with all ("nonhazardous") field work, i.e., falls, slips, trips, cuts, overhead hazards, moving machinery, etc.

AND ABOVE ALL

- Use your own common sense and exercise reasonable caution at all times.

1.2 DESIGNATED SAFETY PERSONNEL

Personnel shall be named to the following positions and will be responsible for the functions of those positions at the site. This safety plan will not be considered complete until these positions are delegated by project management.

Field Team Leader _____

Health and Safety Officer _____

Drillers _____

Radiation Protection Technologists (RPTs) _____

Record Keeper _____

Geologist _____

Field Team Members _____

All activities on site must be cleared through the Field Team Leader. The Field Team Leader has responsibility for the following:

- Allocating and administering the resources to successfully comply with all technical and health and safety requirements;
- Verifying that all permits, supporting documentation and clearances are in place, i.e., electrical outage requests, welding permits, excavation permit, HASP, sampling plan, Radiation Work Permit (RWP), onsite/offsite RSR's (radiation shipping records), etc.;
- Providing technical advice during operations and emergencies;
- Informing the appropriate Site Management and Safety personnel of the activities to be performed each day;
- Resolving any conflicts that may arise between Radiation Work Permits and implementation of the Health and Safety Plan;
- Handling of emergency response situations as may be required;
- Conducting pre-job safety meeting and periodic tail-gate safety meetings;
- Approving all confined space entry.

The Health and Safety Officer is responsible for implementing the HASP at the site. The Health and Safety Officer shall:

- Monitor hazards (to include organic vapor detection) to determine the degree of hazard present when welding, painting or when inert gas cylinders are below grade and at 4 feet or lower, the area will be properly monitored as a confined space;

- Determine protection levels, clothing and equipment needed to ensure the safety of personnel in conjunction with the RPT;
- Monitor performance of all personnel to ensure that the required safety procedures are followed;
- Oversight of all confined space entry;
- Halt operations immediately, if necessary; and,
- Conduct safety briefings.

The Radiation Protection Technologist is responsible for assuring that all radiological monitoring and protection procedures are being followed as specified in the Westinghouse Hanford Radiation Work Permit. Industrial Safety and Fire Protection personnel will provide safety overview during drilling operations to be consistent with Westinghouse Hanford Policy and provide technical advice as requested. Also, an additional Industrial Hygienist may be requested to provide downwind sampling and other analyses beyond the scope of Westinghouse Hanford capabilities.

The ultimate responsibility and ultimate authority for employee health and safety lies with the employee himself, and his or her colleagues. Each employee is responsible for exercising the utmost care and good judgment in protecting his or her own health and safety and that of fellow employees. Should any employee observe a potentially unsafe condition or situation, it is the responsibility of that employee to immediately bring the observed condition to the attention of the appropriate health and safety personnel as designated above. In the event of an immediately dangerous or life threatening situation, the employee automatically has "stop-work" authority and the responsibility to immediately notify the Field Team Leader or the Health and Safety Officer.

1.3 MEDICAL SURVEILLANCE

All WHC personnel and contractors engaged in on site activities on the 200-BP-1 Operable Unit must have baseline physical examinations and be participants in Westinghouse Hanford's (or an equivalent) medical surveillance program.

Medical examinations will be designed to identify any pre-existing conditions which may place an employee at high risk, and will verify that each worker is physically able to perform the work required by this work plan without undue risk to his/her health. The physician shall determine the individuals radiation exposure history and conduct a background interview to determine whether the individual has a history of cancer or other conditions which may impact his/her ability to receive occupational radiation exposure. The physician shall determine the existence of conditions that may reduce the effectiveness or prevent the employee's use of self-contained breathing apparatus. The physician shall also determine the presence of conditions that may pose undue risk to the employee while performing the physical tasks of this work plan using level B personal protection equipment. This would include any condition that increases the employee's susceptibility to heat stress.

The examining physician's report will not include any non-occupational diagnoses unless directly related to the employee's fitness for the work required.

1.4 TRAINING

Prior to engaging in any on site remedial investigation activities, each team member is required to have received the equivalent of 40 hours of health and safety training related to hazardous waste site operations as specified in 29 CFR 1910.120. At a minimum this training must include the following topics:

- Employee rights and responsibilities under Occupational Safety and Health Administration.
- Personal protection equipment (PPE) and clothing, use and care, particularly fitting, operation and use of cascade breathing air systems and self-contained breathing apparatus (SCBA).
- Chemical and radiological hazard recognition.
- Radiation worker training.
- Emergency response, self-rescue and first aid.
- Vehicle operation; mandatory rules and regulations.
- Safe use of drilling and sampling equipment.
- Handling, storage and transportation of hazardous chemical and radioactive materials.
- Site control and management.
- Safe sampling techniques.
- Site surveillance, observation and safety plan development.
- Proper decontamination methods for personnel, protective clothing and equipment.
- Use of field test equipment for radioactivity, explosivity and other measurements as needed.
- Communication procedures.

The Field Team Leader and Health and Safety Officer will provide site specific instructions regarding anticipated hazards, levels of protection, site monitoring, and operation of equipment as appropriate.

In addition, each inexperienced employee will be accompanied by an employee experienced in characterization activities as required by the Westinghouse Hanford Introduction, Training and Qualification procedure.

The Field Team Leader and the Health and Safety Officer will receive an additional 8 hours of training to cover the following topics:

- Management of restricted and safe zones.
- Rules for handling untrained site visitors.
- Site management.
- Other environmental, safety and health topics which relate to the sampling and characterization effort.

1.5 REQUIREMENTS FOR THE USE OF RESPIRATORY PROTECTION

All employees who may be required to use air purifying or air supplied respirators must be included in the medical surveillance program and be approved for the use of respiratory protection by a licensed physician. Each team member must be trained in the selection, limitations, and proper use and maintenance of respiratory protection. Existing respiratory protection training may be applicable towards the 40-hour training requirement.

Finally, prior to using any air purifying respirator, each employee must be fit tested for the specific make, model, and size of respirator he or she will be using according to the qualitative and/or quantitative fit testing procedures set forth in Appendix C of the OSHA 29 CFR 1910.1001 asbestos regulations. Beards (including a few days growth), large sideburns or moustaches which may interfere with a proper respirator seal are not permitted.

2.0 GENERAL PROCEDURES

The following personal hygiene and work practice guidelines are intended to prevent injuries and adverse health effects. These guidelines represent the minimum standard procedures for reducing potential risks associated with this project and are to be followed by Westinghouse Hanford employees <u>at all times</u>.

2.1 GENERAL WORK SAFETY PRACTICES

- A multi-purpose dry chemical fire extinguisher, a complete field first-aid kit, safety eye wash, shovel, and a portable deluge shower shall be available at every drill site.
- Catalytic converters on the underside of vehicles are sufficiently hot to ignite dry prairie grass. Team members should avoid driving over dry grass that is higher than the ground clearance of the vehicle and be aware of the potential fire hazard posed by catalytic converters at all times. <u>Never</u> allow a running vehicle to sit in a stationary location over dry grass or other combustible materials.
- Follow all provisions of each site specific cutting and welding permit.

- Hard hats, safety glasses and steel toe boots will be worn when inside the exclusion zone.

- Eating, drinking, smoking, taking medications, chewing gum, etc., is prohibited within the exclusion zone.

- Personnel shall avoid direct contact with contaminated materials unless necessary for sample collection or required observation. Remote handling of casing, auger flights, etc. will be practiced whenever practical.

- Do not handle soil, waste samples, or any other potentially contaminated items unless wearing NBR (nitrile- butyl rubber) or Neoprene rubber gloves.

- Thoroughly wash hands and, face before eating or putting anything in your mouth. Avoid hand to face contamination.

- At the end of each work day, or each job, disposable clothing shall be removed and placed in drums or plastic lined rad boxes. Clothing that can be cleaned shall be sent to the Hanford laundry.

- Individuals are expected to thoroughly shower as soon as possible after leaving the job site if directed to do so by the RPT, Health and Safety Officer or Field Team Leader.

- Personnel not involved in operation of the cable tool drill rig or monitoring activities shall remain a safe distance from the rig as indicated by the Field Team Leader.

- Always use an appropriate level of personal protection. Lesser levels of protection can result in preventable exposure; excessive levels of safety equipment can impair efficiency and increase the potential for accidents to occur.

- Personnel shall maintain a high level of awareness of the limitations in mobility, dexterity and visual impairment inherent in the use of Level B and Level C personal protection equipment.

- Be alert to the symptoms of fatigue and heat stress, and their effect on the normal caution and judgment of personnel.

- Stand well clear of the trench during excavation. Always approach the excavation from upwind.

- Stand upwind of excavations, boreholes, well casings, drilling spoils, etc., whenever possible, as indicated by a windsock or other wind direction indicator.

- Be alert to potentially changing exposure conditions as evidenced by perceptible odors, unusual appearance of excavated soils, oily sheen on water, etc.

- Do not enter any test pit trench greater than four feet in depth unless in accordance with procedures specified in Section 2.2.

- Do not, <u>under any circumstances</u>, enter or ride in or on any backhoe bucket, materials hoist, or any other similar device not specifically designed for carrying human passengers.

- Personnel shall use the "buddy system" at all times while operating in the exclusion zone. A 2-way radio will be provided at each site location. The channel will provide communication to the five department for emergency response.

- All drilling operations members must make a conscientious effort to remain aware of their own and other's positions in regards to rotating equipment, cat heads, u-joints, etc. and be extremely careful when assembling, lifting and carrying flights or pipe to avoid pinch point injuries and collisions.

- The buddy system and proper techniques will be used for all manual lifting of heavy or large, awkward objects.

- Establish prearranged hand signals or other means of emergency communication when wearing respiratory equipment, since this equipment seriously impairs speech communications.

- Tools and equipment will be kept off the ground whenever possible to avoid tripping hazards and the spread of contamination.

- Noise may pose a health and safety hazard, particularly during drilling and construction activities. A good rule of thumb is that if you have to shout in order to communicate at a distance of three feet in steady state (continuous) noise, you should be wearing hearing protection. Likewise, any impact noise from activities such as driving casing on a drilling operation which is loud enough to cause wincing or discomfort, would also indicate the use of hearing protection. Hearing protection is available and should be included in your standard field kit along with hard hat, safety glasses, etc.

- Requirements of General Regulations and Practices for Radiation Work (GEN-0) shall be followed for all work involving radioactive materials or radioactive contamination.

- Team members will attempt to minimize truck tire disturbance of all stabilized sites.

- All work operations on site shall cease at sunset, unless the entire control zone is adequately illuminated as determined by the Health and Safety Officer with artificial lighting. A new tour (shift) will man the rig after completion of each shift.

- All team personnel are required to attend a pre-job safety meeting prior to the start of the campaign.

- A mandatory "tail-gate" meeting will be conducted prior to each hole drilling operation. All additional rescue equipment should be available at the time of start-up.

- Work will stop if any changes occur or unexpected events happen that threaten employee health and safety.

- Work will stop if any required hazardous materials or radiation monitoring equipment is not on hand and working properly.

2.2 CONFINED SPACE/TEST PIT ENTRY PROCEDURES

The following procedures apply to the entry of any confined space which for the purpose of this document shall be defined as any space having limited egress (access to an exit) and the potential for the presence or accumulation of a toxic or explosive atmosphere. This includes manholes, certain trenches particularly those through waste disposal areas, and all test pits greater than four feet in depth in potentially contaminated soil.

The identified remedial investigation activities on the 200-BP-1 Operable Unit do not include confined space entry. Nevertheless, the hazards associated with confined spaces are of such severity that all employees should be familiar with the general procedures discussed below.

No employee shall enter any test pit or trench greater than 4 feet in depth unless the sides are shored or laid back to a stable slope as specified in 29 CFR 1926.652 or equivalent State Occupational Health and Safety Regulations.

When an employee is required to enter a pit or trench 4 or more feet in depth, an adequate means of access and egress such as a slope of at least 2:1 to the bottom of the pit, or a secure ladder or steps shall be provided.

Prior to entering any confined space including any test pit or any trench which may have the potential for the accumulation of toxic gases or vapors, the atmosphere at the bottom of the space and at 4-foot intervals thereafter (if greater than 4 feet in depth) shall be tested for radioactivity, oxygen deficiency, hydrogen sulfide (H_2S), combustible gases, and organic vapors in that order. If the excavation is located in an area containing known or suspected cyanide wastes the atmosphere shall also be tested for hydrogen cyanide. Depending on the situation, the space may require ventilation and retesting prior to entry.

Any employee entering a confined or partially confined space must be equipped with an appropriate level of respiratory protection in keeping with the monitoring procedures discussed above, and the action levels for airborne contaminants established in Section 5.0. (See Warnings and Action Levels in PJSP and Section 5.)

No employee shall enter any test pit requiring the use of Level B (see Section 6.1) protection, unless a back-up person also equipped with a pressure demand self-contained breathing apparatus is present. No back-up person shall attempt any emergency rescue unless a second back-up person equipped with an SCBA is present, or the appropriate emergency response authorities have been notified and additional help is on the way.

3.0 SITE BACKGROUND

3.1 DESCRIPTION OF FACILITIES IN 200-BP-1 OPERABLE UNIT

The 200-BP-1 Operable Unit is located near the north boundary of the 200 East Area, immediately North of the 241-BY Tank Farm (see Figure 3-1). Due to their location, the waste sites included in this operable unit are commonly referred to as the "BY Cribs". The operable unit includes nine inactive cribs which received waste from U-Plant uranium reclamation operations and waste storage tank condensate from the 241-BY Tank Farm, and 1 inactive crib (216-B-61) which was never used, as well as sites of 3 unplanned releases which were the result of tank farm operations (see Figure 3-2). All but 2 of the cribs have been inactive since the mid-1950's. The remaining 2 were operated into the early 1970's. Eight of the sites within this operable unit individually received Hazard Ranking System (HRS) scores greater than 28.5. The Operable Unit encompasses a total area of 10 hectares (25 acres), although the majority of the sites are concentrated in a 1.6 hecatres (4 acre) region at the Eastern end of the Unit. Table 3-1 presents a list of sites within 200-BP-1 Operable Unit, and the period(s) of use.

3.2 PROCESSES GENERATING WASTE

Wastes sent to the 216-BY-43 through 49 cribs were generated in the tributyl phosphate (TBP) process in the 221-U Building. The TBP process was developed to recover uranium metal from wastes generated by the bismuth phosphate (B_iPO_4) process in the B-Plant into the early 1950's. Prior to implementing the TBP process, the bismuth phosphate process waste had been stored in the 241-BY Tank Farms.

From 1952 to 1958, stored waste was transferred to the U Plant for uranium recovery by the TBP process. The TBP waste sludge was dissolved in nitric acid and the uranium was extracted using tributyl-phosphate in a normal paraffin diluent. This extraction process left the fission products (trontium-90, cesium-137); sulfate, and phosphate ions and traces of uranium in the aqueous acid solution. The uranium was stripped from the pregnant organic solvent with nitric acid. The uranium rich nitric acid solution was concentrated and processed at the U Plant for uranium extraction. The resultant wastes were retained in the 200 West Area.

The aqueous nitric acid solution containing the dissolved TBP process waste sludge was neutralized to a high pH (>9.5) in an effort to precipitate out the dissolved inorganics. At this point, ferrocyanides were added to enhance the precipitation of highly soluble metals such as strontium and cesium. This "slurry" was returned to the BY tanks to allow dissolved solids to precipitate and "settle out". The remaining liquid portion of this waste was then decanted and released to the BY cribs.

Several years later, the ITS (In-Tank Solidification) process was implemented to remove remaining liquids from the single shelled tank sludges. The tanks were heated to drive off excess liquid and the condensate was released to cribs 216-BY-50 and 57. This condensate could be expected to contain high concentrations of tritium (H-3) and other volatiles driven off in the

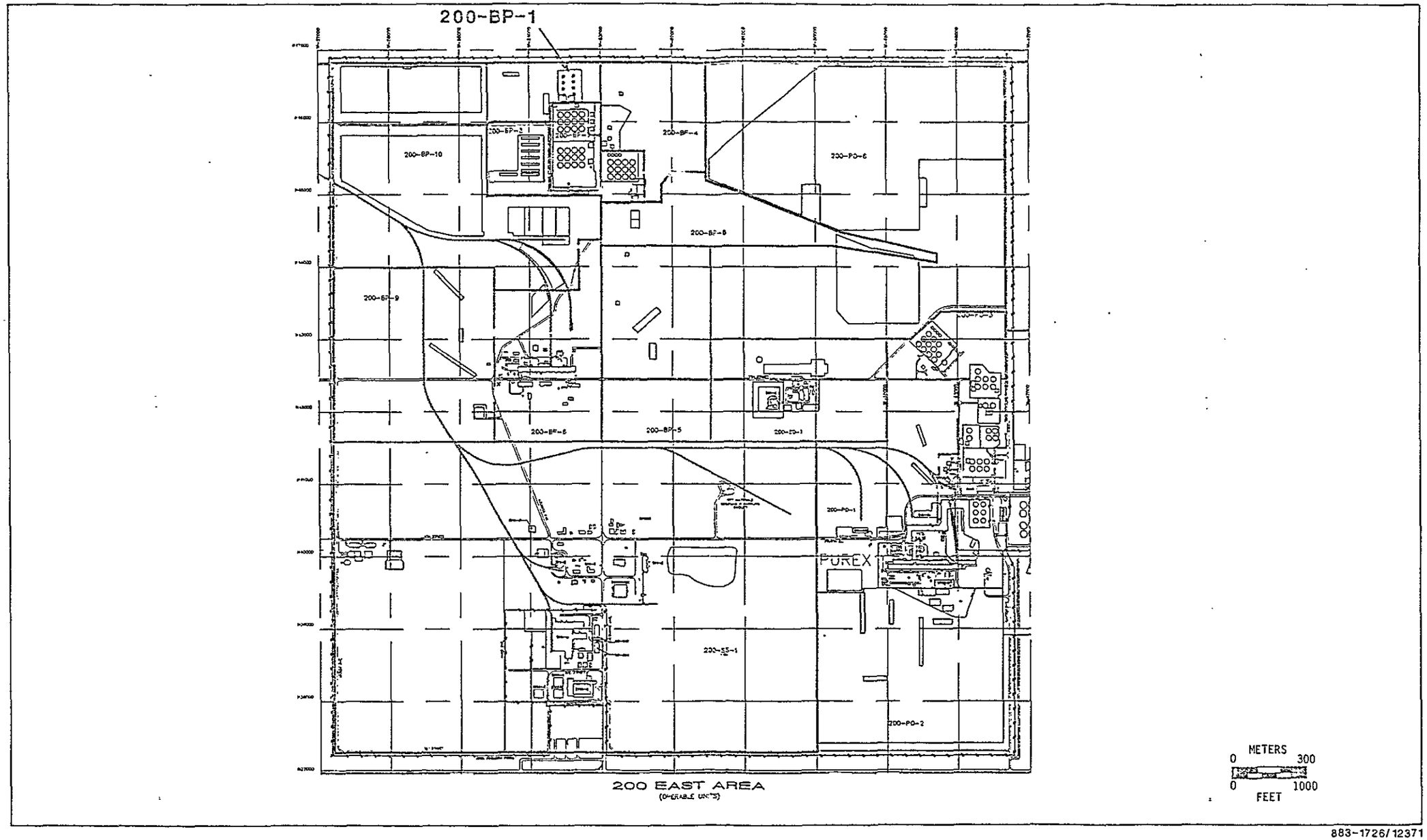

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Figure 3-1. Location of 200-BP-1 Operable Unit

9 0 1 1 7 4 1 1 2 9 6

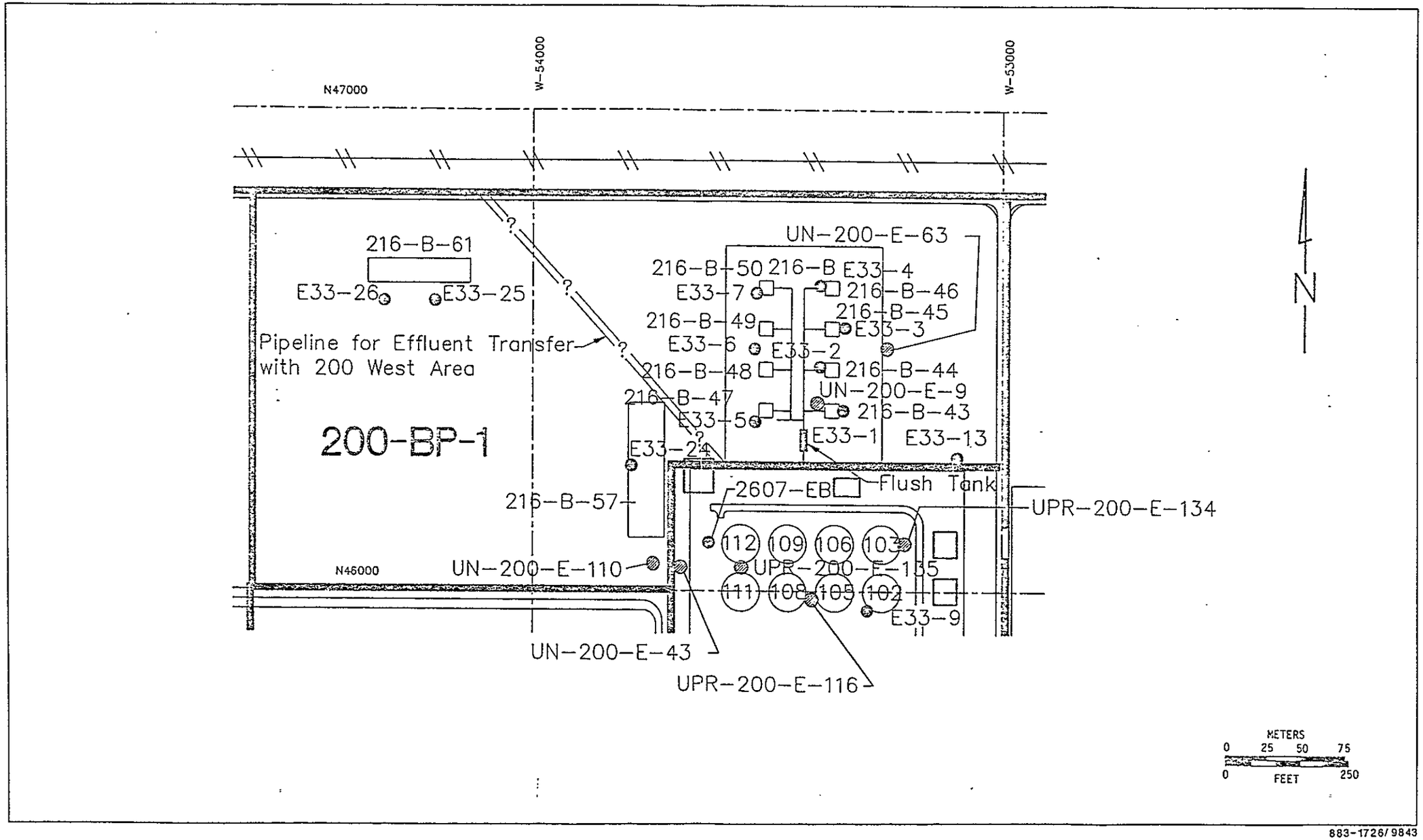

Figure 3-2. 200-BP-1 Operable Unit

Table 3-1. Sites Included in Operable Unit 200-BP-1

CRIBS	Period of Use	Waste Source
216-B-43	11/54 to 11/54	TBP Supernatant From 221-Building
216-B-44	11/54 to 3/55	TBP Supernatant From 221-U Building
216-B-46	4/55 to 6/55	TBP Supernatant From 221-U Building
216-B-47	9/55 to 9/55	TBP Supernatant From 221-U Building
216-B-48	11/55 to 7/57	TBP Supernatant From 221-U Building
216-B-49	11/55 to 12/55	TBP Supernatant From 221-U Building
216-B-50	3/65 to 1/74	Storage Tank Condensate
216-B-57	2/68 to 6/73	From ITS#1 unit in BY-Tank Farm
Unplanned Release	**Date**	
UN-200-E-9	September 15, 1955	
UN-200-E-110	August 7, 1955	
UN-200-E-63	Unknown	

3.3 WASTE DISPOSAL CRIBS

The disposal cribs were designed to receive, disperse and infiltrate liquid waste effluents completely underground. Liquid waste effluents entered the cribs through an underground pipe and discharged through pipe perforations into a gravel bed. The perforated pipe and gravel infiltration zone was about 6 to 12 feet below land surface. A massive soil cover was placed over the gravel bed, to preclude percolation of waste to the surface.

As-built drawings indicate that cribs 216-BY-43 through 49 each include four localized gravel infiltration beds. Cribs 216-BY-50 and 57 each consist of a contiguous gravel drain field over the entire area of the crib.

Table 3-2 presents the total quantities of TBP process decant wastes estimated to have been discharged to the 200-BP-1 cribs. A brief description and estimated waste inventory for each crib is presented in Appendix A of the Work Plan.

As mentioned above, wastes discharged to cribs 216-BY-50 and 216-BY-57 consisted of condensate from the ITS process in the 241-BY Tank Farm. Data are not currently available on the exact nature of wastes generated by this process but, the nature and degree of hazard associated with ITS related waste posed to on-site personnel is not expected to differ substantially from TBP process decant wastes. A similar situation exists regarding a known but otherwise uncharacterized unplanned release (UN-200-E-63).

4.0 SCOPE OF WORK AND POTENTIAL HAZARDS

While Table 3-2 is believed to be representative of the constituents and quantities of wastes at the time of discharge, the present chemical nature, location, extent, and ultimate fate of these wastes in and around the cribs is largely unknown. The emphasis of the remedial investigation in the 200-BP-1 Operable Unit will be to characterize the nature and extent of contamination in the vadose (unsaturated subsurface soil) zone.

4.1 WORK TASKS

The specific work tasks associated with the 200-BP-1 Phase I Remedial Investigation which could involve potential exposure to hazardous toxic or radioactive substances includes the following:

- Borehole Source Sampling and Analysis
- Surface and Near Surface Soil Sampling and Analysis
- Vadose Zone Soil Sampling and Analysis
- Seismic Refraction Survey
- Installation of Monitoring Wells

Table 3-2. Total Estimated Waste Quantities Discharged to Cribs in the 200-BP-1 Operable Unit

Total Liquid Effluent Discharged	1.7304×10^8 L
Chemical Disposed	**Quantity (kg)**
Sodium	2,650,500
Nitrate	6,501,500
Sulfate	469,000
Phosphate	332,000
Ferrocyanide	18,900
Ammonium nitrate	10,000
Ammonium carbonate	21,000
Petroleum hydrocarbons	Unknown
Radionuclide Inventory (April 1, 1986)	**Quantity (Ci)**
^{3}H	2,499
^{90}Sr	6,054
^{137}Cs	2,092
^{60}Co	0.4490
^{239}Pu	4.0457
^{240}Pu	1.0918
^{238}U	0.1806
^{106}Ru	0.00009
^{99}Tc	Unknown
Total beta	16,179.2

All values for radionuclides are decayed through April 1, 1986.

- Groundwater Sampling and Analysis
- Site Topographic Mapping
- Biota Evaluation
- Column Leach Tests
- Hydraulic Slug Testing of Wells
- Sorption Tests

Detailed descriptions of each of the above work tasks are included in Section 5.0 of the work plan.

Dual wall/core barrel drilling and sampling techniques will be employed through the crib infiltration beds and in highly contaminated strata. Soil samples will be collected using conventional cable tool drilling and split tube sampling techniques where permissible. These will be real-time determinations made by the on site RPT (Radiation Protection Technologist) based on criteria specified in the Radiation Work Permit (RWP).

4.2 POTENTIAL HAZARDS

While the specific procedures associated with each of the above tasks will vary considerably, each task involves intrusion into and/or handling of materials (soil samples, water samples, sampling equipment, instruments, etc.), which may be contaminated with potentially hazardous chemical and/or radioactive substances.

Tables 4-1 and 4-2 present known radiological hazards and potential chemical hazards, respectively. A specific site by site evaluation and inventory of wastes believed to have been released in each crib is provided in Appendix A of the work plan.

As discussed above, this project will involve the following:

a. Excavation of shallow test pits with a backhoe, and soil sampling;

b. Drilling shallow boreholes directly through cribs, and soil sampling;

c. Drilling deep boreholes through cribs and in other areas for geologic interpretation, and soil sampling;

d. Installation of groundwater monitoring wells and groundwater sampling;

e. Site surveying and mapping.

Table 4-1. Known Radiologic Hazards

Radionuclide	Type of Radiation
^{3}H	Soft β- (18.6 keV)
^{60}Co	312 keV β-; 1.17, 1.33 MeV gammas
^{90}Sr	540 keV β-
^{99}Tc	292 keV β-
^{106}Ru	39 keV β-
^{137}Cs	510 keV β- 661 keV gamma
^{238}U	4 to 6 MeV alpha
^{239}Pu	4 to 6 MeV alpha
^{240}Pu	4 to 6 MeV alpha

Table 4-2.1 Potential Chemical Hazards

Substance	Threshold Limit Value Time Weighted Average p/m	mg/m^3	Immediately dangerous to Life and Health p/m	Monitoring/ Sampling Method	Primary Hazards and Symptoms	Protection
Tributyl Phosphate $(C_4H_9O)_3PO$	0.2	2.5	1300	volatility very low 1,2	Toxic if inhaled, ingested or absorbed through skin. Irritation of eyes, respiratory tract, skin, nausea.	Protection Levels Will Be Determined By: 1. The Estimated Site Inventory 2. Onsite Conditions 3. Sampling Results 4. Company Standards
Dibutyl Phosphate $(C_4H_9O)_2OHPO$	1.0	5.0	125	1,2	Respiratory irritation, headache, irritation of skin, eyes and nose.	
Kerosene	200.0	1640.0	~5000	OVA or equivalent	Flammable, toxic if inhaled.	
Ammonia NH_3	25.0	18.0	500	color detection tubes and pumps, personal dosimeters	Eye, nose, throat, irritant, edema, burns.	
Cyanide HCN, CN^-	10.0	60	55	color detection tubes and pumps, personal dosimeters	Increased rate and depth of respiration, nausea, headache, gasping.	

1 Downwind sampling station by Hanford Environmental Health Foundation; if needed.
2 No "Real Time" sampling available; however, physical conditions of the drill hole and spoil may aid in determining protective upgrade.

Potential hazards include:

1. External radiation (gamma and possibly beta radiation) from radioactive materials in the soil.

2. Internal radiation due to radionuclides present in contaminated soil entering the body by ingestion or through open cuts and scratches.

3. Internal radiation due to inhalation of particulate (dust) contaminated with radioactive materials.

4. Inhalation of toxic vapors or gases such as volatile organics, free cyanide or ammonia.

5. Inhalation or ingestion of particulate (dust) contaminated with inorganic or organic chemicals, and ferrocyanide.

6. Dermal exposure to soil and/or groundwater contaminated with radionuclides.

7. Dermal exposure to soil and/or groundwater contaminated with inorganic or organic chemicals, and cyanides.

8. Physical hazards such as noise and heat stress.

9. Slips, trips, falls, bumps, cuts, pinch points, falling objects, other overhead hazards, crushing injuries, etc. typical of every construction related job site.

The nature of the occupational hazards will be similar for each of the designated tasks but the likelihood of encountering hazardous chemical or radioactive substances will clearly be greatest during intrusions into and through the cribs. Due to the increased exposed surface area, there is a greater potential for significant airborne concentrations of volatile organic compounds during backhoe excavation. The hazards associated with site surveying are expected to be minimal, however, entry into any "Radiation Surface Contamination Area" will require a radiation work permit.

4.3 ASSESSMENT AND MITIGATION OF POTENTIAL HAZARDS

The likelihood of significant exposure (100 mR/hr or greater) to external radiation is remote and can be readily monitored and controlled by limiting exposure time, increasing distance, and employing shielding as required.

Internal radiation, via inhalation or inadvertent ingestion, of contaminated dust is a realistic concern and must be continuously evaluated by the RPT. Appropriate respiratory protection, protective clothing, and decontamination procedures will be implemented as necessary to reduce potential inhalation, ingestion, and dermal exposure to acceptable levels.

Exposure to toxic chemical substances, via the dermal exposure route, is not expected to pose a significant problem for the designated tasks. As specified below a minimum level of protection including SWPs (protective coveralls) and rubber gloves will be required within the control zone at all times and will be upgraded as necessary.

Chemical exposure, via inhalation of contaminated dust, is not expected to pose a significant hazard due to the relatively low concentrations of chemicals in soil and low concentration of dust in the ambient air.

Similarly, airborne concentrations of toxic gases/vapors are not expected to exceed applicable TLVs. As mentioned above however, the interactions and fate of these compounds are not well characterized. It has been speculated for example, that free cyanide may be released from otherwise stable cyanide complexes by radiolysis. The Health and Safety Officer will periodically monitor airborne levels of toxic vapors and gases with an HNU-PI-101 and appropriate chemical specific detector tubes. Respiratory protection will be employed as appropriate. Warning levels and action levels, if different than those established in Section 5.0, will be designated in the Pre-Job Safety Plans.

5.0 ENVIRONMENTAL AND PERSONAL MONITORING

Air quality monitoring equipment will be used during the field activities to quantify exposure of vapors and gases which pose risks. This equipment is intended to be used to provide adequate warning and allow appropriate action to be taken to prevent harmful exposure to contaminants released into the work environment. The air monitoring program will consist of monitoring air for contaminant vapor/gases in the vicinity of boreholes and breathing zones, and monitoring the general area for radiation. A health and safety officer will be on site at all times. In addition, an RPT must be on site at all times and will observe the action levels and procedures specified in the radiation work permit (RWP) and appropriate ALARA Plans. Core samples will also be monitored to determine levels of radioactivity and industrial risks prior to actual sample collection. As indicated above, the determination to modify the level of protection will be made by the Health and Safety Officer, RPT and the Field Team Leader. This decision will be based on, but not limited to the following.

- The interpretation of organic vapor, gas and radiation detection instrument readings by RPTs and Health and Safety personnel.
- The visual observation, such as wind, dust, discoloration, etc.
- Noticeable odors by the RPTs and Health and Safety personnel.
- Other sampling devices such as O_2 and explosive level meters.
- Information specific to the individual sites (i.e., known or suspected chemical contaminants and levels of each).
- The physical characteristics of the work environment, such as temperature and pH.

Air sampling may be required downwind of the referenced waste sites to monitor particulates and vapors prior to job start up. Siting of such sampling devices will be determined by Operational Health Physics, GEU Site Safety Officer and HEHF (if appropriate). Discrete sampling of ambient air within the work zone and breathing zone will be conducted using the OVA (or equivalent), radiation detectors and other methods as deemed appropriate (e.g., pumps with tubes, O_2 meters, etc.). The following standards will be used in determining critical levels:

- Radionuclide concentrations in air, DOE Order 5480.1b Chapter XI
- Threshold Limit Values and Biological Exposure Indices for 1987-1988, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.
- Occupational Safety and Health Standards, 29 CFR 1910.120
- Westinghouse Hanford standard operating procedures and protocols for hazardous or radioactive work sites.

5.1 AMMONIA

The Health and Safety Officer will periodically sample the air in the vicinity of the test pit/borehole for ammonia using ammonia detector tubes. Ammonia is a primary upper respiratory tract irritant which is not known to exhibit any chronic toxicity. The odor and irritant properties of ammonia will cause workers to leave an area at concentrations well below concentrations associated with acute toxicity. Consequently, the action level for the use of respiratory protection based on the presence of ammonia will be the 15 minute short term exposure limit (STEL) of 35 p/m or the 8 hour time weighted average - threshold limit value (TWA-TLV) of 25 p/m as appropriate, corrected for the typically accepted accuracy of detector tubes of $\pm$ 25 percent. Assuming that the tube reads 25% too low, the action levels as measured on a detector tube will be an STEL of approximately 25 p/m and a TWA-TLV of 19 p/m, respectively. Passive dosimeters (Time-in/Time-out logs) will be employed on at-risk team members in the event that ammonia is encountered.

5.2 HYDROGEN CYANIDE

The Site Safety Officer must also periodically monitor for the presence of hydrogen cyanide using HCN detector tubes.

The TLV for hydrogen cyanide is a ceiling limit of 10 p/m. The immediately dangerous to life and health (IDLH) concentration is around 50-60 p/m.

If detectable concentrations of HCN are present at the mouth of the borehole, the monitoring frequency shall be increased to at least every 15 minutes until 2 consecutive readings are below 5 p/m at the well head. Site personnel should make a conscientious effort to stand upwind of the hole (a wind sock or other device will be installed). If the level at the mouth of the hole is greater than the 10 p/m ceiling limit, the Health and Safety Officer shall momentarily cease operations and determine the HCN

concentrations in the breathing zone immediately downwind of the hole. If detectable levels of HCN are present at the breathing zone at any time, drilling activities shall be immediately halted until HCN levels subside or until site personnel are equipped with pressure demand air supplying respiratory protection.

Air purifying respirators equipped with organic vapor/acid gas cartridges are quite effective in removing H_2S or HCN but are not approved for this particular use due to the potential for the sudden build-up of IDLH conditions. The use of cartridge type air purifying respirators in atmospheres containing H_2S or HCN at concentrations in excess of the 8 hour TWA-TLV, STEL or TLV ceiling value is permitted only for escape. Entry into any atmosphere containing greater than 10 p/m hydrogen cyanide (ceiling value) or 10 p/m hydrogen sulfide (15 p/m STEL) requires the use of a pressure demand supplied air respirator with escape provisions.

5.3 VOC MONITORING

The designated Site Safety Officer shall have an HNU-PI-101 or OVA or equivalent on site at all times and will establish "background readings" well upwind of any excavation, spoils pile, borehole, etc. Calibration of the HNU shall be checked daily against 100 p/m isobutylene as calibration of, or as specified on the individual bottle of calibration gas.

The calibration of the OVA must be checked daily. The instrument shall read between 8 and 10 p/m on the "1X" scale in response to 9 p/m methane with the "gas select" setting at 3.0.

Any consistent readings in the breathing zone that are perceptibly above the upwind background level for more than 5 minutes shall be the action level for donning approved air purifying respirators equipped with organic vapor acid gas cartridges. Cartridges will be replaced after each day of use or immediately upon any indication of "break through", whichever is less.

Any readings consistently greater than 5 p/m above background for 10 minutes or greater than 10 p/m other than for a brief peak, will be the action level for either temporarily discontinuing work, or upgrading the level of respiratory protection to "Level B" self-contained breathing apparatus (SCBA)'s or airlines as appropriate.

5.4 AIRBORNE RADIOACTIVE MATERIALS AND RADIOACTIVE MONITORING

An on-site RPT will monitor airborne radioactive contamination levels and external radiation levels. Action levels will be consistent with DACs (derived air concentrations) and applicable guidelines specified by Westinghouse Hanfords standard radiation protection operating procedures.

Appropriate respiratory protection shall be required when conditions are such that the airborne contamination levels may exceed an 8 hour DAC, i.e., the presence of high levels of uncontained, loose contamination on exposed surfaces or operations which may raise excessive levels of dust contaminated with airborne radioactive materials, such as excavation and/or drilling under extremely dry conditions.

Specific conditions requiring the use of respiratory protection radioactive due to materials in air will be incorporated into the RWP. If, in the judgment of the RPT, any of these conditions arise, work shall cease until appropriate respiratory protection is provided.

6.0 PERSONAL PROTECTIVE CLOTHING AND RESPIRATORY PROTECTION

6.1 PERSONAL PROTECTIVE EQUIPMENT

The level of personal protective equipment required initially at the site during excavation, drilling, and sampling activities will be D-3 which must include the following:

LEVEL D-3 PROTECTION

1. Cloth coveralls (SWPs)
2. Steel toed rubber boots
3. Safety glasses or safety goggles if splash hazards exist
4. Hard hat
5. NBR (nitrile-butyl rubber) or Neoprene rubber outer gloves
6. Leather work gloves where appropriate
7. Inner gloves of PVC or latex rubber

If employees find that there is a likelihood of being splashed with mud or groundwater, the level of protective clothing shall be upgraded to include a 1 or 2 piece Saranex or Chemrel (Level D-2). Gloves shall be worn whenever it is necessary to contact or handle wet soil, groundwater, or any other potentially contaminated implements or materials. The level of protective clothing shall be upgraded to "1" as described below if there is the likelihood of dermal exposure to unknown contaminants or to substances known to be toxic by the dermal exposure route.

Level D respiratory protection shall be immediately upgraded to Level C or Level B as appropriate, if indicated by real-time conditions, site monitoring and the action levels specified in Section 5.0. No changes to the specified levels shall be made without the approval of the Health and Safety Officer, the RPT, and the Field Team Leader.

LEVEL D-2 PROTECTION

1. Cloth coveralls (SWPs)
2. One piece tyvek suit or blue standard coveralls
3. Steel toed rubber boots or steel toe leather boots, as appropriate
4. Outer boot covers (booties)

5. Safety glasses at all times or safety goggles if splash hazard exists
6. Hard hat
7. NBR (nitrile-butyl rubber) or neoprene rubber outer gloves
8. Inner gloves of PVC or latex rubber

LEVEL D-1 PROTECTION

D-2 plus 1 or 2 piece Saranex or Chemrel

LEVEL C-2 PROTECTION

D-2 plus air purifying respirator

LEVEL B-2 PROTECTION

D-2 plus pressure demand supplied-air respirator

LEVEL C-1 PROTECTION

1. Hard hat
2. Cotton coveralls (SWPs)
3. Inner gloves of PVC or latex taped to inner tyvek
4. Hooded one piece waterproof outer suit (Saranex, Chemrel, or PVC)
5. Outer NBR gloves taped to outer suit
6. Solvent resistant steel toed rubber boots taped to outer suit
7. Full-face air purifying respirator

LEVEL B-1 PROTECTION

C-1 with pressure demand supplied-air respirator in place of full-face air purifying respirator.

6.2 HEAT STRESS

Working in protective clothing can greatly increase the likelihood of heat fatigue, heat exhaustion, and heat stroke, the latter being a life threatening condition. If temperatures at the site are above 70 degrees F, site personnel shall be monitored for heat stress by monitoring wet globe/bulb temperature. Work/rest periods will be adjusted according to the standards stated in current TLV. Sufficient cool water and disposable drinking cups will be provided in the rest area. Engineering controls such as solar shielding, etc. will also be applied when and where appropriate.

If the wet bulb-globe temperature exceeds 77 degrees Fahrenheit (25°C), employees shall use the "buddy system" to monitor each other's pulse rate at the start of each rest period. If the pulse rate exceeds 110 beats per

minute, the employee shall take his or her oral temperature with a clean disposal colorimetric oral thermometer. If the oral temperature exceeds 99.6°F, the next work period shall be shortened by one third. The pulse rate and oral temperature shall be monitored again at the beginning of the next rest period; and if the oral temperature exceeds 99.6°F, the work period shall again be shortened by one third, etc., until the oral temperature is below 99.6°F.

All employees are to be alert to the possibility and symptoms of heat stress. Should any of the following symptoms occur: extreme fatigue, cramps, dizziness, headache, nausea, profuse sweating, pale clammy skin, the employee is to leave the work area, rest, cool off, and drink plenty of cool water. If the symptoms do not subside after a reasonable rest period, the employee shall notify the Field Team Leader or Health and Safety Officer and seek medical assistance.

7.0 SITE CONTROL

The Field Team Leader, Health and Safety Officer, and RPT are designated to coordinate access control and security on the site. A temporary exclusion zone will be established (a minimum of a 25 foot radius) at each digging or drilling location. The exclusion zone will be clearly marked with radiation zone rope and Radiation Area signs. The size and shape of the exclusion zone will be dictated by the types of hazards expected, the climatic conditions and specific drilling and sampling operations required. An excavation permit will be required prior to introduction of any drilling activities. The ground surface of the area immediately around the drill hole, the corridors to the command post and the decontamination area and the escape route will be covered with appropriate material to reduce contamination of personnel and equipment. Exclusion zone boundaries will be increased or decreased based upon results of field monitoring, environmental changes or work technique changes. Westinghouse Hanford standard operating procedures and the site Radiation Work Permit will also dictate the boundary size and shape. NO unauthorized person shall be allowed within the exclusion zone. All team members must be surveyed for radioactive contamination upon leaving the exclusion zone.

The onsite command post and staging area will be established near the Exclusion Zone on the upwind side (as determined by a wind sock or other device) if physically possible. Exact location for the command post is to be determined just prior to start of work. Vehicle access, availability of utilities (power and telephone), wind direction and proximity to sample locations should be considered in establishing command post location.

8.0 DECONTAMINATION PROCEDURES

Remedial investigation activities will require intrusion into areas of known chemical and radiological contamination. Consequently, it is likely that personnel and equipment will be contaminated with hazardous chemical and radiological substances.

During drilling and sampling activities at the site, field workers may become contaminated in various ways, many of which are not readily apparent to the individual. Potential sources of contamination include but are not

limited to airborne vapors, gases, dust, mists and aerosols; splashes and spills; walking through contaminated areas; and handling contaminated equipment. All personnel who enter the exclusion zone will be required to go through decontamination procedures upon leaving the zone. The procedures discussed below are intended to be compatible with Westinghouse Hanford's standard decontamination procedures.

Decontamination procedures shall be consistent with Level B and Level C decontamination protocol. Decontamination will be conducted in an area upwind of the exclusion zone. It is anticipated that most of the decontamination work will require the following equipment and facilities:

1. Decontamination garbage/dirty equipment bags
2. Decontamination pad/corridor cover (kraft paper)
3. Emergency response pressurized water tank with wand and adjustable spray nozzle
4. Bagging and taping material
5. Emergency water deluge/detergent, brush and bucket
6. Barrels
7. Step out pads
8. Sponges, wipes and rags
9. Tables and stands.

Specific decontamination procedures will be provided in pre-job safety plans.

8.1 PERSONNEL DECONTAMINATION

All personnel who access the exclusion and contamination reduction zones of the project will process through decontamination at the end of any given work shift. A decontamination corridor will be established within the exclusion zone for each task of the campaign. Clothing that is disposable will be removed in such a manner that outer layers are removed first and placed in sealed containers. Nondisposable clothing such as SWPs that can be cleaned will be removed, bagged and sent to the laundry. After removing outer protective clothing, each team member must be surveyed by qualified and authorized personnel prior to proceeding to an uncontrolled area. When contamination is detected, the Operational Health Physics Organization (OHP) shall be notified and the person shall be escorted by an RPT to an appropriate area for decontamination.

8.2 EQUIPMENT DECONTAMINATION

Equipment decontamination methods will generally consist of washing or steam cleaning with a detergent/water or other decontamination solution as specified in the Field Sampling Plan. In some cases such as contamination with PCBs (polychlorinated biphenyls) an organic solvent rinse (usually hexane) may be required. Rinsing with a dilute nitric acid solution may be necessary to remove metal oxides and hydroxides. Field contamination of drilling equipment, where applicable, shall be performed within impoundments in the Decontamination Zone to ensure that all wash fluids are captured.

Downhole drilling equipment shall be decontaminated prior to use on another borehole and/or as required to assure the safety of personnel and prevent cross contamination of samples.

Equipment which is radiologically contaminated beyond the limits specified in the RWP shall not be decontaminated in the field. Such equipment shall be wrapped or bagged securely and transported to the 2705-T building for decontamination prior to reuse.

8.3 SAMPLING AND MONITORING EQUIPMENT

All possible measures should be taken by personnel to prevent or limit the contamination of any sampling and monitoring equipment used. Sampling devices will become contaminated. In general, air monitoring instruments will not be contaminated by chemicals unless splashed or set down on contaminated areas. Any delicate instrument that cannot be easily decontaminated should be protected while it is being used by placing it in a bag and using tape to secure it around the instrument. Openings in the bag can be made for sample intake, electrical connections, etc. Personnel performing field maintenance procedures on air monitoring instruments should be aware of the fact that instruments may become contaminated internally if air containing high concentrations of radioactive particulate is drawn through the instrument. Foreign material which collects within the probe tip and on the face of the lamp on the HNU photoionization detector may be chemically or radioactively contaminated and should be handled appropriately when disassembling the probe or cleaning the lamp. A similar situation exists with the readout probe and metallic frit filters in the sampling line of the OVA organic vapor analyzer. All instruments and equipment must be surveyed for the purpose of radiological contamination control prior to removal from the exclusion zone. Items with detectable levels of contamination must be controlled as radioactive material or controlled or regulated equipment.

Sampling devices require special cleaning and decontamination (see Field Sampling Plan). When appropriate, disposable sampling equipment will be used to eliminate the need for decontamination liquids.

8.4 RESPIRATORY PROTECTION EQUIPMENT

Respiratory protection will be used based upon the level of protection required for each job. There is a high potential for hoses to become contaminated; therefore, where possible and necessary hoses should be covered with plastic. If grossly contaminated, they may have to be discarded. Cleaning and decontamination of face pieces will be performed by the mask

cleaning station (i.e., Laundry). Maintenance of special respiratory protection equipment (i.e., SKA PAK) is performed by Personal Protective Equipment Unit in MO-412, 200 West Area.

8.5 HEAVY EQUIPMENT

All possible measures will be taken to prevent or limit the contamination of heavy equipment. Those parts of drilling equipment that become contaminated, such as auger flights, will be double bagged and taken to the 2705-T building for decontamination before reuse to minimize personnel contamination potential and cross contamination of samples between boreholes.

9.0 CONTINGENCY AND EMERGENCY RESPONSE PLANS

The following procedures have been established to deal with emergency situations that might occur during drilling or sampling operations. As a general rule, in the event of an unanticipated, potentially hazardous situation as indicated by instrument readings, visible contamination, unusual or excessive odors, etc., team members shall temporarily cease operations, and move away to a predesignated safe area upwind of the site as indicated by the wind direction indicator.

A two way radio will be operational and be manned by the Field Team Leader to maintain contact with the team's base station. Personnel in the Exclusion Zone will maintain line-of-sight with the Field Team Leader. Any failure of radio communications will require evaluation of whether personnel shall leave the Exclusion Zone. Communications from rig to rig or site to site will also be provided in order that the Health and Safety Officer or Field Team Leader can respond accordingly. In addition, a series of three (3) one-second horn blasts from a truck in the support zone is the emergency signal for all personnel to the leave the exclusion zone.

The following standard hand signals will be used in all cases:

Hand gripping throat	Out of air, can't breathe
Grip partner's wrist or both hands around waist	Leave area immediately
Hands on top of head	Need assistance
Thumbs up	OK, affirmative
Thumbs down	No, negative

The Health and Safety Officer is directly responsible for providing safety recommendations on the site to the Site Emergency Coordinator. The Site Emergency Coordinator for the 200-BP-1 drilling operations will be the Field Team Leader. The Health and Safety Officer will call the Fire Department prior to commencing work on each site.

The Site Emergency Coordinator will be responsible for the evacuation, emergency treatment, emergency transport of field personnel as necessary, and notification of the appropriate Hanford site emergency response units and management staff.

Emergency communications will be maintained during all on site field activities by two way radio contact. If an emergency occurs such as fire or explosion, all onsite personnel should exit the site in an upwind direction and assemble in a predesignated area. All emergency response actions for each job will be covered in the tail gate meeting with the pre-job safety plan. If an on site injury occurs, team members should employ the following procedures.

9.1 PROCEDURE FOR PERSONAL INJURY IN THE EXCLUSION ZONE

If able, the injured person should proceed through decontamination to the nearest available source of first aid. If the injured party is extremely muddy, remove outer garments and if necessary, wash the injured area with soap and water.

Upon notification of a serious injury in the exclusion zone, the emergency signal of three one-second horn blasts will be sounded. All site personnel will assemble at the decontamination line. The Health and Safety Officer and Field Team Leader should evaluate the nature of the injury and the extent of decontamination possible prior to movement of the injured person to the support area. No person should reenter the exclusion zone until the cause of the injury is determined and measures taken to prevent recurrence.

If the victim is unable to walk, but is conscious and there is no evidence of spinal injury, escort or transport the injured person through decontamination procedures to the nearest first aid facility (Figure 9-1). If the victim cannot be moved without causing further injury such as in the case of a severe compound fracture, take necessary emergency steps to control bleeding and immediately call for medical assistance as discussed below.

If the victim is unconscious or unable to move, <u>Do Not Move the Injured Person Unless Absolutely Necessary to Save His or Her Life</u>, until the nature of the injury has been determined.

If there is any evidence of spinal injury do not move the victim unless absolutely necessary to save his or her life. Administer rescue breathing if the victim is not breathing, control severe bleeding and <u>immediately</u> contact the Hanford Patrol (811) by phone or radio on channel 2.

9.2 PROCEDURE FOR PERSONAL INJURY IN THE SUPPORT AREA

Upon notification of an injury in the Support Area, the Field Team Leader and the Health and Safety Officer will assess the nature of the injury. If the cause of the injury or loss of the injured person does not affect the performance or safety of site personnel, operations may continue, with initiation of first aid and summoning of medical assistance as discussed above. If the injury increases the risk to others, the emergency signal of three one-second horn blasts will be sounded and all site personnel shall move

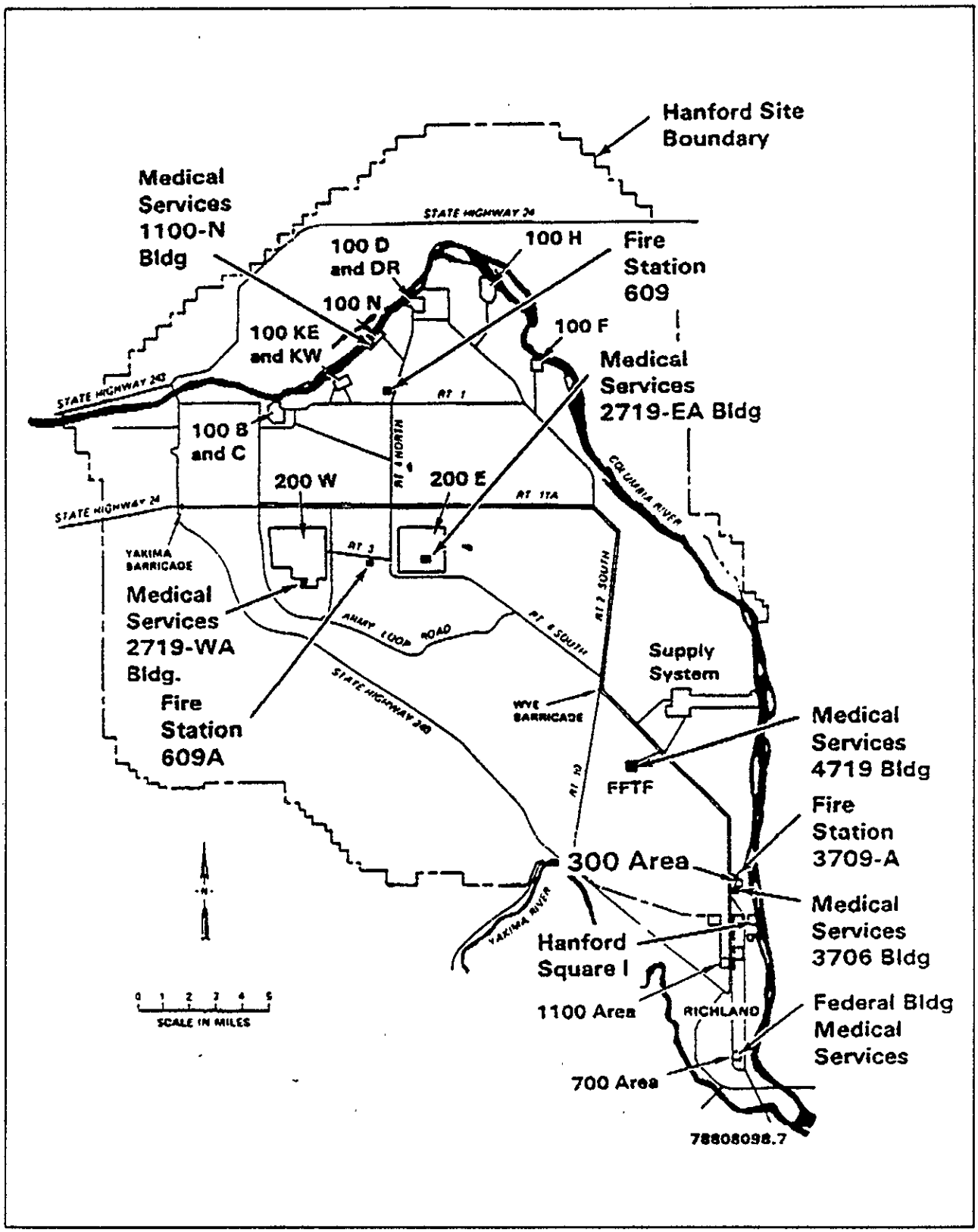

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Figure 9-1. Location of Hanford Emergency Facilities and Evacuation Routes

to the decontamination area for further instructions. Activities on site will stop until the hazardous condition (if any) is evaluated and reduced to an acceptable level.

9.3 PROCEDURES FOR FIRE AND EXPLOSIONS

The dry chemical fire extinguishers which are required on all field vehicles are effective for fires involving ordinary combustibles such as wood, grass, etc., flammable liquids, and electrical equipment. They are appropriate for small, localized fires such as a drum of burning refuse, a small burning gasoline spill, a vehicle engine fire, etc. No attempt should be made to use the provided extinguishers for well established fires or large areas or volumes of flammable liquids.

In the case of fire, prevention is the best contingency plan. Smoking in the Exclusion Zone is strictly prohibited and smoking materials where permitted should be extinguished with care.

In the event of a fire or explosion:

1. If the situation can be readily controlled with available resources <u>without jeopardizing the health and safety of yourself or other site personnel</u>, take immediate action to do so. If not:

2. Isolate the fire to prevent spreading if possible.

3. Clear the area of all personnel working in the immediate vicinity.

4. Immediately notify site emergency personnel and the local fire department by contacting the Hanford Patrol by phone at 811 or by radio on channel 2 to relay message.

5. Upon notification of a fire or explosion onsite, the emergency signal of three one-second horn blasts will be sounded and all site personnel will assemble at the decontamination line. The fire department will be called and all personnel will move to a safe distance from the involved area. Again, based on the individual tail gate meetings, a decision to send all personnel immediately out of the Exclusion Area may be an option.

9.4 PROCEDURE FOR PERSONAL PROTECTIVE EQUIPMENT FAILURE

If any site worker experiences an failure or alteration of protective equipment that results in any potential compromise in the level of protection provided by that equipment, that person and his/her buddy shall immediately leave the Exclusion Zone. Reentry shall not be permitted until the equipment has been repaired or replaced, or the conditions leading to the problem are adequately evaluated and corrected.

9.5 PROCEDURE FOR FAILURE OF OTHER EQUIPMENT

If equipment on site fails to operate properly, the Field Team Leader and Health and safety Officer shall be notified and then determine the effect of the failure on continuing operations. If the failure affects the safety of personnel or prevents completion of the work plan tasks, all personnel shall leave the exclusion zone until the necessary repairs are made.

9.6 EMERGENCY ESCAPE ROUTES

In the event that an emergency situation prevents exiting the exclusion zone by way of the decontamination area, exit the exclusion zone in any direction, preferably upwind, avoiding any barriers.

9.7 RESPONSE ACTION TO PHYSICAL EXPOSURE

If an injury to a worker is chemical in nature, the following first aid procedures are to be instituted as soon as possible.

- Eye Exposure - If contaminated solid or liquid gets into the eyes, wash eyes at the site immediately with an emergency eye wash bottle. Proceed to the emergency eye wash station which will be provided in the field and wash eyes using large amounts of water for at least 15 minutes. Obtain medical attention immediately by calling 811.

- Inhalation Exposure - If a person breathes in large amounts of organic vapor, move the exposed person to fresh air at once. If breathing has stopped perform artificial respiration. If breathing and heart have both stopped, perform CPR. Obtain medical attention as soon as possible by calling 811. Keep the person warm and at rest until medical help arrives.

- Skin Exposure - If contaminated solid or liquid gets on the skin, promptly use the deluge water unit, then wash contaminated skin using soap or mild detergent and water. If solids or liquid penetrate through the protective clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Obtain medical attention immediately if symptoms warrant by calling 811. If a person is contaminated by radioactive material, first aid will be conducted by normal Westinghouse Hanford skin decontamination procedures.

- Ingestion - If contaminated solid or liquid has been swallowed, immediately obtain medical attention and call the Poison Control Center. In any of the above situations if 811 is not notified, the person should be taken to the nearest first aid station.

9.8 EMERGENCY TELEPHONE NUMBERS

Police (Local or State):	Hanford Patrol	811
Local Resources:	Hanford Emergency Response Team	811
Ambulance:	Hanford Fire Department will dispatch the ambulance	811
Hospital:	Kadlec Hospital, Richland	946-4611
Fire Department:	Hanford Fire Department	811
Poison Control Center:		800-572-5842

EMERGENCY CONTACTS

Industrial Safety:	Central Area	373-3948 pager 85-398
Radiological Protection:	Mark E. Hevland	373-4286 373-1996
Environmental Reporting: (Spill Response)	See Figure 9.3	
Radio Channels:	Transportation Tank Farm Operations	Station 1 Station 45 (RPT)

ENVIRONMENTAL RELEASE NOTIFICATION FORM

DATE:	PERSON REPORTING INCIDENT:
TIME:	CONTRACTOR:
RECEIVED BY:	TELEPHONE:

1. WHERE DID THE RELEASE OCCUR?
2. WHAT WAS THE DATE OF THE RELEASE?
3. WHAT WAS THE TIME OF THE RELEASE?
4. WHAT MATERIAL WAS RELEASED?
5. HOW MUCH MATERIAL WAS RELEASED?
6. WHAT IS THE REPORTABLE QUANTITY OF THE MATERIAL?
7. WHAT REGULATIONS REQUIRED THE RELEASE TO BE REPORTED?
8. WHAT WAS THE CAUSE OF THE RELEASE?
9. WHAT IS THE IMPACT OF THE RELEASE?
10. WHAT CLEAN-UP ACTIONS ARE NEEDED?
11. WAS A PRESS RELEASE MADE?
12. WHAT AGENCIES WERE NOTIFIED?

AGENCY	PHONE	PERSON CONTACTED	TIME
NRC	9-1-800-424-8802		
WDOE-HQ (R. Stanley) Central Rgn Office	(206) 438-7020 (509) 575-2490		
HQ EOC	FTS 896-8100		
WA EMERGENCY RESPONSE COMMISSION	9-1-800-262-5990		
BENTON CTY (D. Summer) EMERGENCY MANAGEMENT	586-1451		
TRICOUNTY AIR (P. Cooke) POLLUTION AUTHORITY	946-4489		

RL DISTRIBUTION

AMS AMO AMR MGR COM SED OPD RDD PMD ECB PPB

883-1726/13620

Figure 9-3. Environmental Release Notification Form

ATTACHMENT 3

COMMUNITY RELATIONS PLAN

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1.0 COMMUNITY RELATIONS PLAN

A Community Relations Plan (CRP) is currently being developed for the Hanford Site Environmental Restoration Program (ERP). Because community relations activities are so interrelated among operable units, a decision was made to develop a single CRP that will have the capability to address specific individual concerns associated with each operable unit, but will still provide continuity and general coordination of all the ERP activities with regard to community involvement. The site-wide CRP discusses Hanford Site background information, history of community involvement at Hanford, and community concerns regarding the Hanford Site. It also delineates the community relations program that the U.S. Department of Energy - Richland Operations Office, the U.S. Environmental Protection Agency - Region X Office, and the Washington Department of Ecology will cooperatively implement throughout the cleanup of all the operable units at the Hanford Site. All community relations activities associated with the 200-BP-1 Operable Unit work plan will be conducted under this overall Hanford Site CRP.

ATTACHMENT 4

DATA MANAGEMENT PLAN

9 0 1 1 7 1 1 3 2 2

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1.0 INTRODUCTION AND OBJECTIVES

An extensive amount of data will be generated over the next several years in connection with the RI/FS process that will be conducted to evaluate and remediate hazardous waste sites at the Hanford Site. The quality of the data must be beyond reproach because they will be used to evaluate the need, select the method(s), and support the full remediation of the waste sites as agreed upon by the DOE, EPA, Ecology, and interested parties. Thus, a comprehensive plan for the management of this extensive amount of data is absolutely essential.

This plan describes a two-component data management system (DMS) for accessing and tracking the receipt, storage, and control of validated data, records, documents, correspondence, and other associated information. These components include the following:

- A computer based component
- An administrative component to handle, store, and protect physical records and samples.

An all-inclusive DMS is not presently available for supporting the RI/FS work planned at the Hanford Site over the next several years. This Data Management Plan outlines the following:

- Types of data and information that are expected to be collected
- Currently available computer-based and administrative components
- Plans for developing any needed interim administrative components
- Plans for developing a comprehensive computer-based component that integrates selected existing and anticipated computer data bases
- Plans for establishing an information repository for maintaining the official paper-copy (hard-copy) records and physical samples associated with each operable unit.

Procedures for the system will be developed for directing project-authorized personnel as to the manner in which data are received, stored, tracked, amended, and disseminated so that a record of control is always maintained. These procedures will be developed to assure that the integrity of the data is maintained. The procedures will be provided in a detailed data system procedure manual that describes how data can be entered, accessed, processed, and amended so that a record of use and changes or modifications to the data is maintained. Access to the data base by all interested parties will allow access as described in the agreement being developed by DOE, EPA, and Ecology.

The data system procedures manual will include the procedures necessary for handling and tracking the information that must be maintained in the official (hard-copy) administrative record for each operable unit as well as physical paper-copy records and archived physical samples associated with each unit. It will also include procedures for operation and control of the

computer-based component of the system. Existing procedures will be either modified or used, or new procedures will be developed to address records management for the following general subject areas:

- Congressional inquires and hearings
- Discovery
- Remedial planning, investigation and feasibility study
- Remedial design and implementation
- EPA and State agency coordination
- Community relations
- Imagery (photographs, maps, illustrations, etc.)
- Enforcement activities
- Contracts
- Financial records.

An Environmental Data Management Plan is being prepared for submittal to DOE-RL by March 31, 1989. The plan will address development of the data management system discussed here and will include as a task the development of the data system procedure manual mentioned above. The plan will detail requirements, procedures, and responsibilities for managing environmental data.

The computer-based component is the Hanford Environmental Information System (HEIS), currently being developed by PNL. HEIS will be used to manage the extensive amount of data that will be collected and generated during the RI/FS and site-remediation processes. The HEIS is a computer-based information system that is designed to receive, store, and provide for access to quality-assured data concerning Hanford Site environmental and regulatory issues. As shown in Figure 1-1, HEIS is an integrated data base designed to integrate existing operational data bases and provide facilities for data being gathered as part of the CERCLA process. This allows for accessing and evaluating the data that is collected and generated by the individual Hanford Site environmental data base programs [e.g., Hanford Ground Water Data Base (HGWDB), surface monitoring Program Data and Management System (PDMS), Waste Information Data System (WIDS), Hanford Inactive Site Survey (HISS)], while maintaining the integrity of the individual data bases.

The HEIS will provide the following:

User support capabilities

- A geographic information system (GIS)
- Integrated graphics support
- Comprehensive user access capabilities
- Access by personal computers via existing networks
- Security of the data bases.

The computer based component will serve to list and locate paper records and physical samples. The HEIS will maintain much of the various types of raw-site (operable unit) data, verified program and summary data, and results of approved analytical computer programs. The results of such analyses will be stored separately from the original data files.

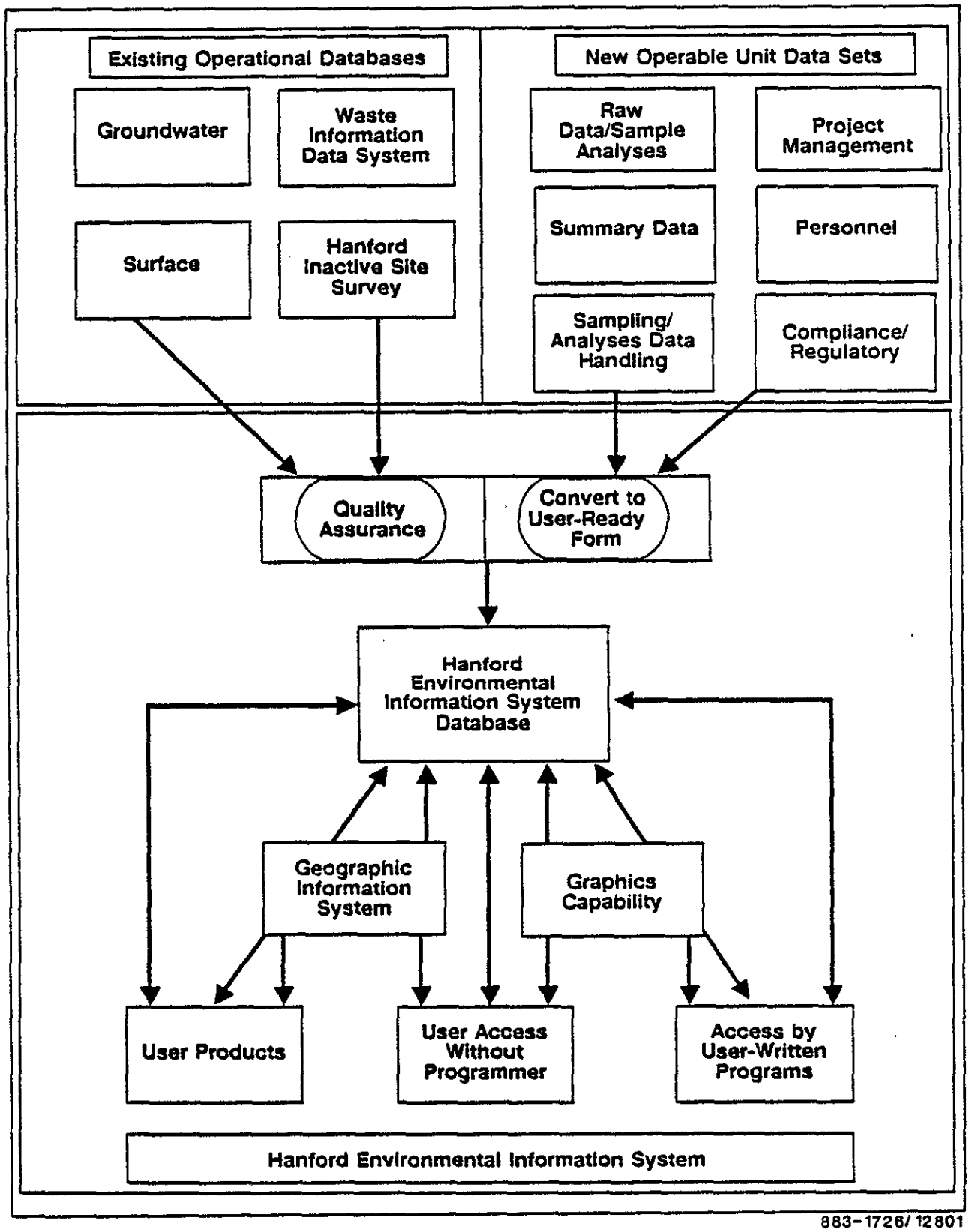

Figure 1-1. Framework of the Hanford Environmental Information System (HEIS)

The ability to enter data into raw data files will be restricted so as to maintain control of validated data. Any changes required to validate data will be procedurally controlled to restrict qualified data from being inadvertently or intentionally altered. All changes will be documented and maintained in the system.

The official paper-copy records (administrative record as well as other official paper-copy records) and archived physical samples will be maintained in designated areas that will be specified in the data system procedures manual. The designated areas will be designed such that they will meet all applicable protection and security requirements. Backup record copies will be maintained as necessary.

2.0 TYPES OF DATA TO BE COLLECTED AND ANALYZED

Records and types of data to be tracked during the RI/FS process at Hanford Site are shown in Table 2-1. The "Raw Data" represents the actual field and laboratory measurements or observations that will be made during the RI/FS processes. The "Summary Data" represents the first-order analyses of the "Raw Data." "Program Tracking" includes information that is programmatic or administrative in nature. It represents the data that are required for the conduct of a project; however, it does not include the field or laboratory data.

To the extent possible, validated data gathered during RI/FS investigations will be kept separate from other Hanford Site project data. However, many of the ongoing Hanford Site projects will provide data that will undoubtedly be very useful for the Hanford Site RI/FS investigations. Data will be stored such that they may be accessed for analyses, the results of which will be stored separately.

A reference collection of applicable EPA, Ecology, DOE, and Hanford Site contractor documents, drawings and correspondence will be maintained to support site characterization and remedial investigation activities. The ARARs drawn from Federal and State requirements and standards will also be kept and updated in a timely manner. Compliance requirements will also be maintained and updated periodically.

3.0 DATA MANAGEMENT PLAN SCOPE RELATIVE TO OTHER REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN COMPONENTS

The DMS will receive and control validated data obtained through implementation of the 200-BP-1 Operable Unit Work Plan and the Field Sampling Plan (FSP), and Health and Safety Plan (HASP). The Quality Assurance Project Plan (QAPP) provides the specific procedural direction and control for obtaining and analyzing samples in conformance with requirements to assure quality data and results of analyses. The FSP provides the detailed

Table 2-1. Types of Remedial Investigation/Feasibility Study Information and Data to be Collected

	Site Characterization
Raw data/sample analyses	Groundwater samples Sediment samples Surface water samples Atmospheric samples Personnel exposure monitoring records Geophysical information Biota samples Site descriptive information (topography, geological and ecological features) Pilot/bench test data Engineering design data
Summary data	Analytical results of environmental media by time, location, depth, contaminant, etc. Health risk assessment results Engineering test results Graphic information system outputs
Sampling/analyses/data handling	Sampling schedule Sample collection procedures Field/laboratory notebooks Analyses scheduling Laboratory quality assurance/quality control Calibration tracking Instrument coordination Data entry procedures Data reduction, validation, storage and transfer procedures
	Program Tracking
Project management	Project schedule and milestones Project costs Equipment, personnel, and supplies scheduling Document tracking Subcontracts Project quality assurance/quality control procedures
Personnel	Personnel training and qualifications Occupational exposure reports Personnel health and safety records
Compliance/regulatory	Applicable or relevant and appropriate requirements (ARARs)/screening levels Guidance document tracking Compliance issues Problem resolution

logistical methods to be employed in selecting the location, depth, frequency of collection, etc., of media to be sampled and in methods to be employed to obtain samples of the selected media for cataloging, shipment, and analyses. The data that result from the analyses will be entered into the DMS for subsequent control and tracking. In a similar manner, data from field and bench tests of potential remedial techniques will be entered into the DMS. Procedural control for such testing will be found in the QAPP. Specific directions and logistical methods to be employed for field and bench testing will be provided prior to Phase II RI activities. Site and personnel health data needed to assure worker safety will be specified in the HASP, which will also specify the manner in which these data are to be obtained. Personnel health records will be protected as required by the Privacy Act and secured in such a way that only authorized personnel will have access to these data.

4.0 PROCEDURAL CONTROL

The data management system will be procedurally regulated by the data systems procedure manual to be developed. A specific example relating to surface environmental monitoring is given in Figure 4-1.

5.0 IDENTIFICATION OF EXISTING DATA BASE SYSTEMS

Several data bases are currently in use at the Hanford Site. These data bases were developed for a variety of different purposes and uses. However, much of the information and data-handling capabilities associated with these data bases is directly useful to RI/FS evaluation of the various operable units located on the Hanford Site. A listing of the existing data bases that are available is provided in Table 5-1.

Westinghouse Hanford maintains an Environmental Resource Center (ERC) that contains copies of environmental and pertinent Federal and Washington State regulations, documents that have been prepared and submitted to Ecology and EPA pertaining to the regulations, and correspondence in support of environmental matters. The ERC contains RCRA permit applications and closure plans as well as RI/FS work plans for individual Hanford Site operable units. Other information such as environmental laws, DOE orders, corporate policies, and case histories will also be added. A computer based indexing system is presently being developed and will allow rapid identification of appropriate documents, copies of which can be obtained from the ERC files. The ERC will contain copies of all correspondence with Ecology and EPA. This will include primary as well as secondary documents.

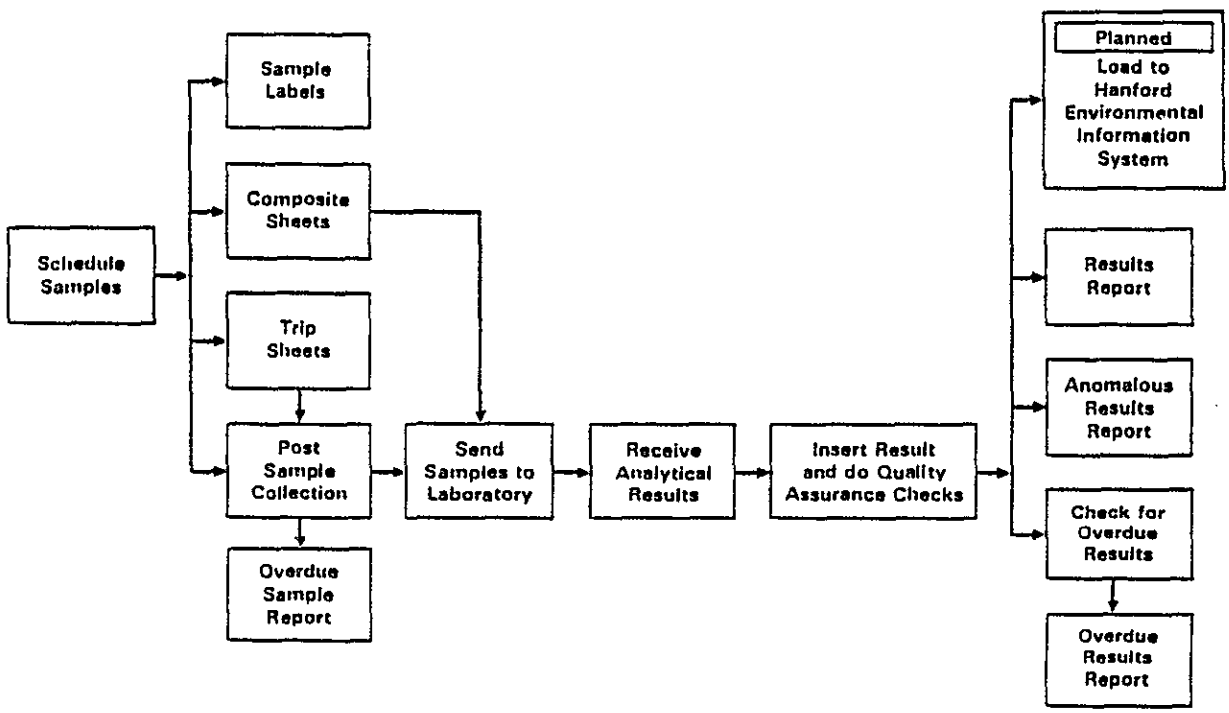

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Figure 4-1. Example Procedure for Collecting, Handling, and Analyzing Samples and for Entry of the Results

Table 5-1. Existing Hanford Data Bases (Sheet 1 of 2)

Data Base Name	Information Type
Hanford Groundwater Data Base (HGWDB)	Contains chemical and radionuclide analytical results for groundwater and sediment samples
Program Data and Management System (PDMS)	Contains chemical and radionuclide analytical results of air, surface water, soil, vegetation, wildlife, and foodstuffs samples
Waste Information Data System (WIDS)	Contains information on the physical and environmental characteristics of waste units at the Hanford Site (radioactive and hazardous chemicals)
Hanford Inactive Site Survey (HISS)	Contains detailed preliminary assessment/site inspection (PA/SI) information on individual waste sites at the Hanford Site
Hanford Environmental Compliance Report (HECR)	Contains information on Hanford Site waste streams for tracking environmental compliance issues
Environmental Compliance Tracking System (ECTS)	Contains regulatory flowsheet information for tracking compliance with Federal, State, and local environmental regulations
Sample Preparation System (SPS)	Generates labels, reports, etc., for sampling preparation and contains information on facilities, location, and time of sampling and chain-of-custody information
BWIP Technical Data System (BTDS)	Contains information on hydrological conditions and some geological data for the Hanford Site; also contains site characterization, hydrological data, hydrochemistry, stratigraphy and constituent data
Warehouse Inventory Management System (WIMS)	Keeps track of all the hazardous material purchased for use on the Hanford Site

Table 5-1. Existing Hanford Data Bases (Sheet 2 of 2)

Flow Gemini - Environmental Information System (HEHF's Occupational Hazardous Materials Exposure/Monitoring System)	Contains information associated with onsite monitoring of exposures to hazardous materials for Hanford workers
Flow Gemini - Occupational Health Information System (HEHF's Medial Information Tracking System)	Contains employee medical information
Material Safety Data Sheet (MSDS) System	Contains information on chemicals found at Hanford. Currently this is a manual system operated by HEHF, but it is in the process of being computerized. This effort is being coordinated with the SARA Title III Right-To-Know Program at the Hanford Site
Occupational Radiation Exposure (ORE)	Contains personnel respiratory protection fitting, work restriction, and radiation exposure information
Quality Control Blind Standards Data Base	Contains the results on spiked samples, replicate samples and interlaboratory comparisons
Training Records Information System (TRIS)	Contains records on individual employee training records
Commitment Control System (CCS)	Tracks correspondence commitments. A network version is available.

6.0 EVALUATION OF EXISTING DATA-BASE SYSTEMS

In general, the existing data bases in use on the Hanford Site were designed for specific purposes. They are not integrated to cover anticipated RI/FS needs. These existing data bases will provide supplementary, historical data to support the RI/FS process. The scope of each data base identified in Table 5-1 is discussed separately in the following paragraph.

The Hanford Groundwater Data base (HGWDB) is used to generate the annual "Groundwater Monitoring at Hanford" report. It also contains the Hanford Site's RCRA compliance-monitoring program's groundwater monitoring data. In addition, it has been modified to handle vadose zone (sediment) sample data.

The Program Data and Management System (PDMS) is generally used by the Hanford Site to generate the annual "Surface Environmental Monitoring at Hanford" report. It is an overall data base for tracking routine-and special air, surface-water, soil, vegetation, wildlife, and foodstuff samples from the Hanford Site.

The Waste Information Data System (WIDS) and the Hanford Inactive Site Survey (HISS) data bases were set up specifically to handle hazardous waste site information. The WIDS contains data on the general physical and environmental characteristics associated with the waste units located on the Hanford Site. The HISS contains Preliminary Assessment/Site Inspection (PA/SI) information on inactive sites at the Hanford Site including fairly detailed information on location, date for receiving waste, types and quantities of waste, cleanup actions, and other similar types of information. In addition, the HISS is supported by the PNL Hazard Ranking System (HRS) and Modified Hazard Ranking System (MHRS) Evaluation Data base, which contains the detailed HRS and MHRS scoring information, with input parameter justifications, for individual waste sites at the Hanford Site. The WIDS system serves as the official Hanford Site waste units identification and tracking system.

The Hanford Environmental Compliance Report (HECR) and Environmental Compliance Tracking System (ECTS) are two systems currently used at the Hanford Site to track compliance. The HECR was developed to provide a uniform method for Hanford Site contractors to use in collecting and maintaining regulatory compliance status information on Hanford Site facilities. Data input into HECR centers primarily around compliance with the various State and Federal legislation that may apply to a particular discharge point at the facility. The discharge point is the primary level for which compliance data are entered. However, the term "discharge point" can be defined with a great deal of flexibility allowing the system to track individual waste sites or operable units with no difficulty. The HECR provides for entry of additional compliance status information for those points needing follow-up action. This is done to allow tracking of compliance actions on a specific point. The ECTS contains regulatory flowsheet information. It is designed to be used in the evaluation of waste streams for compliance with Federal, State, and local environmental regulations. Waste streams are the primary focus of the ECTS; however, waste streams can be defined with some flexibility to allow the system to be used to track individual waste sites or operable units. The HECR and ECTS can be used in the comprehensive DMS to track compliance status of operable units (or individual sites if conditions warrant).

The Sample Preparation System (SPS) was set up to generate labels for sample bottles and to track sample status at the analytical laboratories. It can generate reports on samples collected, samples currently at an analytical laboratory, and samples with results overdue from the laboratory.

The BWIP Technical Data System (BTDS) was being prepared for the Basalt Waste Isolation Program (BWIP) to contain information on hydrological conditions and some geological data at the Hanford Site. The system was intended to handle data obtained from wells in hydrologic units in the basalt strata giving Lambert coordinates, water pressure, and other similar well information. It was also designed to handle site characterization, hydrological, hydrochemistry, stratigraphy, and constituent data. There is some overlap between the capabilities of the HGWDB and the BTDS. The BTDS is not intended for shallow wells in the unconfined aquifer.

The Warehouse Inventory Management System (WIMS) is a data base established to track, from receipt of material to its shipment to the customer, all stock items and to forward costing data to the Financial Data System. For the purpose of safe storage and transportation, hazardous materials are identified within WIMS. The system will be used in conjunction with the MSDS system and the SARA Title III program.

The Flow Gemini - Environmental Information System, managed by the Hanford Environmental Health Foundation (HEHF), is commonly referred to as the HEX system. It is set up to contain information associated with onsite monitoring of exposures to hazardous materials of Hanford workers. This system is in the process of being modified, so there is considerable flexibility to adjust it to accommodate the onsite monitoring needs of the Westinghouse Hanford Environmental Restoration Program (ERP).

The Flow Gemini - Occupational Health Information System (HEHF's Medical Information Tracking System) contains the confidential employee medical evaluation and history information. The HEHF medical surveillance program will need to be given directions from the HASP for each operable unit as to the specific elements that will need to be tracked for the specific individuals involved with its characterization. Once this is done, the HEHF Medical Information Tracking System will contain all of this information.

The Material Safety Data Sheet (MSDS) system contains information on chemicals found at the Hanford Site. Currently, this is a manually operated system operated by HEHF; however, it is in the process of being computerized. The computerization effort is being done in coordination with the SARA Title III mandated "right-to-know" program at the Hanford Site.

The Occupational Radiation Exposure (ORE) data base system contains personnel respiratory protection fitting and qualifications, work restrictions, and radiation exposure information for all Hanford Site employees. Access to individual employee's records must be tightly controlled to comply with the Privacy Act.

The Quality Control Blind Standards Data base (QCBSDB) contains information associated with quality control spiked samples, replicate sampling, and interlaboratory comparison results for the Hanford Site RCRA program. The QCBSDB is currently a manually tracked system, but is in the process of being computerized. It can quite readily be expanded to handle these type of data for the ERP as well.

The Training Records Information System (TRIS) contains training records for Westinghouse Hanford employees. Currently it handles contractors to Westinghouse Hanford manually, but is in the process of being upgraded to handle these electronically. The TRIS can be adjusted to include all contractor personnel working on a particular operable unit.

The Financial Tracking System (FTS) contains financial records for tracking and reporting on status of projects at Westinghouse Hanford. It is the system Westinghouse Hanford uses to track the financial aspects of all their projects. It has the capability of tracking projects by cost accounts and can provide status reports upon request.

Chapter 4 of the March 1988 Review Draft of EPA's Office of Solid Waste and Emergency Response Directive 9355.3-01 "Draft Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" addresses data management procedures. The contents of Table 4-2 of Section 4.2.1.3, which provides an outline of the file structure necessary for a superfund site, were used as a list of elements necessary for a data management system. Table 6-1 shows a listing of these elements and a brief discussion of how the various components of the DMS will address them.

The previous discussions have addressed the existing systems that can be used to provide a historical basis for the RI/FS work. However, there are several data-management needs identified in Table 2-1 for which there is no currently operated or historical data base. These include the following:

- Geophysical (site-by-site basis)
- Soil column analytical data (site-by-site basis)
- Pilot- and bench-scale testing
- ARAR screening
- Cost tracking
- Calibration tracking
- Instrument coordination
- QA/QC tracking
- Field and laboratory notebook tracking
- Document tracking (both site specific documents and guidance documents)
- Treatment/alternative screening
- Summarized/analyzed data (involves most of the raw data types).

The Environmental Data Management Plan to be prepared by March 31, 1989 will address these needs. Initial development of HEIS will focus on these needs in the order listed.

Table 6-1. Analysis of Data Needs as Specified in Environmental Protection Agency's Draft Guidance Directive and Current Historical Hanford Site Data Bases (Sheet 1 of 3)

File structure/data needs	Applicable data bases
Congressional Inquiries and Hearings: Correspondence Transcripts Testimony Published hearing records	None available. These will have to be addressed by written procedures
Discovery: Initial investigation Preliminary assessment Site inspection report Hazard ranking system data	Waste Information Data System and Hanford Inactive Site Survey. The Hanford Inactive Site Survey contains hard copy files of the information used for performing the Hazard Ranking System/Modified Hazard Ranking System evaluations of Hanford waste sites.
Remedial Planning: Correspondence Work plans for Remedial Investigation/Feasibility Study Remedial Investigation/ Feasibility Study Reports Health and Safety Plans Quality assurance/quality control plans Record of Decision/responsiveness summary	The Commitment Control System is presently available to track correspondence. Health and Safety plans and Quality Assurance/ Quality Control plans will be included in each Work Plan that will be developed for each operable unit. The information pertinent to the development of the Remedial Investigation Feasibility Study report will be tracked by HEIS using subordinate databases such as the Hanford Groundwater Data Bases, Program Data Management System, Waste Information Data Syste, Hanford Inactive Site Survey, Sample Preparation System, BWIP Technical Data System, Warehouse Inventory Management System, Flow Gemini-Environmental Information System, and Quality Control Blind Standards Data Base
Remedial implementation: Remedial design reports Permits Contractor work plans and progress reports Corps of Engineers agreements reports and correspondence	All of these items will be tracked by the Data Management System

Table 6-1. Analysis of Data Needs as Specified in Environmental Protection Agency's Draft Guidance Directive and Current Historical Hanford Site Data Bases (Sheet 2 of 3)

State and Other Agency Coordination: Correspondence Cooperative agreement/ Superfund State contract Interagency agreements Memorandum of Understanding with the State	Parts of these may be able to be tracked by Hanford Environmental Compliance Report. A record-file system is also currently being developed at the Hanford Site to track many of these items. These will be managed within the Data Management System.
Community Relations: Interviews Correspondence Community relations plan List of people to contract, e.g., local officials, civic leaders, environmental groups Meeting summaries Press releases News clippings Fact sheets Comments and responses Transcripts Summary of proposed plan Responsiveness summary	There is no known existing system at the Hanford Site available to electronically track community relations information. This information can be handled manually in accordance with the community relations plan or tracking can be added to the Data Management System if desired.
Imagery: Photographs Illustrations Other graphics	The Hanford Inactive Site Survey and associated files contain photographs and maps of sites. Also, the HEIS will have Graphic Information System (GIS) capabilities.
Enforcement: Status reports Cross-reference to any confidential enforcement files and the person to contact Correspondence Administrative orders	The Hanford Environmental Compliance Report and Environmental Compliance Tracking System will be used to contain the compliance status information by operable unit. Any administrative orders that are formally produced can also be tracked in the Data Management System designed to track formal formal documents.

Table 6-1. Analysis of Data Needs as Specified in Environmental Protection Agency's Draft Guidance Directive and Current Historical Hanford Site Data Bases (Sheet 3 of 3)

Contracts: Site-specific contracts Procurement packages Contract status notifications List of contractors	Other than existing project management software systems currently available at the Hanford Site, there is no known electronic system presently available to track contract information such as this. This information can be handled manually by procedures or the Data Management System can track it.
Financial Transactions: Cross-reference to other financial files and the person to contact Contractor cost reports Audit reports	The financial operations for the clean up of a federal facility is different from the normal Environmental Protection Agency-funded Superfund process. The financial information that needs to be tracked for compliance purposes can be tracked manually or by the Data Management System.

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ATTACHMENT 5

PROJECT MANAGEMENT PLAN

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2.1 Interface of Regulatory Authorities and the U.S. Department Of Energy At5-1
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1.0 INTRODUCTION

The purpose of this Project Management Plan (PMP) is to define the administrative and institutional tasks necessary to support RI/FS activities in the 200-BP-1 Operable Unit at the Hanford Site under CERCLA. This plan defines the responsibilities of the various participants, the organizational structure, and the project tracking and reporting procedures.

The EPA, Ecology, and the DOE are entering into an agreement for remedial action on the Hanford Site. An action plan, which implements this agreement, defines EPA and Ecology regulatory integration and the methods and processes to be used to implement the agreement. This PMP is in accordance with the provisions of the draft action plan. Revisions to the action plan may result in changed requirements that would supercede the provisions of this plan.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 INTERFACE OF REGULATORY AUTHORITIES AND THE U.S. DEPARTMENT OF ENERGY

The 200-BP-1 Operable Unit consists of inactive waste management units to be remedied under the CERCLA, as amended by SARA. Therefore, it is under the authority of the EPA. The EPA has been designated as the lead regulatory agency as defined in the agreement. Accordingly, the EPA is responsible for overseeing remedial activity at this unit and ensuring that the applicable authorities of both EPA and Ecology are applied.

As lead regulatory agency, EPA will do the following:

- Assign an EPA Project Manager and a Unit Manager.
- Coordinate with Ecology as the support regulatory agency.
- Review and approve all primary documents prepared by DOE.
- Review and comment on secondary documents, if necessary.
- Evaluate DOE's responses to comments.
- Review and approve any action proposal by DOE.
- Draft the Record of Decision.
- Determine if an Interim Remedial Action (IRA) is required and request a proposed remedy from DOE, if necessary.

Ecology will be the support regulatory agency responsible for assigning an Ecology Project Manager and Unit Manager and for reviewing and commenting on all primary documents.

The DOE will do the following:

- Assign a DOE Project Manager and a Unit Manager.
- Prepare and implement the RI/FS Work Plan.
- Perform the Phase I and II RI and Phase I, II, and III FS.
- Prepare the RI/FS reports.
- Revise documents and respond to comments by the EPA and Ecology.
- Propose appropriate alternatives for an IRA, if required.
- Compile and maintain the administrative record.
- Upon issuance of the ROD, DOE will be responsible for preparing the Remedial Design Report (RDR), Remedial Action Work Plan (RA), and Operation and Maintenance Plan.

2.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project organization is shown on Figure 2-1. The following sections describe the responsibilities of the individuals shown on this figure.

Project Managers. The EPA, DOE, and Ecology will each designate one individual as project manager, who will serve as the primary point of contact for all activities to be carried out under the agreement and action plan. In addition, each of the above three parties will designate an alternate project manager. The primary responsibilities of the project managers are as follows:

- Implement the scope, terms, and conditions of the action plan.
- Direct and provide guidance to unit managers.
- Maintain effective communications among each other.
- Report project status to their respective management.
- Approve any changes to schedules in the work plan that will impact the work schedule contained in the action plan.

The DOE Project Manager will be responsible for maintaining a listing of the current unit managers.

Unit Managers. The EPA, DOE, and Ecology will each designate a unit manager for this RI/FS; the unit manager from EPA serving as the lead unit manager. The lead unit manager will be responsible for the activities required by the 200-BP-1 Operable Unit Area RI/FS work plan. The unit managers will represent their respective parties for these activities and are responsible for keeping their respective project managers informed on the work status, budget, and schedule, and of any problems that may arise.

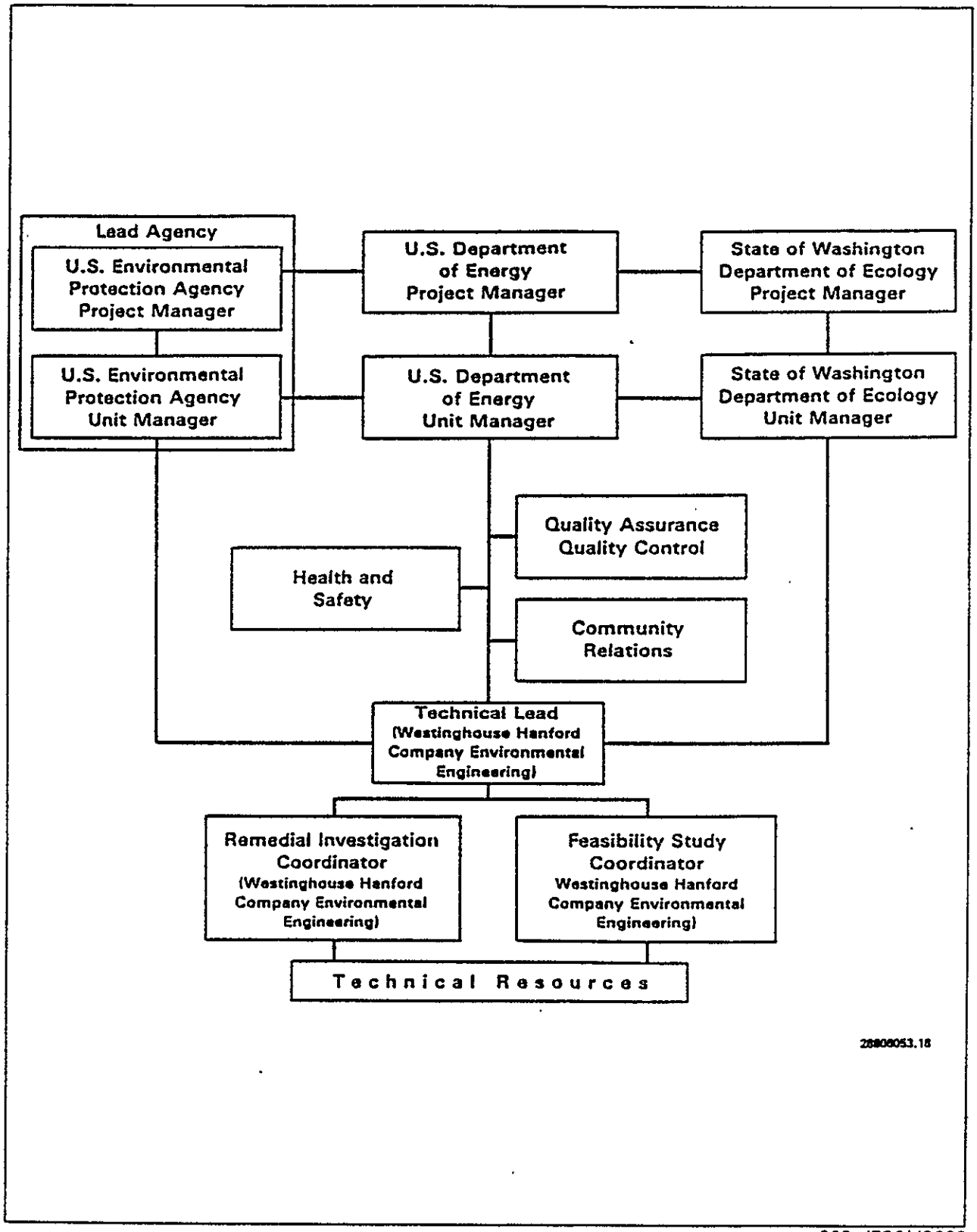

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Figure 2-1. Project Organization

Quality Assurance/Quality Control Coordinator. The quality coordinator is responsible for coordinating and/or oversight of performance to the QAPP requirements by means of internal auditing and surveillance techniques. The quality assurance officer retains the necessary organizational independence and authority to identify conditions adverse to quality and to inform the technical lead of needed corrective action.

Health and Safety Officer (Environmental Division/Environmental Field Services). The health and safety officer is responsible for determining potential health and safety hazards from radioactive, volatile, and/or toxic compounds during sample handling and sampling decontamination activities and has the responsibility and authority to halt field activities due to unacceptable health and safety hazards.

Technical Lead. The technical lead will be a designated person within the Westinghouse Hanford Environmental Engineering Group. The responsibilities of the technical lead will be to plan, authorize, and control work so that it can be completed on schedule and within budget, and to ensure that all planning and work performance activities are technically sound.

Remedial Investigation Coordinator. The RI coordinator will be responsible for coordinating all activities related to Phases I and II of the RI, including data collection, analysis, and reporting. The RI coordinator will be from the Westinghouse Hanford Environmental Engineering Group, and will be responsible for keeping the technical lead informed on the RI work status and any problems that may arise.

Feasibility Study Coordinator. The FS coordinator will be responsible for coordinating all activities related to Phases I, II, and III of the FS, including data collection, analysis, and reporting. The FS coordinator will be from the Westinghouse Hanford Environmental Engineering Group, and will be responsible for keeping the technical lead informed on the FS work status and any problems that may arise.

Remedial Investigation Technical Resources. The various technical resources responsible for performing the RI are shown on Figure 2-2. These resources will be responsible for performing data collection, analysis, and reporting, for the technical activities related to the RI. Figure 2-3 through 2-7 show detailed organizational structure for specific RI tasks.

Internal and external work orders and subcontractor task orders will be written by the RI coordinator to use these technical resources, which are under the control of the technical lead. Statements of work will be provided that will include a discussion of authority and responsibility, a schedule with clearly defined milestones, and a task description including specific requirements. Each group will keep the RI coordinator informed on the RI work status performed by that group and of any problems that may arise.

Feasibility Study Technical Resources. The various technical resources responsible for performing the FS are also shown on Figure 2-2. These resources will be responsible for identifying and screening remedial alternatives, and for detailed evaluation of selected alternatives. Work teams reporting to the technical lead for various phases and types of work are shown in Figures 2-3 through 2-7.

Technical Resources		
Subject/Activity	**Remedial Investigation**	**Feasibility Study**
Hydrogeology and geology	Westinghouse Hanford[a]/Geosciences PNL[b]/Earth and Environmental Sciences Center	Westinghouse Hanford/ Geosciences
Toxicology and risk/ endangerment assessment	Westinghouse Hanford/ Environmental Technology PNL/Earth and Environmental Sciences Center PNL/Life Sciences Center	Westinghouse Hanford/ Environmental Technology
Environmental chemistry	Westinghouse Hanford/Geosciences . PNL/Earth and Environmental Sciences Center	Westinghouse Hanford/ Geosciences
Geophysics and field testing	Westinghouse Hanford/Geosciences (Planning) Environmental Field Services	N/A
Geotechnical and civil engineering	N/A	Westinghouse Hanford/ Environmental Engineering and PNL/Waste Technology Center
Groundwater treatment engineering	N/A	Westinghouse Hanford/ Environmental Engineering and PNL/Waste Technology Center
Waste stabilization and treatment	N/A	Westinghouse Hanford/ Environmental Engineering and PNL/Waste Technology Center
Surveying	Kaiser Engineers	N/A
Soil and water sampling and analysis	Westinghouse Hanford/Environmental Engineering and Geosciences Environmental Field Services PNL/Earth and Environmental Sciences Center PNL/Materials and Chemical Sciences Center U.S. Testing	N/A
Drilling and well installation	Westinghouse Hanford/Geosciences Environmental Field Services Kaiser Engineers	N/A
Radiation monitoring	Westinghouse Hanford/Operational Health Physics	N/A

NOTE: Qualified subcontractors may conduct all or portions of the RI/FS.
[a]Westinghouse Hanford = Westinghouse Hanford Company.
[b]PNL = Pacific Northwest Laboratory .

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Figure 2-2. Technical Resources for Conducting RI/FS

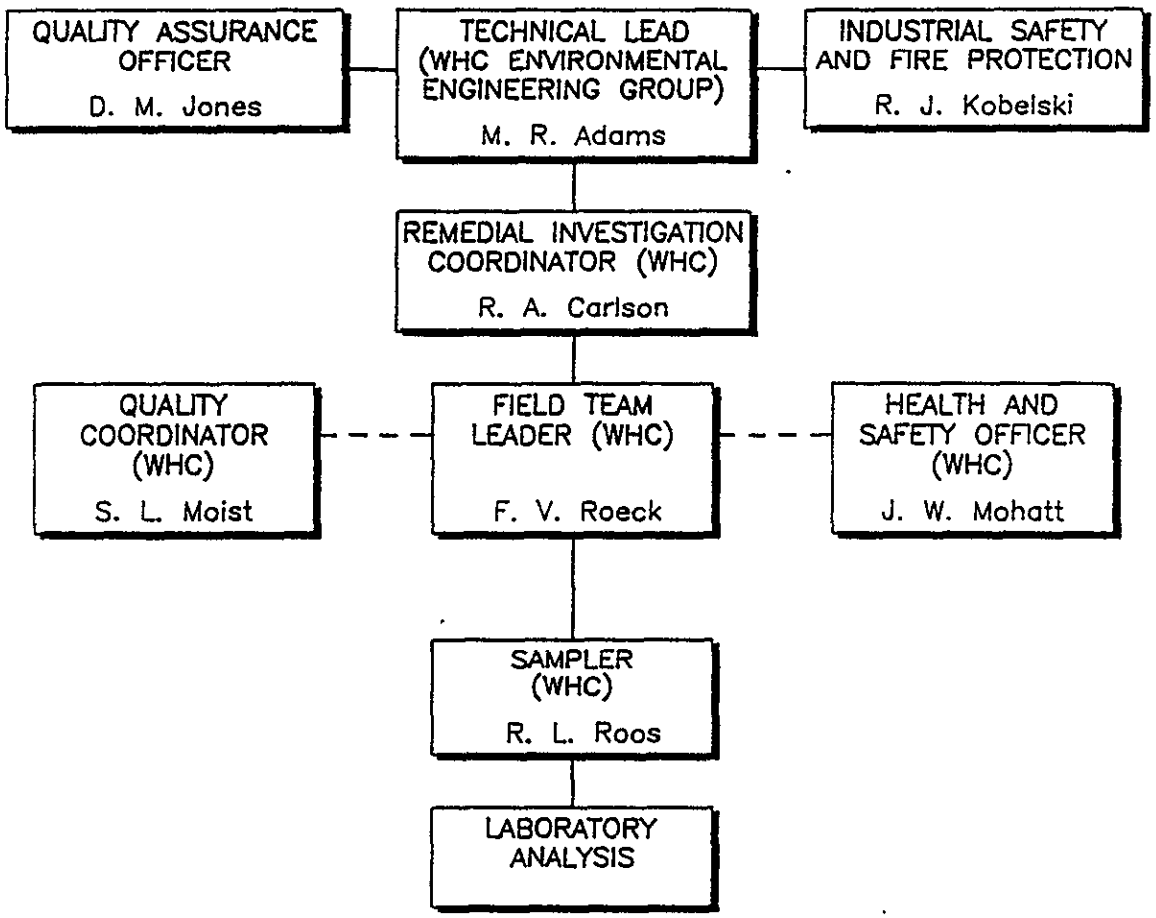

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Figure 2-3. 200-BP-1 Soil Sampling Team

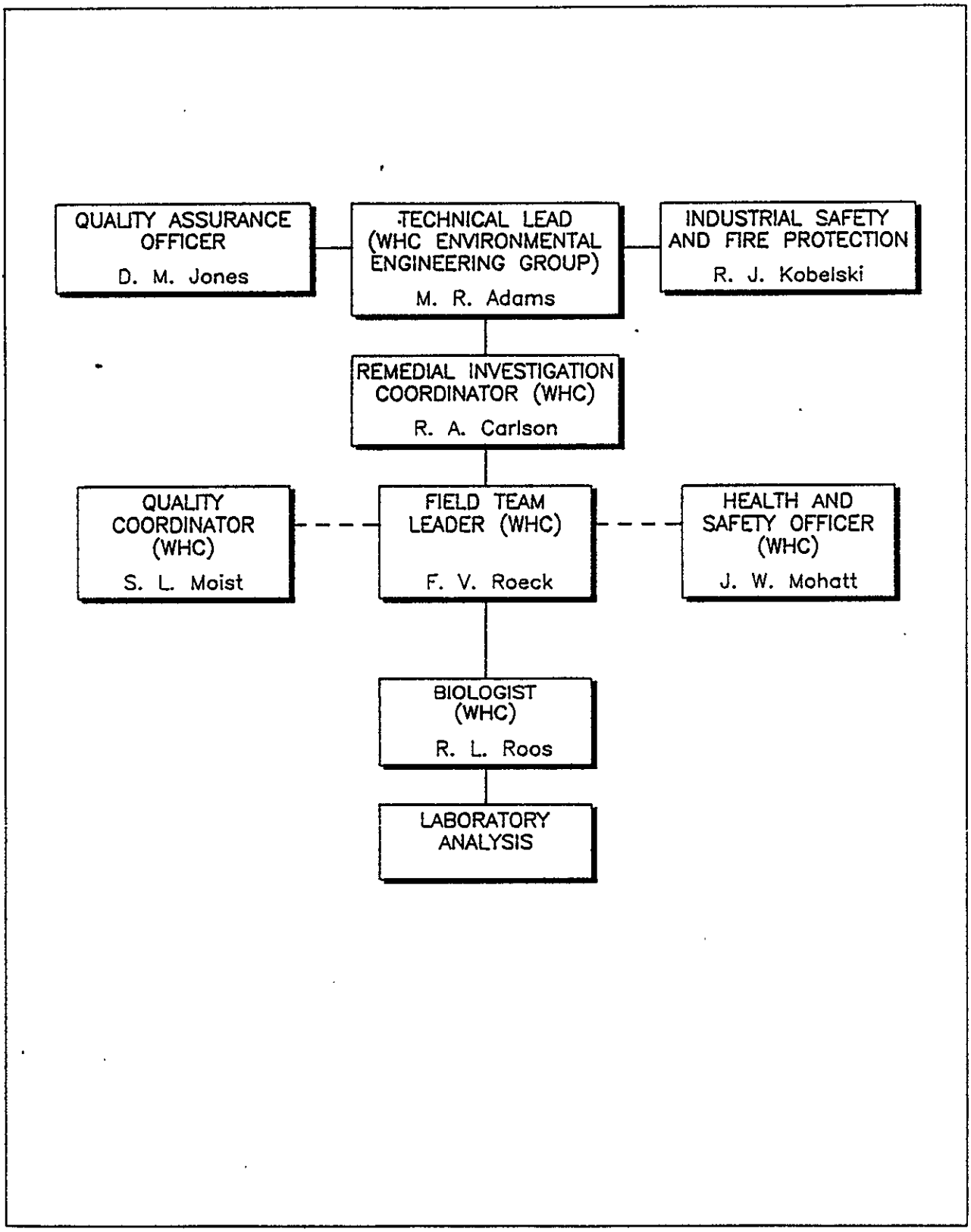

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Figure 2-4. 200-BP-1 Biological Sampling Team

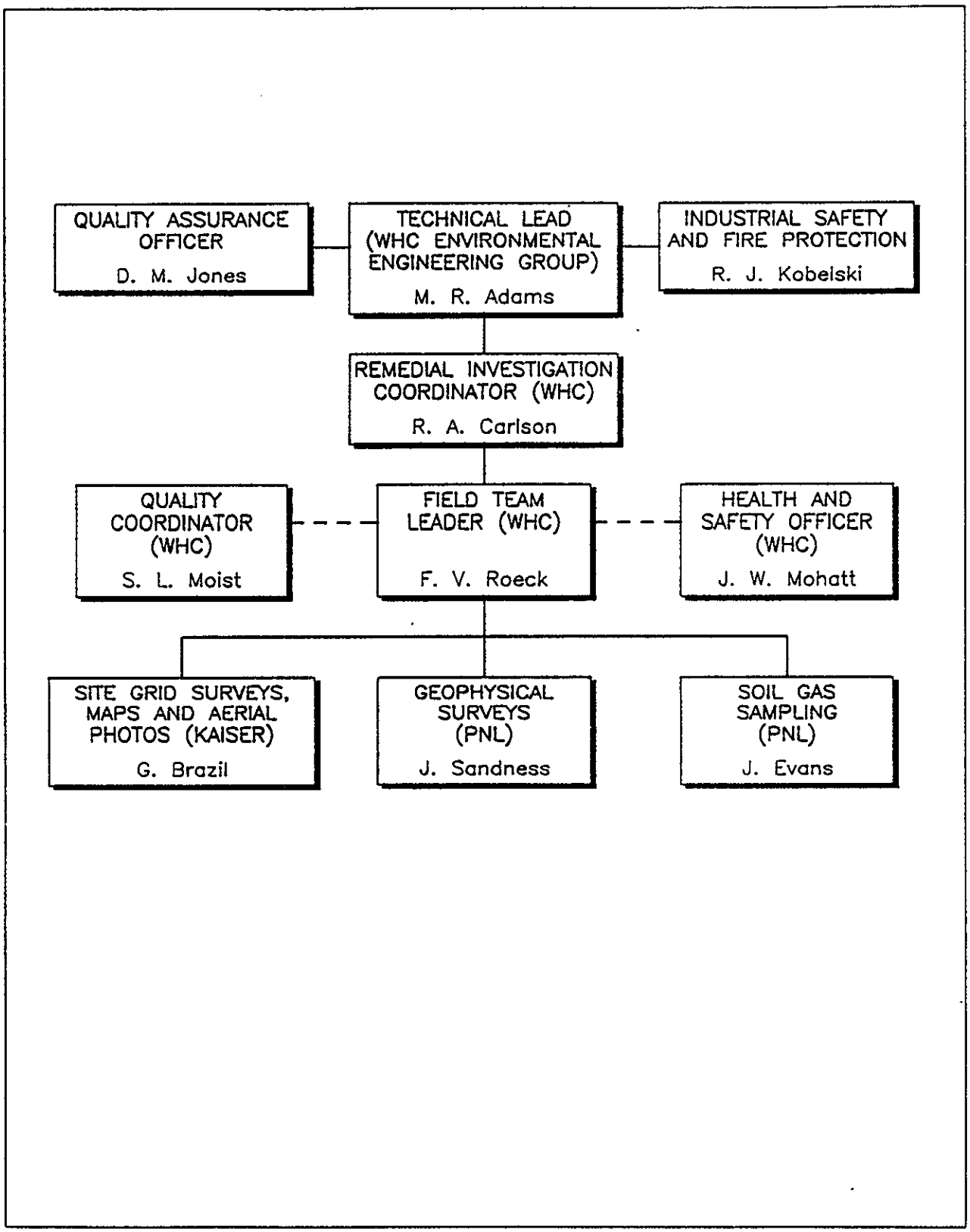

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Figure 2-5. 200-BP-1 Physical and Geophysical Survey Team

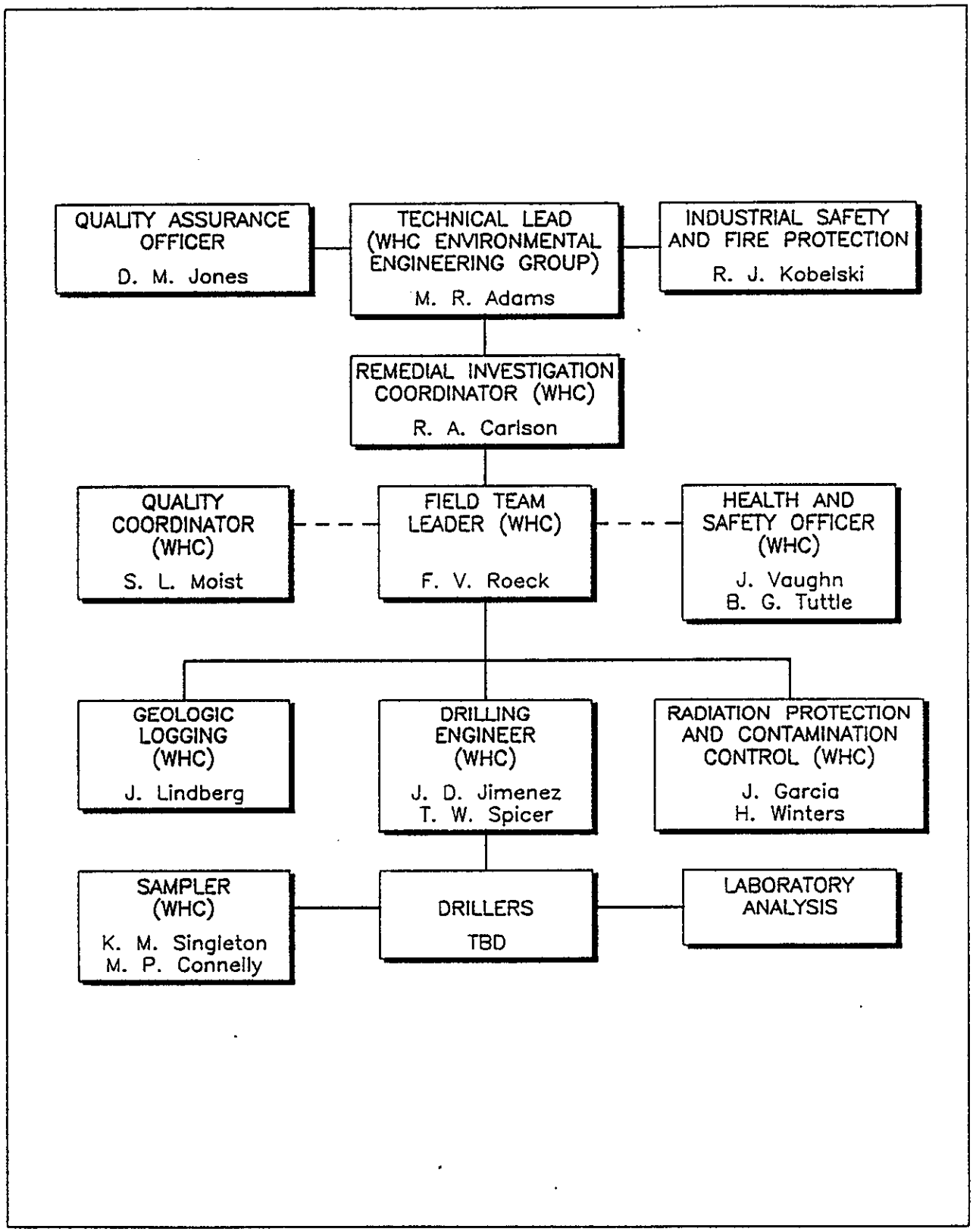

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Figure 2-6. 200-BP-1 Vadose Zone Drilling and Sampling Team

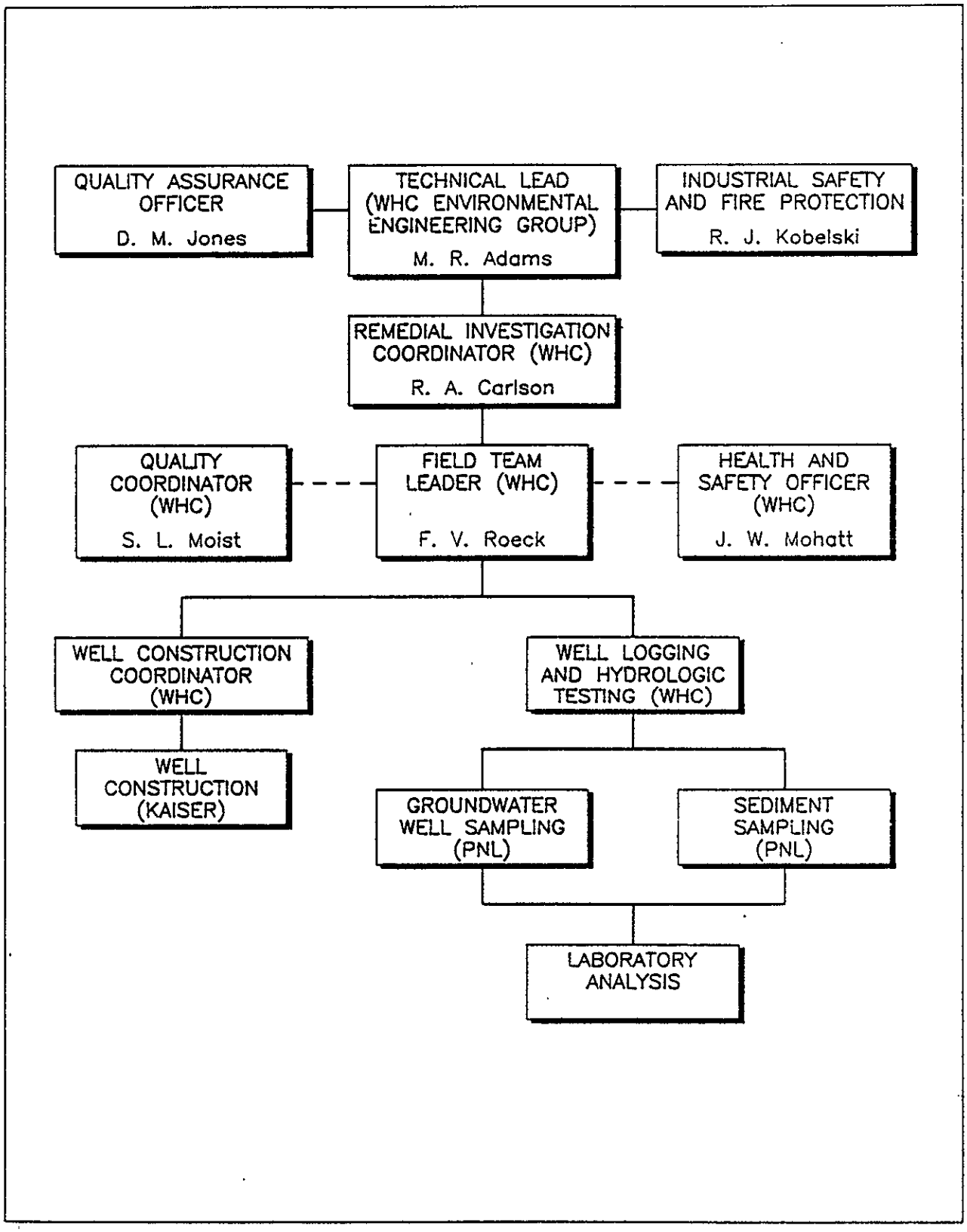

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Figure 2-7. 200-BP-1 Groundwater Well Construction and Hydrological Testing Team

Internal and external work orders and subcontractor task orders will be written by the FS coordinator to use these technical resources, which are under the control of the technical lead. Statements of work will be provided that will include a discussion of authority and responsibility, a schedule with clearly defined milestones, and a task description including specific requirements. Each group will keep the FS coordinator informed on the FS work status performed by that group and of any problems that may arise.

3.0 REPORTING REQUIREMENTS

3.1 CATEGORIZATION OF DOCUMENTS

All documents will be categorized as either primary or secondary. Primary documents, which are managed by EPA and DOE, represent the final documentation of key data and reflect decisions on how to proceed. Primary documents will be handled in accordance with standard Westinghouse Hanford procedures as quality records. Primary documents include the following:

- RI/FS work plan
- RI Phase II Report
- FS Phase I and II Report
- FS Phase III Report
- Proposed Plan.

Secondary documents represent an interim step in a decision- making process or are issued for information and do not reflect key decisions. Secondary documents include the following:

- RI Phase I Report
- Sampling and data results
- Supporting studies and analyses
- Other supporting documents, as necessary.

3.2 DOCUMENT REVIEW AND COMMENT

Primary Documents. Figure 3-1 provides the process flow for reviewing and commenting on primary documents. The flowchart reflects the multiple paths that a primary document may take depending on the type and extent of comments received. Figure 3-1 also designates the time periods, in terms of days, for specific actions.

All comments shall be submitted on a Review Comment Record (RCR) (Figure 3-2). The RCR will provide a record of the comment, together with the disposition, as agreed to by both the reviewer and the preparer. Comments may be made on all aspects of the document, including completeness, and should include, but are not limited to, technical adequacy and consistency with CERCLA or other pertinent guidance or policy. Where possible, comments shall be specific to individual lines, paragraphs, or sections. All comments shall be provided with adequate specificity so that DOE can respond in detail and make appropriate changes in the document. Reviewers shall indicate whether

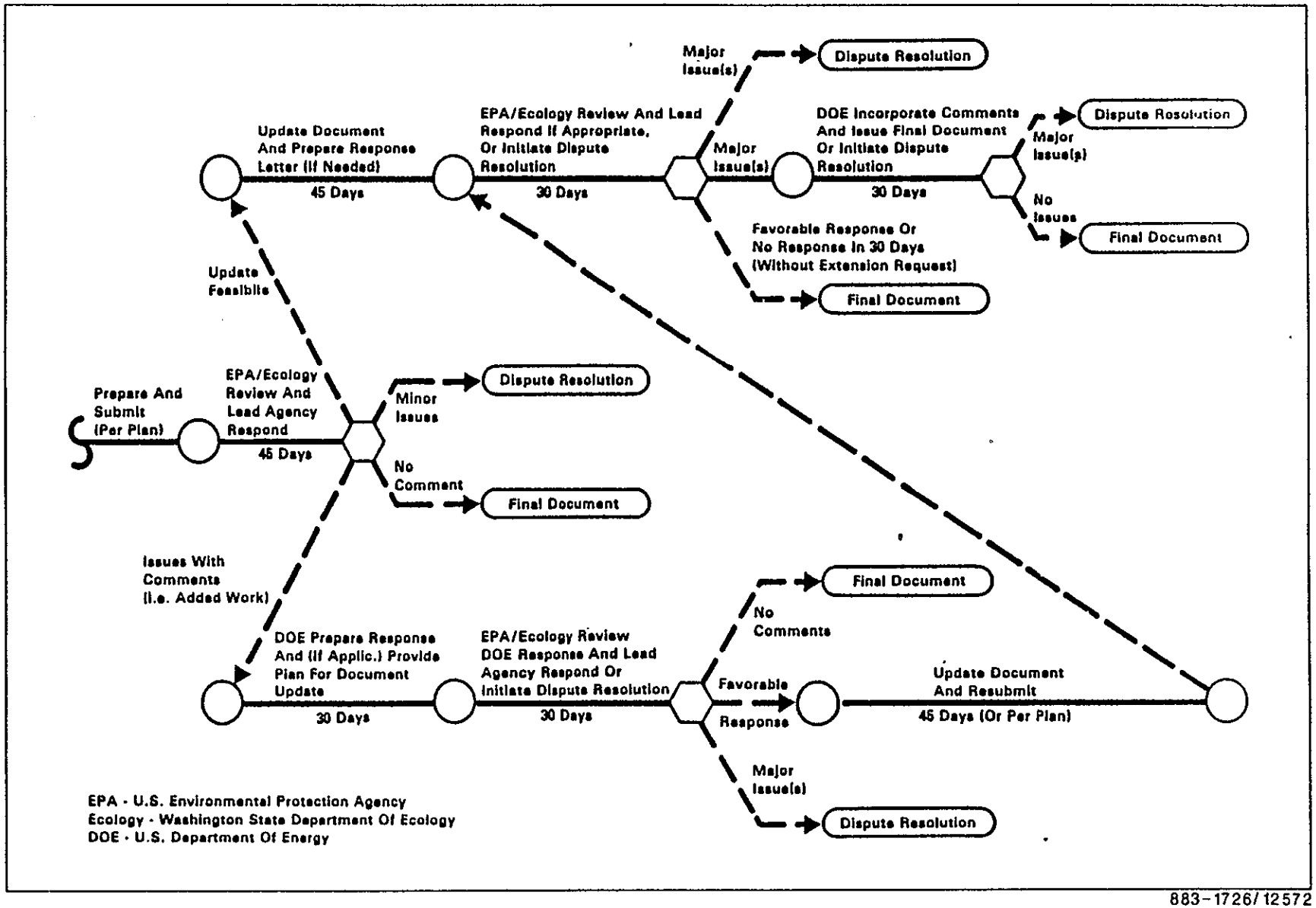

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Figure 3-1. Review and Comment on Primary Documents

REVIEW COMMENT RECORD (RCR)

1 Date	2 Review No
3 Project No	4 Page 1 of _

5 Document Number(s)/Title(s)	6 Program/Project/Building Number	7 Reviewer	8 Organization/Group	9 Location/Pl...

10 Agreement with indicated comment disposition(s)	11 CLOSED
Reviewer Date Project/Cognizant Engineer	Reviewer Date Project/Cognizant Engineer

17 Comment Submittal Approval
Reviewer

12 Item	13 Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated).	14 Hold Point	15. Disposition (provide justification if NOT accepted).	16 Status

A-6400 090 1 (10/8/...)

Figure 3-2. Review and Comment Record

they consider their comment to be mandatory (m), suggested (s), editorial (e), or clarification (c). Comments shall refer to any pertinent sources of authority or references upon which the comments are based, and, upon request of DOE, the commenting agency shall provide a copy of the cited authority or reference. In cases involving complex or unusually lengthy documents, EPA may extend the comment period for an additional period by written notice to DOE prior to the end of the first period. On or before the close of the comment period, EPA shall transmit their written comments by next-day mail to the DOE Unit Manager. Within one day of receiving EPA comments the DOE Unit Manager will transmit them to the technical lead.

Representatives of the DOE shall make themselves readily available to EPA during the comment period for the purpose of informally responding to questions and comments. Oral comments made during such discussions need not be the subject of a written response by DOE but will be addressed as appropriate.

In commenting on a draft document that contains a proposed "Applicable or Relevant and Appropriate Requirements" (ARAR) determination, the EPA shall include a reasoned statement of whether or not they object to any portion of the proposed ARAR determination. To the extent that the EPA does object, it shall explain the basis for its objection in detail and shall identify any ARARs that it feels were not properly addressed in the proposed ARAR determination.

Upon receiving the comments from the EPA, DOE will update the document and/or respond to the written comments. The response will include a schedule for obtaining additional information if required. The DOE may extend the period for responding to the comments by obtaining written approval from the EPA.

Upon receiving the responses to the comments, the EPA will complete its evaluation of the response. In the event that the responses are inadequate, the matter will enter the dispute resolution process as set forth in Section XI of the agreement. The majority of the disputes are anticipated to be resolved during the initial informal dispute resolution period. Within 30 days of completion of the dispute resolution, or of the EPA evaluation of the responses if there is no dispute, DOE will incorporate the resolved comments into the document (see Part III of the agreement). The DOE may extend the 30-day period for revising the document by obtaining written approval of the EPA if the comments require additional information to be developed.

Upon receiving an updated document (with or without supporting responses), the EPA will determine if the document is adequate. If major issues still exist, the dispute resolution process will be initiated. If the document is adequate or if only minor modifications are necessary, the EPA will notify DOE in writting in which case the document will become final at the end of the 30-day period. If no such notice is received at the end of the 30 day period, the document will become final.

Secondary Documents. On secondary documents, EPA and Ecology have the option to provide comments within 45 days of submittal or take no action. Comments will be transmitted via RCR forms (Figure 3-2). If comments are provided, DOE will respond in writing within 30 days. The same criteria for review presented above for primary documents will be used for secondary documents.

However, secondary documents are not subject to the dispute resolution process.

3.3 REVISION OF PRIMARY AND SECONDARY DOCUMENTS

Following finalization, modification of primary or secondary documents may become necessary. Modification of a document shall be required only if the modification could be of significant assistance in: (1) evaluating impacts on the public health or the environment, (2) evaluating the selection of remedial alternative, or (3) protecting human health and the environment. Modification may require additional field work, pilot studies, computer modeling, or other supporting technical work. The following criteria must be met to revise a document:

- A party may seek to modify a document after finalization if it determines, based on new information (i.e., information that became available, or a condition that became known, after the document was finalized), that the requested modification is necessary. The party may seek such a modification by submitting a concise written request to the project managers. The request shall specify the nature of the requested modification and the new information on which the request is based.

- Consensus should be reached by the project managers on the need for the modification. In the event that consensus is not reached, any party may invoke dispute resolution to determine if such modification shall be conducted.

Nothing in this section shall alter the EPA's ability to request the performance of additional work that does not constitute modification of a final document. The review and comment process will be the same as the original document.

3.4 ADMINISTRATIVE RECORDS

An administrative record shall be established to support the ROD. The administrative record file will contain all of the documentation used to arrive at the ROD. It will be available for public inspection when the investigation process begins. The administrative record file will be maintained in Richland. There will be two additional copies of the file: one will be at the EPA Region 10 Office and one at the Washington State Department of Ecology Office. The DOE will compile and maintain the file at Richland, and provide copies to EPA and Ecology for their respective files. The Administrative Record File will be initiated when the first document relating to the 200-BP-1 Area Operable Unit is submitted to EPA/Ecology. The contents of the file will increase as the process continues. When the decision document is signed, all documentation relevant to the selection of the final action(s) must be in the file.

The administrative record includes all primary and secondary documents. In addition, it will include the following:

- All EPA, Ecology and Public comments on documents

- All DOE responses to comments
- Documentation of EPA and Ecology evaluation of the responses
- All documentation of dispute resolution activities, including correspondence and final resolutions.

3.5 DISTRIBUTION OF DOCUMENTS AND CORRESPONDENCE

Table 3-1 indicates the appropriate distribution of all documents and correspondence. In general, any correspondence or documents relevant to the evaluation and selection of a remedial alternative will be included in the administrative record.

3.6 CHANGE CONTROL

This section provides the process for modifying the work schedule in the work plan, as well as minor field changes, without having to process a formal revision as described in Section 3.3 above.

Authority to Approve Changes. Project manager approval is required on all changes to the work plan schedules that impact the work schedule contained in the action plan as described in Section 2.2. Changes to the work plan schedules that do not impact the action plan can be approved by the unit managers.

Formal Change Control Process. Changes to the work plan schedule, including those that impact the work schedule in the action plan shall be processed using the change control sheet included as Figure 3-3.

Changes are tracked by a "change number." The DOE shall maintain a log of all changes by number and title, along with a file copy of the change. An individual will be assigned responsibility for maintaining the change file and will be responsible for assigning change numbers. The change number can be obtained any time during the change process, even after the change is approved.

The change control form should include a short title for the change, which will be used primarily as a cross-reference on the change log. It should also provide a description of the change, along with justification as to why the change should be made and should briefly explain the likely consequences if the change is not made. All documents that will have to be revised because of the change shall be listed.

Once approved, the change is considered implemented. The work schedule in the action plan or the work plan schedule need not be updated until its next scheduled update.

Field Changes. With exception of minor field changes, revisions to specified technical requirements and design will be made through revision of the technical documents in which they are presented. Minor field changes are those that do not affect established requirements (i.e., ARARs) or that do not degrade the level of investigation, monitoring, or cleanup. Examples of minor

Table 3-1. Distribution of Documents and Correspondence

	Not affecting decisions on remedial actions	Affecting decisions on remedial actions
Unit manager's correspondence	Unit managers for that operable unit at other two agencies Project managers at all three agencies	Unit managers for that operable unit at other two agencies Project managers at all three agencies Administrative Record Files
Project manager's correspondence	Project managers at other two agencies Affected unit managers	Project managers at other two agencies Administrative Record Files
Draft primary or secondary documents Final secondary documents	Unit managers for that operable unit at all three agencies Project mangers at all three agencies Administrative Record Files	NA
Final primary documents	NA	Unit managers for that operable unit at all three agencies Project managers at all three agencies Administrative Record Files
Quarterly Reports	Unit managers for that operable unit at all three agencies Project mangers at all three agencies Administrative Record Files	Unit managers for that operable unit at all three agencies Project managers at all three agencies Administrative Record Files

Change Number: (1)	CHANGE CONTROL SHEET Originator: (2)	(3)

Class of Change: (4)

☐ I-Signatories (Section 13.0) ☐ II-Project Manager ☐ III-Unit Manager

Change Title: (5)

Description/Justification of Change:

(6)

Impact of Change:

(7)

Affected Documents: (List Specific Documents)

(8)

Approvals	
_____ _____ (9) _____ _____ _____ _____	(10)

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Figure 3-3. Change Control Sheet

field changes include revision of sampling locations, additional sampling as required, and operational decisions required to accommodate actual field conditions.

To ensure efficient and timely completion of tasks, minor field changes can be made by the field team leader in accordance with Westinghouse Hanford procedure, "Deviation from Environmental Investigation Instruction." Such changes will be documented in the daily log books that are maintained in the field in accordance with Westinghouse Hanford procedure, "Field Logbooks." If such field change is anticipated to affect the schedule, the DOE Unit Manager will then be notified so that a change control sheet can be processed for the schedule change.

4.0 FINANCIAL AND PROJECT TRACKING REQUIREMENTS

4.1 MANAGEMENT CONTROL

Westinghouse Hanford will be responsible to plan and control activities and to provide effective technical, cost, and schedule baseline management. The Westinghouse Hanford Management Control System (MCS) will be used for effective planning and control practices. The MCS meets the requirements of DOE Order 4700.1, Project Management System (DOE 1987) and DOE Order 2250.1B, (DOE 1985) Cost and Schedule Control Systems Criteria for Contract Performance Measurement. The primary goals of the Westinghouse Hanford MCS are to provide methods for planning, authorizing, and controlling work so that it can be completed on schedule and within budget and to ensure that all planning and work performance activities are technically sound and in conformance with management and quality requirements.

The work plan schedule and major milestones are described in Section 6.0 of the 200-BP-1 Operable Unit work plan. The work plan schedule will be the primary vehicle for the unit and technical leads to track progress. The work plan schedule must be consistent with the work schedule contained in the action plan for implementation of the agreement.

The work plan schedule will be updated at least annually, with the primary purpose to expand the new current fiscal year and follow-on year. In addition, any approved schedule changes (see Section 3.6 for formal change control system) would be incorporated at this time, if not previously incorporated. This update will be performed in the fourth quarter of the previous fiscal year (e.g., July to September) for the upcoming current fiscal year. The work schedule can be revised at any time during the year if the need arises, but would be restricted to major changes that would not be suitable for the change control process.

4.2 MEETINGS AND PROGRESS REPORTS

Project Managers Meeting. The project managers shall meet, at a minimum, on a quarterly basis to discuss progress, address issues, and review plans for the next quarter. A status of the work schedules from selected RI/FS work plans will be reviewed at the meeting and will include any supporting technical

information. Any agreements and commitments resulting from the meeting will be prepared and signed by all parties prior to the conclusion of the meeting.

Unit Managers Meeting. The Unit Managers shall meet at least monthly to discuss work progress, address technical issues, and review near-term plans. The DOE Unit Manager will prepare a monthly status report on the schedules of all ongoing activities from the RI/FS Work Plan prior to the meeting. The schedule status report will be provided by DOE to all parties and reviewed at the meeting. Any agreements and commitments (within the unit managers level of authority) resulting from the meeting will be prepared and signed by all parties prior to the conclusion of the meeting. The DOE Unit Manager shall issue the meeting minutes to all parties, with information copies to the project managers, within five (5) working days following the meeting. The minutes will include, as a minimum, the following:

- Status of previous agreements and commitments
- Description of agreements and commitments resulting from meeting
- Work schedule status
- Any approved changes signed off at the meeting in accordance with Section 3.6 of this Project Management Plan.

Quarterly Progress Report. The DOE shall issue a quarterly progress report to the EPA and Ecology within 45 days following the end of the quarter being addressed for all ongoing work associated with the agreement and action plan. The issuance of these reports will be shown on the action plan. The report shall include the following:

- Highlights of significant progress and problems
- Technical progress, with supporting pictures as appropriate
- Problem areas with recommended solutions
- Significant activities planned for next quarter
- Work schedule status.

Following issuance of the report to the EPA and Ecology, it will be placed in the public reading room for public access.

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