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Draft A

RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-DR-2 Operable Unit, Hanford Site, Richland, Washington

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United States
Department of Energy
Richland, Washington

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RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-DR-2 Operable Unit, Hanford Site, Richland, Washington

Date Published
October 1993

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EXECUTIVE SUMMARY

INTRODUCTION

This work plan establishes the operable unit setting and the objectives, approach, tasks, and schedule for conducting the Resource Conservation Recovery Act (RCRA) facility investigation/corrective measure study (RFI/CMS) for the 100-DR-2 Operable Unit in the 100 Area of the Hanford Site. This work plan is intended to cover the entire RFI/CMS program, but it is focused on limited field investigation (LFI) activities. The plan may require revision if significant additional field work is necessary. The 100 Area is one of four areas at the Hanford Site that are on the U.S. Environmental Protection Agency's (EPA) National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

The 100-DR-2 Operable Unit is one of three source operable units in the 100 D/DR Area (Figure ES-1). Source operable units are those that contain facilities and unplanned release sites that are potential sources of hazardous substance contamination.

All work conducted under this work plan will conform to the conditions set forth in the *Hanford Federal Facility Agreement and Consent Order*, (Ecology et al. 1990a),and its amendments, signed by the Washington State Department of Ecology (Ecology), the EPA, and the U.S Department of Energy (DOE).

The approach described in this work plan is based on the *Hanford Site-Past Practice Strategy* (DOE-RL 1991a). This strategy streamlines the past-practice remedial action process with a bias for action through optimizing the use of interim actions. This approach culminates with decisions of final remedies on both an operable unit and 100 Area scale. The strategy focuses on reaching early decisions (interim remedial measures [IRM]) to initiate and complete cleanup projects, maximizing the use of existing data (historical and analogous facilities), coupled with focused short time-frame LFI where necessary.

The RFI/CMS process for the 100-DR-2 Operable Unit follows the path detailed in Figure ES-2. The work scope described in the work plan is a result of the scoping process which involved Ecology, EPA, and DOE. The pathway selected during the scoping process for the high-priority liquid waste sites and solid waste burial grounds in the 100-DR-2 Operable Unit is the IRM pathway. Other sites (low-priority sites) will be deferred and will follow the regular RFI pathway.

OVERVIEW

The investigative approach to waste sites associated with the 100-DR-2 Operable Unit are listed in Table ES-1. The waste sites fall into three general categories: high-priority liquid waste disposal sites, low-priority waste disposal sites, and solid waste burial grounds. Several sites have been identified as candidates for conducting an IRM. Three sites have been identified as warranting additional field sampling. These sites are the 116-DR-3 Storage Basin Trench, the 116-DR-7 Inkwell Crib, and the Sodium Dichromate Tanker Car Off-Loading Facility. All sites will continue to be evaluated through the RFI, even if they do not require an IRM. The potential exists that the work plan may be rewritten for the full RFI.

The limited field sampling will consist of one borehole at the 116-DR-7 site and test pit excavations at the 116-DR-3 and Sodium Dichromate Tanker Car Off-Loading sites. Figure ES-3 shows waste site locations in the 100-DR-2 Operable Unit. Figures ES-4 and ES-5 show the proposed sampling sites. Sampling will take place where field screening instruments detect contamination. Samples collected will be analyzed for chemical and radiological constituents. The data quality objective process identified the Ecology, EPA, or DOE and technical lead agencies as the primary data users. The primary data uses are: (1) determination of maximum contaminant concentration to support a qualitative risk assessment; (2) define vertical distribution of contaminants; and (3) determine if and when an IRM action is necessary.

A report will be prepared upon completion of the LFI. The report will include the results of source investigations, historical investigations, process knowledge, field screening, and geophysical surveys; identify the nature and vertical extent of contamination at the high-priority liquid waste sites; identify the contaminant- and location-specific applicable or relevant and appropriate requirements; and provide a summary of the qualitative risk assessment performed for each of the high-priority sites. The report will include an assessment of whether thresholds are exceeded that warrant action through IRM. The LFI report will also evaluate sites analogous to those in the 100-DR-2 Operable Unit to aid in the determination of the need for an IRM. The LFI report will support the focused feasibility study (FS), which will address remediation options for the waste sites.

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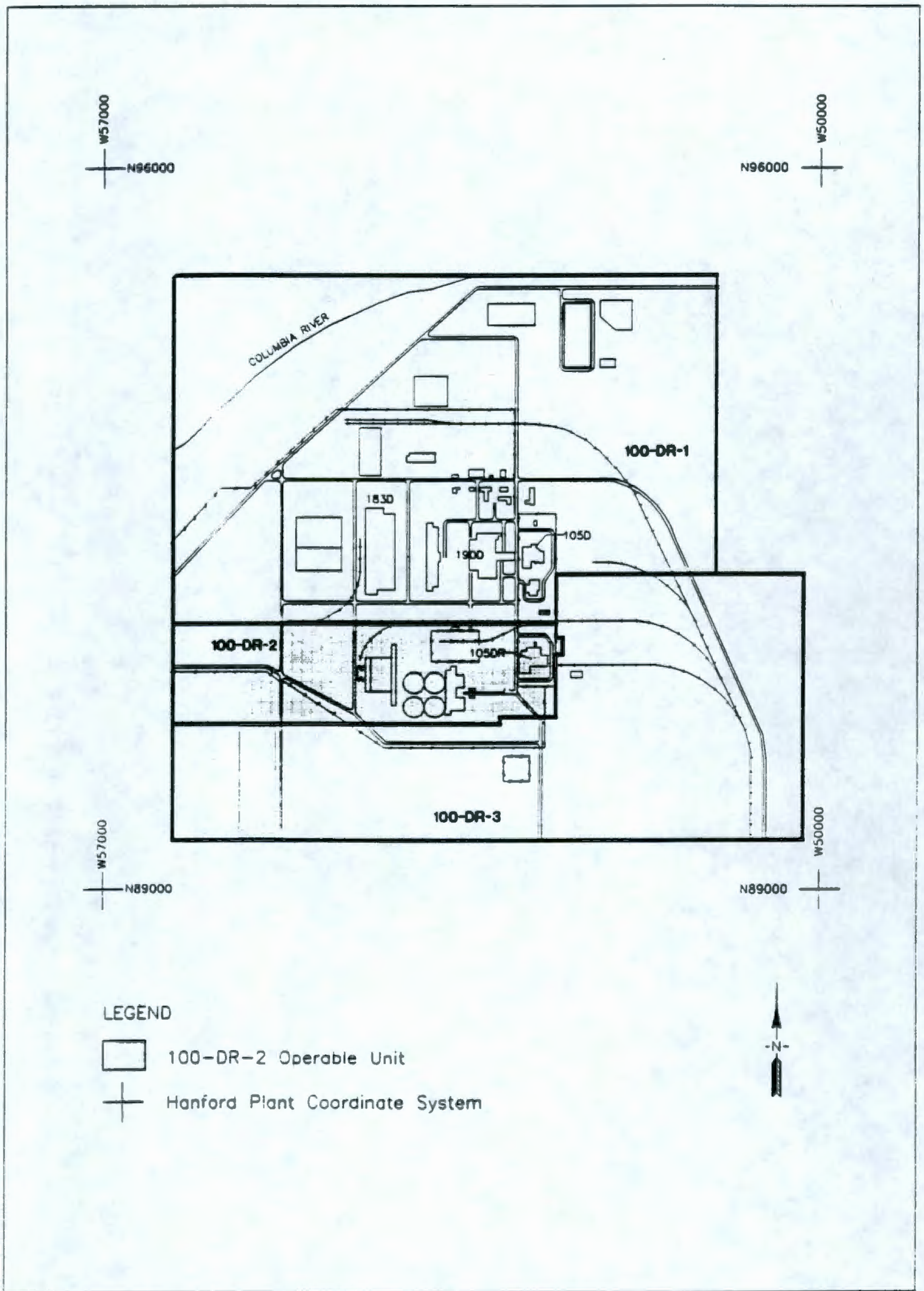
The FS process for the 100 Area will be conducted on both an aggregate area and operable unit basis. This process includes preparation of a 100 Area FS, a focused FS, and a final FS. Figure ES-2 displays how the entire RFI/CMS process culminates in the implementation of remedial actions for the operable unit.

Figure ES-1 100 D/DR Opeable Units



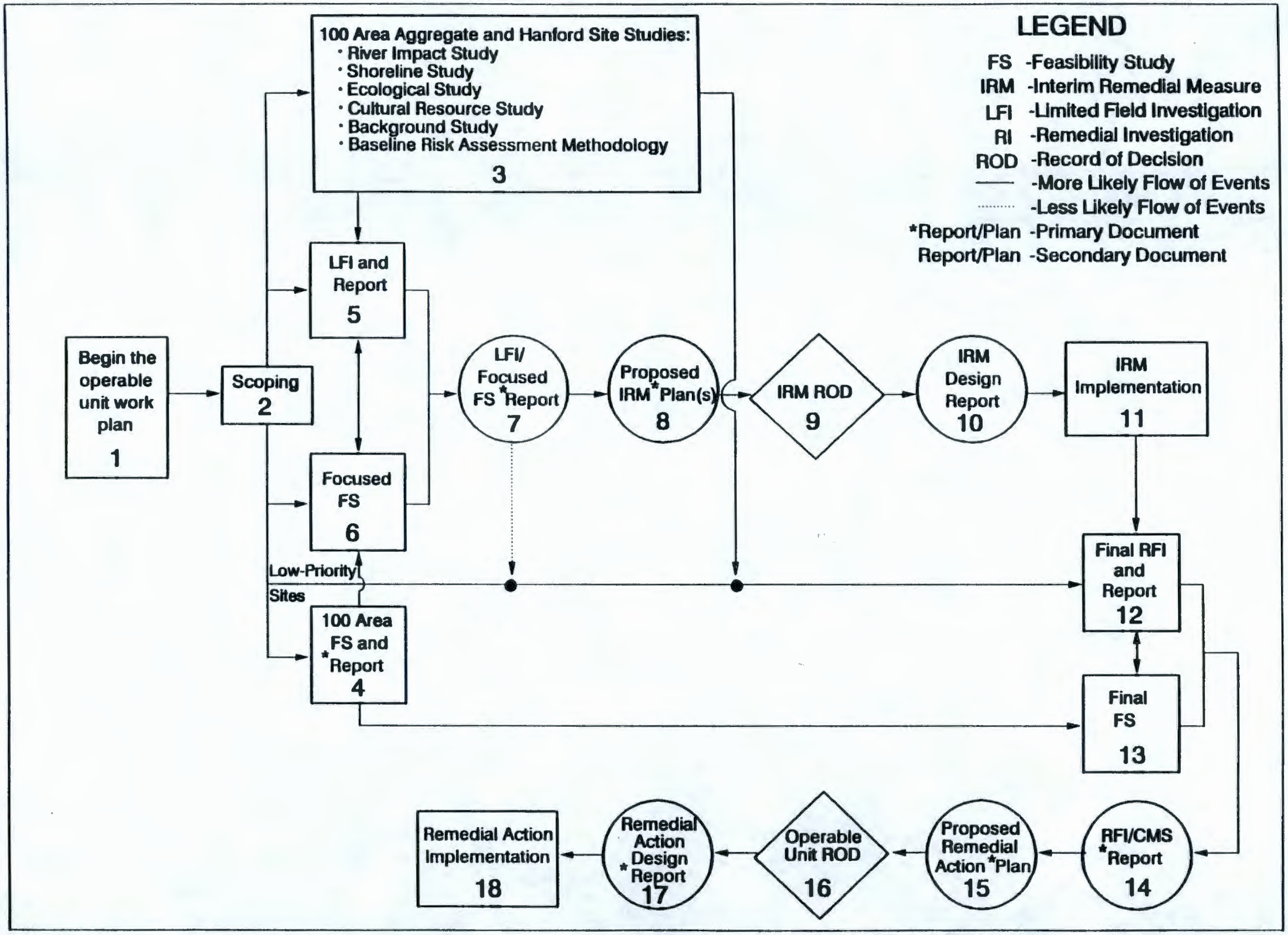


Figure ES-2 RFI/CMS Process for the 100-DR-2 Operable Unit

Figure ES-3
Waste Site Locations in the 100-DR-2 Operable Unit

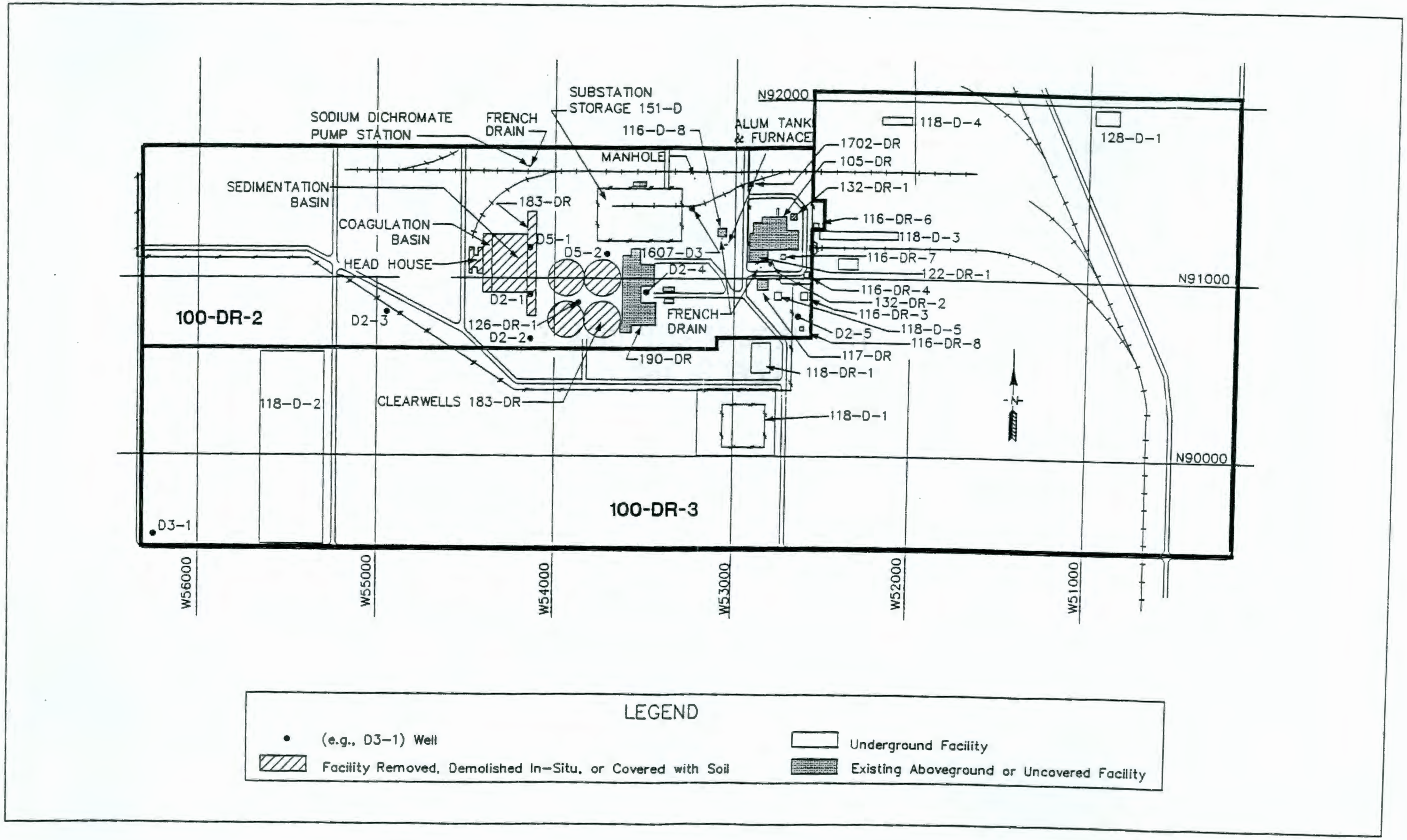


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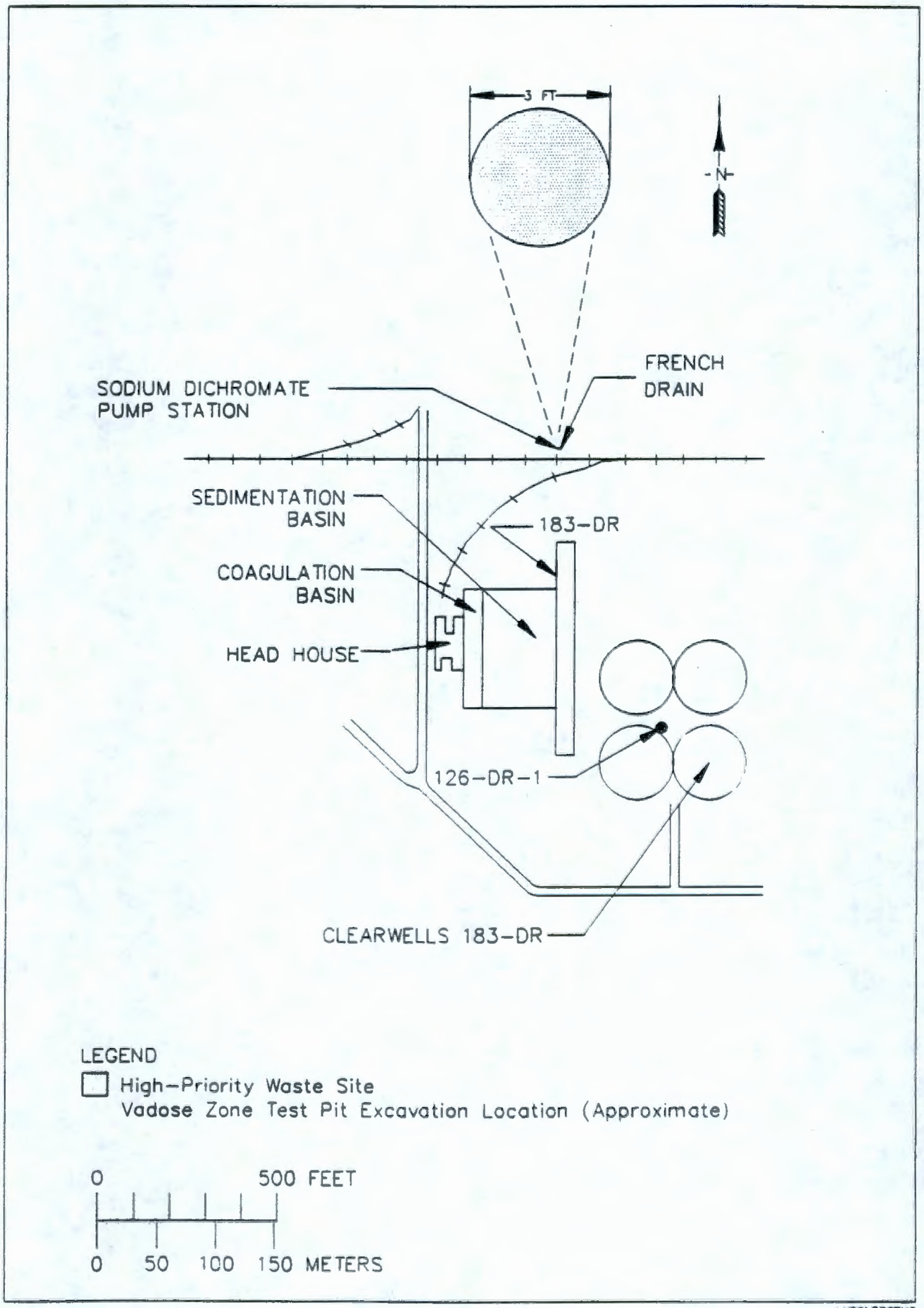
Figure ES-4 Proposed Sampling Sites for the 100-DR-2 Operable Unit



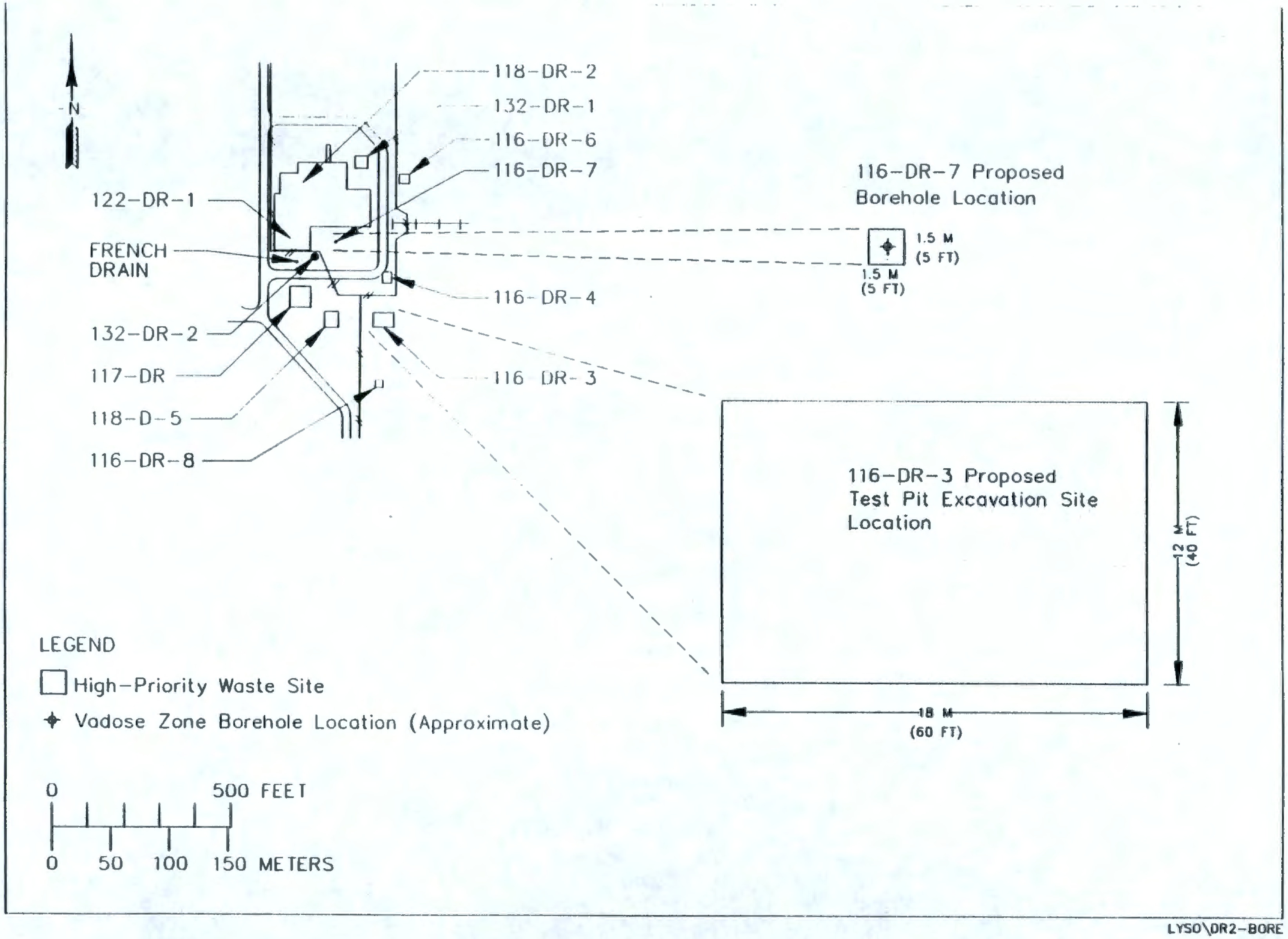


Figure ES-5 Proposed Sampling Sites for the 100-DR-2 Operable Unit

Table ES-1 100-DR-2 Investigation (Sheet 1 of 4)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
		High Priority Sites		
116-D-8 (100-D Cask Storage Pad)	Active from 1946-1975. Facility has 2 drainage systems; one for storm water and one for spillage. Spillage was handled by disposal through a french drain. The storage pad was decontaminated by removing portions of the concrete. The concrete chips were reported disposed of in the 200 Areas. Rinse water was disposed of adjacent to the pad in an area currently marked "Underground Radioactive Material."	Identify number and volume of spills that occurred on the pad. Site to include adjacent site posted as underground rad. Geophysics will be used to aid in location of french drain and evaluation of site.	IRM/0	The waste at this site is a result of leaks and spills that occurred on the pad. The site has already undergone a partial cleanup.
116-DR-3 (105-DR Storage Basin Trench)	This site was active during 1955, received 4,000,000 L of contaminated sludge and water from the 105-DR Fuel Storage Basin.	Geophysical survey using GPR of EMI to ascertain the presence and nature of materials used to fill the trench. One vadose zone test pit in a location determined by the geophysical survey.	LFI-IRM/1	This site has an HRS score of 40.09 and is considered a high-priority site. Previous sampling revealed the presence of radionuclide contamination at this site.
116-DR-4 (105-DR Pluto Crib)	116-DR-4 was active from 1952-1953, and received 4,000 L of liquid wastes from isolated tubes containing ruptured fuel elements in the 105-DR Fuel Storage Basin.	No LFI activity is planned for this facility as it is analogous to 116-D-2A.	IRM/0	This site has an HRS score of 9.13. The constituents present should be the same as those for 116-D-2A and thus the cleanup will use the results of 116-D-2A to define a remedial action.

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Table ES-1 100-DR-2 Investigation (Sheet 2 of 4)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
116-DR-6 (1608-DR Liquid Disposal Trench)	The site was active from 1953-1965, received 7,000,000 L of diverted coolant during the Ball 3X upgrade. It also received diverted water during reactor shutdown.	LFI will be limited to currently locating the trench. This site is analogous to 116-DR-1 and 116-DR-2.	LFI-IRM/0	This site has an HRS score of 42.32. The constituents present should be the same as those for 116-DR-1 and 116-DR-2 and thus the cleanup will use the results of 116-DR-1 and 116-DR-2 to define a remedial action.
116-DR-7 (105-DR Inkwell Crib)	The site was active during 1953, received 4,000 L of liquid potassium borate from the 3X System prior to the Ball 3X System upgrade. There is reason to believe the site may be a storage tank rather than a crib.	LFI should consist of geophysical surveys to determine if the facility is a crib or a storage tank. If surveys indicate it is a crib then a single borehole should be drilled to characterize the crib.	LFI-IRM/1	This site has an HRS score of 28.96. The waste received at this site came from the 3X System prior to the Ball 3X System upgrade.
116-DR-8 (117-DR Crib)	The site was active from 1960-1964, received 240,000 L of drainage from the containment system 117 Building Seal Pits. From 1972-1986, supported the 105-DR Sodium Fire Facility.	Research/identify waste(s) that were placed in crib. Determine if wastes exhibit extraordinary contamination problems; should this be the case, further field investigations will be implemented.	LFI-IRM/0	This site has an HRS score of 0.0. Data determined during research will determine if field investigations are necessary.

Table ES-1 100-DR-2 Investigation (Sheet 3 of 4)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
132-DR-1 (1608-DR Waste Water Pumping Station)	The site was active from 1950-1964, received low level liquid waste. Unit consisted of an above ground structure and a below grade structure.	Research WIDS specific files to determine if any leaks occurred at this facility; if leaks occurred, determine volume, number, etc.	LFI-IRM/0	This site has been decommissioned.
Sodium Dichromate Tanker Car Off-Loading Facility	Possibly a source of contamination. Located north of the railroad tracks on the northern boundary of the operable unit.	Vadose zone test pit to ascertain the distribution and quantity of sodium dichromate in the vadose zone.	LFI-IRM/1	This is a significant waste site because undiluted volumes of sodium dichromate and acid solutions were disposed directly to the soil column.
Solid Waste Burial Grounds				
118-D-5 (Ball 3X Burial Ground)	Site was active during 1954, received 10 cubic meters of thimbles removed from the 105-DR Reactor during Ball 3X work.	Locate using geophysical methods.	LFI-IRM/0	The potential for solid waste to migrate is very small.
126-DR-1 (190-DR Clearwell Tank Pit)	This site has been active since 1970's as a landfill. The waste is nonhazardous, nonradioactive. The unit is an excavated area between 183-DR and 190-DR. Approximately 25% of the bottom surface contains a layer of waste 1.5 to 3.0 m deep that is covered with backfill.	Research and determine if "recent" disposal activities have occurred, if so, volumes, period of time, etc. The site will not be included in work plan if active status.	Defer/0	The potential for solid waste to migrate is very small.

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Table ES-1 100-DR-2 Investigation (Sheet 4 of 4)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
Low-Priority Facilities				
1607-D-3 (Septic Tank and Associated Drain Field)	Site was started in 1944 and is currently active; receives sanitary waste from the 151-D Electrical Distribution Substation. The flow rate of this unit is estimated at a maximum of 3,975 L/day.	No intrusive activities are planned, action is deferred pending resolution of common septic system approach.	Defer	Potential for hazardous or radioactive contamination is very small.
118-DR-2 (105-DR Reactor Building)	Site was active from 10/3/50 through 12/30/64; contains an estimated 13,500 Ci of radionculides, 85 metric tons of lead, 3 cubic meters of asbestos and 500 pounds of cadmium.	N/A	Defer	The potential for solid waste to migrate is very small.
122-DR-1 (105-DR Sodium Fie Facility)	Site was active from 1972-1986; site wastes consist of sodium, lithium, and sodium potassium alloy. Approximately 20,000 Kg are managed at this facility each year. The facility also stores up to 20,000 L of dangerous wastes.	RCRA TSD facility; coordinate with closure Part A Permit, Part B Permit; interim closure plan has been submitted for this site.	Defer	
132-DR-2 (116-DR Reactor Exhaust Stack)	The site was active from 1950-1986; waste is solid low-level waste. The unit is a monolithic, reinforced concrete structure with a maximum wall thickness of .46 m at the base.	N/A	Defer	The potential for solid waste to migrate is very small.

HRS = hazard ranking system
IRM = interim remedial measure
LFI = limited field investigation
defer = these sites will be addressed with the final remediation of the site.

ACRONYMS

ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
CAR	corrective action requirement
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CFR	Code of Federal Regulations
CLP	contract laboratory program
CMS	corrective measures study
CRDL	contract required detection limit
CRQL	contract required quantitation limit
CRP	Community Relations Plan
CWA	Clean Water Act
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy - Richland Operations Office
DOW	description of work
DQO	data quality objective
Ecology	Washington State Department of Ecology
EII	environmental investigations instructions
EPA	U.S. Environmental Protection Agency
ERA	expedited response action
FS	feasibility study
GC	gas chromatography
GPR	ground penetrating radar
HASM	Hanford Analytical Services Management
HEHF	Hanford Environmental Health Foundation
HEIS	Hanford Environmental Information System
HRS	hazard ranking system
HSBRAM	Hanford Site Baseline Risk Assessment Methodology
HSP	Health and Safety Plan
HSWA	Hazardous and Solid Waste Amendments (of 1984)
HWOP	hazardous waste operations permit
IMO	Information Management Overview
IRM	interim remedial measure
IU	isolated unit
JSA	job safety analysis
LFI	limited field investigation
LLW	low level waste
LSR	large-scale remediation
MDL	method detection limit
MTCACR	Model Toxics Control Act Cleanup Regulations
NCP	National Contingency Plan
NEPA	National Environmental Impact Statement
NPL	National Priorities List
NRDA	natural resource damage assessment

ACRONYMS (cont)

OSHA	Occupational Safety and Health Administration
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PNL	Pacific Northwest Laboratory
PQL	project quantitation limits
QA	quality assurance
QAPI	QA program index
QAPjP	Quality Assurance Project Plan
QC	quality control
QI	Quality Instruction
QR	Quality Requirement
QRA	qualitative risk assessment
RCRA	Resource Conservation and Recovery Act (of 1976)
RFI	RCRA facility investigation
RI	remedial investigation
ROD	record of decision
RPD	relative percent difference
RWP	radiation work permits
TAL	target analyte list
TCL	target compound list
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
TRU	transuranic waste
TSD	treatment, storage, and disposal
UTL	upper threshold limit
VOA	volatile organics analysis
WAC	Washington Administrative Code
WHC	Westinghouse Hanford Company
WIDS	Waste Information Data System
WISHA	Washington Industrial Safety and Health Act
XRF	X-ray fluorescence

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1.0 INTRODUCTION

Four areas of the Hanford Site (the 100, 200, 300, and 1100 Areas) have been included on the U.S. Environmental Protection Agency's (EPA) National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). Figure 1-1 shows the location of these areas. Under the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1990a), signed by the Washington State Department of Ecology (Ecology), EPA, and the U.S. Department of Energy (DOE), more than 1,000 inactive waste disposal and unplanned release sites on the Hanford Site have been grouped into a number of source and groundwater operable units. These operable units may contain contamination in the form of radioactive waste (low level waste [LLW] and transuranic waste [TRU]), hazardous waste, radioactive/hazardous mixed waste, and other CERCLA hazardous substances. Also included in the Tri-Party Agreement are 55 Resource Conservation and Recovery Act (RCRA) treatment, storage, and/or disposal (TSD) facilities that will be closed or permitted to operate in accordance with RCRA regulations, under the authority of Chapter 173-303 Washington Administrative Code (WAC). Some of the TSD facilities are included in the operable units.

The Tri-Party Agreement requires that the cleanup programs at the Hanford Site integrate the requirements of CERCLA, RCRA and Washington State's dangerous waste (the State's RCRA-equivalent) program. The EPA maintains authority for CERCLA, and Ecology implements RCRA under the authority of the State's dangerous waste program. The State has also received authorization to implement the EPA's radioactive mixed waste program. The state does not yet have authority to implement the most recent amendments to RCRA, the Hazardous and Solid Waste Amendments (HSWA); this authority remains under EPA. A comparison of CERCLA and RCRA terminology used in this work plan is provided in Table 1-1. Pursuant to the Tri-Party Agreement, the 100-DR-2 Operable Unit is subject to RCRA corrective action authority.

1.1 IMPLEMENTATION OF RCRA FACILITY INVESTIGATION/CORRECTIVE MEASURE STUDY

This work plan and the referenced supporting project plans establish the operable unit setting and the objectives, procedures, tasks, and schedule for conducting the RCRA facility investigation/corrective measures study (RFI/CMS) for the 100-DR-2 Source Operable Unit. Source operable units include facilities and unplanned release sites that are potential sources of contamination. The 100-DR-2 Operable Unit consists predominantly of liquid waste disposal facilities and solid waste burial grounds, and it also contains septic tanks, a reactor building, a TSD facility, and a landfill that is no longer active. It is located near the Columbia River in the northwest portion of the Hanford Site designated as the 100 D/DR Area. The associated groundwater operable unit for this area is the 100-HR-3 Operable Unit. It underlies the 100 D/DR and H Areas, the 600 Area between them, and the six source operable units these areas contain (Figure 1-2). The 100-HR-3 Operable Unit includes all contamination found in the aquifer soils and water within its boundary. Separate work plans have been initiated for the 100-HR-3 Groundwater Operable Unit, the 100-DR-1 and the 100-HR-1 Source Operable Units.

All work conducted under this plan will conform to the conditions set forth in the Tri-Party Agreement and its amendments. In accordance with the Tri-Party Agreement, relevant EPA guidance documents were consulted in the preparation of the work plan, including the following:

- *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA; Interim Final* (EPA 1988a)
- *Data Quality Objectives for Remedial Response Activities: Volume 1, Development Process* (CDM Federal Programs Corporation 1987)
- *Superfund Exposure Assessment Manual* (EPA 1988b)
- *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual; Interim Final* (EPA 1989a)
- *Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual; Interim Final* (EPA 1989b).

This chapter is designed to set forth the general purpose, scope and goals of the project without repeating material from preceding documents, and to focus more on site specific aspects of the 100-DR-2 Operable Unit. Additional data regarding processes, strategies and background information can be found in the *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-HR-3 Operable Unit, Hanford Site, Richland, Washington* (DOE-RL 1992a) and the *RCRA Facility Investigation/Corrective Measure Study Work Plan for the 100-DR-1 Operable Unit, Hanford Site, Richland, Washington* (DOE-RL 1992b).

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1.2 PROJECT GOALS

The approach described in this work plan is based on the *Hanford Site Past-Practice Strategy* (DOE-RL 1991a). This strategy streamlines the past-practice remedial action process with a bias for action through optimizing the use of interim actions. The goal of the 100-DR-2 Operable Unit RFI/CMS is to provide sufficient information to optimize the use of IRM to expedite cleanup, while still maintaining a technically sound and cost-effective program of investigations that culminates with a decision of final remedial actions on both an operable unit and 100 Area aggregate scale. The strategy focuses on reaching early decisions (IRM pathway) to initiate and complete cleanup projects, maximizing the use of existing data (historical and analogous facilities), coupled with focused short time-frame LFI where necessary.

Source operable units are units which contain facilities and unplanned release sites that are potential sources of hazardous substance contamination. The 100-DR-2 Operable Unit is one of the three source operable units in the 100 DR Area. The 100-DR-1 and 100-DR-2 Source Operable Units are concerned with reactor liquid effluent sites and the 100-DR-3 Source Operable Unit is concerned with solid and buried wastes. These three operable units are underlain by the 100-HR-3 Operable Unit which is the groundwater operable unit beneath the 100 H and 100 D/DR Areas.

The 100-DR-2 Operable Unit is a reactor liquid effluent site operable unit. It consists predominantly of reactor liquid effluent sites, solid waste burial grounds, and also contains a septic system and several demolished facilities. It is located near the Columbia River in the northeast portion of the Hanford Site designated as the 100 D/DR Area. The 100-HR-3 Operable Unit includes all contamination found in the aquifer soils and water within its boundary. Separate work plans have been initiated for the 100-HR-3 Groundwater Operable Unit (DOE-RL 1992a), the 100-DR-1 Source Operable Unit (DOE-RL 1992b) and *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-HR-1 Operable Unit, Hanford Site, Richland, Washington* (DOE-RL 1992c). Limited field investigations have been conducted at these operable units. An expedited response action (ERA) has been initiated at the 100-IU-4 Isolated Unit (IU).

The work scope described in the work plan is a result of the scoping process which involved Ecology, EPA, and DOE. The pathway selected during the scoping process for the reactor liquid effluent sites in the 100-DR-2 Operable Unit is the IRM pathway.

The wastes sites in the 100-DR-2 Operable Unit fall into three categories: high-priority sites; solid waste burial grounds; and low-priority sites. Five waste sites in the 100-DR-2 Operable Unit received scores from the *Hazard Ranking System Evaluation of CERCLA Inactive Waste Sites at Hanford* (Stenner et al. 1988). Scores in the 100-DR-2 Operable Unit ranged from 0.0 to 42.32. Sites with scores above 28.5 are to be listed on the NPL. The entire 100 Area is on the NPL, however the 28.5 is used as a screening threshold and will therefore be used in a similar fashion to indicate the need for specific waste units at the operable units (OU) to follow the LFI/IRM path. (These five sites were the only sites known at the time of the hazard ranking system [HRS] scoring).

As a result of the scoping studies and the work done in preparing the work plan, the historical information and the information from similar facilities were determined to be sufficient to formulate conceptual models and perform a qualitative risk assessment (QRA) following the IRM pathway. The emphasis in this work plan is on describing those data that will be obtained at the high-priority sites to develop the conceptual model, conduct the QRA, evaluate the corrective action requirements (CAR), conduct a focused feasibility study (FS), and prepare an IRM determination. Work performed during the scoping phase and in developing this work plan indicates that intrusive activities are required during the conduct of the LFI for the 100-DR-2 Operable Unit. The work on low-priority sites will be deferred until the final remedy selection process.

The LFI report for the 100-DR-2 Operable Unit will be prepared which will include the results of the historical investigations, analogous site investigations, process knowledge, field screening, and the scoping phase geophysical surveys; identification of the nature and extent of contamination at the high-priority sites; identification of contaminant- and location-specific applicable or relevant and appropriate requirements (ARAR); and a summary of the QRA performed for the high-priority sites. The report will include an assessment of whether the IRM pathway should continue to be followed for each waste site. The LFI report will provide support for the focused FS, which will address final remediation options for the waste sites.

The FS process for the 100 Area will be conducted on both an aggregate area and operable unit basis. This process includes preparation of a 100 Area FS, a focused FS, and implementation of remedial actions for individual operable units.

1.3 ORGANIZATION OF THE WORK PLAN

This work plan is organized in the same manner as the 100-DR-1 Operable Unit Work Plan (DOE-RL 1992b), but utilizes the philosophy of incorporation by reference. Information that is not specific to the 100-DR-2 Operable Unit is referenced to either the 100-HR-3 (DOE-RL 1992a) or 100-DR-1 (DOE-RL 1992b) Work Plans.

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1.4 QUALITY ASSURANCE

The 100-DR-2 Operable Unit Work Plan and its supporting project plans have been developed to meet specific EPA guidelines for format and structure, within the overall quality assurance (QA) program structure mandated by DOE - Richland Operations Office (DOE-RL) for all activities at the Hanford Site. The 100-DR-2 Operable Unit Quality Assurance Project Plan (QAPjP) (Appendix A) supports the field sampling program described in Chapter 5.0. It defines the specific means that will be used to ensure that the sampling and analytical data obtained as part of the LFI and aggregate area studies will effectively support the purposes of the investigation. As required by the Westinghouse Hanford Company (WHC) QA Program for RFI/CMS activities and the *Hanford Federal Facility Agreement and Consent Order* (Ecology 1990a), the structure and content of the QAPjP are based on *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (Stanley and Verner 1983). Where required, the QAPjP invokes appropriate procedural controls selected from the Westinghouse Hanford Company QA Program Plan for RFI/CMS activities, or specifically developed to accommodate the unique needs of this investigation.

1.5 NATURAL RESOURCE DAMAGE ASSESSMENT

The Clean Water Act (CWA) and CERCLA provide that natural resource trustees may assess damages to natural resources resulting from a discharge or release of a hazardous substance and may seek to recover those damages. According to the

National Contingency Plan (NCP), the lead agency shall make available, information and documentation that can assist the respective trustees in the determination of actual or potential natural resource injuries.

To that end, for RCRA corrective action units, the trigger for Natural Resource Damage Assessment (NRDA) is the discharge or release of a hazardous substance. Potential injury from past releases will need to be identified. Potential future injuries, as a result of remedial/removal actions, will need to be considered in the context of NRDA. The NRDA considerations are important prior to establishing the ecological remedial/removal action objectives.

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Figure 1-1 Hanford Site

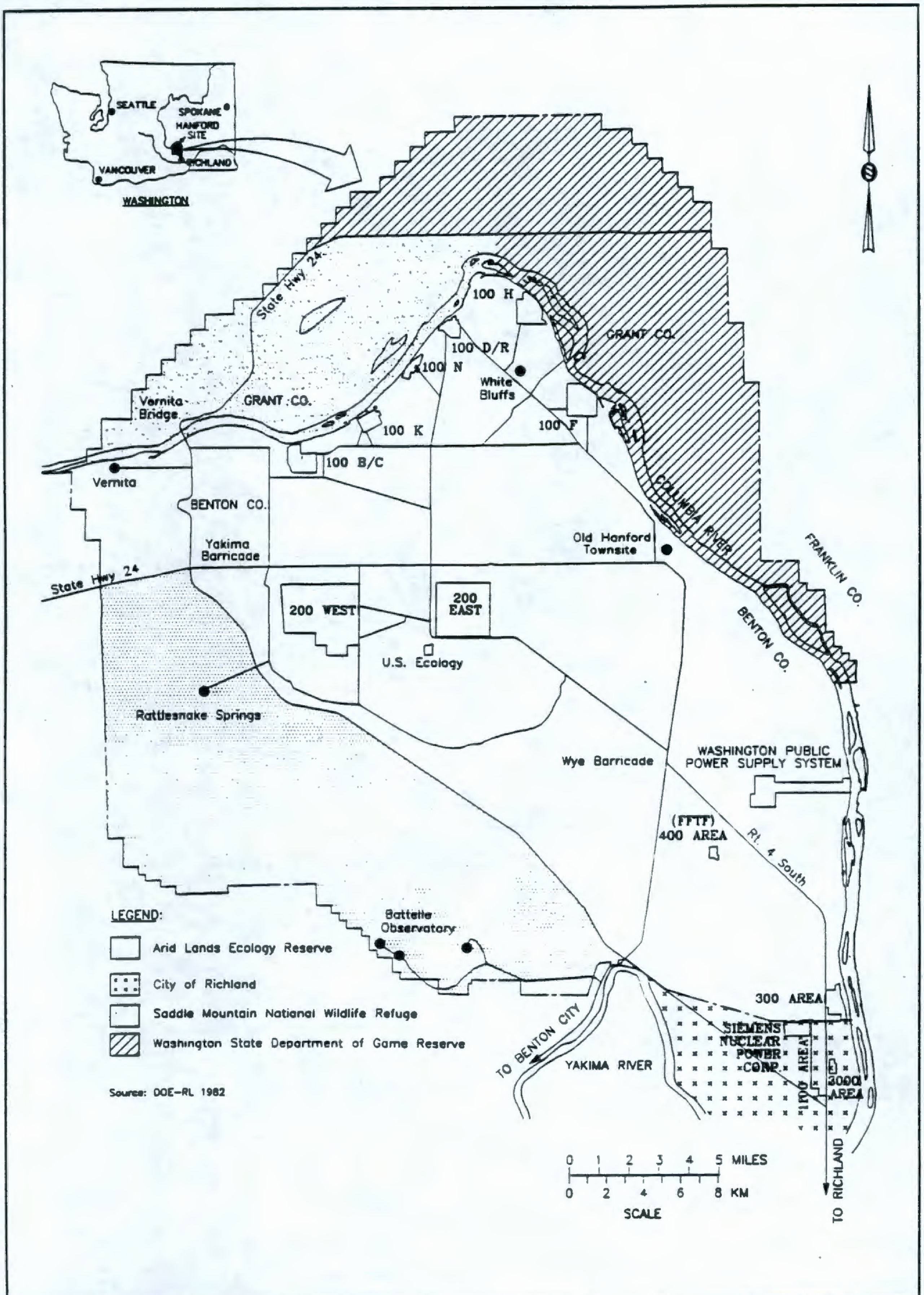

Figure 1-2 Map of the 100-HR-3 Groundwater Operable Unit, Showing the Associated Source Operable Units

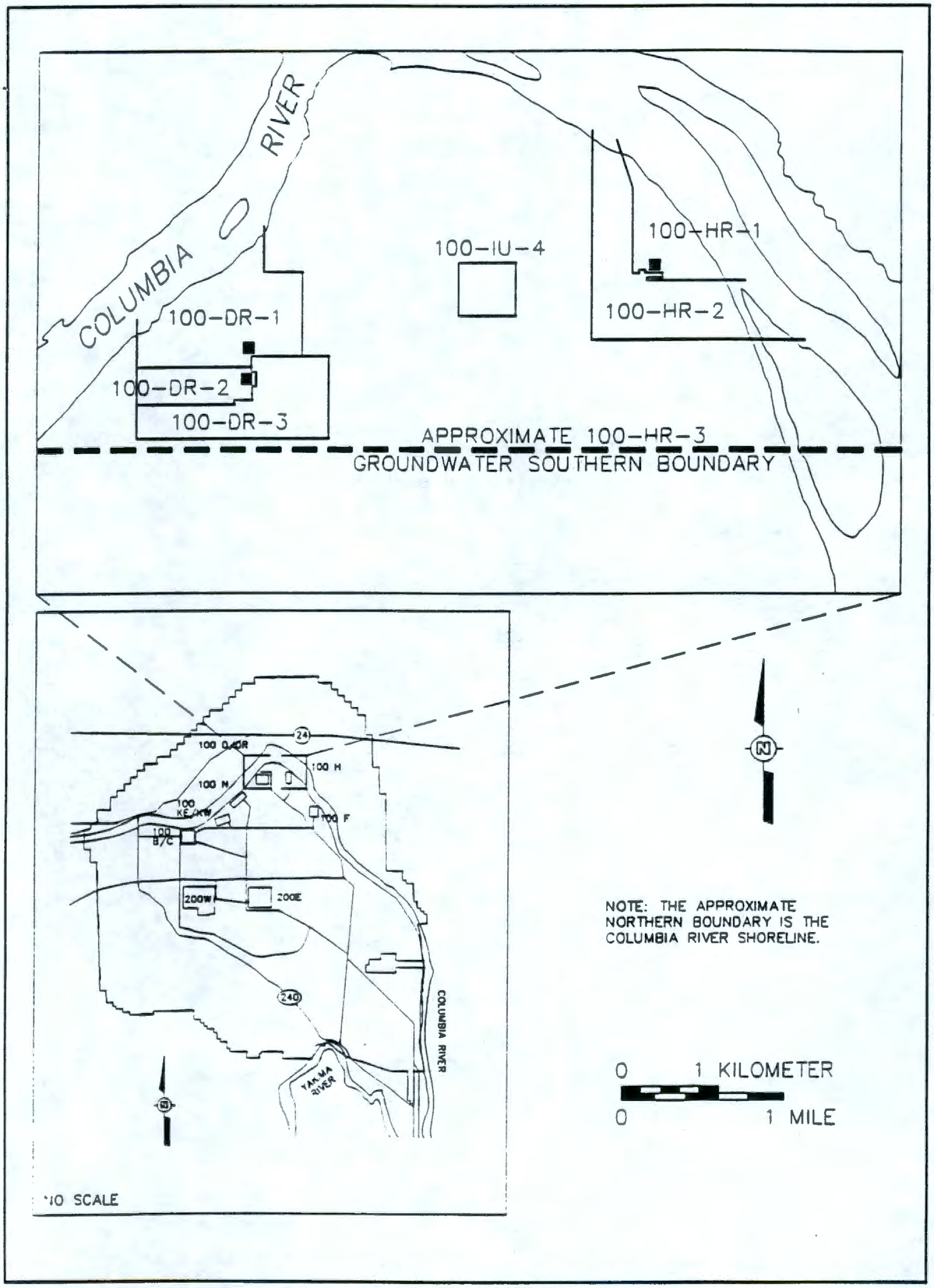

Table 1-1 The Relationship Between RCRA and CERCLA Terminology Used in this Work Plan

RCRA Terminology	CERCLA Terminology
Resource Conservation and Recovery Act Facility Investigation (RFI)	Remedial Investigation (RI)
Corrective Measures Study (CMS)	Feasibility Study (FS)
Limited Field Investigation (LFI)	Limited Field Investigation (LFI)
Focused Feasibility Study (Focused FS)	Focused Feasibility Study (Focused FS)
Expedited Response Action (ERA)	Expedited Response Action (ERA)
Interim Response Measure (IRM)	Interim Response Measure (IRM)
Proposed IRM Plan	Proposed IRM Plan
IRM Record of Decision (ROD)	IRM Record of Decision (ROD)
IRM Design Report	IRM Design Report
IRM Implementation	IRM Implementation
Proposed Corrective Action Plan	Proposed Remedial Action Plan
Corrective Action ROD	Remedial Action ROD
Corrective Action Design Report	Remedial Action Design Report
Corrective Action Implementation	Remedial Action Implementation
Corrective Action Requirement (CAR)	Applicable or Relevant and Appropriate Requirement (ARAR)

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2.0 OPERABLE UNIT BACKGROUND AND SETTING

This chapter presents a summary, based on available data, of the pertinent physical, historical, biological, and sociological settings for the 100-DR-2 Operable Unit. Chemical and radiological data representing the known and suspected nature and extent of contamination, as well as the background conditions of the local environmental media, are presented.

2.1 OPERABLE UNIT DESCRIPTION

The 100 D/DR Area at the Hanford Site was used by the U.S. Government from 1944 to 1967 for plutonium production reactors and related operational support facilities. These operations resulted in the release of chemical and radioactive wastes into the soil, air, and water. For cleanup purposes, the 100 D/DR Area has been divided into four operable units, three of which are concerned with sources and solid waste burial grounds (100-DR-1, 100-DR-2, and 100-DR-3) while the fourth (100-HR-3) is concerned with groundwater beneath and between the 100 H and 100 D/DR Areas, including all saturated soils, groundwater, surface water and aquatic biota. The 100-DR-1 and 100-DR-2 Operable Units, designated as reactor effluent waste sources, each contain a reactor building and associated support facilities within the operable unit boundaries. The 100-DR-3 Operable Unit contains solid waste disposal units associated with operations at the 118-D-6 (105-D) and 118-DR-2 (105-DR) Reactors. Figure 2-1 shows in detail the boundaries of the source operable units.

The purpose of this section is to describe the location of the 100 D/DR Area, the history of operations in the area, the facilities and structures located in the 100-DR-2 Operable Unit, and the contamination associated with each facility, structure or waste unit.

2.1.1 Location

The 100-DR-2 Operable Unit is situated within the 100 D/DR Area of the DOE Hanford Site located in the south-central portion of the state of Washington. The 100 D/DR Area is located in Benton County along the south bank of the Columbia River in the north-central part of the Hanford Site, approximately 50 km (31 mi) north-northwest of the city of Richland, Washington, as shown in Figure 1-1.

The 100-DR-2 Operable Unit encompasses an area south of the 100-DR-1 Operable Unit which is bounded on the south and east by the 100-DR-3 Operable Unit. The 100-DR-2 Operable Unit extends eastward from a boundary common to all three operable units to a point just east of the 118-DR-2 (105-DR) Reactor Building. It lies predominantly within the northeast quadrant of Section 22 and the northwest quadrant of Section 23 of T.14 N., R.26 E., and is located within latitude 46°41' and 46°41'10" north and longitude 119°33' and 119°32' west.

2.1.2 History of Operations

2.1.2.1 Reactor Operations. Between 1943 and 1963, nine water-cooled graphite moderated plutonium production reactors were built along the Columbia River upstream from the now-abandoned town of Hanford. These nine reactors (B, C, D, DR, F, H, KE, KW, and N) have been retired from service and are under evaluation for decommissioning.

The 100 D/DR Area contains the D and DR Reactors and their operational support facilities. The D Reactor is located in the 100-DR-1 Operable Unit, and the DR Reactor is located in the 100-DR-2 Operable Unit, and support facilities are distributed throughout both units. Fuel elements for the reactors were manufactured in the 300 Area, and the plutonium-enriched fuel produced by the reactors was processed in the 200 Areas. The D Reactor operated from 1944 to 1967, when it was retired. The DR Reactor operated from 1950 to 1964, when it was also retired. Currently, sanitary and fire-protection water is provided to the 100 H and 100 F Areas from the 100 D/DR Area. The water system is also a backup for systems in the 100 B Area that supply the 200 Areas.

The 100 D/DR Area support facilities for the DR Reactor included an access road, rail spur, warehouse, major electrical substation, and several intermediate smaller substations (located throughout both the 100-DR-1 and 100-DR-2 Operable Units), and maintenance shops. Additional facilities include a water reservoir, filter plant, a sanitary water supply system, a process effluent system, a subsurface sanitary sewage disposal system, and a solid waste landfill. Many of the above-ground facilities have undergone some degree of decommissioning, and in many instances facilities no longer exist.

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2.1.2.2 Post-Reactor Operation Activities. Currently the active facilities existing within the boundaries of the 100-DR-2 Operable Unit are the septic tank and electrical substation. To minimize the potential spread of radioactive isotopes from the reactors and associated facilities, DOE instituted a program of decontamination and decommissioning of buildings and facilities after the reactors were retired. The process is ongoing, and in the 100 D/DR Area many of the above ground facilities have undergone decommissioning and no longer exist. The layout of the 100-DR-2 Operable Unit, illustrating both present and past facilities, is shown in Figure 2-2. Shading is used to indicate structures that have been demolished since reactor deactivation.

2.1.3 Facility Characteristics and Identification

The following sections describe the facilities and structures originally located in the 100-DR-2 Operable Unit. All 100-DR-2 Operable Unit waste facilities can be grouped into the following general categories:

- reactor building and associated disposal facilities
- contaminated reactor ancillary facilities
- sanitary sewage, transfer, treatment, and disposal facilities
- RCRA-permitted facilities
- support facilities
- solid waste landfill, burial grounds
- electrical facilities.

Table 2-1 lists each of the 100-DR-2 facilities identified during the background research phase of this project. Photographs, drawings, reports, and field visits were used as much as possible to locate all of the facilities. Each facility is listed, followed by the appropriate *Hanford Site Waste Information Data System* (DOE-RL 1991b) site number with any alias names shown in parenthesis, facility name, years in service and present status, and types of wastes received or produced. These facilities are shown on Figure 2-2.

Chapter 3.0 of this work plan describes the known and suspected contamination at these facilities, including waste inventories where data are currently available. Additional information will be collected, as needed, during the LFI.

2.1.3.1 Reactor Building and Associated Disposal Facilities. This category includes all facilities involved with the 118-DR-2 Reactor and the effluent generated by reactor operations, decontamination activities, and fuel storage that were not discharged immediately into the process effluent pipelines.

2.1.3.1.1 118-DR-2 (105-DR) Reactor Building. This building houses the plutonium production reactor, which is no longer operational. The 118-DR-2 Building is located in the northeast corner of the operable unit. It is surrounded by a placarded chain-link security fence.

The 118-DR-2 Building operated from 1950 to 1964. The building consists of the following:

- the reactor moderator stack, an assembly of graphite blocks with channels from the process tubes, control rods, and other equipment

- the process tubes that held the uranium metal fuel elements and provided channels for cooling water

- control rods, fuel handling equipment, monitoring equipment, and experimental test holes

- the thermal and biological shields

- a welded steel-plate box that encloses the biological shield and served to confine the gas atmosphere within the reactor

- reactor work areas, instrument room, decontamination station

- Sodium Fire Facility (now a RCRA waste storage and treatment facility), located in the supply and exhaust fan wing

- an irradiated-fuel storage basin, as reported in the *Radiological Characterization of the Retired 100 Areas* (Dorian and Richards 1978).

The reactor building was the source of much of the contamination in the 100-DR-2 Area, although it is not designated as a component of the 100-DR-2 Operable Unit area. The decommissioning of the 105-DR Reactor, along with the other 100 Area retired reactors, is the subject of a draft environmental impact statement, as reported in the *Environmental Restoration Field Office Management Plan* (DOE-RL 1989), and is not within the scope of this work plan.

2.1.3.1.2 116-DR-4 (105-DR) Pluto Crib. The 116-DR-4 site received 4,000 liters (1,000 gal) of liquid wastes isolated from tubes containing ruptured fuel elements in the 105-DR Reactor. Based upon the estimated volume of liquid discharged to the Pluto Crib, an estimated total of 0.004 Kg of sodium dichromate was disposed to this crib (Stenner et al. 1988). This site is analogous to 116-D-2A (the rational for analogous sites is that the sites had the same process options, similar geology and like soil conditions).

The Pluto Crib radionuclide inventory in curies decayed through April 1, 1986, includes the following (Stenner et al. 1988):

Cobalt-60	$1.180E^{-003}$	Europium-155	$1.800E^{-004}$
Strontium-90	$4.34E^{-003}$	Plutonium-239	$9.000E^{-005}$
Cesium-137	$3.810E^{-002}$	Plutonium-240	$1.000E^{-005}$
Europium-152	$3.150E^{-003}$		

Additionally, Dorian and Richards (1978) reports the results of soil samples taken from three locations.

RADIONUCLIDE	AVE. pCi/g	CURIES
Tritium		0.00
Cobalt-60	$2.20E^{+00}$	$3.50E^{-03}$
Strontium-90	$3.30E^{+00}$	$5.30E^{-03}$
Cesium-134	$1.60E^{-02}$	$2.60E^{-05}$
Cesium-137	$2.90E^{+01}$	$4.60E^{-02}$
Europium-152	$3.00E^{+00}$	$4.80E^{-03}$
Europium-154	$3.60E^{-01}$	0.00
Europium-155	$6.30E^{-02}$	$5.80E^{-04}$
Plutonium-238		0.00
Plutonium-239/240		$1.00E^{-04}$
TOTAL CURIES		$6.00E^{-02}$

The crib was small, 3 m (10 ft) x 3 m (10 ft) x 3 m (10 ft) deep, constructed of railroad ties and gravel-filled as reported in Waste Information Data System (WIDS) (DOE-RL 1991b).

2.1.3.1.3 116-DR-3 (105-DR) Storage Basin Trench. The 116-DR-3 (105-DR) Storage Basin Trench is an inactive liquid waste site that operated during 1955. This is an 18 m (60 ft) x 12 m (40 ft) x 3 m (10 ft) deep trench. This site received 4,000,000 liters (1,000,000 gal) of contaminated sludge and water from the 105-DR Fuel Storage Basin.

The Storage Basin Trench radionuclide inventory in curies decayed through April 1, 1986, includes the following (Stenner et al. 1988):

Tritium	$2.080E^{-001}$	Europium-152	$1.970E^{-002}$
Cobalt-60	$1.010E^{-002}$	Europium-154	$3.090E^{-003}$
Strontium-90	$5.150E^{-002}$	Plutonium-239	$2.970E^{-003}$
Cesium-134	$1.000E^{-005}$	Plutonium-240	$3.300E^{-004}$
Cesium-137	$3.560E^{-002}$		

Additionally, Dorian and Richards (1978) reports the results of soil samples taken from four locations in the trench.

RADIONUCLIDE	AVE. pCi/g	CURIES
Tritium	$1.30E^{+02}$	$3.30E^{-01}$
Cobalt-60	$1.20E^{+01}$	$3.00E^{-02}$
Strontium-90	$2.50E^{+01}$	$6.30E^{-02}$
Cesium-134	$7.00E^{-02}$	$1.80E^{-04}$
Cesium-137	$1.70E^{+01}$	$4.30E^{-02}$
Europium-152	$1.20E^{+01}$	$3.00E^{-02}$
Europium-154	2.40^{+00}	$6.00E^{-03}$
Europium-155	$3.20E^{-01}$	$8.00E^{-04}$
Plutonium-238	$1.30E^{+00}$	0.00
Plutonium-239/240		$3.30E^{-03}$
TOTAL CURIES		$5.10E^{-01}$

2.1.3.1.4 116-DR-6 (1608-DR) Liquid Disposal Trench. The 116-DR-6 Liquid Disposal Trench is an inactive liquid waste site that operated from 1953 to 1965. This trench received coolant that was diverted to the trench during the Ball 3X upgrade. It also received diverted water when maintenance on the effluent system was necessary.

The 15 m (50 ft) x 3 m (10 ft) x 3 m (10 ft) deep trench received an estimated 7,000,000 liters (1,849,204 gal) of waste effluent. Based upon the estimated volume of liquid discharged to the trench, an estimated total of 2.0 Kg (4.4 lb) of sodium dichromate was disposed to this trench (Stenner et al. 1988). No radionuclide inventory is available for this facility. This site is analogous to 116-DR-1 and 116-DR-2 (the rationale for analogous sites is that the sites had the same process options, similar geology and like soil conditions). Upon closure it was covered with about 2 m (6 ft) of clean soil (WIDS) (DOE-RL 1991b).

2.1.3.1.5 116-DR-7 (105-DR) Inkwell Crib. The 116-DR-7 (105-DR) Inkwell Crib is an inactive liquid waste site that operated during 1953. The 116-DR-7 Inkwell Crib was used to receive the liquid potassium borate solution that was drained from the 3X system prior to the Ball 3X system upgrade. This site received 4,000 liters (1000 gal) of liquid potassium borate. There is reason to believe the site may be a storage tank rather than a crib. About 3,000 Kg (6,600 lb) of potassium borate was disposed in this site (Stenner et al. 1988). The radionuclide inventory for the 116-DR-7 Crib, decayed through April 1, 1986, was reported by Stenner et al. (1988) as 0.101 Ci.

The 1.5 m (5 ft) x 1.5 m (5 ft) x 3 m (10 ft) deep crib is a registered underground injection well.

2.1.3.1.6 116-DR-8 (117-DR) Seal Pit Crib. The 116-DR-8 (117-DR) Crib is an inactive liquid waste site that operated from 1960 to 1964 for reactor operations and until 1986 in support of the 105-DR Sodium Fire Facility.

The 3 m (10 ft) x 3 m (10 ft) x 3 m (10 ft) deep 116-DR-8 Crib received an estimated 240,000 liters (63,401 gal) of liquid wastes from the containment system 117-DR Building Seal Pit. No radionuclide inventory is available for this facility.

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2.1.3.2 Contaminated Reactor Ancillary Facilities. This includes all facilities involved with the secondary wastes from the 118-DR-2 Reactor Building maintenance activities that may involve irradiated products.

2.1.3.2.1 116-D-8 (100-D) Cask Storage Pad. The 116-D-8 (100-D) Cask Storage Pad is an inactive solid waste site that operated from 1946 to 1975. The cask pad was used to store shipping and handling casks when they were not in use. The cask pad is a concrete pad with two drains. One of the drains facilitated rain runoff and the disposal of minor decontamination solutions. This drain discharged into the 105-DR Process Sewer. The second drain was for decontamination use and emptied into a french drain. The location of the french drain is currently unknown. No radionuclide inventory is available for this facility.

There are two devices standing to the south of the cask pad: a tank, about 12 ft tall by 10 ft in diameter, labeled Alum Storage; and a structure about 8 ft tall by 10 ft in diameter, that appears to be a furnace. The exterior of the Alum Storage tank is marked with Internal Radioactive Material warning stickers. No radionuclide inventory is available for these devices.

2.1.3.2.2 132-DR-1 (1608-DR) Waste Water Pumping Station. The 132-DR-1 (1608-DR) Waste Water Pumping Station is an inactive liquid waste site that operated from 1950 to 1964. The pump station has been decommissioned. The unit was adjacent to the northeast corner of the 118-DR-2 (105-DR) Reactor Building within the

105-D/DR exclusion area fence. The 1608-DR facility received water from reactor building drains containing trace amounts of low-level radionuclides and decontamination chemicals. Radionuclides were primarily miscellaneous fission and activation products. The decontamination chemicals consisted of sodium fluoride, oxalic acid, and citric acid. No radionuclide inventory is available for this site.

2.1.3.2.3 132-DR-2 (116-DR) Reactor Exhaust Stack. The 132-DR-2 (116-DR) Reactor Exhaust Stack is an inactive solid waste site that operated from 1950 to 1986. The stack is located on the south side of 118-DR-2 (105-DR). The stack was used to exhaust air from the 105-DR Reactor work areas and later from the 122-DR-1 (105-DR) Sodium Fire Facility. The stack is a monolithic, reinforced concrete structure with a maximum wall thickness of 1.5 ft at the base. It rests on a double octagon-shaped base that extends 17.5 ft below grade.

2.1.3.2.4 Sodium Dichromate/Acid Pumping Station. The sodium dichromate/acid pumping station is located just south of the 184-D Building next to the railroad tracks. A 3-inch diameter buried pipeline transported solutions from the pump station to storage tanks located at 185-D and outside 190-DR. There is a 1 m diameter french drain located at the site. The french drain received liquids from the flushing and draining of the hoses and lines used to off-load the railcars and tank cars. No radionuclide or chemical contaminant inventories are available for this facility. However, chromium is a potential contaminant at this site.

2.1.3.3 Sanitary Sewage, Transfer, Treatment, and Disposal Facilities. Sanitary sewage generated at the 100 D/DR Area was treated in underground septic tanks and then discharged to tile fields. There is no documentation of hazardous wastes being disposed of in any of these facilities.

2.1.3.3.1 1607-D Septic Tanks and Associated Drain Fields. One septic tank system is located in the 100-DR-2 Operable Unit. It is active and supports the 151-D Electrical Substation. This facility is not known to have received hazardous or radioactive wastes, although it supports a facility where hazardous and/or radioactive materials may have been routinely handled and used. Of these, solvents and polychlorinated biphenyl (PCB) contaminated oils are most likely to have been used, although only in very small concentrations. They would have been generated by hand washing and small parts cleaning.

2.1.3.4 122-DR-1 (105-DR) Sodium Fire Facility - Resource Conservation and Recovery Act of 1976 Facilities. The 100-DR-2 Operable Unit currently contains one waste storage and treatment facility subject to permitting and/or closure as a TSD facility under RCRA; the 122-DR-1 Sodium Fire Facility. The 122-DR-1 (105-DR) Sodium Fire Facility is an inactive liquid waste site that operated from 1972 to 1986. The facility is located in the supply and exhaust fan wing of the 105-DR Reactor Building (WIDS) (DOE-RL 1991b) and includes portions of the 116-DR Reactor Exhaust Stack, the 117-DR Filter Building and associated crib (116-DR-8) and the 119-DR Reactor Exhaust Stack Sampling Building. This facility was used for the thermal testing and treatment of sodium and other alkali metals. Wastes consisted of sodium, lithium, and sodium-potassium alloy. Approximately 20,000 Kg were managed at this facility each year. The facility is also used to store up to 20,000 liters of dangerous wastes. The facility was also known as the 105-DR Large Sodium Fire Facility.

2.1.3.5 Support Facilities. Located throughout the 100-DR-2 Operable Unit are facilities that provide support services so that the primary function of the reactor building, generation of plutonium, could be accomplished. Limited information was found in the background search on a majority of the buildings. It is important that all decommissioned buildings be identified so that a thorough analysis regarding waste generation and contaminant potential can be made.

The buildings that have been identified are listed in Table 2-1. These buildings/structures, (if locations are known) whether existing or demolished, are shown in Figure 2-2. The facilities that are of primary concern include the following:

- 1702-DR Exclusion Area Badge House
- Temporary Garage and Gasoline Dispensing Station
- 117-DR Filter Building
- 183-DR Filter Plant, Head House, Sedimentation and Coagulation Basins
- 190-DR Main Pump House.

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2.1.3.5.1 1702-DR (105) Area Exclusion Area Badge House. The 1702-DR (105) Area Exclusion Area Badge House is located northwest of the 105-DR Reactor. This facility provided entry into the exclusion zone.

2.1.3.5.2 Temporary Garage and Gasoline Dispensing Station. During construction of the water treatment facilities for the 118-DR-2 Reactor, a temporary garage facility was built. On May 2, 1950 the garage facility was destroyed by a fire. The location of this facility is unknown. It is not known if there was an underground tank associated with this facility (generally temporary garages housed above ground storage tanks) as reported in the *100-D Area Technical Baseline Report* (WHC 1993).

2.1.3.5.3 117-DR Filter Building. Originally 105-DR exhaust air flowed directly from the 118-DR-2 Reactor Building to the exhaust stack. Following completion of the confinement project in 1960, the exhaust air was diverted to the 117-DR Filter Building, via underground ducts, prior to release through the stack.

2.1.3.5.4 183-DR Filter Plant, Head House, Sedimentation and Coagulation Basins. This facility was constructed in 1950 to supply treated cooling water to the 105-DR Reactor. As part of the deactivation of 118-DR-2, the flocculating basins were cleaned and the silt flushed from the basins. Radiation surveys of the basins after cleaning revealed beta-gamma contamination levels of < 500 counts per minute (cpm) as reported in the *DR-Plant Radiation Zones Final Status Report* (Winship 1965).

2.1.3.5.5 190-DR Main Pump House. The 190-DR Main Pump House treated water from the 183-DR Facility with sodium dichromate prior to releasing it to the 118-DR-2 Reactor.

2.1.3.6 Solid Waste Landfill and Burial Grounds.

2.1.3.6.1 126-DR-1 (190-DR) Clearwell Tank Pit. The 126-DR-1 (190-DR) Clearwell Tank Pit is an active solid waste site that began operations in the 1970's. The site is located directly east of the 183-DR Waste Treatment Facility site (demolished) and about 1,200 ft southwest of the 118-DR-2 Reactor Building.

The site is an excavated area between the 183-DR and 190-DR that contained four (14,195,294 liters [3,750,000 gal]) steel water storage tanks that were removed by a salvage contractor. Approximately 25% of the bottom surface area contains a layer of waste about 1.5 - 3 m (5 - 10 ft) deep that is covered with pit run backfill and is located in the northeast sector of the pit. The wastes placed in this area were demolition and inert waste from the decommissioned facilities, including rubble from released portions of the 115-D/DR, and some rubble from 183-DR. The southern sector is posted as an asbestos area. In 1989, small amounts of friable asbestos were found scattered throughout the southern sector. The asbestos is believed to be the result of salvage operations during the 1970's.

2.1.3.6.2 118-D-5 (Ball 3X) Burial Ground. The 118-D-5, Ball 3X Burial Ground is an inactive solid waste site that operated during 1954. This burial ground is located about 100 ft south of the 118-DR-2 (105-DR) Building, outside the exclusion area fence (WIDS) (DOE-RL 1991b). It received thimbles removed from the 105-DR Reactor during the Ball 3X upgrade project in 1954 (Stenner et al. 1988). (Thimbles were sealed aluminum tubes that ran through the graphite to maintain the gas seal in the vertical safety rod and horizontal control rod channels.) This site is also known as Minor Construction Burial Ground Number 3, as reported in *Unconfined Underground Radioactive Waste and Contamination--100 Areas* (Heid 1956).

The 118-D-5 site consists of two parallel burial trenches with one trench on each side of the existing aboveground experimental level-one discharge pipe. Each trench is 12 m (40 ft) x 6 m (20 ft) x 3 m (10 ft) deep (WIDS) (DOE-RL 1991b). It is possible that the west trench was relocated in 1960 during the construction of the 117-DR Building, so the exact location is uncertain and total volume disposed at this location is unknown. For example, the 118-DR-5 is also described as a 6 m (20 ft) x 6 m (20 ft) x 3 m (10 ft) deep single trench (Stenner et al. 1988), and as being two trenches, both located east of the experimental level discharge pipe (Hanford Drawing H-1-4046, sites 4 and 17).

2.1.3.7 Electrical Facilities. This category includes the transformers, capacitors, switches, and other miscellaneous electrical facilities within the 100-DR-2 Operable Unit. The main substation for the 100 D/DR Area, 151-D, is located within the 100-DR-2 Operable Unit. All PCB transformers on the Hanford Site have been characterized for PCB content and are tracked on a computer file data base. Transformers are inspected regularly, and any leaks are addressed promptly. There is a possibility of PCB-contaminated soil resulting from past-practices, however.

2.1.4 Waste Generation Process

All of the 100-DR-2 Operable Unit waste management units can be grouped into the following categories:

- process liquid waste and sludges
- reactor exhaust stack emissions
- radioactive solid wastes
- sanitary liquid wastes
- nonradioactive solid waste
- other liquid waste
- hazardous waste.

Before discussing the specific waste facility characteristics in Section 2.1.4, these general categories of waste generation processes are described below.

The information presented on waste generation processes at the 100-DR-2 Operable Unit is based on information available at the time of preparation of this work plan. Additional information will be obtained, as needed, during the LFI source data compilation described in Section 5.0.

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2.1.4.1 Process Liquid Wastes and Sludges. Process wastes were generated as a result of reactor cooling, reactor and equipment decontamination, and filtration of reactor exhaust stack emissions.

2.1.4.1.1 Reactor Cooling Water System. The DR Reactor used a once-through cooling process in which water from the Columbia River was circulated through the reactor one time and then was discharged back to the river or to the soil column disposal facilities, (Dorian and Richards 1978). The cooling water that left the reactor contained radioactive species from the reactor and chemicals that were added to treat the water before its use. Detailed information regarding the physical description of the reactor, its associated water supply, and effluent disposal facilities may be found in the *Hazards Summary Report: Volume 3 - Description of the 100-B, 100-C, 100-D, 100-DR, 100-F, and 100-H Production Reactor Plants* (General Electric 1963).

A detailed summary of the reactor cooling water system is included in Section 2.1.3.1.1 of the 100-DR-1 Operable Unit Work Plan (DOE-RL 1992b).

2.1.4.2 Reactor Exhaust Stack Emissions. The primary ventilation system circulated air through the 118-DR-2 Reactor and then discharged it through the 132-DR-2 (116-DR) Exhaust Stack. In order to control the release of radioactive matter into the atmosphere, a confinement system was installed to filter it for particulates and halogens in the 117-DR Filter Building before exhausting it through the 132-DR-2 Stack.

2.1.4.3 Radioactive Solid Waste. Radioactive solid wastes generated in the 100 D/DR Area consisted mainly of discarded activated metallic reactor parts containing nickel-59, cobalt-60, and nickel-63. Most radioactive solid wastes from the 100 D/DR Area were discarded in burial grounds 118-D-1, 118-D-2, and 118-D-3 in the 100-DR-3 Operable Unit.

2.1.4.4 Sanitary Wastes. Sanitary wastes from the 100 DR Area were treated in the 1607-D-3 Septic Tank and disposed of in associated tile fields. There are no records of hazardous or radioactive wastes being disposed of in these systems.

2.1.4.5 Nonradioactive Solid Waste. Nonradioactive solid waste generated within the 100 D/DR Area primarily includes decommissioning wastes such as scrap metal, concrete, and other building materials. An inventory has been prepared, and can be found in *Estimates of Solid Waste Burial in 100 Area Burial Grounds* (Miller and Wahlen 1987), that identifies and quantifies the volumes of solid waste disposed within the 100 Area. This inventory is based on historical documents, the reconstruction of operating practices, and the experience of knowledgeable individuals involved in waste disposal practices during the years of reactor operations.

2.1.4.6 Other Liquid Waste. Other liquid waste includes anything nonradioactive or not sanitary related. This category encompasses potential gasoline or oil leaks from underground or aboveground storage tanks, potential PCB contamination of the soil from electrical facilities, and backwash and discharge water from various support facilities.

2.1.4.7 Hazardous Waste. Hazardous wastes generated include herbicides, insecticides, solvents, paints, and other chemicals, either by industrial or support services operations. Specific information on hazardous waste disposal practices at the operable unit is currently unavailable.

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2.1.5 Interactions with Other Operable Units

As shown in Figure 2-1, the 100-DR-2 Operable Unit is bordered on the north by the 100-DR-1 and on the east and south by the 100-DR-3 Operable Units. The 100-HR-3 Operable Unit (the groundwater unit) underlies the entire area between the 100 D/DR and 100 H Areas. Information gained from CMS/FS work at the 100-DR-1 and 100-HR-3 Operable Units will be used as much as possible to guide activities at the 100-DR-2 Operable Unit.

The RFI/CMS and remedial investigation/feasibility study (RI/FS) activities to be performed at other operable units at the Hanford Site 100 Area will also be integrated with the work in the 100-DR-2 Operable Unit. Operable units for which work plans have been approved and work is under way are: 100-BC-1, 100-BC-5, 100-DR-1, 100-FR-1, 100-FR-3, 100-HR-1, 100-HR-3, 100-KR-1, 100-KR-4, 100-NR-1, and 100-NR-2. Information gathered at each operable unit will be evaluated for relevance by investigators at other operable units and used where appropriate.

2.1.6 Interactions with the Resource Conservation and Recovery Act of 1976

According to Appendix B of the Hanford Federal Facility Agreement and Consent Order Action Plan (Ecology et al. 1990a), the 100-DR-2 Operable Unit contains one waste storage and treatment facility subject to permitting and/or closure as a TSD facility under RCRA; the 122-DR-1 Sodium Fire Facility. The 100-DR-2 and 100-HR-3 Operable Unit RFI/CMS coordinators and the 122-DR-1 Sodium Fire Facility RCRA closure coordinators will work to satisfy all regulatory requirements and avoid duplication of efforts.

2.2 OPERABLE UNIT SETTING

This section discusses the physical setting of the 100-DR-2 Operable Unit, including topography, geology, hydrogeology, surface hydrology, meteorology, environmental resources, and human resources. The discussion is general in nature for the entire 100 D/DR Area. Information describing the physical setting of the 100-DR-2 Operable Unit can be found in Section 2.2 of the 100-DR-1 Operable Unit Work Plan (DOE-RL 1992b). Specific subsections in the referenced Section 2.2 include:

- Section 2.2.1 Topography
- Section 2.2.2 Geology
- Section 2.2.3 Hydrogeology
- Section 2.2.4 Surface Hydrology
- Section 2.2.5 Meteorology
- Section 2.2.6 Environmental Resources
- Section 2.2.7 Human Resources.

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Figures 2-3 through 2-9 are included to present a condensed form of the material referenced from the 100-DR-1 Work Plan. Figure 2-3 is a topographic map of the 100 D/DR and surrounding area. Figure 2-4 presents a general stratigraphic cross-section of 100 D/DR Area (the vadose zone geology, as determined from the *100-DR-1 Operable Unit Limited Field Investigation Report* (DOE-RL 1993a) boring logs, support the generalized vadose zone geology as depicted in Figure 2-4). Figure 2-5 shows water-table contours. Figure 2-6 illustrates a generalized hydrostratigraphic column for 100 D/DR Area. And Figure 2-7 depicts wind patterns across the Hanford Site. Figure 2-8 shows the surface of the Saddle Mountain Basalt Formation near the 100 D/DR Area. Figure 2-9 shows a geologic cross-section across the western Wahluke Syncline in the vicinity of the 100 D/DR Area.

The geology of the Hanford Site has been investigated in detail as a part of siting studies for the use of the 200 West Area as a deep geologic repository for high-level nuclear waste. *Geologic Studies of the Columbia Plateau: A Status Report* (Myers et al. 1979) describes the regional geologic studies performed between 1977 and 1979 in support of this program; the *Site Characterization Plan, Reference Repository Location, Hanford Site, Washington; Consultation Draft* (DOE 1988) describes much of the geologic information of the area (with emphasis on the 200 West Area). Geologic data were also obtained from recent stratigraphic studies of the Hanford Site from *Revised Stratigraphy for the Ringold Formation, Hanford Site, South Central Washington* (Lindsey 1991), and *Geology and Hydrology of the Hanford Site: A Standardized Text for Use in Westinghouse Hanford Company Documents and Reports* (Delaney et al. 1991). A detailed discussion of the groundwater beneath the 100-DR-2 Operable Unit can be found in Section 2.2.3 of the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a). Meteorological data have been collected at the Hanford Meteorological Station since 1945. Before that time, data were available from a U.S. Weather Bureau station 10 miles away. *Climatological Summary for the Hanford Area* (Stone et al. 1983) and the *Final Environmental Impact Statement - Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes* (DOE 1987) summarize much of this data.

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Figure 2-1 The 100 D/DR Operable Unit

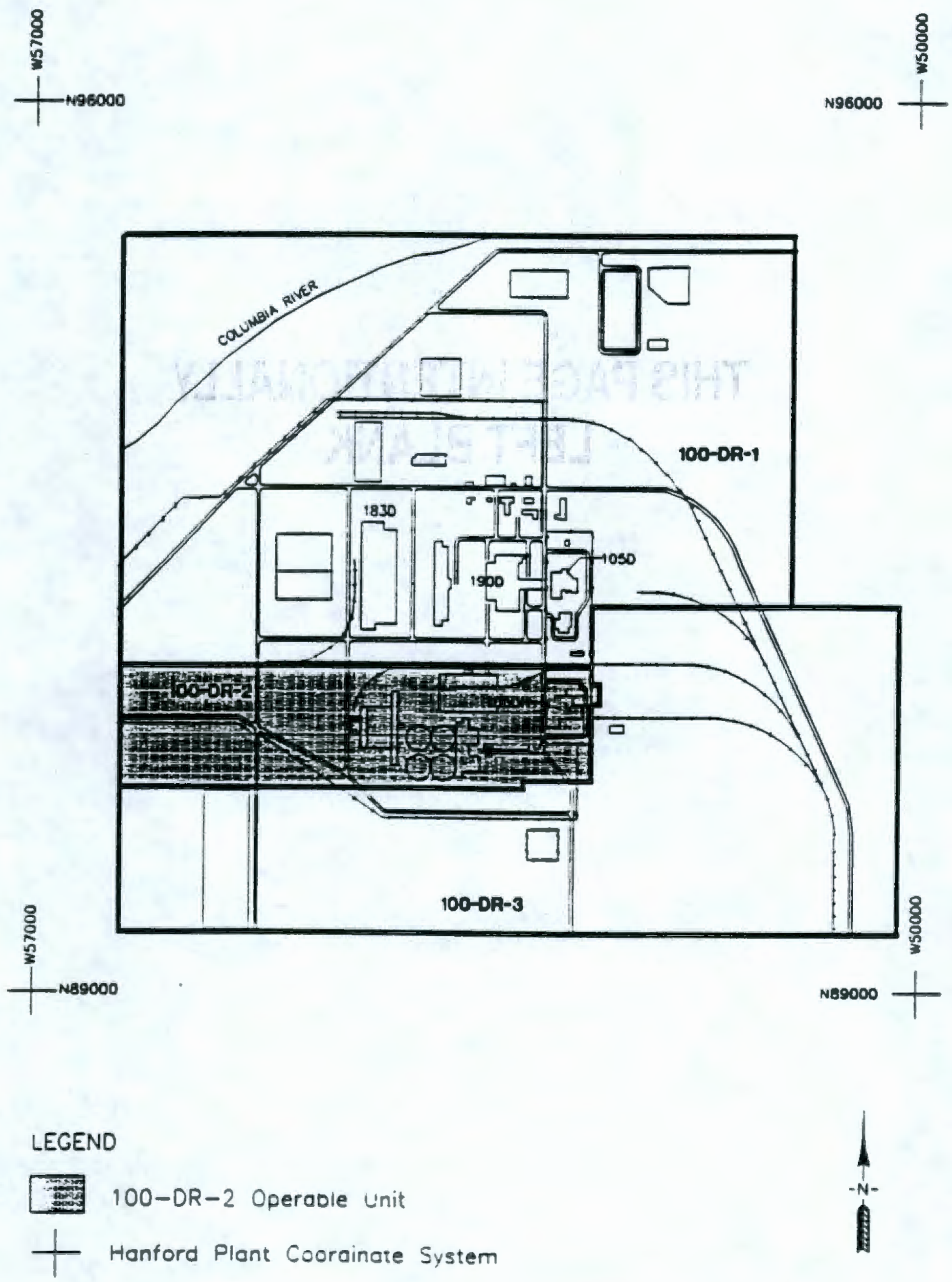

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Figure 2-2 100-DR-2 Operable Unit

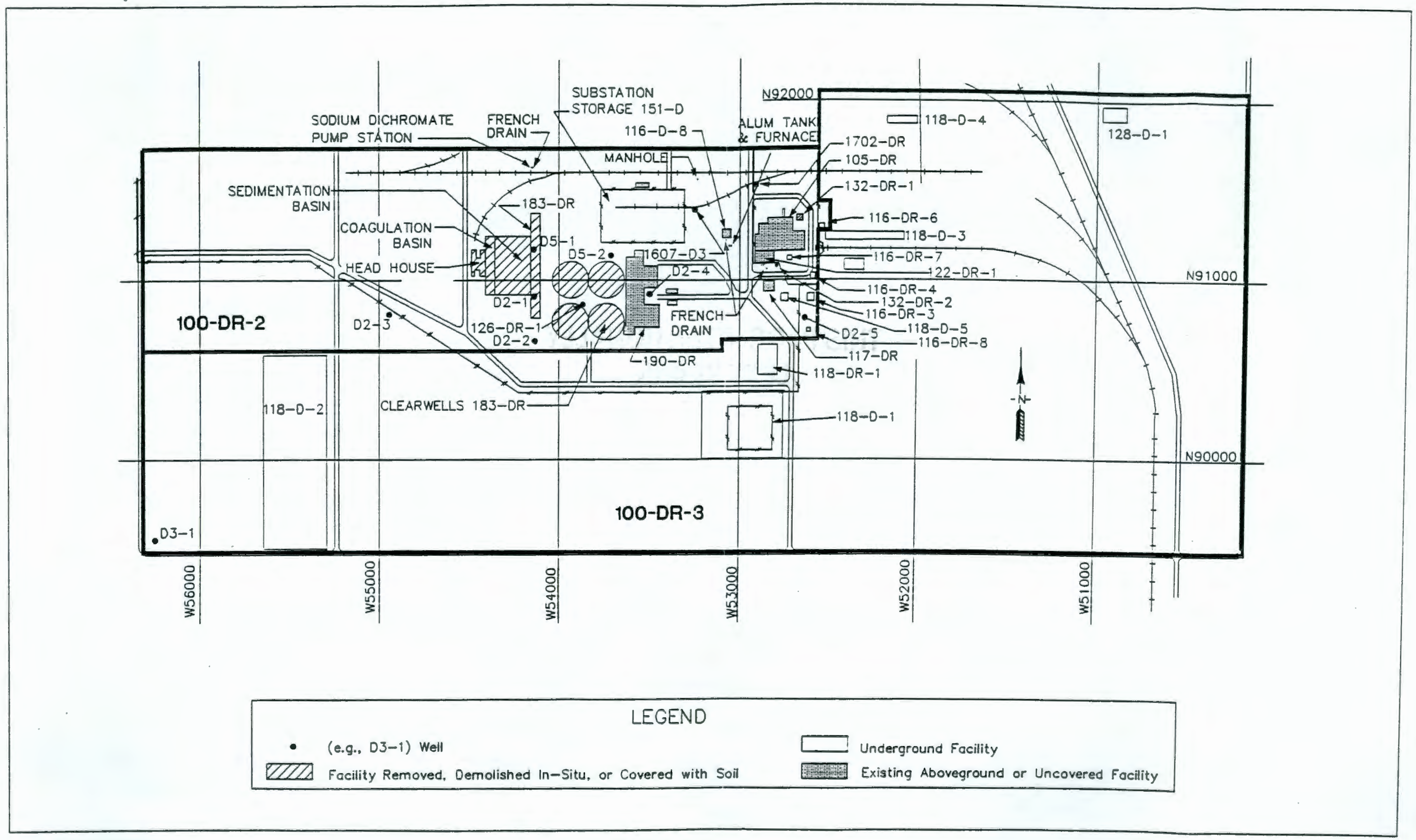

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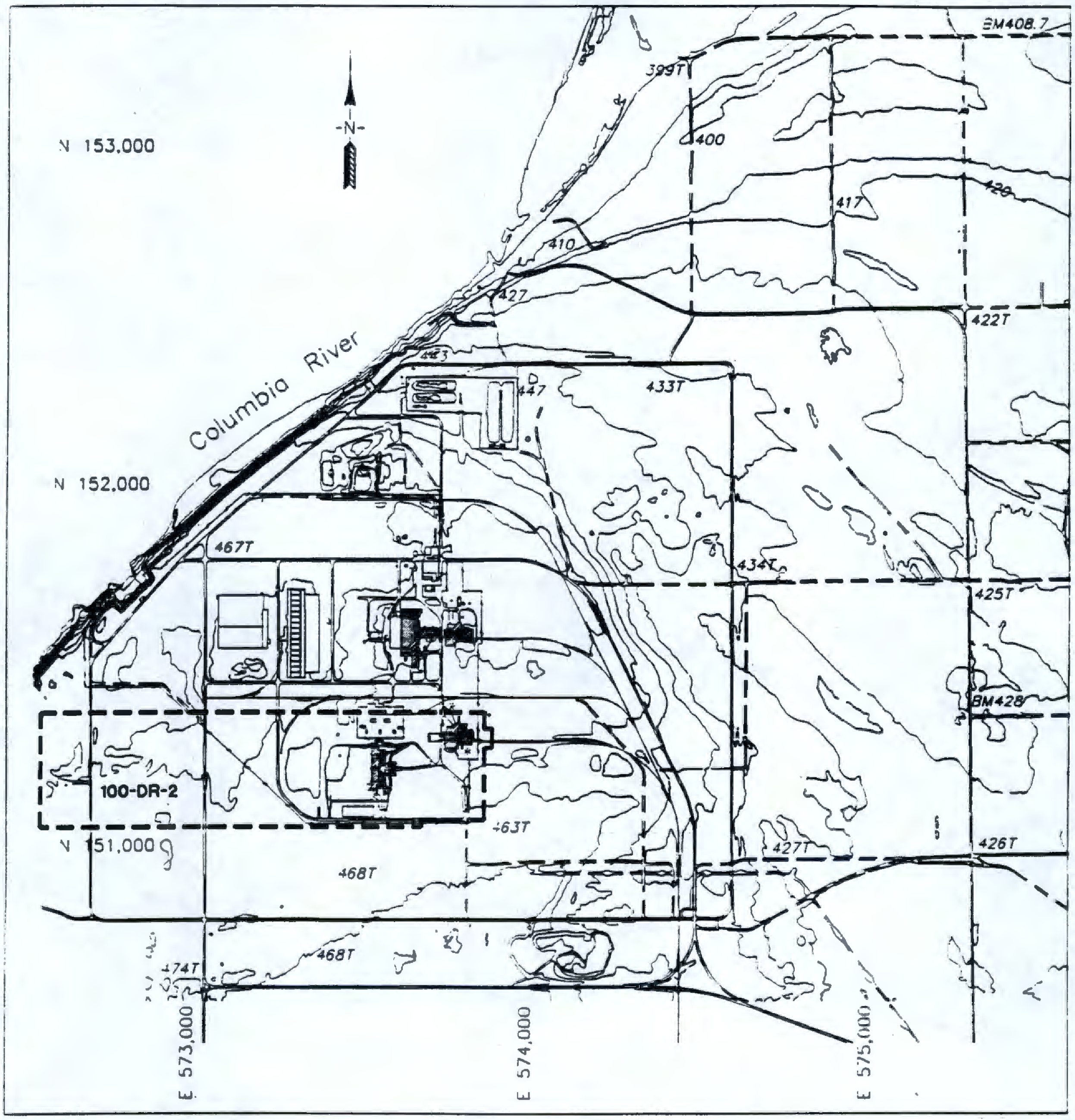
Figure 2-3 Topographic Map



Elevation in feet (National Geodetic Vertical Datum)
Contour interval = 10 feet

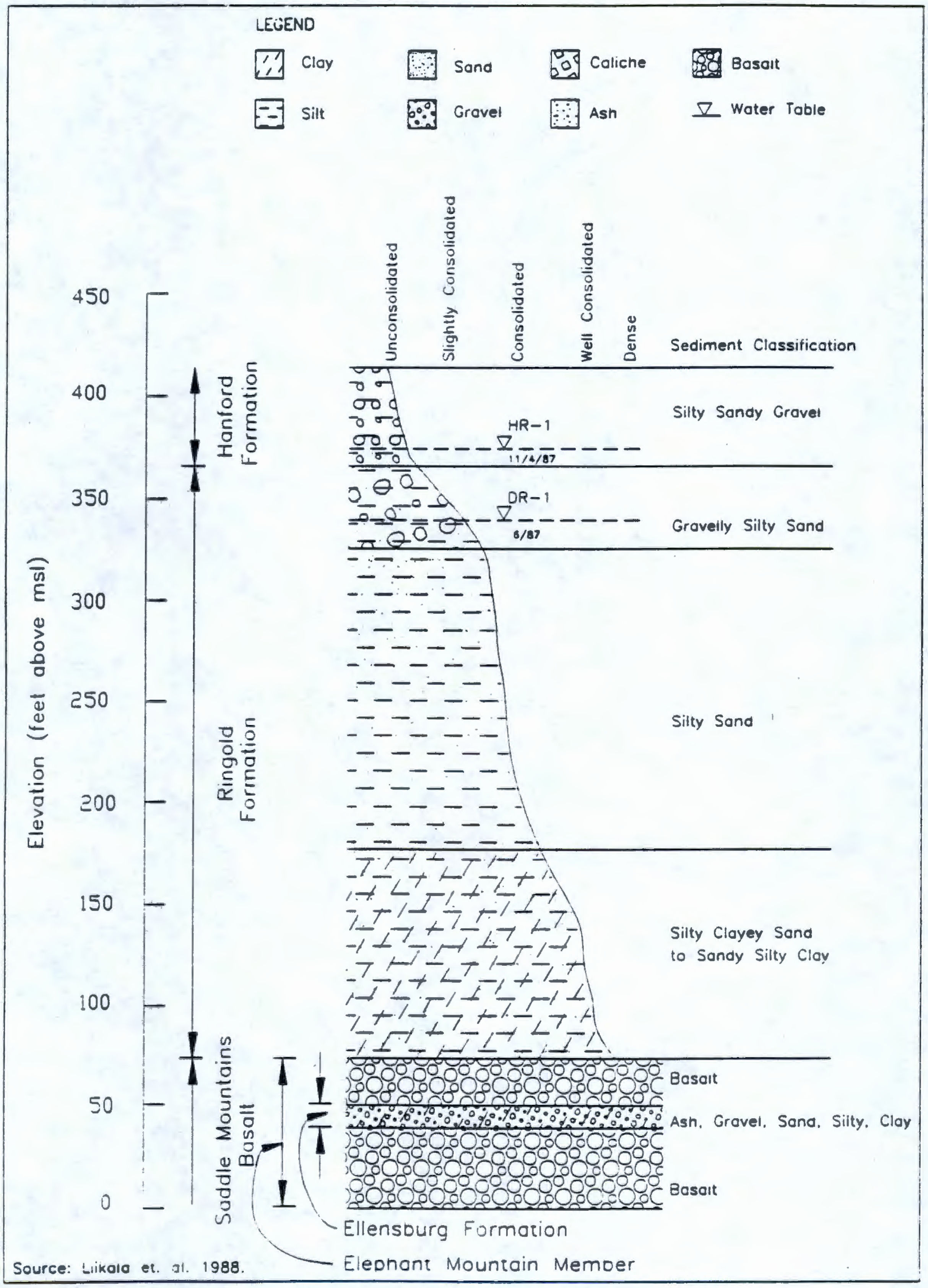
LEGEND

---- 100-DR-2 Operable Unit Boundary

0 600 Meters
0 2000 Feet

Modified from: USGS 1986.

Figure 2-4 Generalized Stratigraphic Column for the 100 H Area, Assumed to be Similar in the 100 D/DR Area



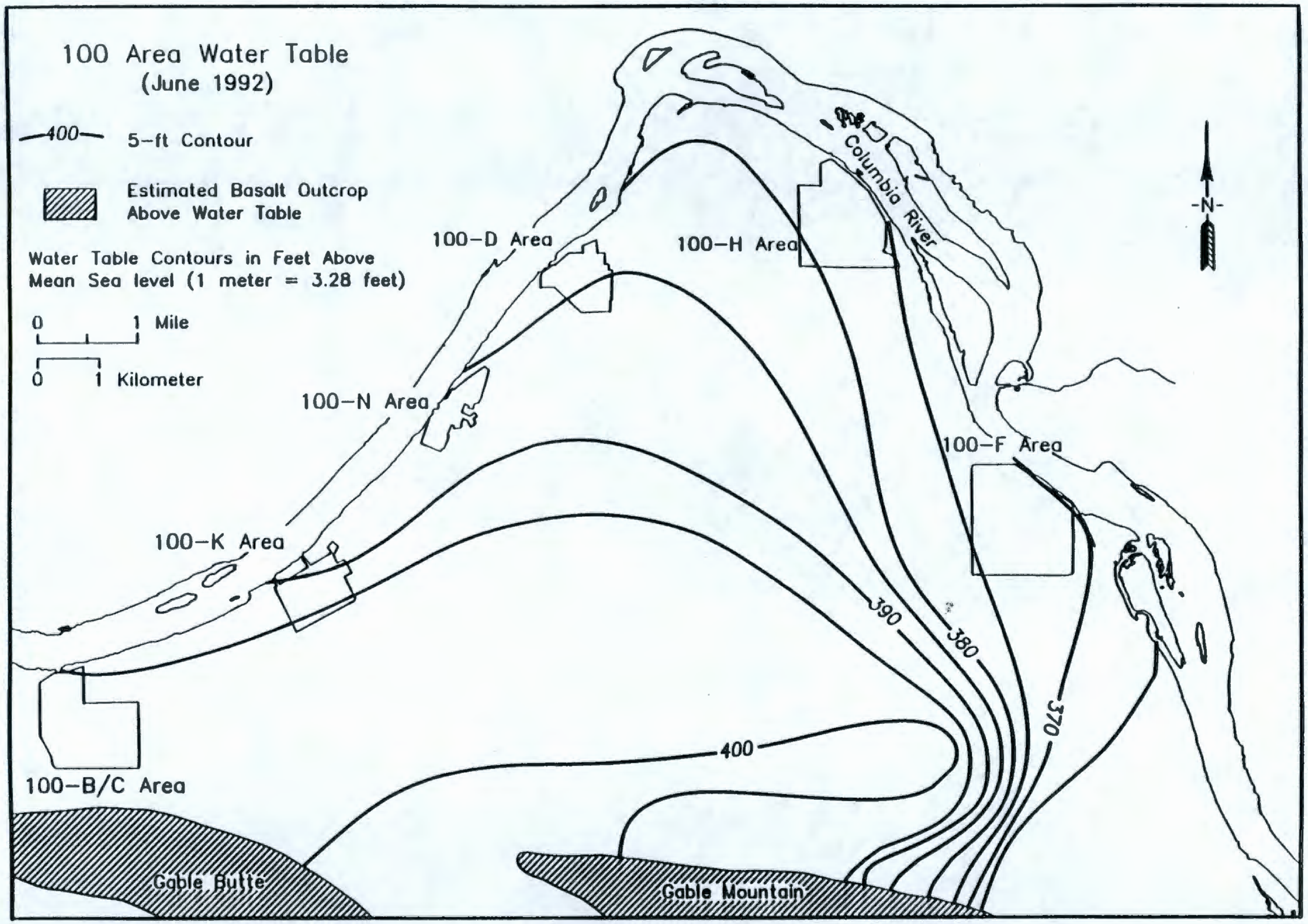
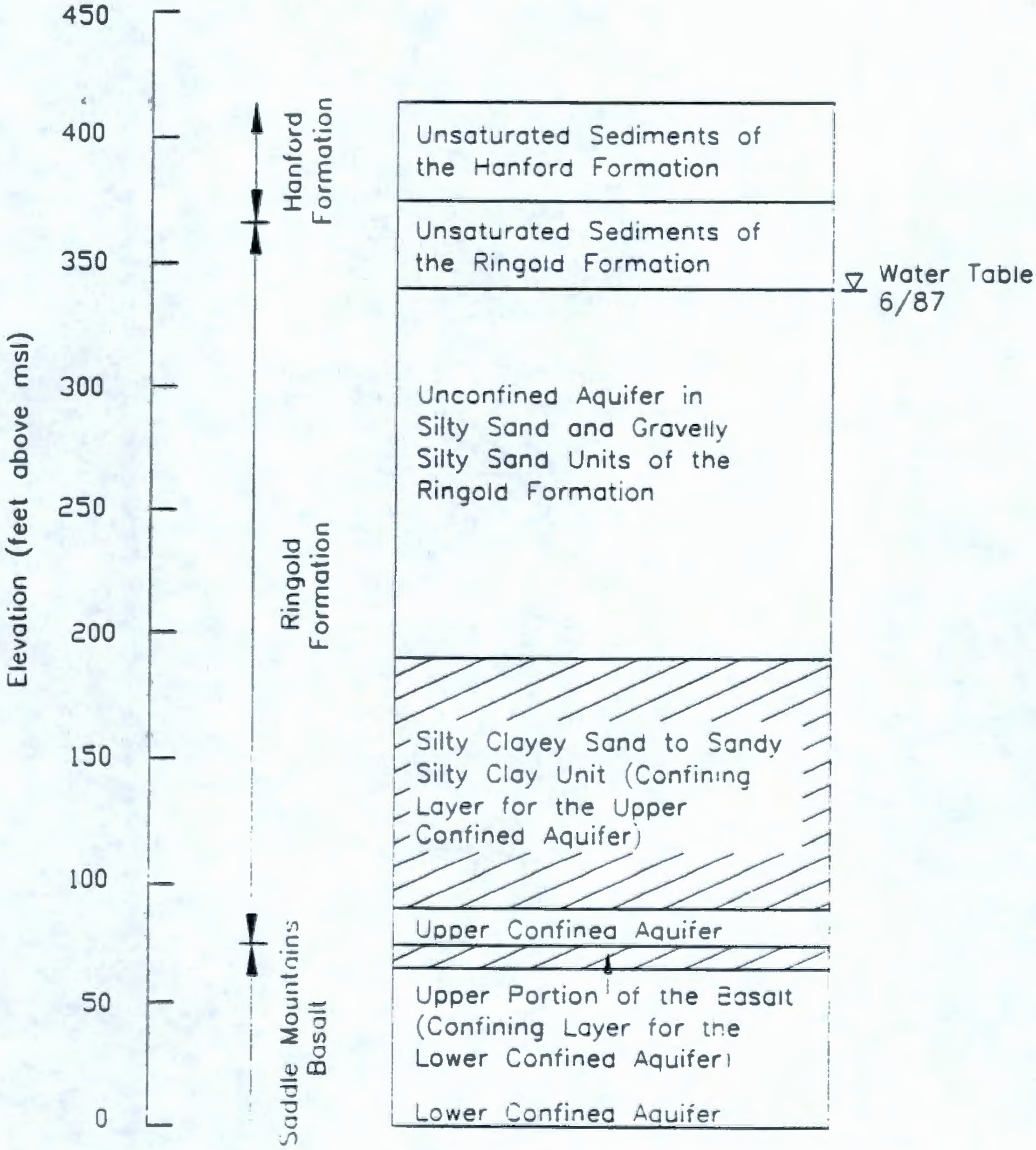


Figure 2-5 Water Table Elevations for June 1987

Figure 2-6 Conceptual Hydrostratigraphic Column Assumed for the 100 D/DR Area, Based on 100 D/DR Area Well Data



Source: Liikala et. al. 1988

Figure 2-7 Wind Roses for the Hanford Telemetry Network, 1979-1982

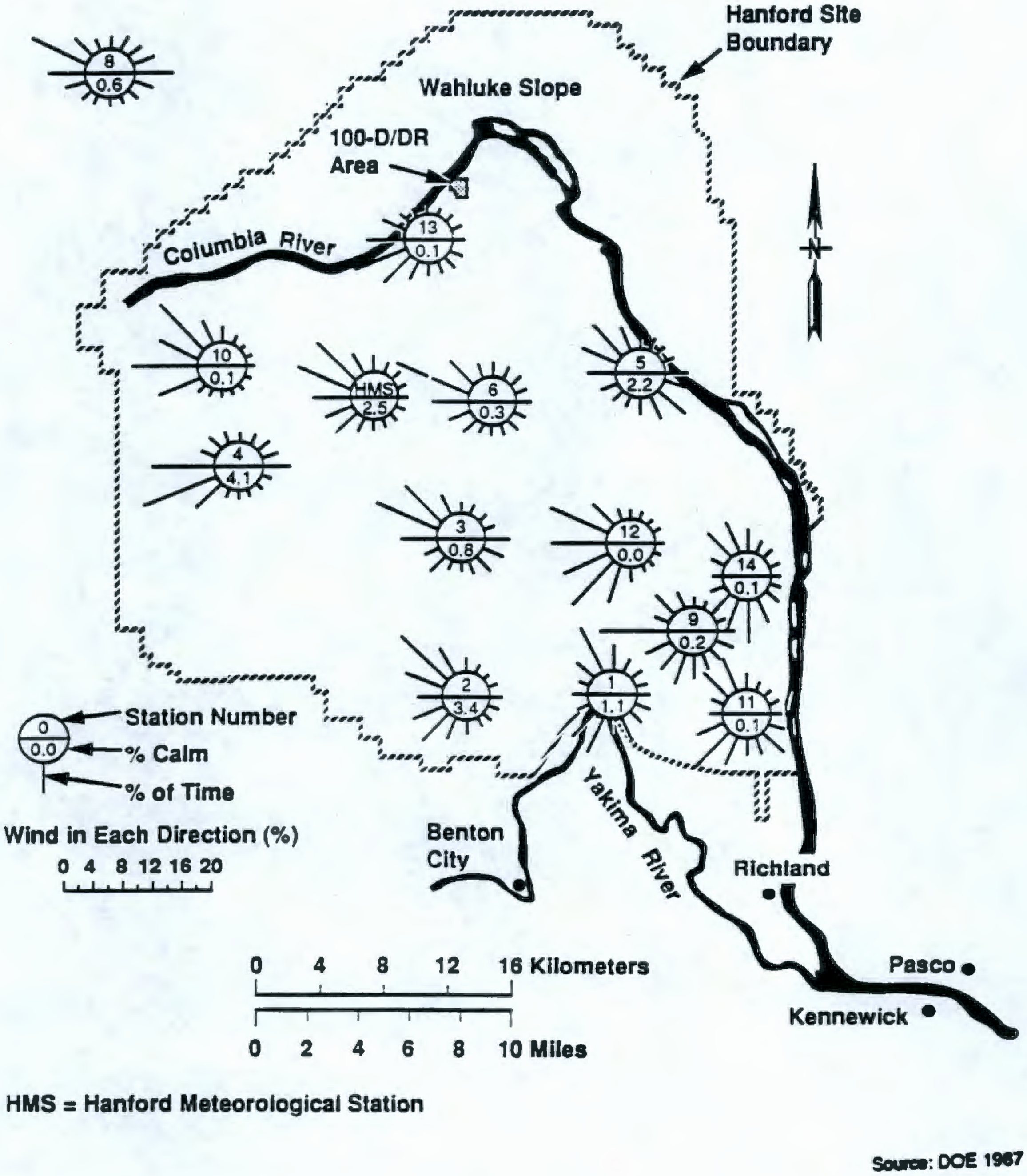
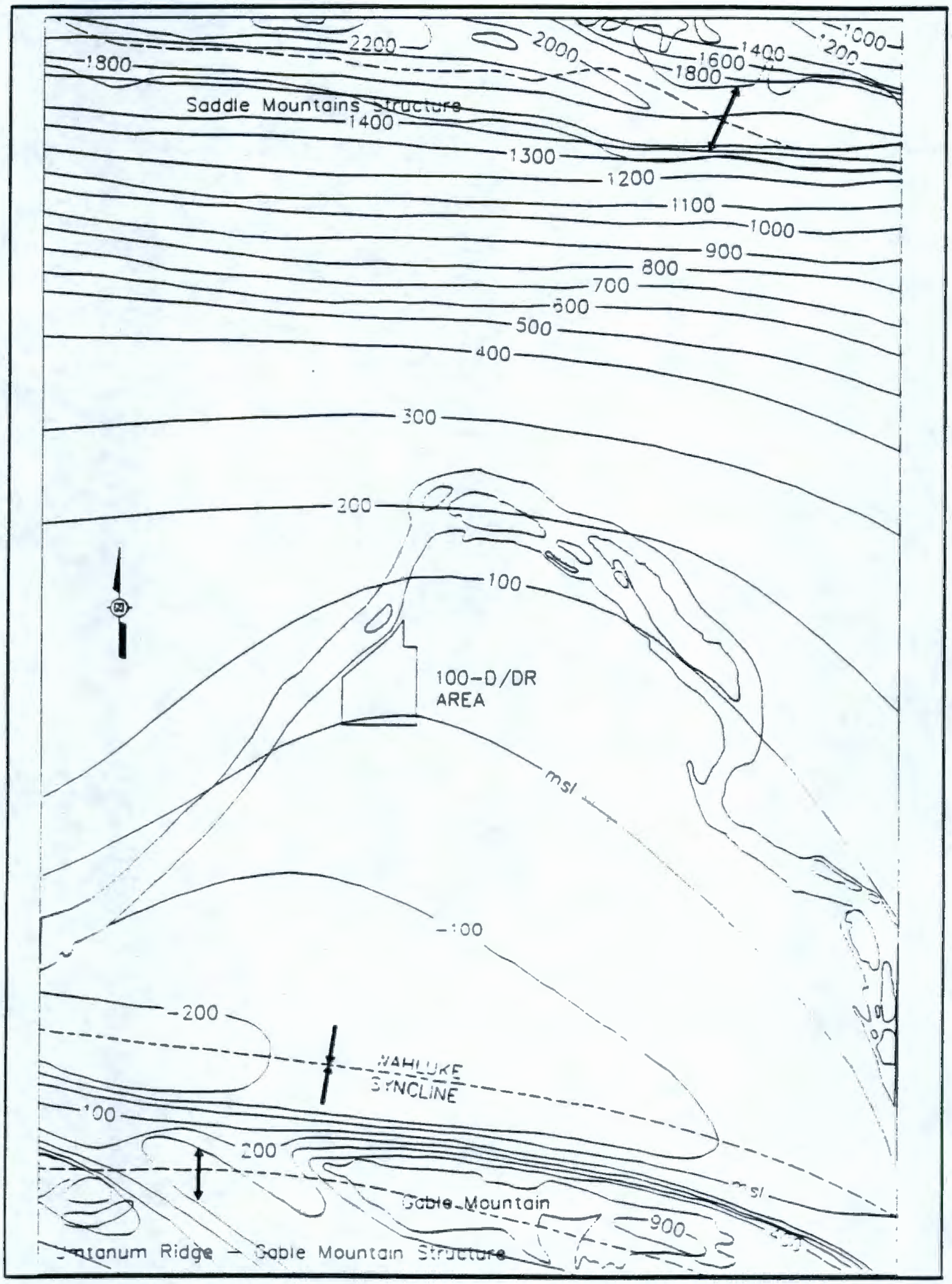
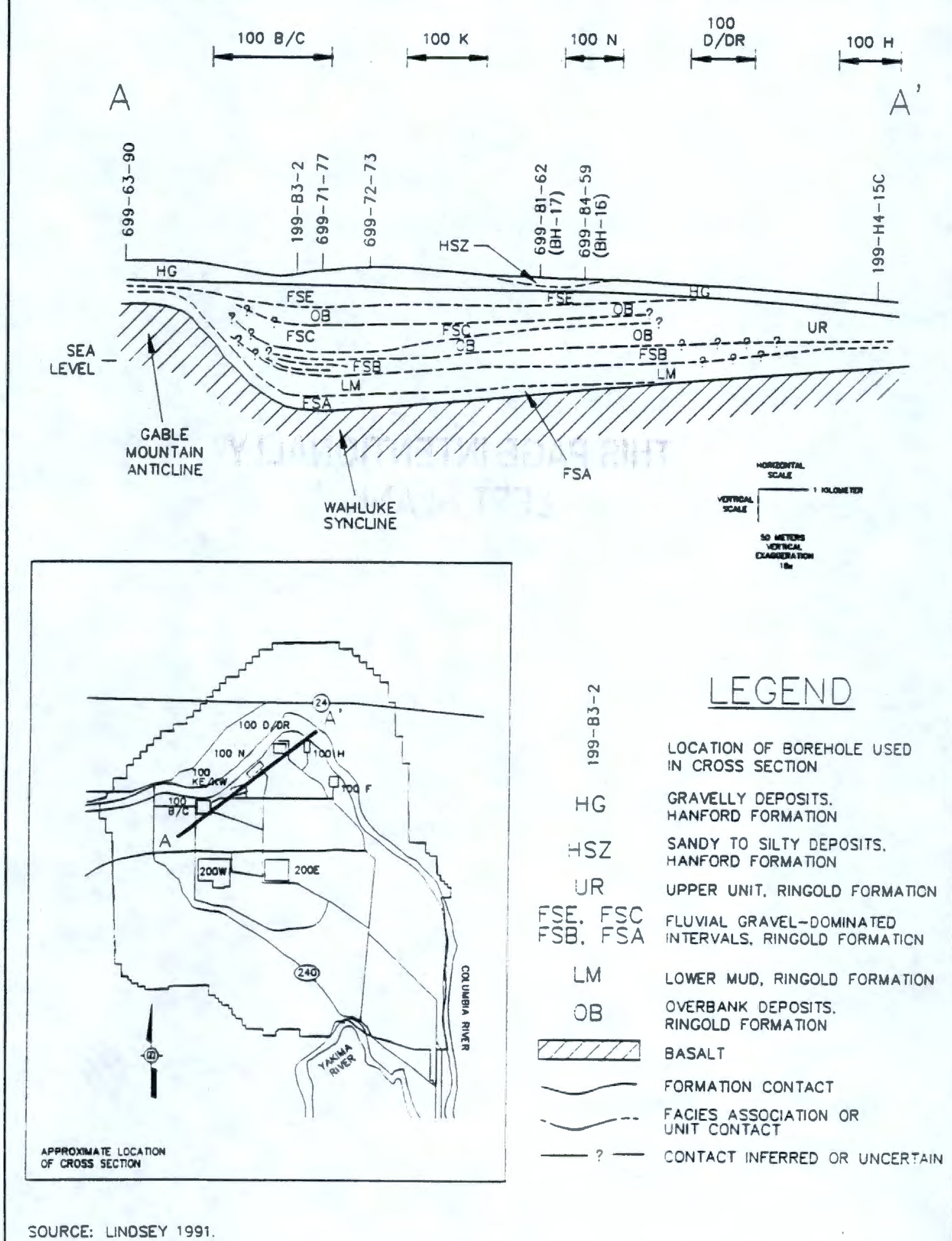


Figure 2-8 Surface of the Saddle Mountains Basalt Formation Near the 100 D/DR Area (Contours in Feet Above or Below Mean Sea Level)



Source: Reidel et al 1988.

Figure 2-9 Northeast to Southwest Geological Sediments Across the Western Wahluke Syncline in the Vicinity of the 100 B/C, 100 K, 100 N, 100 D/DR, and 100 H Areas of the Hanford Site



SOURCE: LINDSEY 1991.

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Table 2-1 Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-2 Operable Unit Area (Sheet 1 of 5)

*Current Designation (Alias Designation)	Name	Years in Service/Status	Facility Description/Purpose	Waste Received or Handled
118-DR-2 (105-DR)	Reactor Building	1950-1964/Inactive	Consists of reactor block, graphite moderator stack, biological and thermal shields, process tubes, the safety and control systems, the irradiated fuel storage basin, and contaminated portions of reactor buildings.	House the reactor core.
116-DR-4 (105-DR)	Pluto Crib	1950-1956/Inactive	Crib 10 ft x 10 ft x 10 ft deep. Located 200 ft southeast of the 118-DR-6 building and 40 ft northeast of the 116-DR-3. Received liquid wastes isolated from tubes containing ruptured fuel elements in the 118-DR-6 Reactor.	Received 4,000 L of liquid wastes isolated from tubes containing ruptured fuel elements in the 105-DR Reactor. Handled an estimated 0.0088 lb of sodium dichromate.
116-DR-3 (105-DR)	Storage Basin Trench	1955/Inactive	Unlined trench 60 ft x 40 ft x 10 ft deep. Contaminated sludge and water removed from the 105-DR Fuel Storage Basin was placed in this trench.	Received 4,000,000 L of contaminated sludge and water from the 105-DR Fuel Storage Basin.
116-DR-6 (1608-DR)	Liquid Disposal Trench	1953-1965/Inactive	Unlined trench 50 ft x 10 ft x 10 ft deep. Received coolant that was diverted to the trench during the Ball 3X upgrade.	Received coolant that was diverted to the trench during the Ball 3X upgrade. It also received diverted water when maintenance on the effluent system was necessary. An estimated 7,000,000 L of waste effluents were received, including 4.4 lb of sodium dichromate.

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Table 2-1 Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-2 Operable Unit Area (Sheet 2 of 5)

[a]Current Designation (Alias Designation)	Name	Years in Service/Status	Facility Description/Purpose	Waste Received or Handled
116-DR-7 (105-DR)	Inkwell Crib	1953/Inactive	Unlined crib, 5 ft x 5 ft x 10 ft deep. Registered underground injection well. Was used to receive the liquid potassium borate solution that was drained from the 3X System prior to the Ball 3X System upgrade. It may be a tank rather than a crib.	Received approximately 6,600 lb of potassium borate, plus 4,000 L of liquid potassium borate.
116-DR-8 (105-DR)	Seal Pit Crib	1960-1964(reactor operations) 1972-1986/Inactive	Unlined crib 10 ft x 10 ft x 10 ft deep. Purpose was to receive liquid wastes from the containment system 117-DR Building Seal Pit.	Received an estimated 240,000 L of liquid waste from the containment system 117-DR Building Seal Pit.
116-D-8 (100-D)	Cask Storage Pad	1946-1975/Inactive	Solid waste site used to store shipping and handling casks. The cask pad is a concrete pad with two drains. One of the drains facilitated rain runoff and the disposal of minor decontamination solutions. The second drain was for decontamination use and emptied into a french drain.	Stored shipping and handling casks.
[c]	Alum Storage Tank	[b]In storage at site not part of any operation.		
[c]	Furnace	[b]In storage at site not part of any operation.		

Table 2-1 Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-2 Operable Unit Area (Sheet 3 of 5)

[a]Current Designation (Alias Designation)	Name	Years in Service/Status	Facility Description/Purpose	Waste Received or Handled
132-DR-1 (1608-DR)	Waste Water Pumping Station	1950-1964/Inactive	Inactive liquid waste site that has been decommissioned. This facility received water from reactor building drains containing low-level radionuclides and decontamination chemicals.	Handled water from reactor building drains containing trace amounts of low-level radionuclides and decontamination chemicals. Radionulides were primarily miscellaneous fission and activation products. The decontamination chemicals consisted of sodium fluoride, oxalic acid, and citric acid.
132-DR-2 (116-DR)	Reactor Exhaust Stack	1950-1986/Inactive	Monolithic, reinforced concrete structure with a maximum wall thickness of 1.5 ft at the base. Exhaust ventilation air and gas from the DR Reactor.	Interior of stack contains radioactive materials from the reactor exhaust air.
[c]	Sodium Dichromate/Acid Pumping Station	[b]Inactive	Transported solutions from the pump station to storage tanks located at 185-D and outside 190-DR.	Unknown volume of solutions was transported from the pump stations.
1607-D	Septic Tanks and Associated Drain Field	Active	One septic tank drain system that supports the 151-D Electrical Substation.	Handles sanitary wastes.
122-DR-1 (105-DR)	Sodium Fire Facility	1972-1986	Inactive liquid waste site located in the supply and exhaust fan wing of the 105-DR Reactor Building. Facility was used for thermal testing and treatment of sodium and other alkali metals.	Handled wastes consisting of sodium, lithium, and sodium-potassium alloy. Approximately 20,000 Kg were managed at this facility each year. It also used to store up to 20,000 L of dangerous waste.

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Table 2-1 Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-2 Operable Unit Area (Sheet 4 of 5)

[a]Current Designation (Alias Designation)	Name	Years in Service/Status	Facility Description/Purpose	Waste Received or Handled
1702-DR	Exclusion Area Badge House	Inactive	Badge House located northwest of the 105-DR Reactor. This facility provided entry into the exclusion zone.	
[c]	Temporary Garage and Gasoline Dispensing Station	Unknown-1950[b]	Temporary garage facility used during the construction of the water treatment facilities for the 118-DR-6 Reactor.	
117-DR	Filter Building	Unknown-1960/ Inactive[b]	Reinforced concrete structure, almost completely below grade. Filter ventilation air from the confinement zone of the DR Reactor before discharge through the ventilation stack.	Filter reactor exhaust air.
183-DR	Filter Plant, Head House, Sedimentation and Coagulation Basin	1950-1964?/ Demolished	Supplied treated cooling water to the 105-DR Reactor. Housed water treatment and filtering facilities.	
190-DR	Main Pump House	1950-1964?/ Inactive	Included four steel tanks with a storage capacity of 5 million gal each. Provide primary cooling water for 105-DR Reactor. Treated water with sodium dichromate prior to releasing it to the 105-DR Reactor.	
126-DR-1 (190-DR)	Clearwell Tank Pit	1970's-present Demolished tanks, pit still remains.	Excavated area located between the 183-DR and 190-DR facilities that received demolition and inert waste.	

Table 2-1 Waste Transfer, Treatment, Storage, Disposal, and Related Facilities in the 100-DR-2 Operable Unit Area (Sheet 5 of 5)

[a]Current Designation (Alias Designation)	Name	Years in Service/Status	Facility Description/Purpose	Waste Received or Handled
118-D-5 (Ball 3X)	Burial Ground	1954/Inactive	Two parallel burial trenches with one trench on each side of the existing experimental level-one discharge pipe. Each trench is 40 ft x 20 ft x 10 ft deep. It has also been described as being a 20 ft x 20 ft x 10 ft deep single trench.	Received thimbles removed from the 105-DR Reactor during the Ball 3X upgrade project.
151-D	Main Substation	Active	Main substation for 100 D/DR Area	Polychlorinated biphenyls associated with the electrical facilities.

Sources: Dorian and Richards (1978), General Electric (1963), and Miller and Wahlen (1987).

[a]Waste Information Data System (WIDS) (DOE-RL 1991b).
[b]No information currently available.
[c]No site designation number.

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3.0 INITIAL EVALUATION

This chapter provides an initial evaluation of contamination in the 100-DR-2 Operable Unit. It includes a summary of available information on contaminants, an evaluation of potential ARAR, a preliminary site conceptual model of contaminant transport, and an evaluation of the potential impacts to human health and the environment.

3.1 KNOWN AND SUSPECTED CONTAMINATION

Aside from recent LFI in the 100-DR-1 and 100-HR-3 Operable Units, the most current knowledge of radioactive contamination in the 100 Areas is based on Dorian and Richards (1978), who sampled many of the facilities in 100-DR-2 and other operable units in the 100 Areas. The most substantial potential environmental threats from the 100-DR-2 Operable Unit come from contaminants leaching from area soils into groundwater. These contaminants can subsequently be transported to the Columbia River. Because of the source and groundwater operable unit division, preliminary remedial action objectives for the 100-DR-2 Operable Unit focus on preventing further contamination of groundwater.

An important consideration throughout this discussion is that previous sampling efforts in the 100 D/DR Area have focused on characterizing radiological contamination with little or no sampling for hazardous chemical contaminants. Some historical data on the general use of organic and inorganic chemicals are available, but quantification of nonradioactive contaminant species has been minimal. The recent investigations in the 100-DR-1 Operable Unit (DOE-RL 1993a) should provide useful data to the investigations in the 100-DR-2 Operable Unit, especially in regards to the analogous facility approach. The data will be reviewed and incorporated as appropriate.

Much of the available data related to the 100-DR-2 Operable Unit are presented and evaluated in Chapter 2; therefore, the goal here is to describe the contaminants of concern as a whole, based on information presented in Chapter 2. However, data investigation and evaluation will be conducted as part of the LFI. Data from the 100 D/DR Area source data compilation will be used as appropriate and supplemented with new information generated by the 100-DR-2 investigations. Groundwater, surface water, river sediments, and biota investigations can be referenced in, Sections 3.1.3, 3.1.4, and 3.1.6, respectively, of the 100-HR-3 Operable Unit work plan (DOE-RL 1992a). Air investigations can be referenced in Section 3.1.5 of the 100-DR-1 Operable Unit work plan (DOE-RL 1992b).

3.1.1 Sources

The 100-DR-2 Operable Unit includes sources generated from the operation of the DR Reactor and its ancillary facilities. These sources have been described in Section 2.1.3, and the waste generating processes have been described in Section 2.1.4. Figure 2-2 shows the approximate location of the waste units (116-D-8, 116-DR-3, 116-DR-4, 116-DR-6, 116-DR-7, 116-DR-8, 132-DR-1, 118-D-5, 126-DR-1, Sodium Dichromate Tanker Car Off-Loading Facility, 1607-D-3, 118-DR-2, 132-DR-2). Facilities (existing and demolished) that are not considered potential waste units: 1702-DR, 183-DR, 190-DR, 151-D, 126-DR-1, 122-DR-1 (122-DR-1 is being addressed under the RCRA program), are also shown on Figure 2-2.

A primary reference for radiological characterization of the 100-DR-2 Operable Unit sources is a sampling study of the 100 Areas performed during 1975/1976 by Dorian and Richards (1978), which has served as a reference document for the HRS evaluation of the Hanford Site (Stenner et al. 1988), the WIDS database (WHC 1991a) maintained by the WHC, and this work plan. It should be noted, however, that only concentrations and inventories of selected radionuclides were reported in the 1975/1976 study. In particular, nickel-63, which is generally present at activities on the same order of magnitude as cobalt-60, was reported for only some samples; and daughter product radionuclides of strontium-90 and cesium-137 were not included in summaries of total activity.

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3.1.2 Soil

Except for routine process effluent, most wastes generated during operation of the DR Reactor were intentionally disposed into the 100-DR-1 and 100-DR-2 Operable Unit soils. In addition, the piping associated with the process effluent system is known to have leaked into soils of the 100 D/DR Area.

3.1.2.1 Background Soil Quality. There are no background soil data available specifically for the 100-DR-2 Operable Unit. However, a Low Background survey was conducted to establish baseline radiological background conditions in a designated test plot adjacent to the 100 D Area. The radiological data collected during this survey is considered representative of the undisturbed soil surfaces in the 100 Areas of the Hanford Site. Surface soil samples are collected periodically at a number of locations to determine the extent of contamination both on and off the Hanford Site as part of the Hanford Environmental Monitoring Program and the analytical results can be found in the *Environmental Monitoring at Hanford for 1987* (Jaquish and Mitchell 1988) and the *Hanford Site Environmental Report for Calendar Year 1989* (Jaquish and Bryce 1990). These samples are of limited utility because they do not provide subsurface soil data, are only analyzed for a limited range of radionuclides, and are purposely located in areas where radionuclide levels are most easily detected. Onsite samples are collected at locations adjacent to major operating facilities, whereas offsite samples are collected around the Hanford Site perimeter, generally in a downwind direction. Because of the intentional proximity to operating facilities, onsite samples may not be regarded as providing an adequate background concentration reference point. Figure 3-1 shows the locations of these sampling stations. Data from both onsite and offsite samples collected in 1988 are presented in Table 3-1. A background soil study was conducted, *Characterization and Use of Soil and Groundwater Background for the Hanford Site* (Hoover and LeGore 1991) that analyzed soil samples for inorganic constituents. The results of that study are available in Table 3-1 of that report.

The composition of naturally occurring soils in the vadose zone of the Hanford Site has been determined for nonradioactive inorganic and organic analytes in accordance with EPA analysis methods. This work is in support of the Tri-Party Agreement Milestone M-28-00, which states "Submit all soils and groundwater background determination documents to EPA and Ecology."

As a result of the background samples analyzed, comparisons for the correlation coefficient (goodness of fit) and several percentiles (80, 90, and 95), as well as the upper tolerance intervals associated with each percentile, have been formulated. The 95% upper threshold limit (UTL) for inorganic analytes from a lognormal distribution of the data are presented in Table 3-2.

3.1.2.2 Soil Contamination. One surface soil sampling station located outside the southwestern margin of the 100 D/DR Area is sampled as part of the Pacific Northwest Laboratory (PNL) environmental monitoring program at the Hanford Site (Jaquish and Mitchell 1988). Samples analyzed for gamma-emitting radionuclides (uranium, strontium-90, and plutonium-239/240) show, in general, radionuclide concentrations that are low when compared to onsite average concentrations, but are higher than offsite concentrations.

3.1.3 Groundwater

A substantial amount of information is available on the quality of the groundwater in the 100 D/DR Area. The known nature and extent of groundwater contamination in the vicinity of the 100-DR-2 Operable Unit is discussed in detail in Section 3.1.3 of the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a).

3.1.4 Surface Water and Sediment

The known and suspected nature and extent of contamination in the Columbia River water column and sediment are discussed in Section 3.1.4 of the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a). These areas of concern, as well as specific runoff events that may have caused potential sources of contamination, will be investigated during the LFI for the 100-HR-3 Operable Unit.

3.1.5 Air

Current releases of contamination into the air from 100-DR-2 could only be from fugitive dust from contaminated areas of the operable unit. Air quality investigations and contamination are discussed in greater detail in Section 3.1.5 of the 100-DR-1 Operable Unit work plan (DOE-RL 1992b).

3.1.6 Biota

Information pertaining to contamination of terrestrial biota exclusive of the riparian zone is presented in Section 3.1.6 of the 100-DR-1 Operable Unit Work Plan (DOE-RL 1992b). Information regarding contamination of aquatic biota in the Columbia River and the riparian zone from releases of hazardous substances from the 100-DR-2 Operable Unit is presented and evaluated in Section 3.1.6 of the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a).

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3.2 POTENTIAL CORRECTIVE ACTION REQUIREMENTS (CAR)

Corrective action at the 100-DR-2 Operable Unit is required to comply with federal and state environmental laws and promulgated standards, requirements, criteria, and limitations that are legally applicable or relevant and appropriate under the circumstances presented by the release or threatened release of hazardous substances, pollutants, or contaminants. As stated in Chapter 1.0, cleanup of the 100-DR-2 Operable Unit will be addressed under the RCRA corrective action authority. Cleanup requirements for RCRA corrective actions (40 Code of Federal Regulations [CFR] 264.100) are not as fully documented as are those for remedial actions under CERCLA. The EPA has, however, identified groundwater protection standards for RCRA corrective actions, and has stated that other "relevant and applicable standards for the protection of human health and the environment" are to be identified in the RFI/CMS process.

Because the investigations described in this work plan are intended to aid in the definition of contaminant characteristics in the 100-DR-2 Operable Unit, the initial CAR cover a wide scope. Corrective action requirements are presented in Section 3.2 of the 100-DR-1 Operable Unit Work Plan (DOE-RL 1992b). The contaminant-specific requirements addressing currently known or suspected contaminants that may be present in the 100-DR-2 Operable Unit are the same as those listed in Section 3.2.1.1 and 3.2.1.2 of the 100-DR-1 Work Plan (DOE-RL 1992b).

3.3 POTENTIAL IMPACTS TO PUBLIC HEALTH AND THE ENVIRONMENT

This section presents a conceptual model of exposure pathways. Information on waste sources, pathways, and receptors is used to develop a conceptual understanding of exposure pathways for evaluation of potential risks to human health and the environment.

This preliminary assessment is based on current land and water use, which is commercial/industrial use, in the 100-DR-2 Operable Unit. This is appropriate because DOE is currently maintaining active institutional controls of the Hanford Site and intends on doing so for the foreseeable future. However, the possibility and consequences of future residential, agricultural, commercial/industrial, or recreational land uses may need to be considered for determining potential risk to receptors under these scenarios. The methodology for conducting both a qualitative and baseline risk assessment for future potential land use scenarios has been developed, *Hanford Site Baseline Risk Assessment Methodology* (DOE-RL 1993b).

3.3.1 Conceptual Exposure Pathway Model

Based on information presented thus far, a preliminary conceptual model of potentially significant contaminant exposure pathways for the 100-DR-2 Operable Unit was developed. This model, which focuses on the current understanding of the operable unit, is presented in Figure 3-2. The model also includes media (i.e., groundwater, surface water and sediments, and aquatic biota) that will be specifically investigated under the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a).

The purpose of the conceptual model is to present hypotheses of operable unit-specific contaminant exposure pathways. During the RFI, the conceptual model hypotheses will be tested and refined in an iterative manner until the understanding of the operable unit is sufficient to support subsequent decisions regarding remedial action. By conducting the RFI in an iterative manner, the project becomes more efficient because the investigation remains in focus with operable unit-specific objectives.

Risk assessments and sensitivity analyses are two methods of testing and refining the conceptual model. Computer codes used in the risk assessment will be determined based on the site-specific modeling requirements identified during the RFI. Computer codes for risk assessment are identified in the Appendix of the Hanford Site Baseline Risk Assessment Methodology (HSBRAM) (DOE-RL 1993b).

Each exposure pathway must contain the following for there to be potential impact on human health or the environment:

- a contaminant source
- a contaminant release mechanism
- an environmental transport medium
- an exposure route
- a receptor.

3.3.1.1 Sources. Primary contaminant sources at 100-DR-2 include decommissioned and active facilities, trenches, cribs, french drains, septic tanks, burial grounds, and unplanned releases.

Soils at the 100-DR-2 Operable Unit may serve as a secondary contaminant source. Once a release to the environment occurs, contaminants can be bound in soils before being slowly re-released or they can be directly encountered by intrusion. Soil is indicated in Figure 3-2 as a secondary contaminant source.

Preliminary information on each of the operable unit waste facilities and their associated contaminants is presented in Section 2.1.3. Waste inventories have been estimated for some sources, where data are available. Groundwater, surface water, and river sediments are addressed through the 100-HR-3 Operable Unit work plan (DOE-RL 1992a).

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3.3.1.2 Release Mechanisms. Release mechanisms can also be divided into primary and secondary categories. A primary release is one from a primary contaminant source, such as a release from a septic tank's drainage field to the soil; a secondary release is one that occurs for example, from the contaminated soil to the groundwater.

Process effluent at the 100-DR-2 Operable Unit are known to have infiltrated, intentionally and unintentionally, into the soils surrounding the various process effluent transfer, treatment, and disposal facilities. As indicated in Figure 3-2, the most significant of these release mechanisms at the 100-DR-2 Operable Unit is infiltration, and the most substantial contributions are from process effluent and fuel fabrication wastes. Although the reactor is no longer generating process effluent, past discharge of water contaminated with immobile substances could be a significant source of present contamination.

The most significant release mechanism from the secondary soil sources is desorption of the contaminants from the soil matrix, and infiltration to groundwater. Other potential mechanisms that could be significant are fugitive dust generation from dry, contaminated surface soils, and dispersion of such soils by wind or overland flow during precipitation events.

3.3.1.3 Environmental Transport Media. Contaminants in the soil can be transported to the surface by burrowing animals or possibly plant root uptake. Contamination could then migrate through wind transport dispersion. Biota may be a transport medium through ingestion, absorption or carrying contaminants lodged in fur. Contaminants can infiltrate the soil column and eventually reach the groundwater, which in turn, transports the contaminants to the Columbia River. The Columbia River also serves as a transport medium for these contaminants, as well as those introduced directly into the river.

3.3.1.4 Exposure Routes. Receptors can be exposed to contaminants through the following routes:

- inhalation of contaminants in the ambient atmosphere
- absorption of soil contaminants (for plants) or ingestion of contaminated materials and biota (for animals and humans)
- direct contact with contaminated media, including external radiation exposure from radionuclides.

3.3.1.5 Receptors. Receptors are organisms that have the potential for exposure to the released contaminants. Figure 3-2 divides this component of the pathway into humans and biota.

Because of the absence of nearby residences, the most likely potential for current human exposure to the 100-DR-2 Operable Unit contaminants is to onsite workers. Because most of the contamination is buried beneath the ground surface, the workers who could have the greatest potential exposure are those who will be involved in collecting environmental samples for this project.

The most likely point of contact for terrestrial animals (especially burrowing animals) is exposure by direct contact, inhalation, and ingestion of contaminated soil, water, plants, and animals. Terrestrial plants may be exposed in the root zone, where they could absorb buried contaminants or reach contaminated groundwater in the riparian zone. The likely exposure points in the aquatic environment are covered in Section 3.3.1 of the 100-HR-3 Operable Unit work plan (DOE-RL 1992a).

3.3.1.6 Summary. Preliminary evaluation suggests that the most probable primary sources of contaminant releases to the 100-DR-2 Operable Unit environment are the process effluent disposal facilities. Although some process effluent from the 100 D/DR Area were discharged directly to the Columbia River, the highly contaminated effluent discharged to the 116-DR-3 Storage Basin Trench, 116-DR-7 Inkwell Crib, and the Sodium Dichromate Tanker Car Off-Loading Facility were disposed directly into the soil column. The current mechanism of contaminant release is through infiltration into the underlying groundwater from contaminated soils near the 100-DR-2 Operable Unit facilities. This groundwater eventually discharges into the river, where it can contaminate the sediments and has the potential to impose adverse impacts upon local biota, with possible food-chain effects on humans offsite. The conceptual exposure pathway model will be tested and refined during the RFI as additional data provide a better understanding of the operable unit.

3.3.2 Preliminary Identification of Contaminants of Concern

With the variety of waste types known to have been used and disposed of in the 100-DR-2 Operable Unit, it becomes necessary to focus on those that pose a potential threat to human health or the environment. The focus will be on those contaminants that are characterized by the following:

- present in the greatest quantity
- most hazardous
- most persistent in the environment
- found at elevated levels in the environment.

The information provided will be used for preliminary identification of operable unit contaminants of concern.

3.3.2.1 Quantity. One means to focus on those contaminants of greatest concern is to identify those contaminants that are potentially present in the greatest quantity. It should be noted that most of the quantities of waste disposed of are unknown and that waste inventories are not available for many of the compounds that may have been disposed within the 100-DR-2 Operable Unit. No disposal data are presently available for any organic compounds that may have been used at this site.

3.3.2.2 Hazard. The hazard of a contaminant is generally associated with toxicity. The definition of hazardous is basically waste that may cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment.

The primary constituents that would be present following the dissociation of acids or soluble salts include sodium, sulfate, fluoride, and chloride ions and chromium (VI). Sodium and chloride ions are considered essentially nontoxic to humans under most environmental conditions, but may influence the salinity of groundwater or surface water. Sulfate toxicity is minimal and ingestion is commonly associated with mild gastrointestinal effects. Fluoride may have beneficial effects at low levels but higher levels are associated with toxic human effects.

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Chromium (VI) exhibits significant environmental or human toxicity that will be considered in the baseline risk assessment. Chromium (VI) is classified as an EPA Class A human carcinogen by the inhalation route; however, there is no evidence that chromium (VI) is carcinogenic from oral exposure (EPA 1991a). Systemic toxic effects include respiratory irritation and allergic reactions, *Quality Criteria for Water 1986* (EPA 1986). Chromium (III) can also exhibit toxic effects although not as severe as chromium (VI). Chromium (VI) is toxic to aquatic organisms. Ambient water quality criteria for the protection of freshwater organisms are: acute, 16.0 μg/L, and chronic, 11.0 μg/L (EPA 1986).

Cadmium may also exhibit significant environment or human toxicity. Cadmium accumulates in the kidney tissue and contributes to progressive renal damage that may result in renal failure. Occupational inhalation exposures to cadmium have been associated with lung damage and possibly lung and prostate cancer. Cadmium is classified as EPA Class B1 carcinogen by the inhalation route (EPA 1991a). Ambient water quality criteria are dependent on water hardness (EPA 1986).

Lead is a cumulative toxin producing symptoms that range from mild blood enzyme changes to severe neurological disease. Effects from lead exposures may be so subtle as to be without a threshold, and the EPA currently does not recommend quantitative evaluation of health effects associated with the lead exposures (EPA 1991a). Lead is classified as an EPA Class B2 carcinogen (EPA 1991a). Ingestion is a primary route of exposure. Ambient water quality criteria for lead are dependent on water hardness (EPA 1986).

Toxicity associated with mercury is highly dependent on the chemical form (inorganic, organic, elemental) and the route of exposure. Toxic effects include central nervous system damage with chronic exposure to inorganic mercury; exposure to organic mercury compounds can produce kidney disease, central nervous system effects, and birth defects. Inorganic forms of mercury can be methylated in sediments, in fish, and in the food chain for fish. Ambient water quality criteria for the protection of freshwater organisms are: acute, 2.4 μg/L, and chronic, 0.12 μg/L.

Polychlorinated biphenyls are of environmental and human concern because they are persistent and bioaccumulate. The primary toxicity associated with human occupational exposures to PCB is chloracne. Animal studies suggest PCB may cause liver damage, liver cancer, and reproductive effects; however, these effects have not been confirmed in humans. Polychlorinated biphenyls are classified as an EPA Class B2 carcinogen (EPA 1991a). A 24 hour average freshwater quality criterion for PCB of 0.014 μg/L is considered protective for both acute and chronic toxicity (EPA 1986).

Asbestos, known to be present in operable unit buildings, is a known human carcinogen. Exposures to asbestos are associated with chronic lung disease (asbestosis), lung cancer, and mesothelioma (a rare and rapid fatal cancer). Asbestos is classified as an EPA Class A human carcinogen (EPA 1991a).

Nitrate is a decomposition product of nitric acid. This inorganic ion is of concern primarily because of possible human health effects. High levels in drinking water can produce problems in the oxygen transport system of the blood. Infants are particularly sensitive to this toxic effect.

The potential exposure to any of the radionuclides is toxicologically significant. The dose response functions used by EPA to estimate radiation risks (linear and linear quadratic) presume that any radionuclide exposure carries with it some associated excess cancer risk. Consequently, based on conservative assumptions, the presence of and potential exposure to any radionuclide at greater than background concentrations is presumed to introduce some excess cancer risk that must be evaluated. In light of the additive effects of the various radionuclides, all of the isotopes of concern identified during RFI activities must be considered in the baseline assessment of cancer risk.

The toxic effects of a contaminant in the environment on biological systems vary dramatically between species. Toxic substances may display effects on survival, reproduction, behavior, and physiology.

Metals such as cadmium, chromium, lead, and mercury are of concern because they may bioaccumulate. Rates of bioaccumulation vary depending on the chemical form of the metal, the metal's relationship with the local physical environment (eg., soil pH), and the species position in the food chain, as reported in *Wildlife Toxicology* (Peterle 1991). Mercury is also a neurotoxin to all organisms. Ionizing radiation can be damaging to all organisms, however, the effects depend on the level of radiation and each organism's sensitivity.

3.3.2.3 Persistence. The compounds present include corrosives, radionuclides, metals, and other persistent compounds. Corrosive acids, bases, and salts such as nitric acid, sodium hydroxide, and sodium fluoride, do not persist in the environment in their original form because they rapidly dissociate into their constituent ions once they come in contact with water. The constituent ions may pose less of an immediate environmental and toxicological concern than the parent compound; however, the ions may persist and accumulate with time in the environment, producing concern over long-term effects. For example, gradual increases in nitrate in surface waters and groundwater are linked to human health effects and environmental effects such as eutrophication of lakes. Metals such as chromium are also persistent in the environment and may pose an environmental and toxicological concern.

The environmental persistence of a radionuclide is in part directly related to the half-life of the particular isotope.

3.3.2.4 Environmental Occurrence. The environmental occurrence of contaminants at the 100-DR-2 Operable Unit can be determined empirically through the evaluation of existing 100 D/DR groundwater data. Groundwater in and adjacent to the 100 Areas is contaminated with tritium, nitrate, strontium-90, and chromium (VI). Chromium (VI) contamination resulted from widespread use of sodium dichromate and chromic acid. One potential source of nitrate is nitric acid. Although other contaminants have been identified in the groundwater within the 100 D/DR Area, it is not currently possible to assign any of these contaminants to specific 100-DR-2 Operable Unit sources. The radiological sampling efforts undertaken in conjunction with decommissioning activities have identified the radionuclides known to be present at the 100-DR-2 Operable Unit. Radionuclides have also been detected in the groundwater.

3.3.2.5 Summary of Preliminary Contaminants of Concern. The following is a list of preliminary contaminants of concern for the 100-DR-2 Operable Unit:

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Metals	Radionuclides
cadmium	tritium
chromium	carbon-14
lead	cobalt-60
mercury	nickel-63
	strontium-90
Nonmetallic Ions	technetium-99
nitrate	ruthenium-106
nitrite	iodine-129
sulfate	cesium-137
	europium-152, -154, -155
Other	uranium-235, -238
asbestos	plutonium-238, -239, -241
PCB	americium-241

This list was developed based on the types of wastes known to have been disposed of, or to have been derived from a constituent known to have been disposed of at the 100-DR-2 Operable Unit, and the contaminant characteristics presented in Section 3.3.2. The list contains metals, nonmetallic ions, and radionuclides; it does not include organic compounds with the exception of PCB. Organic compounds have not been included because data are currently unavailable on the types, locations, and quantities of organic compounds that may have been disposed of at the 100-DR-2 Operable Unit. Additional contaminants of concern may be identified when the nature of contamination is identified during the limited field sampling performed during the LFI.

3.3.3 Assessment of Need for Expedited Response Actions

Expedited response actions are either removal actions under the DOE authority of the Atomic Energy Act, removal actions under CERCLA (40 CFR 300.415), or interim measures under RCRA proposed (40 CFR 264.540). In deciding whether an ERA is appropriate, both technical engineering judgement and an evaluation of potential threat to human health and the environment are considered. The decision to conduct an ERA is based on the immediacy and magnitude of the potential threat to human health and the environment, the nature of appropriate corrective action, and the implications of deferring the corrective actions. Basically, ERA are conducted when an unacceptable health or environmental risk and a short-time frame available to mitigate the problem exist.

During the work plan scoping, DOE, Ecology, and EPA determined that ERA are not currently warranted in the 100-DR-2 Operable Unit. This determination was based in part on the conceptual exposure pathway model presented herein. The discussion in this section briefly reviews the assessment of the need for ERA, which was based on the current understanding of site conditions. The conclusions in this section are tentative, and will be subject to refinement as data are collected throughout the RFI process.

3.3.2.1 Human Health. Based on the existing environmental data discussed in Section 3.1, and the exposure pathways discussed in Section 3.3.1, the 100-DR-2 Operable Unit does not appear at this time to pose an immediate danger to human health. The conceptual exposure pathway model indicates that on-site workers are currently the most significant potential human receptor population. Essentially all of the contamination is below the ground surface, and on-site controls are sufficient to prevent contact with contaminants. Surface radiation surveys are performed annually to identify those sites with surface contamination. All areas of known surface contamination are posted. Once the RFI is completed, potential corrective action measures are reviewed and evaluated. The results of the RFI may be used as the basis to take some actions, either an ERA, an IRM, or the LFI pathway. The interim measure or in this case, the interim remedial measure may be necessary to stabilize a release and mitigate harm to human health. Intrusive field activities will be performed within the boundaries of the 100-DR-2 Operable Unit. The general considerations, requirements, procedures, and plans set forth in the Health and Safety Plan developed for remedial investigation activities at the 100-DR-2 Operable Unit (Appendix B of this work plan) will adequately cover the surface investigations proposed for the 100-DR-2 Operable Unit. The plan specifies site control and personnel monitoring procedures that will ensure the health and safety of those involved with the field portions of the project.

3.3.2.2 The Environment. Existing information and ongoing Hanford Site monitoring, as well as site access restrictions, and the exposure pathways discussed in Section 3.3.1, indicate that imminent and substantial endangerment to the environment does not exist within the 100-DR-2 Operable Unit. Essentially all of the contamination is below the ground surface.

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3.4 PRELIMINARY CORRECTIVE ACTION OBJECTIVES AND CORRECTIVE ACTION ALTERNATIVES

This section develops both interim and final preliminary corrective action objectives, general response actions, remedial technologies and process options, and a range of preliminary corrective action alternatives for each group of prioritized facilities within the 100-DR-2 Operable Unit. This evaluation is based on available site data, the QRA and the conceptual exposure pathway model that were presented earlier in this work plan. General response actions are identified and represent broad classes of corrective actions that may be appropriate to achieve corrective action objectives. Corrective action objectives may change or be refined as additional site data are gathered and evaluated during the LFI and implementation of the IRM. Recommendations are made as to the range of preliminary corrective action alternatives that will be considered and more fully developed in the FS outlined in Section 5.2 of the 100-DR-1 Work Plan (DOE-RL 1992b). In addition, the observational approach is described and incorporated throughout this section with a bias toward action through implementation of IRM. This approach and the *Hanford Site Past-Practice Strategy* (DOE-RL 1991a) are used to limit the range of corrective action alternatives that will be evaluated in the focused feasibility study, if necessary.

Overall, the Hanford past-practice RFI/CMS process is defined as the combination of IRM (including concurrent characterization), LFI for final remedy selection where interim actions are not clearly justified, and feasibility/treatability studies for further evaluation of treatment alternatives. After completion of an IRM, data including concurrent characterization and monitoring data will be evaluated to determine if a final remedy can be selected for the operable unit.

Interim corrective measures may be implemented before the land issues are resolved. The corrective action alternatives will not be limited during evaluation and implementation of IRM because of land use. If land use is later determined to require more stringent cleanup standards than required during implementation of the IRM, a final corrective action alternative based on land use will be selected.

Figure 3-3 identifies the interim corrective action objectives, the general interim response actions, the interim remedial technologies, and the process options which are discussed in the following sections. It also presents the potential conflict with CAR or future land/water use associated with each of the process options. The criteria used to determine whether conflict exists includes the extent of site contamination, type of contaminants, land use options, governing regulatory authority (state or federal), and the implications of each process option. As land use is decided, the potential for conflict may change.

3.4.1 Preliminary Corrective Action Objectives

The fundamental objective of the RFI/CMS at the 100-DR-2 Operable Unit is to protect environmental resources and/or human receptors from the threats that may exist resulting from the known or suspected contamination. Specific corrective action objectives will depend, in part, on current and potential future land use for the 100 Area and the Columbia River.

Specific interim and final corrective action objectives must consider both current land and water uses, and reasonable potential future land and water use in the 100 Area and the Columbia River. Potential future land and water use will affect the risk-based cleanup objectives, potential CAR and point of compliance. The corrective action objectives for protecting human health for residential or agricultural land use would be based on risk assessment exposure scenarios requiring cleanup to lower levels than for recreational or industrial land use. It is important that potential future land use and the corrective action objectives be clearly defined and agreed upon by the three parties, prior to further and more detailed evaluation of corrective actions. Data collection requirements and corrective actions required to meet the objectives based on a specific land use may not be consistent with objectives for other land uses.

To focus the RFI/CMS with a bias for action through implementing IRM, the following preliminary corrective action objectives are identified for the 100-DR-2 Operable Unit. These objectives are identified for both current and reasonable potential land uses:

- Reduce the risk of harmful effects to the environment and human recreational users of the area by reducing the toxicity, mobility, or volume of contaminants from the source areas to meet CAR or risk-based levels that will allow the use of the area for wildlife habitat and/or recreational use. (This is a potential final corrective action objective, and is also an interim remedial action objective based on current wildlife and recreational use on the Columbia River).

- Reduce the risk of harmful effects to human receptors by reducing the toxicity, mobility, or volume of contaminants from the source areas to meet CAR or risk-based levels that will allow residential use of the 100 Area. (This is a potential final corrective action objective, but interim actions could be implemented consistent with this objective.)

- Reduce the risk of harmful effects to livestock, food chain crops and human receptors by reducing the toxicity, mobility, or volume of contaminants from the source areas to meet CAR or risk-based levels that will allow agricultural use of the 100 Area. (This is a potential final corrective action objective, but interim actions could be implemented consistent with this objective.)

- Reduce the risk of harmful effects to onsite workers by reducing the toxicity, mobility, or volume of contaminants from the source areas to meet CAR or risk-based levels that allow industrial use of the 100 Area. (This is a potential final corrective action objective and an interim corrective action based on current land use.)

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3.4.2 Preliminary General Response Actions

General response actions which represent broad classes of corrective actions that may be appropriate to achieve both interim and final corrective action objectives at the 100-DR-2 Operable Unit are presented in Figure 3-3. The following are the general response actions, followed by a brief description for the 100-DR-2 Operable Unit:

- no action (applicable to specific facilities)
- institutional controls
- waste removal and treatment or disposal
- waste containment
- combinations of the above actions.

No action is included for evaluation as required by the NCP (40 CFR 300.68 (f)(1)(v)). No action also provides a baseline for comparison with other response actions. Finally, no action may be appropriate for some facilities and sources of contamination if the risk assessment determines that unacceptable natural resource or human health risks are not presented by those sources or facilities and that contaminant-specific CAR are not exceeded.

Institutional controls involve the use of physical barriers or access restrictions to reduce or eliminate public exposure to contamination. Considering the nature of 100-DR-2 Operable Unit and the Hanford Site as a whole, institutional controls will likely be an integral component of all interim corrective action alternatives. Many access and land use restrictions are currently in place at the site and will remain during implementation of IRM. Institutional controls may also be important for final corrective alternatives. The decisions regarding future land use at the 100 Area will be important in determining whether institutional controls will be a part of the corrective alternative, and what type of controls may be required.

Waste removal and treatment or disposal involves excavation of contamination sources for eventual treatment and/or disposal either on a small- or large-scale basis. One approach being considered for large-scale waste removal is Large-Scale Remediation (LSR), which is based on high-volume excavation using conventional mining technologies. Waste removal on a macroengineering scale would be used over large areas such as groups of waste sites, operable units, or operational areas. Waste removal on a small scale would be conducted for individual waste units on a selective basis. Waste removal could be conducted as either an interim or final corrective action.

Waste containment includes the use of capping technologies (i.e., capping and grouting) to minimize the driving force for downward or lateral migration of contaminants. Capping also provides a radiation exposure barrier and a barrier to direct exposure. In addition, these barriers provide long-term stability with relatively low maintenance requirements. Containment actions may be appropriate for either interim or final remedial actions.

Waste treatment involves the use of biological, thermal, physical, or chemical technologies. Typical treatment options include biological landfarming, thermal processing, soils washing/dechlorination, and stabilization/fixation. Some treatment technologies may be pilot tested at the highest priority facilities. Waste treatment could be conducted either as an interim or final action and may be appropriate in meeting corrective action objectives for all potential future land uses.

Combinations of the above actions may be used in several different alternatives. For example, containment actions could be used in combination with removal actions for highly contaminated areas, and institutional controls (i.e., fences and deed restrictions) to prevent disruption of the containment system.

Implementation of the general response actions will be accomplished using an observational approach. Such an approach is iterative, where each iteration results in a more refined conceptual model. Data needs are determined by the model, and data collected as a result of an action to fulfill these needs are used as additional input to the model. Use of the observational approach while conducting response actions of the 100 Area will result in the opportunity for integrating these actions with longer range objectives of final site remediation including other analogous areas. Site characterization and remediation data will be collected concurrently with the use of LFI, IRM, and pilot-scale remediation testing to apply knowledge gained to similar areas. The overall goal of this approach is convergence on a response action as early as possible while continuing to obtain valuable characterization information during remediation phases.

3.4.3 Preliminary Remedial Action Technologies and Process Options

The preliminary contaminant-specific CAR, the QRA, and the current and potential future land and water use of the 100 Area will serve as the basis for establishing target cleanup levels for remediation of each operable unit facility area. Preliminary corrective action technologies and process options associated with each general response action and corrective action objective are identified and compared with potential CAR and future land and water use in Figure 3-3. These technologies and process options may be applicable to the 100-DR-2 Operable Unit based on current available data, present knowledge of the site and individual facility units, and their associated primary contaminants of concern. Available treatment technologies are limited for radiological and hazardous waste contaminated sites.

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3.4.4 Preliminary Corrective Action Alternatives

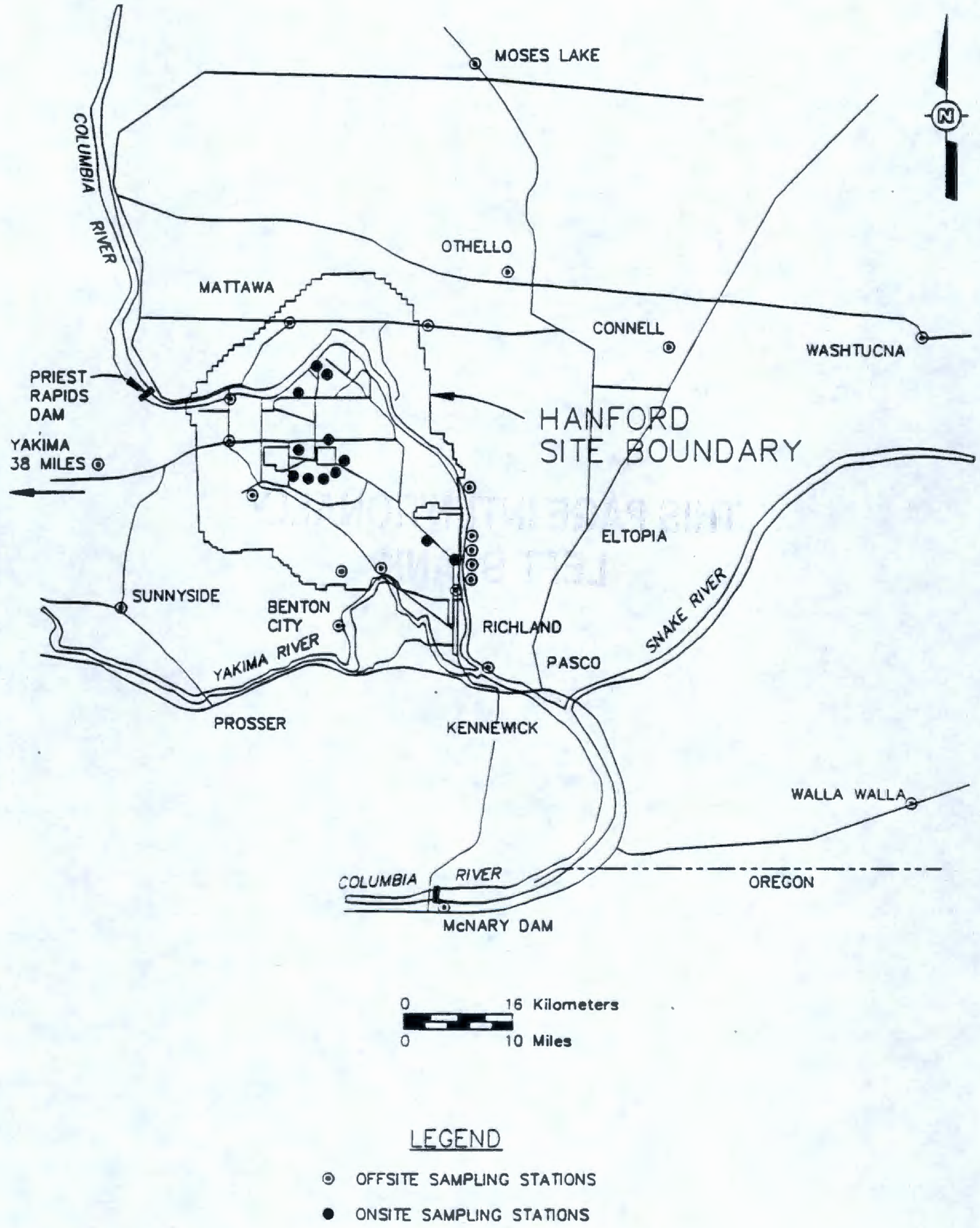
A range of preliminary interim and final corrective action alternatives will be evaluated for implementation at the 100-DR-2 Operable Unit. During the work plan rescoping efforts, the three parties have established priority waste sites where it is anticipated that an IRM will be implemented. Final selection of sites for interim action will be based on the results of LFI and the conceptual exposure pathway model and QRA. Corrective action alternatives for lower priority sites will be evaluated as part of the final remedy selection process for the operable unit record of decision (ROD).

Interim and final corrective action alternatives for waste sources in the 100-DR-2 Operable Unit would be similar for some alternatives. However, the final corrective action alternatives must meet corrective action objectives based on future land uses in the 100 Area to select a final remedy. Some interim and final corrective action alternatives may only meet specific objectives for certain land uses and may be inconsistent with other land uses. A range of alternatives will be developed for evaluation in the focused FS, and will likely include:

- alternatives emphasizing containment
- alternatives emphasizing removal
- alternatives emphasizing institutional controls
- alternative of no action.

The corrective action alternatives will be addressed and evaluated in the 100 Area FS, the focused FS, and the final FS, discussed in Section 5.2 of the 100-DR-1 Work Plan (DOE-RL 1992b). These studies may address additional alternatives or eliminate certain alternatives described above.

Figure 3-1 Background Sampling Stations for Soil and Vegetation



Source: Jaquish and Bryce 1990.

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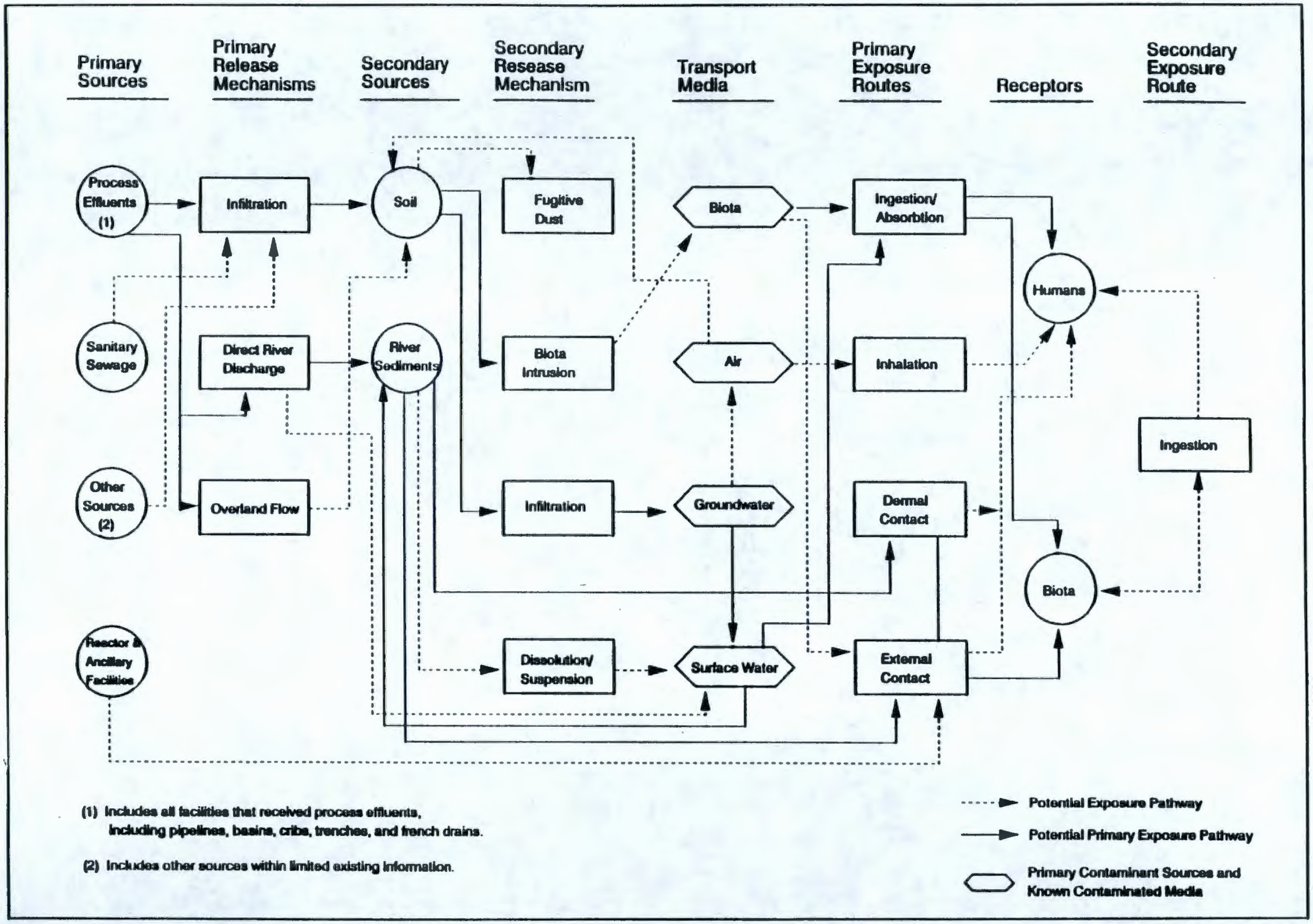

Figure 3-2 Contaminant Exposure Pathway for the 100-DR-2 Operable Unit

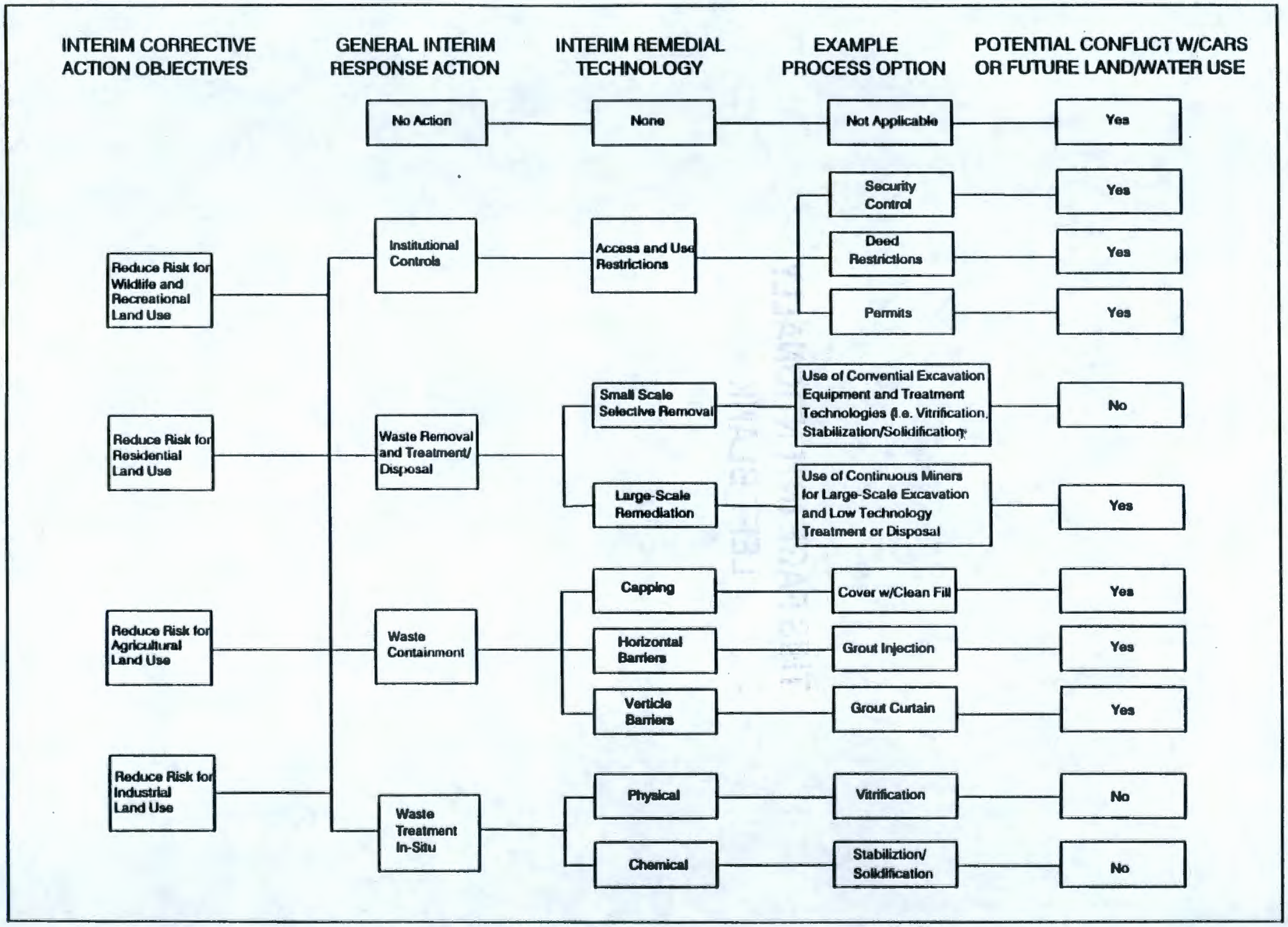

Figure 3-3 A Matrix of Preliminary Interim Response Actions, Technologies, and Process Options Available

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Table 3-1 1989 Data From Onsite and Offsite Soil Sampling Hanford Environmental Monitoring Program

	Onsite[a] Average pCi/g (dry weight[b])	Offsite[a] Average pCi/g (dry weight[b])
Strontium-90	0.25 ± .33	0.13 ± .03
Cesium-137	2.48 ± 9.90	0.74 ± .27
Plutonium-239/240	0.061 ± .296	0.013 ± .003
Uranium	0.60 ± .51	0.73 ± .13

[a] = Onsite and Offsite are as shown on Figure 3-1; numbers of onsite samples = 12; number of offsite samples = 23.
[b] = The values given after ± sign are two standard errors of calculated mean.
Source: Adapted from Jaquish and Bryce 1990.

Table 3-2 Hanford Site Background Summary Statistics and Upper Threshold Limits (UTL) for Inorganic Analytes

Analyte	95% Dist[a] (mk/kg)	95% UTL[b] (mg/kg)	Analyte	95% Dist[a] (mg/kg)	95% UTL[b] (mg/kg)
Aluminum	13,800	15,600	Silver	1.4	2.7
Antimony	NR*	15.7[c]	Sodium	963	1,290
Arsenic	7.59	8.92	Thallium	NR*	3.7[c]
Barium	153	171	Vanadium	98.2	111
Beryllium	1.62	1.77	Zinc	73.3	79
Cadmium	NR*	0.66[c]	Molybdenum	NR*	1.4[c]
Calcium	20,410	23,920	Titanium	3,020	3,570
Chromium	23.4	27.9	Zirconium	47.3	57.3
Cobalt	17.9	19.6	Lithium	35	37.1
Copper	25.3	28.2	Ammonia	15.3	28.2
Iron	36,000	39,160	Alkalinity	13,400	23,300
Lead	12.46	14.75	Silicon	108	192
Magnesium	7,970	8,760	Fluoride	6.4	12
Manganese	562	612	Chloride	303	763
Mercury	0.614	1.25	Nitrite	NR*	21[c]
Nickel	22.4	25.3	Nitrate	96.4	199
Potassium	2,660	3,120	Ortho-phosphate	3.7	16
Selenium	NR*	5[c]	Sulfate	580	1,320

NOTES:
* = Not reported
[a] = 95th percentile of the data for a lognormal distribution.
[b] = 95% confidence limit of the 95th percentile of the data distribution.
[c] = Limit of detection.
adapted from Hoover and LeGore (1991)

4.0 RATIONALE AND APPROACH

The RFI/CMS is the method by which risks are characterized and corrective action alternatives are evaluated. There are specific data quality objectives (DQO) and data needs that must be identified prior to designing a data collection program. The data collected are used as a basis for making an informed risk management decision regarding the most appropriate corrective action. The data needs and DQO are based in part, on the Hanford Site Past-Practice Strategy (DOE-RL 1991a) described in Section 1.1. This strategy and the scoping effort of the EPA, DOE and Ecology emphasize a bias for action, by quickly and efficiently implementing ERA and IRM, to achieve cleanup at high priority areas of contamination. The three parties did not identify any candidate sites within this operable unit for conducting ERA (during the scoping effort). Several sites have been identified as potential candidates for conducting an IRM. Some sites require additional data or information to be collected through LFI. Either way, the sites are IRM candidates. All sites are subject to a QRA. The three parties also recognize the need to more closely integrate source and groundwater operable unit investigations and remediation, and acknowledge that some environmental media should be investigated on an aggregate area basis.

To implement this strategy, data are needed for specific waste sources, groundwater contaminant plumes and contamination of other environmental media to refine existing conceptual models and to conduct a QRA. Data are also needed to complete a quantitative baseline risk assessment and select a final remedy for the overall operable unit and the 100 Area NPL Site, respectively. Some of these data will be collected during the 100-DR-1 and 100-HR-3 LFI, and other data can be collected as needed when implementing the IRM or preparing the final CMS. Section 4.1 describes the DQO for all these data needs and indicates whether data will be obtained during source, groundwater, or aggregate area investigations. The approach for collecting, analyzing, and evaluating these data is presented in Section 4.2. The approach presented here is in general terms; the specific RFI/CMS tasks are described in Chapter 5.0.

4.1 DQO PROCESS

The central rationale for undertaking RFI at the 100-DR-2 Operable Unit is to develop needed data that are lacking in the available information. The amount and quality of available information are not adequate to quantify the risk posed by the operable unit and to complete the CMS.

The rationale for the technical approach presented in this RFI/CMS work plan is based on two concepts. First, every activity and effort of the RFI field program shall be justified by producing data for one or more of the following project purposes:

- Confirm or revise the conceptual models for specific waste sites/areas of contaminated environmental media for the operable unit and aggregate area.

- Support a QRA.
- Support development and evaluation of IRM for individual waste sites, groups of sites or areas of environmental contamination.
- Support the quantitative baseline risk assessment for the operable unit.
- Support the CAR evaluation.
- Support the development, evaluation, and selection of a final remedial alternative.

Second, a streamlined approach with a bias-for-action will be followed through the use of LFI. This approach will focus on obtaining data sufficient to implement IRM and will use the observational approach during implementation of the remedy to reduce the amount of data required to initiate cleanup. The emphasis in this work plan is on describing those data that will be obtained at high-priority areas of contamination to determine whether to implement IRM. However, general data needs for the quantitative risk assessment and final remedy selection are also addressed. Other secondary data uses include, health and safety planning, and environmental monitoring during the implementation of a remedial action.

The methods used to identify data uses and needs can be referenced to Section 4.1.1 of the 100-DR-1 Operable Unit work plan (DOE-RL 1992b) or Data Quality Objectives for Remedial Response Activities (CDM Federal Programs Corporation 1987). The three elements of the DQO process are: (1) the identification of data users, (2) identification of data uses and needs, and (3) data collection program design.

4.1.1 Data Users

The primary data users will be the decision makers identified in the Tri-Party Agreement. These are the DOE, the EPA, and Ecology. Additional primary data users will be any technical lead organization responsible for the RFI/CMS tasks as directed by DOE, EPA, and Ecology. Secondary data users include the support groups within the technical lead organization who may utilize the data for activities not necessarily associated with this investigation (i.e., Geosciences for site-wide modeling). Other potential data users include technical support groups who provide input through the review process described in environmental investigation instruction (EII) 1.9 of the *Environmental Investigations and Site Characterization Manual* (WHC 1988).

4.1.2 Identification of Data Uses and Needs

The second element of the DQO process is the identification of data uses and needs. The determination of data uses and needs is supported by evaluation of available data, and development of an operable unit conceptual model. These are presented in

Chapters 2 and 3 of this work plan. The data that have been reviewed are the basis for prioritizing sites for conducting LFI, which may lead to IRM. Historical data were discussed at scoping meetings with the DOE, EPA, and Ecology to develop the final strategy for each site. The information has also been used to help determine what additional data must be obtained.

The data types needed to support the decision making process are outlined below:

- location, disposal history, and construction of all identified and newly discovered contaminant sources (100-DR-2 Operable Unit)
- quantity, nature, and extent of contamination in surface soils, the vadose zone and aquifer matrix, especially from disposal of radioactive and nonradioactive liquid wastes in the cribs and trenches
- geochemical, geologic, and physical characteristics of the vadose zone, especially in relation to the fate and transport of contaminants from waste sites in the groundwater (100 Area source operable units and 100 Area aggregate investigations)
- an understanding of the relationship between water-table fluctuations (especially related to fluctuations in levels in the Columbia River) and release and transport of contaminants from the lower vadose zone and capillary fringe to groundwater (100-HR-3 Groundwater Operable Unit and 100 Area aggregate investigations)
- the nature and geometry of the hydrologic system, including the thickness, areal extent, and intrinsic properties (e.g., hydraulic conductivity) of the various hydrostratigraphic units (100-HR-3 Groundwater Operable Unit and 100 Area aggregate investigations)
- horizontal and vertical gradients in contaminated hydrostratigraphic units (100-HR-3 Groundwater Operable Unit)
- information on the nature of contamination in water emanating from seeps and springs along the shoreline of the Columbia River in the 100 Area, and the nature and extent of contamination in seep and spring sediments and adjacent river water (Surface Water/Sediment Investigations for the 100 Area, Appendix D-1 of the 100-HR-3 Operable Unit work plan)
- information on the nature and extent of contamination in the terrestrial, riparian and aquatic biota adjacent to and in the vicinity of the 100 H Area (100 Area aggregate investigations)
- information on the potential for airborne contamination from fugitive dust (100-DR-1 Source Operable Unit)

- information on the groundwater recharge and discharge, and contaminant transport from offsite sources to the 100 H Area (100-HR-3 Groundwater Operable Unit and 100 Area aggregate investigation)

- the impact of fluctuations in river stage on shallow groundwater flow (100-HR-3 Groundwater Operable Unit).

Table 4-1 is a summary of the data needs for the 100-DR-2 Operable Unit. If additional data are needed at the completion of the LFI to evaluate IRM, additional data may be collected as part of the focused FS.

The quality of the data needed is defined by sampling and analysis protocols outlined in the QAPjP (Appendix A). The quantity of data needed is difficult to define at the LFI stage. The goal is to obtain sufficient data to identify the nature and vertical extent of contamination. The final quantity of data obtained will be dependent on information from analogous facilities, and information collected by employing the observational approach in the investigations. The specific analytical requirements related to precision and accuracy parameters are detailed in Appendix A (Table QAPjP-1).

The DQO specific to the LFI program for 100-DR-2 are shown on Table 4-2. These data types were developed from the list of preliminary contaminants of concern. The minimum analytical detection limits were selected as one-tenth of the 10^{-6} risk-based exposure level for ingestion of the particular contaminant. The 10^{-6} risk-based exposure level was calculated using the HSBRAM (DOE-RL 1993b).

In addition to the data types shown in Table 4-2, geologic descriptions, soil types, and contamination physical position(s) are necessary to support the data uses. This information is obtained through standard geologic description methods described in the QAPjP.

Precision and accuracy results from the laboratory will be compared with those identified for the particular analytical method employed. Sampling representativeness is controlled by the sampling program for the particular site. At the 100-DR-2 limited field sampling sites, samples will be selected for analysis through screening, with a bias for sending contaminated samples to the laboratory for analysis. The target for completeness for the analysis is set for 70% of the requested analytes for each sample submitted. Comparability will be judged by whether or not the precision and accuracy goals are met and how well the data collected from the limited field sampling compares with historical data from the same horizon.

4.1.3 Design of Data Collection Program

The final element of the DQO process consists of the design of a data collection program. The associated QAPjP provides the mechanism by which the data collection program is implemented, controlled, and documented.

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4.2 INVESTIGATION STRATEGY

The overall approach to the 100-DR-2 Operable Unit investigation is based on the Hanford Past-Practice Strategy (DOE-RL 1991a) and is described in Chapter 1.0. In particular, this strategy recognized that to expedite the ultimate goal of cleanup, much more emphasis needs to be placed on initiating and completing waste site cleanup through interim measures.

4.2.1 Hanford Site Past-Practice Strategy

The three parties have agreed to a streamlined approach to past-practice sites at the 100 Area that is intended to maximize efficiency, maintain project schedules, and achieve earlier remedial action. Figure 4-1 is a decision flow chart that shows the streamlined Hanford Site RI/FS (RFI/CMS) process.

Following the agreement on the past-practice strategy, the three parties rescoped the initial 100 Area work plans with a bias toward interim remedial action, and with the initial focus of the limited intrusive investigations placed on the highest-priority waste sites within each operable unit. The collective knowledge and judgement of the three parties and the information contained in the existing work plan were used to identify the high-priority waste sites and the paths to be followed to implement the new, streamlined strategy. The decisions made during joint meetings with the three parties were documented by meeting minutes that are part of the administrative record.

The near-term strategy agreed to by DOE, EPA, and Ecology for the 100 Area source operable units focuses on two preferred decision making paths which will lead to interim remedial measures:

- Limited field investigations will be performed at high-priority waste sites where only limited data are needed to make decisions for conducting an IRM.

- Interim remedial measures have been determined appropriate along the IRM path, without additional field investigations at waste sites where existing data are considered sufficient to indicate that the site poses a risk through one or more pathways, based on information in existing work plans, data collected from analogous facilities, and the collective knowledge of the three parties.

The 100-DR-2 Operable Unit Work Plan approach described below focuses on these preferred decision-making pathways.

4.2.2 Investigation Strategy for the 100-DR-2 Operable Unit

This work plan describes the approach for implementing the past-practice strategy for currently identified contaminant sources at the 100-DR-2 Operable Unit. Investigations at the low-priority sites will be deferred for long-term action for the final remedy selection process (see Table 4-2), as deemed necessary.

Table 4-3 lists the 100-DR-2 facilities to be addressed by the past-practice investigation strategy, the facilities to be deferred to decommissioning, and facilities to be deferred to the final remedy selection. The table also describes, in general terms, the number and location of boreholes where limited intrusive field investigations are to be performed to define the nature and vertical extent of contamination, and lists those facilities for which the three parties have determined sufficient data exists that an IRM is appropriate without further field investigations. At these sites, further characterization will be performed concurrently with remediation, using the observational approach. Figure 4-2 shows the IRM selection process.

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Options for contingencies have also been developed as part of the past-practice strategy, which include:

- Perform treatability studies or technology demonstrations at selected facilities and use data from analogous 100-DR-2 Operable Units or 100 Area facilities; the decision as to which waste sites will ultimately be selected as candidates for these studies must be agreed upon by the three parties at future unit managers meetings.

- Collect additional data during a focused FS.

- Defer a waste site to the final remedy selection process.

Details on facilities within the 100-DR-2 Operable Unit and proposed investigations are listed in Table 4-3. Proposed investigations shown on Table 4-3 may require modifications as data are collected and evaluated from other 100 Area analogous sites. Changes of scope to the investigative strategy and LFI described in this work plan will be documented by minutes in the monthly unit managers meetings.

4.2.2.1 Investigations at High-Priority Liquid Waste Disposal Facilities. The IRM path, as shown in a logic diagram in Figure 4-3, is proposed at the following liquid waste disposal facilities in the 100-DR-2 Operable Unit:

- 116-DR-3 (105-DR) Storage Basin Trench
- 116-DR-6 (1608) Liquid Disposal Trench
- 116-DR-7 (105-DR) Inkwell Crib
- 132-DR-1 Waste Water Pumping Station.

116-DR-7 will be evaluated during the LFI by placing one vadose zone borehole through the waste site. 116-DR-3 will be evaluated during the LFI by excavating a test pit at the site. Limited field investigation geophysical surveys will be performed at the following sites: 116-DR-3, 116-DR-6, and 116-DR-7 in order to correctly locate these sites. The primary investigative activity for the remaining sites will be a review of historic records to further document the activities/usage at each site.

4.2.2.2 Investigations at Other High-Priority Sites. The LFI path leading to the IRM path, as shown in a logic diagram in Figure 4-3, is also proposed at other currently identified high-priority sites at the 100-DR-2 Operable Unit, as follows:

- Sodium Dichromate Tanker Car Off-Loading Facility
- 118-D-5 Ball 3X Burial Ground.

A test pit excavation is the proposed intrusive investigation activity for the sodium dichromate tanker car off-loading facility. Geophysical surveys are proposed for 118-D-5 to locate the site.

4.2.2.3 Sites Deferred to Final Remedy. The 126-DR-1 (190 DR Clearwell Tank Pit) and 1607-D-3 (Septic Tank and associated Drain Field) facilities have been deferred to the final remedy strategy.

4.2.2.4 Investigations at Decommissioned Facilities. Data will be reviewed for facilities already decommissioned, as shown in a logic diagram in Figure 4-4, to determine if further investigation is needed.

4.2.2.5 Investigations at Existing Facilities Proposed for Decommissioning. Investigations are not planned at facilities proposed for decommissioning, including the 118-DR-2 Reactor Building and associated fuel storage basin, and the 132-DR-2 Reactor Exhaust Stack. These facilities are deferred to the decommissioning program.

4.2.2.6 Investigations at Low-Priority Facilities. Low-priority facilities include septic tanks, electrical facilities, and support facilities where contamination is not suspected. Investigations proposed in this work plan under the past-practice strategy preliminary investigation will, in general, be limited to evaluation of existing data and a site walkover. Any field activities for low-priority sites will be deferred until the final remedy selection phase for the operable unit (see Figure 4-1). Future sampling of inactive septic tanks and placing a minimum of one shallow borehole or trench in each active or inactive tile field is recommended. The need for long-term investigations at electrical facilities will be determined by reviewing records for historic PCB equipment locations and associated possible PCB contamination, and data from analogous sites. Further investigations at support facilities where contamination is not suspected will be dependent upon the results of the site walkover and data compilation.

4.2.3 100-DR-2 Operable Unit Sampling and Analysis Approach

A primary assumption made for this work plan is that investigations can be limited in scope by employing the observational approach during implementation of interim actions. During the rescoping effort, it was agreed that limited data on the nature and vertical extent of contamination are needed for priority source areas. It was agreed that for most sites, one borehole, at a location likely to represent "worst case" conditions is sufficient to determine the nature and vertical extent of contamination. These investigations, including the number and locations of boreholes were identified in Section 4.2.1.2. Lateral extent of contamination and complete characterization is not required, as these data can be obtained either during the focused FS or during implementation of the IRM.

4.2.3.1 Source Sampling and Analysis. Depth of vadose zone borings will be based on field screening results (Section 5.1.1.5), where screening techniques are available for the contaminants expected to be present (i.e., radioactive and/or volatile organic compounds). At these sites, borings will extend to 1.5 m (5 ft) below detectable contamination to permit the collection of one sample to verify that the vertical extent of contamination has been defined. If screening continues to indicate detectable contamination to the water table, the boring will go below the water table to permit collection of at least one sample of the aquifer matrix. If screening techniques are not available or adequate relative to the criteria necessary to trace the extent of contamination, the boring will extend below the water table.

In the borings, samples will be collected at a maximum of 1.5 m (5 ft) intervals. Source samples will also be collected. For this investigation, a reduced analyte list is being used. Unless field screening results indicate the presence of volatile organics, no analysis should be performed for target compound list (TCL) contaminants. Pesticide/PCB analyses should not be performed unless there is a reason to suspect their presence. Chemical analysis will be conducted using EPA contract laboratory program (CLP) methods. Standard methods will be used for radionuclide analysis. Routine analytical detection, quantitation limits, precision and accuracy will be specified in the QAPjP. As information is obtained from initial borings, and for borings at analogous facilities, a project-specific list of analytes will be determined. The reduced analyte list for borehole sampling is shown in Table 4-4. The reduced analyte list for test pit sampling is shown on Table 4-5.

4.2.3.2 Data Validation Requirements. Validation will be done in accordance with Section 8.2 of the QAPjP (Appendix A).

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Figure 4-1 Final Remedy Selection Process

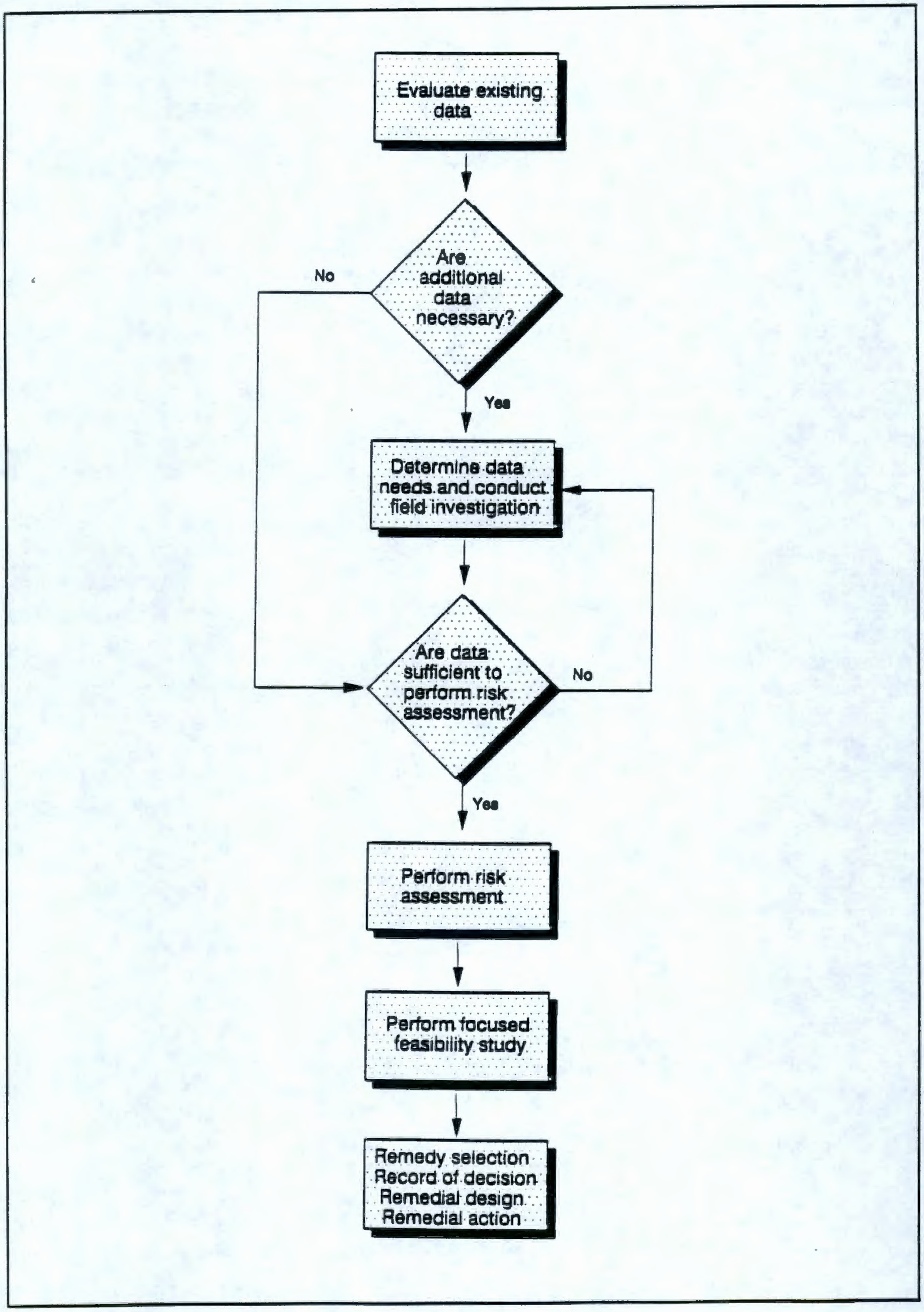

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Figure 4-2 Interim Remedial Measures Selection Process

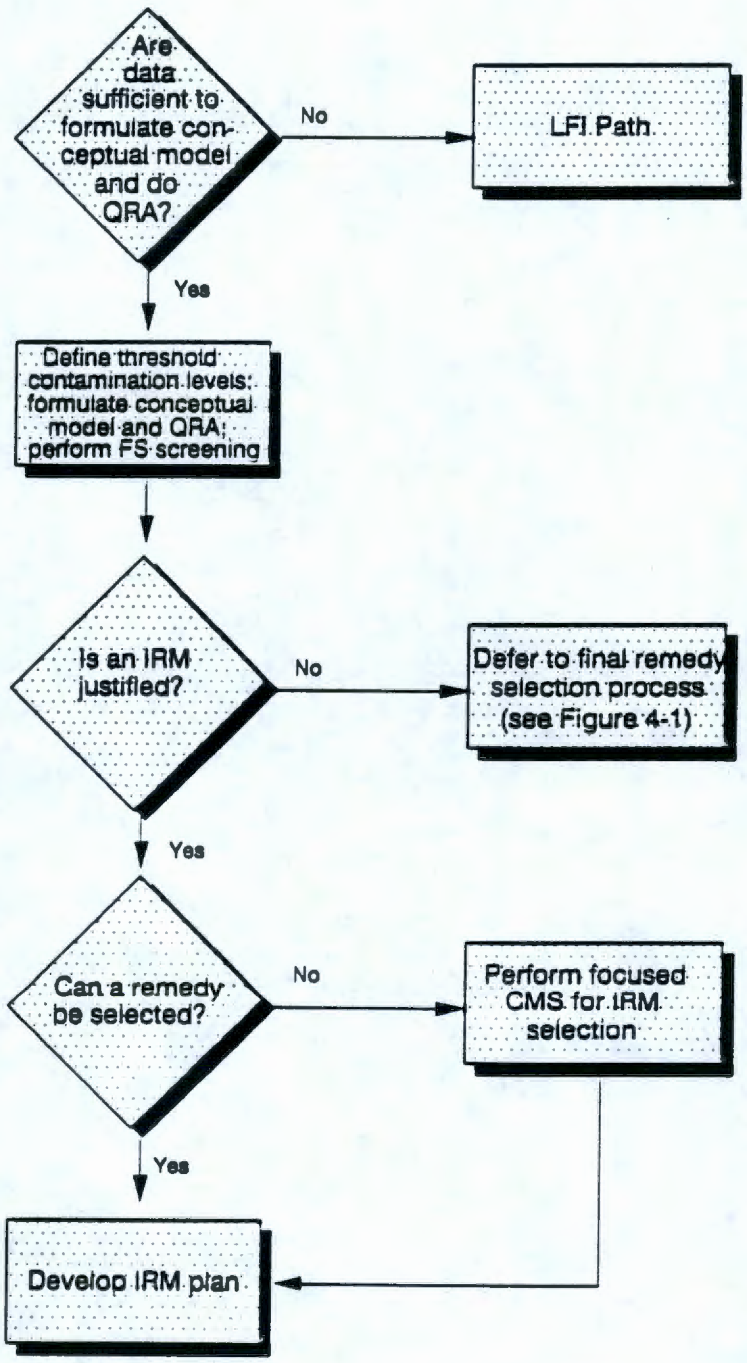

Figure 4-3 Investigations at High-Priority Liquid Waste Sites

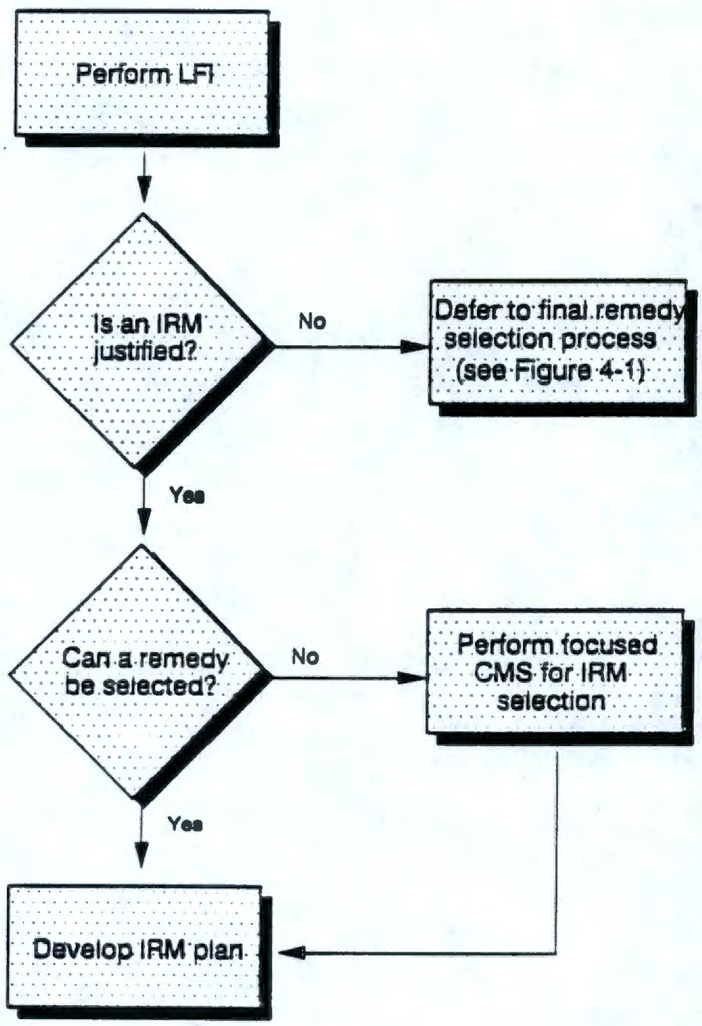

Figure 4-4 Investigations at Facilities That Have Been Decommissioned

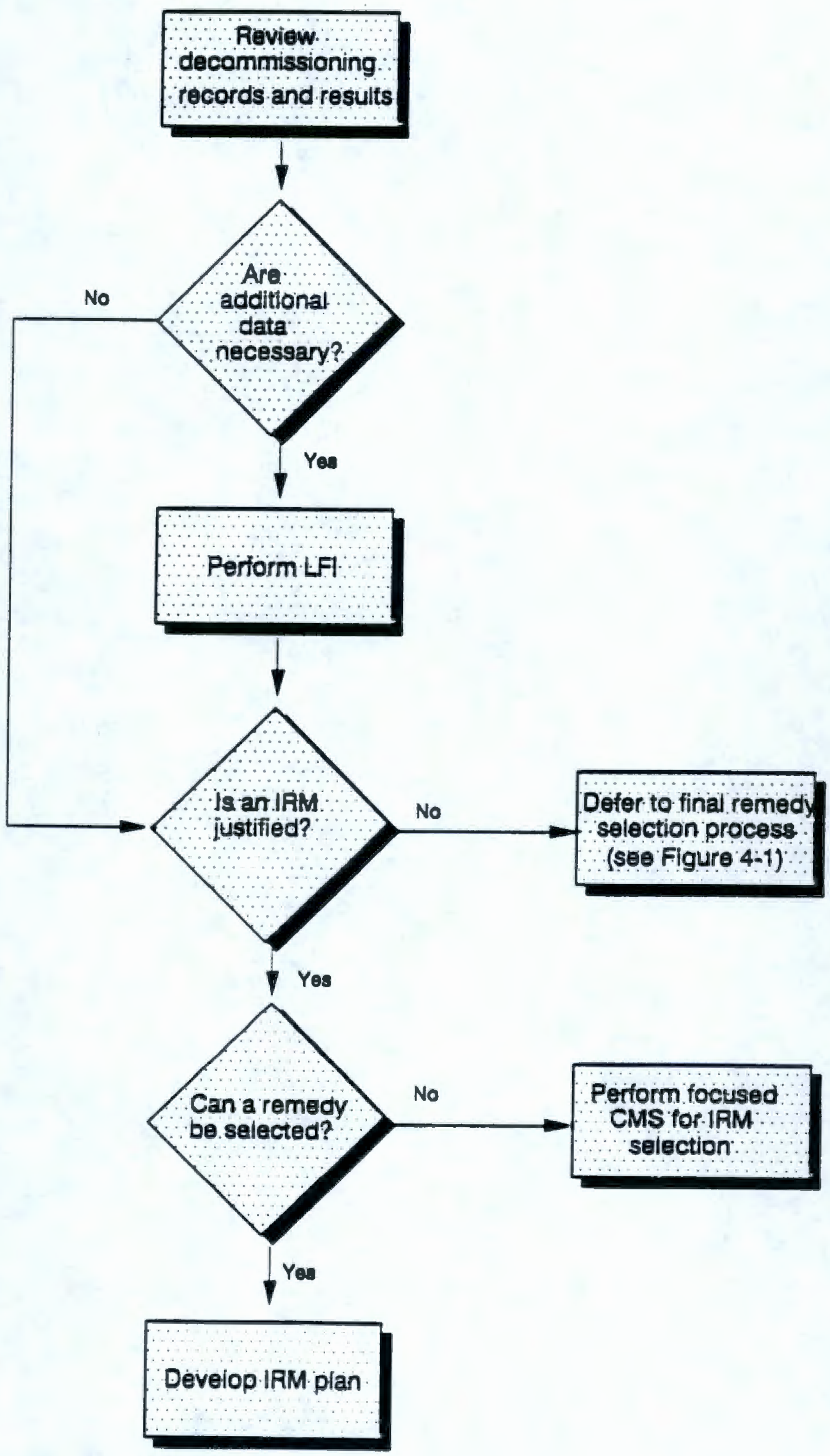

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Table 4-1 Data Needs Summary (Sheet 1 of 3)

Data Needs	Purpose of Data					
	Refine Conceptual Operable Unit Model	Conduct Quantitative Baseline Risk Assessment	Conduct Qualitative Risk Assessment	Evaluate CARs	Conduct Focused Corrective Measures Study for IRM	Conduct Final Corrective Measures Study for Operable Unit
Source Data:						
• Locations and dimensions of all contaminant sources	S	S	S	S	S	S
• Types, quantities, and concentrations of contaminant sources	S	S	S	S	S	S
• Waste chemical and physical properties	S	S		S		S
Geologic Data:						
• Geological unit thickness and areal extent	S,G	S,G		S,G		S,G
• Soil mineralogy		H			H	H
• Stratigraphic features	S,G	S,G		S,G		S,G
Vadose Zone Data:						
• Soil/sediment types (classification)	S,G	S,G		S,G		S,G
• Saturated and unsaturated hydraulic conductivity[a]	S,G	S,G		S,G		S,G
• Moisture content	S,G	S,G				S,G
• Physical properties (grain-size, distribution, and bulk density)	S,G	S,G				S,G
• Soil chemistry and pH	S,G	S,G		S,G		S,G
• Contaminant concentrations and extent	S,G	S,G	S,G	S,G	S,G	S,G
• Soil/sediment lithology	S,G					S,G
• Depth to water table/thickness of vadose zone	S,G	S,G			G	S,G
• Infiltration[b]	H	H				H
Groundwater Data:						
• Nature and extent of contaminants in groundwater system	G	G	G	G	G	G
• River/aquifer interactions	A	A			A	A
• Hydraulic head in selected stratigraphic units	G	G			G	G

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Table 4-1 Data Needs Summary (Sheet 2 of 3)

Data Needs	Purpose of Data					
	Refine Conceptual Operable Unit Model	Conduct Quantitative Baseline Risk Assessment	Conduct Qualitative Risk Assessment	Evaluate CARs	Conduct Focused Corrective Measures Study for IRM	Conduct Final Corrective Measures Study for Operable Unit
• Hydraulic properties	A,G,S	A,G,S			A,G,S	A,G,S
Surface Water and Sediment Data:						
• Nature and extent of contaminants in riverbank seeps, Columbia River and river sediments	A	A	A	A	A	A
Air Data:						
• Precipitation (annual and monthly averages and extremes; 1-hr and 24-hr max; PMP)	H	H		H		H
• Temperature (annual and monthly averages and extremes; days per year below freezing)	H	H		H		H
• Wind velocity and direction (monthly/seasonal averages and extremes)	A	A		A		A
• Barometric pressure	H	H				H
• Relative humidity	H	H				H
• Evaporation rate (monthly averages)	H	H				H
• Atmospheric stratification and inversions (duration and frequency)	H	H				H
• Magnitudes and frequencies of extreme weather events	H	H				H
• Air quality	S[c]	S[c]	S[c]	S[c]		S[c]
Ecological Data:						
• Terrestrial vegetation wildlife potentially affected by source or groundwater contamination	A	A	A	A	A	A
• Presence of critical habitats	A	A	A	A	A	A
• Biocontamination	A	A	A	A	A	A
• Receptor demographics	A	A	A	A	A	A
• Land use characteristics; existing and potential future uses	A	A	A	A	A	A

Table 4-1 Data Needs Summary (Sheet 3 of 3)

Data Needs	Purpose of Data					
	Refine Conceptual Operable Unit Model	Conduct Quantitative Baseline Risk Assessment	Conduct Qualitative Risk Assessment	Evaluate CARs	Conduct Focused Corrective Measures Study for IRM	Conduct Final Corrective Measures Study for Operable Unit
• Water use characteristics; existing and potential future uses	A	A	A	A	A	A
Cultural Resource Data:						
• Location of surficial archaeological sites	A			A		A
• Presence of historic or archaeological sites that may be eligible for the National Register of Historic Places	A			A		A

[a] A range of unsaturated hydraulic conductivity values will be developed bounded by the saturated hydraulic conductivity and laboratory values of unsaturated hydraulic conductivity from tests on selected vadose zone samples.
[b] A range of infiltration values will be developed using current Hanford literature, studies such as the Hanford Protective Barrier Program, and actual site surface conditions.
[c] No field activities except routine health and safety monitoring.

Note:
CAR = Corrective action requirement
PMP = Probable maximum precipitation
S = Source operable unit investigation
G = Groundwater operable unit investigation
H = Hanford site-wide studies
A = Aggregate area studies

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Table 4-2 100-DR-2 Investigation (Sheet 1 of 4)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
High Priority Sites				
116-D-8 (100-D Cask Storage Pad)	Active from 1946-1975. Facility has 2 drainage systems; one for storm water and one for spillage. Spillage was handled by disposal through a french drain. The storage pad was decontaminated by removing portions of the concrete. The concrete chips were reported disposed of in the 200 Areas. Rinse water was disposed of adjacent to the pad in an area currently marked "Underground Radioactive Material."	Identify number and volume of spills that occurred on the pad. Site to include adjacent site posted as underground rad. Geophysics will be used to aid in location of french drain and evaluation of site.	IRM/0	The waste at this site is a result of leaks and spills that occurred on the pad. The site has already undergone a partial cleanup.
116-DR-3 (105-DR Storage Basin Trench)	This site was active during 1955, received 4,000,000 L of contaminated sludge and water from the 105-DR Fuel Storage Basin.	Geophysical survey using GPR of EMI to ascertain the presence and nature of materials used to fill the trench. One vadose zone test pit in a location determined by the geophysical survey.	LFI-IRM/1	This site has an HRS score of 40.09 and is considered a high-priority site. Previous sampling revealed the presence of radionuclide contamination at this site.
116-DR-4 (105-DR Pluto Crib)	116-DR-4 was active from 1952-1953, and received 4,000 L of liquid wastes from isolated tubes containing ruptured fuel elements in the 105-DR Fuel Storage Basin.	No LFI activity is planned for this facility as it is analogous to 116-D-2A.	IRM/0	This site has an HRS score of 9.13. The constituents present should be the same as those for 116-D-2A and thus the cleanup will use the results of 116-D-2A to define a remedial action.

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Table 4-2 100-DR-2 Investigation (Sheet 2 of 4)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
116-DR-6 (1608-DR Liquid Disposal Trench)	The site was active from 1953-1965, received 7,000,000 L of diverted coolant during the Ball 3X upgrade. It also received diverted water during reactor shutdown.	LFI will be limited to currently locating the trench. This site is analogous to 116-DR-1 and 116-DR-2.	LFI-IRM/0	This site has an HRS score of 42.32. The constituents present should be the same as those for 116-DR-1 and 116-DR-2 and thus the cleanup will use the results of 116-DR-1 and 116-DR-2 to define a remedial action.
116-DR-7 (105-DR Inkwell Crib)	The site was active during 1953, received 4,000 L of liquid potassium borate from the 3X System prior to the Ball 3X System upgrade. There is reason to believe the site may be a storage tank rather than a crib.	LFI should consist of geophysical surveys to determine if the facility is a crib or a storage tank. If surveys indicate it is a crib then a single borehole should be drilled to characterize the crib.	LFI-IRM/1	This site has an HRS score of 28.96. The waste received at this site came from the 3X System prior to the Ball 3X System upgrade.
116-DR-8 (117-DR Crib)	The site was active from 1960-1964, received 240,000 L of drainage from the containment system 117 Building Seal Pits. From 1972-1986, supported the 105-DR Sodium Fire Facility.	Research/identify waste(s) that were placed in crib. Determine if wastes exhibit extraordinary contamination problems; should this be the case, further field investigations will be implemented.	LFI-IRM/0	This site has an HRS score of 0.0. Data determined during research will determine if field investigations are necessary.

Table 4-2 100-DR-2 Investigation (Sheet 3 of 4)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
132-DR-1 (1608-DR Waste Water Pumping Station)	The site was active from 1950-1964, received low level liquid waste. Unit consisted of an above ground structure and a below grade structure.	Research WIDS specific files to determine if any leaks occurred at this facility; if leaks occurred, determine volume, number, etc.	LFI-IRM/0	This site has been decommissioned.
Sodium Dichromate Tanker Car Off-Loading Facility	Possibly a source of contamination. Located north of the railroad tracks on the northern boundary of the operable unit.	Vadose zone test pit to ascertain the distribution and quantity of sodium dichromate in the vadose zone.	LFI-IRM/1	This is a significant waste site because undiluted volumes of sodium dichromate and acid solutions were disposed directly to the soil column.
Solid Waste Burial Grounds				
118-D-5 (Ball 3X Burial Ground)	Site was active during 1954, received 10 cubic meters of thimbles removed from the 105-DR Reactor during Ball 3X work.	Locate using geophysical methods.	LFI-IRM/0	The potential for solid waste to migrate is very small.
126-DR-1 (190-DR Clearwell Tank Pit)	This site has been active since 1970's as a landfill. The waste is nonhazardous, nonradioactive. The unit is an excavated area between 183-DR and 190-DR. Approximately 25% of the bottom surface contains a layer of waste 1.5 to 3.0 m deep that is covered with backfill.	Research and determine if "recent" disposal activities have occurred, if so, volumes, period of time, etc. The site will not be included in work plan if active status.	Defer/0	The potential for solid waste to migrate is very small.

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Table 4-2 100-DR-2 Investigation (Sheet 4 of 4)

Site (Alias)	Comments	Investigation Approach	Pathway/Boreholes (Test Pit)	Rationale
Low-Priority Facilities				
1607-D-3 (Septic Tank and Associated Drain Field)	Site was started in 1944 and is currently active; receives sanitary waste from the 151-D Electrical Distribution Substation. The flow rate of this unit is estimated at a maximum of 3,975 L/day.	No intrusive activities are planned, action is deferred pending resolution of common septic system approach.	Defer	Potential for hazardous or radioactive contamination is very small.
118-DR-2 (105-DR Reactor Building)	Site was active from 10/3/50 through 12/30/64; contains an estimated 13,500 Ci of radionculides, 85 metric tons of lead, 3 cubic meters of asbestos and 500 pounds of cadmium.	N/A	Defer	The potential for solid waste to migrate is very small.
122-DR-1 (105-DR Sodium Fie Facility)	Site was active from 1972-1986; site wastes consist of sodium, lithium, and sodium potassium alloy. Approximately 20,000 Kg are managed at this facility each year. The facility also stores up to 20,000 L of dangerous wastes.	RCRA TSD facility; coordinate with closure Part A Permit, Part B Permit; interim closure plan has been submitted for this site.	Defer	
132-DR-2 (116-DR Reactor Exhaust Stack)	The site was active from 1950-1986; waste is solid low-level waste. The unit is a monolithic, reinforced concrete structure with a maximum wall thickness of .46 m at the base.	N/A	Defer	The potential for solid waste to migrate is very small.

HRS = hazard ranking system
IRM = interim remedial measure
LFI = limited field investigation
defer = these sites will be addressed with the final remediation of the site.

Table 4-3 Data Quality Objectives

Objectives	Determine nature and vertical extent of contamination.								
Prioritized Data Uses	Determine maximum contaminant concentration to support qualitative risk assessment. Define vertical distribution of contaminants in soil. Determine IRM action.								
Appropriate Analytical Level	Level II Field Screening CLP (Level IV) Methods EPA (Level III) SW-846 Methods								
Target Analytes (Level II Screen)	Chromium, gross beta, and gross gamma								
Level of Concern	Two times background[a]								
Required Detetion Limit	Two times background								
Target Analytes (Level III)	Cr	Co-60[c]	Cs-137[c]	Cs-134[c]	Eu-152[c]	Eu-154[c]	H-3[c]	Pu-239/240[c]	Sr-90[c]
Level of Concern[d]	400	51	27	19	360	250	14,000	3.5	21
Minimum Detection Limit[e,f]	40	5.1	2.7	1.9	36	25	1,400	1.0[g]	2.1
Critical Samples	One sample at expected waste depth. Two clean samples below lowest contamination. One sample at highest level detected during value screening.								

[a] = Background is from uncontaminated area near site.
[b] = Mg/Kg
[c] = pCi/g
[d] = Based on 10^{-6}
[e] = Method-specific detection limit is specified in Table QAPjP-1
[f] = 0.1 of level of concern value
[g] = 0.1 of level of concern value

Cr = Cromium
Co = Cobalt
Cs = Cesium
Eu = Europium
H = Hydrogen
Pu = Plutonium
Sr = Strontium

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Table 4-4 Borehole Sampling Contaminants of Concern

ANALYTE	METHOD	HOLDING TIME	CONTAINER/VOLUME
GENERIC			
ICP/AA Metals	200.7 CLP-H[a]	6 mo	Glass, 500 mL
Mercury	245.1 CLP-H, 245.1 CLP-H	28 d	
ANIONS/IC:			
Fluorides	EPA 300[b]	28 d	Glass/plastic 250 mL
Sulfates	EPA 300[b]		
Nitrates, nitrites	EPA 353.2		
TMA			
Gross alpha	EA-10	6 mo	Glass/plastic, 1,000 mL
Gross beta	EA-10		
Gamma spec	RC-30		
Strontium-90	RC-306, RC-303, RC-309 RC-304		
WESTON			
Gross alpha	PRO-032-15	6 mo	Glass/plastic, 1,000 mL
Gross beta	PRO-032-15		
Gamma spec	PRO-042-5		
Strontium-90	PRO-032-38 PRO-032-25		
222-S LABORATORY			
Total Activity	Prep: LA-548-111	24 h	Plastic or glass, small vial (at least 1 g)
	Procedure:LA-508-121		

AA = atomic absorbtion
IC = ion chromatography
ICP= inductively coupled plasma
[a]modified for the Contract Laboratory Program
[b]Modified (Lindahl 1984)

Table 4-5 Test Pit Sampling Contaminants of Concern

ANALYTE	METHOD	HOLDING TIME	CONTAINER/VOLUME
ICP/Metals	SW-846	6 mo	Glass, 250 mL
Mercury	SW-846	28 d	
ANIONS			
Sulfate	EPA 300[a]	28 d	Glass/Plastic 250 mL
Fluoride	EPA 300[a]	28 d	
Nitrate/nitrite	EPA 353.2	28 d	
RADIONUCLIDES			
Strontium-90	Lab SOP	6 mo	Glass or plastic, 1,000 mL
Gross alpha			
Gross beta			
Gamma spec			
Total activity (222-S Lab)	Lab SOP	6 mo	Glass or plastic small vial (at least 1 g)

[a]EPA 300/Modified per work plan quality assurance project plan.
AA = atomic absorbtion
ICP = inductively coupled plasma
SOP = standard operating procedure

5.0 RCRA FACILITY INVESTIGATION/CORRECTIVE MEASURES STUDY PROCESS

This chapter describes the RFI/CMS process through the final RFI and final CMS for the operable unit. Section 5.1 outlines the tasks to be implemented during the LFI and the 100 Area aggregate and Hanford Site studies, and during the final RFI. Tasks are designed to provide information needed to meet the DQO identified in Chapter 4. The detailed information necessary to carry out these tasks for field activities, if needed, will be presented in descriptions of work (DOW) for the operable unit (see Subtask 1e). Environmental monitoring requirements for protecting the health and safety of onsite investigators are described in the Health and Safety Plan (HSP) (Appendix B).

The feasibility and corrective measures studies that will be conducted in support of remedy selections during the RFI/CMS process are described in Section 5.2. A detailed analysis of remedial alternatives for IRM will be conducted as part of the focused FS, and an analysis for operable unit corrective actions will be conducted as part of the final CMS. Both the focused FS and final CMS will use information provided by the analysis of generic remedial alternatives completed as part of the *100 Area Feasibility Study, Phases 1 and 2* (DOE-RL 1992d).

Following approval, this work plan will not be modified. Any changes to the scope of work that may be needed will be documented through change requests.

5.1 RCRA FACILITY REMEDIAL INVESTIGATION PROCESS

5.1.1 Limited Field Investigation and the 100 Area Aggregate and Hanford Site Studies

To satisfy the data needs and DQO specified in Chapter 4.0, the following tasks will be addressed during the LFI:

- Task 1 - Project Management
- Task 2 - Source Investigation
- Task 3 - Geological Investigation
- Task 4 - Surface Water and Sediments Investigation
- Task 5 - Vadose Zone Investigation
- Task 6 - Groundwater Investigation
- Task 7 - Air Investigation
- Task 8 - Ecological Investigation
- Task 9 - Other Tasks
- Task 10 - Data Evaluation
- Task 11 - Risk Assessment
- Task 12 - Verification of CAR
- Task 13 - LFI Report.

The tasks and their component subtasks and activities are outlined in the following sections. Information is provided on each task to allow estimation of the project schedule (see Section 6.0) and costs.

5.1.1.1 Task 1 - Project Management. The project management objectives throughout the course of the 100-DR-2 Operable Unit RFI/CMS are to direct and document project activities so that the data and evaluations generated meet the goals and objectives of the work plan, and to ensure that the project is kept within budget and schedule. The initial project management activity will be to assign individuals to roles established in Chapter 7.0. Specific subtasks that will occur throughout the LFI/Focused FS and RI/FS include the following:

- Subtask 1a - General Management
- Subtask 1b - Meetings
- Subtask 1c - Cost Control
- Subtask 1d - Schedule Control
- Subtask 1e - Work Control
- Subtask 1f - Records Management
- Subtask 1g - Progress and Final Reports
- Subtask 1h - Quality Assurance
- Subtask 1i - Health and Safety
- Subtask 1j - Community Relations.

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Each of these subtasks are described in the following sections. Further detail on schedule control, cost control, meetings, and reporting can be found in the DOE-RL (1989) Environmental Restoration Field Office Management Plan and the Action Plan in the Tri-Party Agreement (Ecology et al. 1990a).

5.1.1.1.1 Subtask 1a - General Management. This subtask includes the day-to-day supervision of, and communications with, project staff and subcontractors. Throughout the project, daily communications, between office and field personnel will be maintained, along with periodic communications with subcontractors, to assess progress and to exchange information. This constant exchange of information will be necessary to assess the progress of the project and to identify problems early enough to make necessary corrections to keep the project focused on its objectives, on schedule, and within budget.

5.1.1.1.2 Subtask 1b - Meetings. Meetings will be held, as necessary, with members of the project staff, subcontractors, regulatory agencies, and other appropriate entities (particularly those involved with the nearby 100 Area operable units and reactor decommissioning projects) to communicate information, assess project status, and resolve problems. Monthly unit managers' meetings will be held to report progress, resolve problems, and address changes in work scope, as necessary.

Operable unit project coordinators for this and other operable units will meet periodically to share information and to discuss progress and problems. The frequency of other meetings will be determined based on need and on schedules published in the Tri-Party Agreement Action Plan (Ecology et al. 1990a).

5.1.1.1.3 Subtask 1c - Cost Control. Project costs, including labor, other direct costs, and subcontractor expenses, will be tracked monthly. The budget tracking activity will be computerized and will provide the basis for invoice preparation and review, and for preparation of progress reports.

5.1.1.1.4 Subtask 1d - Schedule Control. Scheduled milestones will be tracked monthly for each task for each phase of the project. This will be performed in conjunction with cost tracking.

5.1.1.1.5 Subtask 1e - Work Control. The level of detail provided in this work plan is adequate for initial planning purposes. Detailed information needed to carry out the investigative tasks discussed in this chapter will be provided in the 100-DR-2 Source Operable Unit DOW. The DOW will be provided to the lead regulatory agency for review and approval. Where appropriate, the DOW will reference WHC EII from the Environmental Investigations and Site Characterization Manual, (WHC 1988) rather than listing the entire procedure for a task. Environmental Investigation Instructions for field activities and laboratory analysis are also referenced in the QAPjP (Appendix A). Any reference to the DOW or QAPjP as a source of additional information is inclusive of the EII they reference.

The DOW shall be prepared in accordance with the procedures listed in the QAPjP. The DOW must satisfy the following requirements:

- Include a scope of work introductory section.
- Include the DQO, as specified in the work plans, for each type of activity.
- Identify the proposed locations for sampling and the criteria for selecting those locations. A map, at a scale appropriate to locate the sites in the field, should be included.
- Identify any field screening activities not described in the work plan or in the relevant EII. Identify any field screening equipment to be used which is not described in the relevant EII.
- Include the frequency of measurements (e.g., five foot intervals and lithology breaks).
- Identify the applicable EII needed to conduct the work. If an EII includes several different ways to accomplish the work, then the DOW should specify the method of choice or reference the specific EII section.
- Identify any calibrating standards and frequencies not included in the relevant EII.

- Describe any data collection procedures, chain of custody procedures, sample container size and preparation, holding times, type of analysis, number of split samples, number of duplicate samples, number of blank samples and data reporting requirements not included in the relevant EII.

- Provide an estimate of the proposed field activity schedule, including sampling periods.

- Include provisions to document any field changes using a project change form and submit the form to EPA/Ecology within 10 working days of the change.

5.1.1.1.6 Subtask 1f - Records Management. The project file will be kept organized, secured, and accessible to the appropriate project personnel. All field reports, field logs, health and safety documents, quality assurance/quality control (QA/QC) documents, laboratory data, memoranda, correspondence, and reports will be logged into the file upon receipt or transmittal. This subtask is also the mechanism for ensuring that data management procedures documented in the Information Management Overview (IMO) are carried out appropriately.

5.1.1.1.7 Subtask 1g - Progress and Final Reports. Monthly progress will be documented at unit managers' meetings. Meeting minutes will be prepared, distributed to the appropriate personnel and entities (e.g., project and unit managers, coordinators, contractors, subcontractors), and entered into the project file. Other reporting requirements (e.g., DOE quarterly progress reports) are discussed in Chapter 7.0.

All LFI/Focused FS and RFI/CFS reports and plans will be categorized as either primary or secondary documents. The process for document review and comment is covered by the Tri-Party Agreement Plan (Ecology et al. 1990a). Administration records must be maintained, as described in Section 9.4 of the Action Plan.

5.1.1.1.8 Subtask 1h - Quality Assurance. The specific planning documents required to support the LFI/Focused FS and RFI/CMS have been developed within the overall QA program structure mandated by the DOE for all activities at the Hanford Site. Within that structure, the documents are designed to meet current EPA guidelines for format and content and are supported and implemented through the use of standard operating procedures drawn from the existing program or that have been developed specifically for environmental investigations. To ensure that the objectives of this RFI/CMS are met in a manner consistent with applicable DOE guidelines all work conducted by WHC will be performed in compliance with existing QA manuals and the WHC QA program plan that specifically describe the application of manual requirements to environmental investigations. The 100-DR-2 Operable Unit QAPjP (Appendix A) supports the LFI described in this chapter. The QAPjP defines the specific means that will be used to ensure that the sampling and analytical data are defensible and will effectively support the purposes of the investigation. The QAPjP will be implemented by this subtask.

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5.1.1.1.9 Subtask 1i - Health and Safety. The HSP (Appendix B) will be used to implement standard health and safety procedures for WHC employees and contractors engaged in RFI/CMS activities in the 100-DR-2 Operable Unit.

5.1.1.1.10 Subtask 1j - Community Relations. Community relations activities will be conducted in accordance with the *Community Relations Plan for the Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1990b). All community relations activities associated with the 100-DR-2 Operable Unit will be conducted under this overall Hanford Site Community Relations Plan (CRP).

5.1.1.2 Task 2 - Source Investigation. The source investigation for the LFI at the 100-DR-2 Operable Unit is composed of five subtasks and their component activities:

- Subtask 2a - Source Data Compilation and Review
- Subtask 2b - Surveying
- Subtask 2c - Field Activities
    - Activity 2c-1 - Site Walkover
    - Activity 2c-2 - Surface Radiation Survey
    - Activity 2c-3 - Source Sampling
- Subtask 2d - Laboratory Analysis and Data Validation
- Subtask 2e - Source Data Evaluation.

These subtasks will be conducted to identify sources, locations, and potential contamination associated with each high-priority facility and identified low-priority sites as agreed to by the three parties. Additional activities described under Task 5, Vadose Zone Investigation, will be conducted to define the nature of soil contamination. As described in the following subtasks, not all activities will be conducted at each facility.

The source investigation performed as part of the 100-DR-2 Source Operable Unit investigation will be integrated with similar investigations to be performed as part of the 100-HR-3 Groundwater Operable Unit investigation to avoid duplication of effort and maximize use of the data obtained.

5.1.1.2.1 Subtask 2a - Source Data Compilation and Review. A search for the 100-DR-2 Operable Unit documents, photographs, and drawings is currently underway. A review of this material was used to provide additional information about source units or potential source areas in order to focus all subsequent investigative tasks and subtasks. The source data compilation subtask consists of reviewing the existing information on 100-DR-2 Operable Unit facilities to more accurately and completely characterize the potential sources of contamination within the operable unit.

This compilation will provide additional information on the history of operations of the reactor and support facilities, as well as the waste generation processes, solid and liquid waste streams, waste facility characteristics, radioactive and hazardous waste storage volumes and inventories, and exact location and construction specifications for facilities for which information is currently lacking. Some or all of this information is needed to supplement information for facilities listed on Table 2-1 of the work plan that are identified as known or suspected to have received or produced radioactive or hazardous wastes, or for which waste receipt or production is currently unknown. The above information is necessary to more accurately and completely characterize the potential sources of contamination at the operable unit and to further characterize the physical and ecological setting. The information obtained in this subtask will be evaluated and subsequently used to refine the 100-DR-2 Operable Unit conceptual model, and support the QRA.

The available historical documents, including aerial photographs, engineering plans, environmental or decommissioning reports, effluent discharge reports, daily and monthly reactor operating logs, and environmental release reports not evaluated during this scoping process will be reviewed. This subtask may also include interviews with those personnel having knowledge of past activities, including former and current operations, decommissioning, and maintenance personnel. Records from the PCB programs, performed under Section 3, Asbestos and PCB, *Environmental Compliance Manual* (WHC 1991b), in accordance with (40 CFR 761), will be reviewed to investigate possible past-practice PCB leaks.

Any data gathered during LFI at analogous waste units within the other 100 Area operable units will be compiled. These data will be evaluated to determine applicability to analogous waste units in the 100-DR-2 Operable Unit.

5.1.1.2.2 Subtask 2b - Surveying. The objectives of this activity are to provide horizontal and vertical control for sampling points and to document all sample-point locational data on an operable-unit-wide basis. A topographic base map for the operable unit has been developed using computer aided design at a scale of 1:2,000 that shows elevation contours at 0.5 m (1.5 ft) intervals. Horizontal control will be provided for sampling points established for completing the sampling at low-priority sites. The topographic base map will provide adequate horizontal and vertical control for source samples. Subtask 2b, surveying, will continue throughout the field program. A list of supporting procedures for surveying is presented in Table QAPjP-2 in the QAPjP.

5.1.1.2.3 Subtask 2c - Field Activities. Three field activities are planned for the 100-DR-2 Operable Unit. These activities are:

Activity 2c-1 - Site Walkover. This activity will be conducted during the LFI at low-priority facilities deferred to the final remedy selection process. The objectives of this activity are to identify and locate additional sources and areas of disturbed and/or unnatural appearance, to locate known (but misplaced) sources, and to obtain a general understanding of the site with emphasis on those facilities deferred to the long-term final remedy selection process. The entire operable unit will be walked, and areas of disturbance, monuments, old foundations, and so forth, will be mapped. The walkover will be extended outside the operable unit boundary if it is determined that previously

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unidentified source units are present near the operable unit. Available aerial photographs will be used by the crew performing the walkover. The crew will note areas of potential interest on the photographs and will ground-truth unusual areas noted on the photographs. All areas of potential interest will be flagged and surveyed as part of Subtask 2b - Surveying.

Activity 2c-2 - Surface Radiation Survey. The surface radiation survey will be used to identify areas of surface, and potentially, subsurface radioactive contamination that will require further study.

Surface radiation will be measured by using portable alpha detectors and sodium-iodine beta/gamma detectors that read in cpm. Radiation detection equipment will be either a manual (hand-held) system or a computer-based integrated system using vehicle-mounted or backpack-mounted detectors. The survey will identify any currently unknown areas of surface radiation contamination. A background plot will not be established for the 100-DR-2 Operable Unit because a 2,750 m^2 (25,000 ft^2) area was selected outside of the 100-DR-1 Source Operable Unit boundary, based on the absence of radiation related operations and an initial survey. This area will be used for determining ambient background surface radiation levels related to the 100-DR-2 Operable Unit. Methods used to conduct the background measurements will be the same as those used within the operable unit.

If a manual radiation detection system is used, the survey will be conducted on 8 m (25 ft.) spacing in all areas where no source units are known or suspected. The survey will consist of continuous readings collected along traverses 8 m (25 ft.) apart. The traverse spacing will be $<$ 8 m (25 ft.), as necessary, in anomalous areas noted during the area walkover survey. As a potentially cost-effective alternative to conducting the surface radiation survey entirely with portable (for example, hand-held) radiation detectors, an integrated vehicle-mounted and backpack-mounted computer based mapping system will be evaluated. If the integrated vehicle-mounted and backpack-mounted computer based radiation mapping system proves effective during tests, they will be used for the surface radiation surveys.

Areas with radiation statistically above background results will be staked and flagged for more-detailed investigation under Task 5, Vadose Zone Investigation. Each anomaly will be assigned a unique number. The statistical method for designating anomalies will be determined based on the type of equipment and counting array used. The exact technique, including statistical methods of designating anomalies, will be described before initiating the radiation survey. Procedures for performing the radiation survey are listed in Table QAPjP-2 in the QAPjP.

Activity 2c-3 - Source Sampling. At the 100-DR-2 Operable Unit, there are no plans to perform any source sampling.

5.1.1.2.4 Subtask 2d - Source Sample Laboratory Analysis and Data Validation. There are no plans proposed to perform source sampling, therefore there will be no requirements for laboratory analysis or data validation.

5.1.1.2.5 Subtask 2e - Source Data Evaluation. Additional existing information compiled under Subtask 2a, Source Data Compilation, will be evaluated, and any necessary changes to the planned work will be made. This compilation will include descriptions of each source with levels and types of contamination in the source. The information collected during Subtask 2c, Field Activities, will be compiled and evaluated to identify areas for more detailed soil investigation. Sampling locations will be plotted on the automated site topography maps. Source sampling data will support the risk assessment.

5.1.1.3 Task 3 - Geologic Investigation. The purpose of the geologic investigation is to further characterize the geology of the operable unit. Because geological data needs overlap with those of the 100-DR-1 Operable Unit vadose zone investigations and the 100-HR-3 Groundwater Operable Unit, the geological investigation will require an integrated compilation of geologic information from both the source and groundwater operable units. For this reason, the geologic investigation will be performed as part of the 100-HR-3 Groundwater Operable Unit, and is described in Section 5.1.1.3 of that work plan (DOE-RL 1992a).

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5.1.1.4 Task 4 - Surface Water and Sediments Investigation. No surface water and sediments are included within the boundaries of the 100-DR-2 Operable Unit. The subtasks for the surface water and sediments investigation for the 100-DR-2 Operable Unit were performed as part of an aggregate area investigation for the 100 Area, and are discussed in Appendix D-1, Surface Water and Sediment Investigation, of the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a).

5.1.1.5 Task 5 - Vadose Zone Investigation. The objective of this task is to define the nature and vertical extent of contamination related to waste disposal facilities at the 100-DR-2 Operable Unit, to define relevant migration paths between the disposal units and potentially contaminated media, especially groundwater, and to support the selection of IRM. On the basis of existing data and judgement, the lateral extent of the contamination below liquid waste facilities is expected to be limited to the size of the facility. The remediation will be performed using the observational approach; with this method the actual limits of lateral extent will be determined and remediated simultaneously. Data obtained during the LFI will be used for the following purposes:

- refining the conceptual model
- supporting a QRA for implementing IRM
- supporting a focused FS for developing and evaluating IRM alternatives.

To implement the *Hanford Site Past-Practice Strategy* (DOE-RL 1991a) with a bias for action, the investigation has been designed with an emphasis on the primary data needs for supporting the QRA and implementing IRM. However, some of the data needed for the QRA, the definition of ARAR, and the final FS will also be obtained.

The approach to the vadose zone investigations is to obtain information from test pit excavations and drilling conducted in this investigation and from drilling conducted for installation of monitoring wells in the 100 Area groundwater operable units. Information on the nature and vertical extent of contamination will be obtained from borings and test pit excavations in the priority liquid waste disposal facilities identified in Table 4-2. Additional vadose zone information can be obtained from the data collected during drilling of groundwater monitoring wells in the 100-HR-3 Operable Unit from the screening samples and cuttings and collecting samples if contamination was indicated. Samples will also be collected near the water table to determine contamination remaining as a result of past groundwater mounding or fluctuating groundwater levels. Physical properties of the vadose zone soils required to model fate and transport for the quantitative baseline risk assessment will be obtained from both source borings and boreholes for monitoring well installations throughout the 100 Area. This approach is described in more detail in Section 5.1.1.5.2.

The vadose zone soils investigation will consist of the following subtasks:

- Subtask 5a - Data Compilation
- Subtask 5b - Borehole Soil Sampling and Logging
- Subtask 5c - Test Pit Sampling
- Subtask 5d - Soil Sample Analysis
- Subtask 5e - Geophysical Borehole Logging/Geophysical Ground Penetrating Radar
- Subtask 5f - Data Evaluation.

5.1.1.5.1 Subtask 5a - Data Compilation. Data from the source data compilation task described in Task 2 and data from vadose zone investigations at other 100 Area operable units will be reviewed to determine whether any modifications are needed to the drilling and sampling activities. The Task 2 activities may identify additional facilities where a borehole is necessary to determine the need for an IRM, or to complete the quantitative risk assessment and final remedy selection for the operable unit. In addition, data collected from the most recent soils characterization effort at the Hanford Site (DOE-RL 1993c) will be reviewed. These data will be used for comparison with the vadose zone sampling data to determine presence of contamination.

5.1.1.5.2 Subtask 5b - Borehole Soil Sampling and Logging. Objectives of the boring and soil sampling activities include analyzing soils associated with the high-priority liquid waste disposal facilities in the 100-DR-2 Operable Unit. Final borehole locations will be approved by the unit managers and documented in the DOW. Borehole coordinates will be established by a survey following completion. Table 5-1 is a summary of the proposed vadose zone sampling locations, number of boreholes, number of samples, and types of analyses. One borehole will initially be drilled at the 116-DR-7

(105-DR) Inkwell Crib. Figure 5-1 shows the proposed borehole location for the 116-DR-7 site.

Borings may be necessary to support the final operable unit ROD at some of the low-priority facilities based on the results of Task 2 activities.

Boreholes will be advanced and sampled using cable tool drilling methods and split-spoon or core barrel samples. Cable tool drilling will be used for this task because of the gravels, cobbles and boulders common to the operable unit, and because the quantity of drilling residuals is minimal and can be easily controlled compared to other drilling methods. Other methods that provide essentially equal means of containing wastes and limiting spread of contamination may be considered. Procedures for borehole drilling, sample collection, handling, and analysis are listed in Table QAPjP-2 in the QAPjP.

Depth of the vadose zone borings will be based on field screening results. The use of the field screening instruments will be detailed in the DOW. Radiological screening is expected to be effective in determining the extent of contamination and depth of drilling for all the facilities identified for the initial boring activities at this operable unit. Organic vapor monitors and hexavalent chromium test kits may also be used for field screening. X-ray fluorescence (XRF) may be considered as an alternative method of metal contaminant screening. At these facilities, sampling for chemical analyses will be conducted at 1.5 m (5 ft) intervals, with drilling and sampling extending to 1.5 m (5 ft) beyond detectable contamination. This will permit the collection of a sample for laboratory analysis to verify that the vertical extent has been defined. If screening continues to indicate detectable contamination to the water table, the boring will extend below the water table to permit collection of at least one sample of the aquifer matrix.

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Samples will also be collected for physical property data from one boring at the 116-DR-7. The data are needed for quantitative flow and solute transport analyses in the unsaturated zone for development of defensible risk analysis. The physical properties of the sediments at high-volume waste disposal facilities may have changed by solution of carbonates, the flushing of silt and clay-sized particles from the soil, or by the precipitation of iron complexes. A maximum of five samples will be collected. All samples for physical data will be collected during drilling, using a reinforced carbide-tipped core barrel. This technique will be used initially and as deep as is practical in these boreholes. Sampling will not be conducted for soil physical properties in intervals where the hard tool was used to advance the borehole. It is recognized that this sampling strategy will result in a biased or censured data set because cobbly soils cannot be effectively sampled by core barrel techniques, and hard tool drilling does not provide representative samples for these properties. Sample collection, handling and analysis for physical property analysis are discussed in Section 5.1.1.5.3, and procedures are listed in Table QAPjP-2 of the QAPjP. Specific procedures will be documented in the DOW.

All boreholes will be geologically logged, based on drill cuttings and the split-spoon or core samples taken at specified intervals. Borehole geologic logs will be prepared in accordance with procedures specified in the QAPjP and will be documented in the DOW. Drill cuttings and core samples will be screened with hand-held instruments for radiation and volatile organic compounds. Screening results and general observations as to drilling progress and problems will be included in each borehole log.

Soil cuttings containing unknown, low-level mixed radioactive waste and/or hazardous waste will be contained, stored, and disposed of according to Westinghouse Hanford Company procedures specified in Table QAPjP-2 of the QAPjP and will be documented in the DOW.

All boreholes will be abandoned following completion of the geophysical logging described in Section 5.1.1.5.5. Specific procedures for borehole abandonment are identified in Table QAPjP-2 of the QAPjP and will be documented in the DOW. These procedures are written to comply with EPA requirements and Chapter 173-160 WAC.

5.1.1.5.3 Subtask 5c - Test Pit Sampling. The objective of using test pits is to provide a fast and relatively inexpensive method to characterize sites. Test pit sampling shall be conducted per Appendix I, "Test Pit/Trench Sampling" of EII 5.2, "Soil and Sediment Sampling" (WHC 1988). The bucket of the backhoe will be decontaminated before each test pit excavation. Soils will be field screened for radionuclides, organics, and hexavalent chromium. The samples shall be taken from the bucket before the excavated material is placed on the ground. A minimum of one, and maximum of two analytical samples shall be collected from each test pit utilizing field screening criteria. The first time the material does not pass the screening criteria, a sample shall be collected. Excavated test pit soil will be replaced in the test pit site after sampling is completed in the reverse order of the excavation and packed. Figure 5-1 shows the proposed location for the test pit excavation for the 116-DR-3 site and Figure 5-2 shows the proposed location for the test pit excavation for the Sodium Dichromate/Acid Tanker Car Off Loading Facility.

5.1.1.5.4 Subtask 5d - Soil Sample Analysis. For the initial borings/test pit excavations in the priority waste sites, a reduced suite of analyses will be conducted to determine the nature of contamination. Samples collected for chemical analysis will be analyzed for the TCL and target analyte list (TAL) constituents, for specific anions that may be present, using EPA (1986) Level IV methods (SW-846 methods will be used to analyze test pit samples, and CLP methods will be used to analyze vadose borehole samples for all analytes except radionuclides, which will be analyzed by standard methods as defined in the laboratory statement of work). Analysis of soils for hexavalent chromium will be performed using non-CLP methods. Analytical methods, routine analytical detection limits and quantitation limits, and precision and accuracy specified for the methods are provided in Table QAPjP-1 of the QAPjP and will be documented in the DOW.

Soil samples collected from the one high-volume liquid waste disposal facility will be tested for the following physical properties:

- moisture content American Society for Testing and Materials (ASTM D2216)
- bulk density
- particle-size distribution (ASTM D422-63)
- saturated hydraulic conductivity (K_{sat}) (ASTM D2434-68).

Analytical methods for the physical properties are identified in Table QAPjP-2 of the QAPjP and will be documented in the DOW.

5.1.1.5.5 Subtask 5e - Geophysical Borehole Logging/Ground Penetrating Radar. Geophysical logging will be performed in existing wells that may be located in contaminated areas. Prior to borehole abandonment, boreholes will be geophysically logged to provide additional characterization information to supplement the soil sampling data. The following logging techniques will be used:

- gross-gamma logging to identify confining layers and for stratigraphic correlation
- spectral-gamma logging for measuring the distribution of selected radionuclides.

The existing equipment and procedures for gross-gamma and spectral-gamma logging in use at the Hanford Site provide acceptable data. The procedures are specified in Table QAPjP-2 of the QAPjP and will be documented in the DOW. Gross gamma logging will be used only when spectral-gamma equipment is not available or when site conditions do not allow its use.

Ground penetrating radar (GPR) or an analogous type of survey method (e.g., electro-magnetic inductance (EMI)) will be performed at four sites (116-D-3, 116-DR-4, 116-DR-6, and 118-D-5). The purpose of the surveys to be performed at sites 116-DR-6 and 118-D-5 is to accurately locate these sites. The purpose of the survey to be performed at 116-DR-3 is to ascertain the presence and nature of materials used to fill the trench. The survey to be performed at 116-DR-7 is to determine if the facility is a crib or a storage tank.

5.1.1.5.6 Subtask 5f - Data Evaluation. This task will include evaluating all the information collected during the vadose zone investigation. The emphasis of the evaluation will be to determine whether an IRM should be conducted at the high-priority sites. The data may also be used to determine what is to be done at analogous facilities at other operable units. Chemical data will be evaluated and compared to CAR and soil background data. Borehole logs will be evaluated to confirm or refine the conceptual geologic model of the site. Physical properties measured in the high-volume liquid waste disposal site will be compared with the 100 Area site wide data collected in the groundwater operable units.

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If the data fall within an acceptable confidence interval, this will indicate that the 100 Area-wide data can be used to represent the physical properties of the waste sites for solute fate and transport analysis. Geophysical logs will be compared with data from soil sampling and will serve to fill in data gaps between sampling locations. The data collected from the vadose zone investigation will be used in conjunction with data collected from other tasks for completing the quantitative risk assessment and selecting a final remedy for the operable unit. A description of data evaluation for all tasks is provided in Section 5.1.1.10.

5.1.1.6 Task 6 - Groundwater Investigation. The groundwater investigation is being performed as part of the 100-HR-3 Operable Unit RFI, and is described in that work plan (DOE-RL 1992a).

5.1.1.7 Task 7 - Air Investigation. Although the proposed 100-DR-2 field sampling activities include actions that may expose waste and potentially contaminated soil to the atmosphere, it is anticipated that there will be minimal disturbance of significant volumes of contaminated materials during these activities. Because air is not anticipated to be a significant contaminant transport medium for the 100-DR-2 Source Operable Unit, no field activities other than routine health and safety air monitoring are planned for the air investigations (see HSP Appendix B). If the need for additional air investigation becomes apparent, however, during the course of the project or because of experience at other projects, additional air investigations will be performed as required.

5.1.1.8 Task 8 - Ecological Investigation. The ecological investigation determines the potential biocontamination transport pathways through the environment, the critical habitat for major species, and conceptual models of human and environmental risk. The ecological investigation provides information necessary to complete the risk assessment and conduct a CMS which will evaluate remedial alternatives. These tasks were performed as part of the 100 Area aggregate investigation in accordance with the activities addressed in Appendix D-2, Ecological Investigation, of the 100-HR-3 Operable Unit Work Plan (DOE-RL 1992a). Aquatic sampling was performed on the 100-HR-3 and the 100-NR-2 Operable Units to determine if further testing is necessary for the other operable units of the 100 Area.

5.1.1.9 Task 9 - Other Tasks. This task has been reserved in the event that additional tasks are identified during the course of the project. Currently, one subtask has been identified: Subtask 9a - Cultural Resource Investigation.

5.1.1.9.1 Subtask 9a - Cultural Resource Investigation. The cultural resource investigation will deal with the entire 100 Area and the 600 Area north of the Gable Mountain and south of the Columbia River, rather than individual operable units. Details of this investigation are presented in Appendix D-3, Cultural Resource Investigation, of the 100-HR-3 Groundwater Operable Unit Work Plan (DOE-RL 1992a). The task will include review of available existing data on historic land uses by local Indian tribes as well as early 20th century land use by pioneer farmers and settlers. A field survey will be conducted by a qualified archaeologist following the review of existing data.

5.1.1.10 Task 10 - Data Evaluation. Data generated during these tasks will be integrated and evaluated, coordinated with CMS activities, and presented in an ongoing manner to allow decisions to be made regarding any necessary rescoping during the course of the project. The results of these evaluations will be made available to project management personnel to keep project staff informed of progress being made. The interpretations developed under this task will be used in Task 11 - Risk Assessment, which will evaluate the overall risk to human health and the environment posed by the 100-DR-2 Operable Unit.

5.1.1.11 Task 11 - Risk Assessment. Both qualitative and baseline risk assessments will be conducted during the course of the RI/FS (RFI/CMS) process for the 100 Area. A QRA based on available site data will be used to support IRM decisions following the initial data evaluation and LFI. Baseline risk assessments will be conducted after evaluation of data from ERA, IRM, and LFI paths, the corrective measures and FS, and when necessary, the completion of additional field investigations.

The 100-DR-2 Operable Unit risk assessment process will determine the magnitude and probability of potential harm to human health and the environment by the threatened or actual release of hazardous substances from the 100-DR-2 Operable Unit in the absence of an action-oriented corrective measure. Both the qualitative and baseline risk assessments will be developed in accordance with HSBRAM (DOE-RL 1993b). This methodology addresses both human health and environmental risk assessments in accordance with appropriate federal and state guidance, including the Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Part A (EPA 1989a), Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation manual (EPA 1989b), EPA-Region 10, *Supplemental Risk Assessment Guidance for Superfund* (EPA 1991b), and Model Toxics Control Act Cleanup Regulations (MTCACR) (WAC 173-340). Only an overview of the risk assessment process is presented here; refer to the HSBRAM (DOE-RL 1993b) for additional information.

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The risk assessment task will be divided into two subtasks:

- Subtask 11a - Human Health Evaluation
- Subtask 11b - Environmental Evaluation.

The subtasks are more fully described in the 100-DR-1 Work Plan (DOE-RL 1992b).

5.1.1.12 Task 12 - Verification of Contaminant- and Location- Specific CAR. The formulation of operable-unit-specific CAR is an ongoing process throughout the RFI/CMS. Preliminary CAR were identified and discussed in Section 3.2. Potential ARAR for the 100 Area have been developed. Following the evaluation of analytical data under Task 10, contaminant-specific and location-specific CAR will be reviewed and identified, based upon the new knowledge of contamination at the site and the site setting. Once the potential CAR for the 100-DR-2 Operable Unit have been properly identified, EPA and Ecology will be asked to verify the contaminant- and location-specific CAR. Project staff will work with the regulatory agencies, taking operable unit-specific conditions into account, and will decide which promulgated environmental standards, requirements, criteria, and limitations are actually applicable or relevant and appropriate to the 100-DR-2 Operable Unit.

5.1.1.13 Task 13 - Limited Field Investigation Report. An interim report will be prepared upon completion of the LFI. This report will consist of a preliminary summary of the characterization activities described in Tasks 1 through 12. Information pertinent to the operable unit conceptual model will be refined, as necessary. The report will include the results of the historical investigation, identify the contaminant- and location-specific CAR, and provide an assessment of whether contaminant concentrations pose an unacceptable risk that warrants action through an IRM.

5.1.1.14 Task 14 - Natural Resource Damage Assessment. For RCRA corrective action units, the trigger for NRDA is the discharge or release of a hazardous substance. Potential injury from past releases will need to be identified. Potential future injuries, as a result of corrective actions, will need to be considered in the context of NRDA. The NRDA considerations are important prior to establishing the ecological corrective action objectives.

5.1.2 Final RCRA Facility Investigation

The final RFI provides any additional data and characterization needed to support selection, design and implementation of a final corrective action for the operable unit. The final RFI is performed at remaining low-priority sites where existing data are considered insufficient by the unit managers, and at any remaining high-priority sites where final cleanup criteria and/or existing data are considered insufficient by the unit managers, and at any remaining high-priority sites where final cleanup criteria were not achieved during the IRM. The final RFI may consist of data compilation, nonintrusive investigations, intrusive investigations, and data evaluation. Analyses conducted during the final RFI will use data collected during the LFI, during IRM implementation, and in previous investigations.

A baseline risk assessment is performed as part of the final RFI. This assessment provides a quantitative evaluation of residual risk at the operable unit after completion of the IRM, and is conducted according to HSBRAM (DOE-RL 1993b). The results of this assessment are used to help determine the need for corrective actions, to select the corrective action, and to determine risk-based cleanup levels for the corrective action.

The final RFI is conducted in parallel with the final CMS, permitting the collection of any additional data that may be identified when conducting the final CMS. The final RFI and the baseline risk assessment are documented in the final RFI report, which is a secondary document.

5.2 CORRECTIVE MEASURES STUDY PROCESS

In accordance with the *Hanford Federal Facility Agreement and Consent Order Change Packages* (Ecology et al. 1991), the FS and CMS process for the 100 Area will be conducted on both an aggregate area and operable unit basis. The EPA published Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA 1988a) will be used as the guidance document for the content and approach to each of the feasibility and corrective measures studies performed. This process includes preparation of a 100 Area FS completed on an aggregate area basis, a focused FS, and a final CMS completed on an operable unit basis. The IRM process takes place between the focused FS and final CMS. A description of the IRM process and each of the corrective measures and FS is provided in the 100-DR-1 Work Plan (DOE-RL 1992b). The emphasis in this work plan is placed on the focused FS. If a final CMS is necessary, the tasks outlined for the focused FS would be repeated. This process is intended to reduce the level of effort required for any one individual study and allow initiation of corrective action activities based on known data and previously tested/demonstrated technologies.

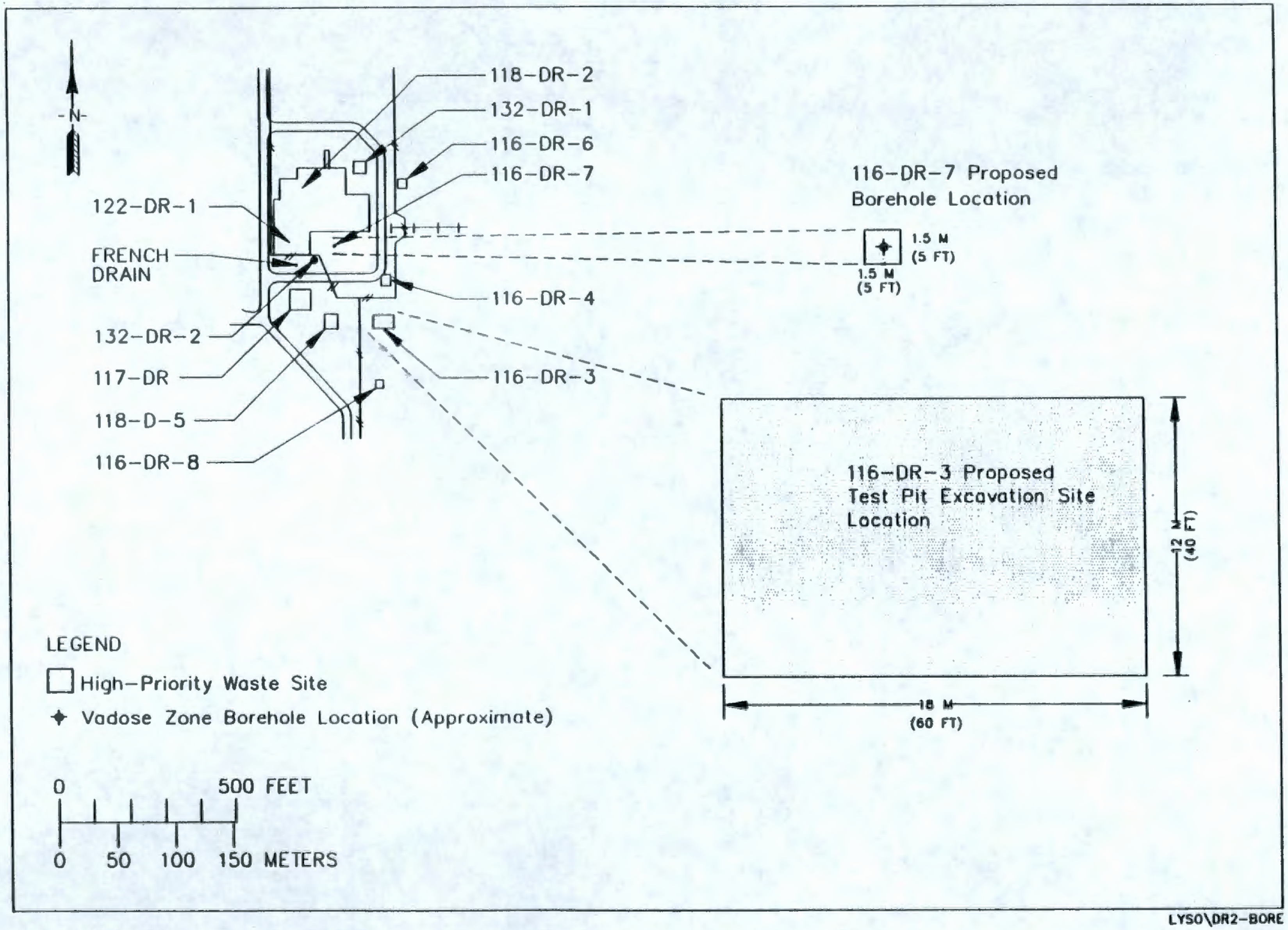

Figure 5-1 High-Priority Liquid Waste Facility

Figure 5-2 Sodium Dichromate French Drain

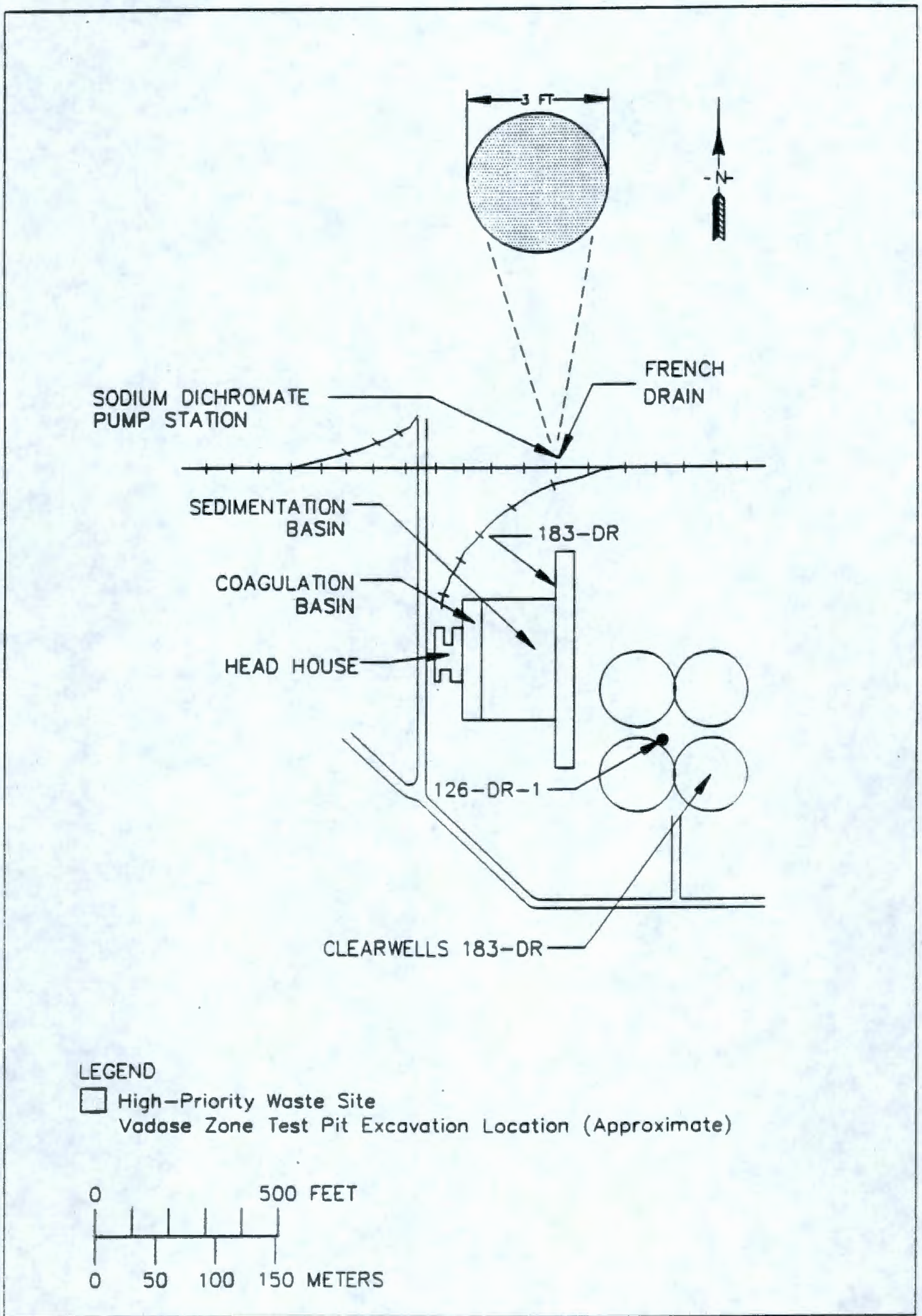

Table 5-1 100-DR-2 Operable Unit Vadose Zone Investigation

Location	Number of Boreholes/ Test Pit	Number of Samples	Types of Analyses				
			TAL	TCL[a]	RAD	Physical	Cr^{6+}
116-DR-3 Storage Basin Trench	1	2	X	X	X		X
116-DR-7 Inkwell Crib	1	8	X	X	X	X	X
Sodium Dichromate/ Acid Tanker Car Off Loading Facility	1	2	X	X	X		X

[a]= If field screening results indicate the presence of VOCs, samples will be collected and submitted for TCL analyses.
TAL= Target Analyte List
TCL= Target Compound List
RAD= Radionuclides

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6.0 SCHEDULE

An operable unit schedule, which supports the Tri-Party Agreement Action Plan work schedule (Ecology et al. 1990a), has been prepared detailing the work described in Chapter 5 of this work plan. This schedule (Figure 6-1) is the baseline that will be used to measure progress in implementing this work plan. The approval of this work plan is for the work associated with the 100-DR-2 Operable Unit and is not binding for any other work plan.

The integrated schedule, the operable unit schedule, and the 100 Area-wide activity schedule (Figures 6-2, 6-3, and 6-4) from the 100-HR-1 Operable Unit Work Plan (DOE-RL 1992c) are incorporated by reference. They include interim milestones established to track and help ensure progress of the various tasks. A formal change control process has been established in the Tri-Party Agreement Action Plan, and will be used, if necessary, to modify milestones shown in the schedules.

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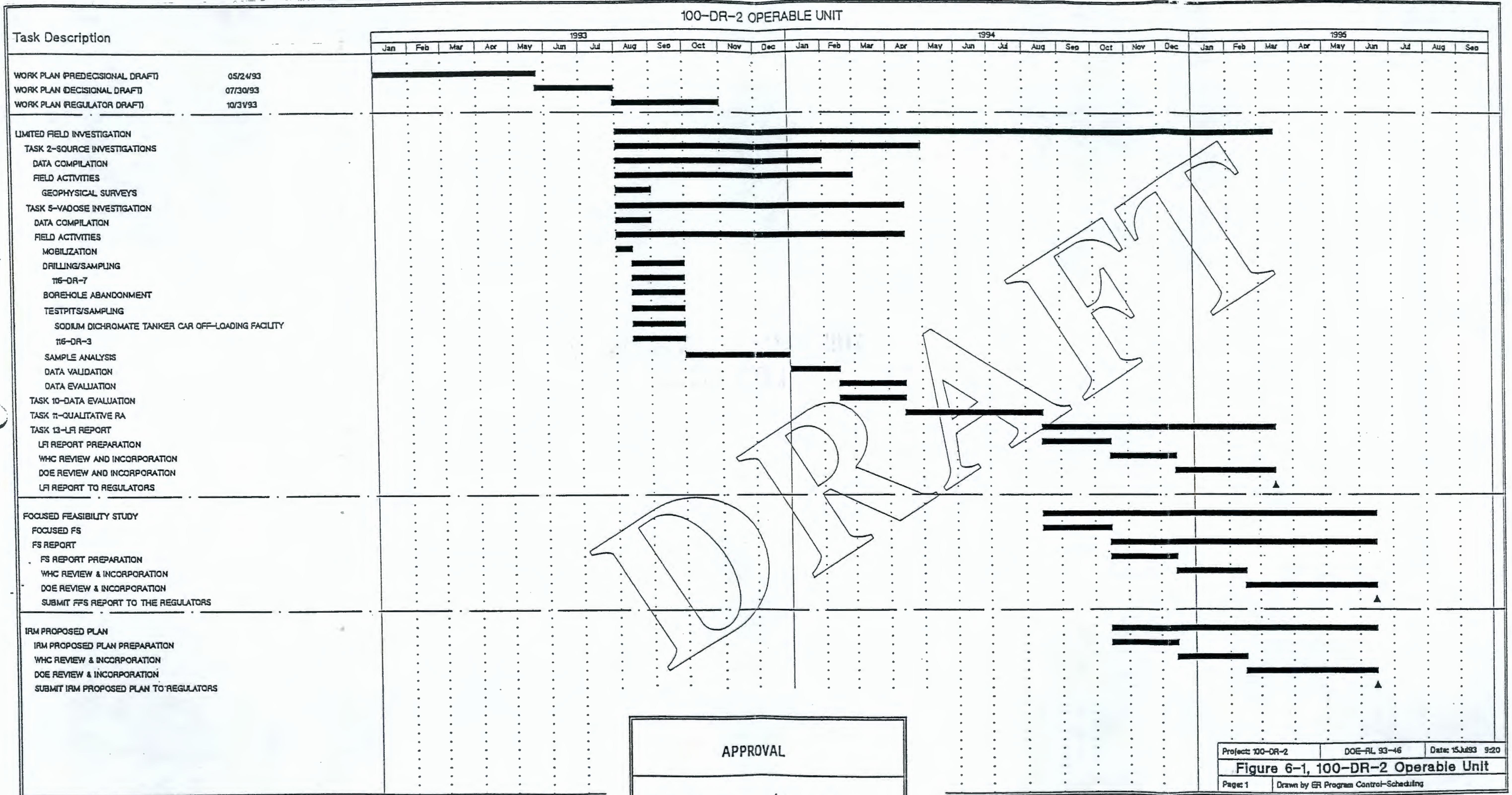
Figure 6-1 100-DR-2 Operable Unit Schedule



APPROVAL

M.R. ADAMS

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7.0 PROJECT MANAGEMENT

This chapter defines the administrative and institutional tasks necessary to support the RFI/CMS for the 100-DR-2 Operable Unit at the Hanford Site. Also, this chapter defines the responsibilities of the various participants, the organizational structure, and the project tracking and reporting procedures. This chapter is in accordance with the provisions of the Tri-Party Agreement Action Plan dated August 1990. Any revisions to the Tri-Party Agreement Action Plan that would result in changes to the project management requirements would supersede the provisions of this chapter.

The project management activities included in the 100-DR-1 Work Plan (DOE-RL 1992b) cover all of the activities which are part of the 100-DR-2 Work Plan. Therefore, the 100-DR-1 Work Plan (DOE-RL 1992b), Chapter 7.0 *Project Management* shall be used for 100-DR-2, by reference.

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8.0 REFERENCES

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APPENDIX A

QUALITY ASSURANCE PROJECT PLAN

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GLOSSARY

Accuracy: For the purposes of environmental investigations, accuracy may be interpreted as the measure of the bias in a system. Sampling accuracy is normally assessed through the evaluation of matrix-spiked samples, reference samples, and split samples.

Audit: For the purposes of environmental investigations, audits are considered to be systematic checks to verify the quality of operation of one or more elements of the total measurement system. In this sense, audits may be of two types: (1) performance audits, in which quantitative data are independently obtained for comparison with data routinely obtained in a measurement system, or (2) system audits, involving a qualitative onsite evaluation of laboratories or other organizational elements of the measurement system for compliance with established quality assurance program and procedure requirements. For environmental investigations at the Hanford Site, performance audit requirements are fulfilled by periodic submittal of blind samples to the primary laboratory, or the analysis of split samples by an independent laboratory. System audit requirements are implemented through the use of standard surveillance procedures.

Bias: Bias represents a systematic error that contributes to the difference between a population mean of a set of measurements and an accepted reference or true value.

Blind Sample: A blind sample refers to any type of sample routed to the primary laboratory for performance audit purposes, relative to a particular sample matrix and analytical method. Blind samples are not specifically identified as such to the laboratory. They may be made from traceable standards, or may consist of sample material spiked with a known concentration of a known compound. See the glossary entry for Audit.

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 valid data obtained compared to the total data expected under normal conditions.

Deviation: For the purposes of environmental investigations, deviation refers to an approved 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.

Equipment Blanks: Equipment blanks shall consist of pure deionized, distilled water washed through decontaminated sampling equipment and placed in containers identical to those used for actual field samples. They are used to verify the adequacy of sampling equipment decontamination procedures, and are normally collected at the same frequency as field duplicate samples.

Field Duplicate Sample: Field duplicate samples are samples retrieved from the same sampling location using the same equipment and sampling technique, placed in separate, identically prepared and preserved containers, and analyzed independently. Field duplicate samples are generally used to evaluate the reproducibility of analytical data and the field variability. Field duplicates are normally collected with each analytical batch or every 20 samples, whichever is greater.

Matrix-Spiked Samples: Matrix-spiked samples are a type of laboratory quality control sample. They are prepared by splitting a sample received from the field into two homogenous aliquots (i.e., replicate samples) and adding a known quantity of a representative analyte of interest to one aliquot in order to calculate the percentage of recovery of that analyte.

Nonconformance: A nonconformance is a deficiency in the characteristic, documentation, or procedure that 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. If the nature of the condition is such that it cannot be immediately and satisfactorily corrected; then, it shall be documented in compliance with approved procedures and brought to the attention of management for disposition and appropriate corrective action.

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Precision: Precision is a measure of the repeatability or reproducibility of specific measurements under a given set of conditions. The relative percent difference (RPD) is used to assess the precision of the sampling and analytical method. RPD is a quantitative measure of the variability. Specifically, precision is a quantitative measure of the variability of a group of measurements compared to their average value. Precision is normally expressed in terms of standard deviation, but may also be expressed as the coefficient of variation (i.e., relative standard deviation) and range (i.e., maximum value minus minimum value). Precision is assessed by means of duplicate/replicate sample analysis.

Quality Assurance: For the purposes of environmental investigations, 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 and/or the intended end use of the data.

Quality Assurance Project Plan: The QAPjP is an orderly assembly of management policies, project objectives, methods and procedures that define how data of known quality will be produced for a particular project or investigation.

Quality Control: For the purposes of environmental investigations, QC refers to the routine application of procedures and defined methods for the performance of sampling, measurement and analytical processes.

Range: Range refers to the difference between the largest and smallest reported values in a sample, and is a statistic for describing the spread in a set of data.

Reference Samples: A reference samples is a type of laboratory quality control sample prepared from an independent, traceable standard at a concentration other than that used for analytical equipment calibration, but within the calibration range. Such reference samples are required for selected analytical methods, and are normally analyzed at a frequency of one per analytical batch.

Replicate Sample: Replicate samples are two aliquots removed from the same sample container in the laboratory and analyzed independently.

Representativeness: For the purposes of environmental investigations, representativeness may be interpreted as the degree to which data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of a sampling program.

Split Sample: A split sample is produced through homogenizing a field sample and separating the sample material into two equal aliquots. Field split samples are usually routed to separate laboratories for independent analysis, generally for purposes of auditing the performance of the primary laboratory relative to a particular sample matrix and analytical method. See the glossary entry for Audit. In the laboratory, samples are generally split to create matrix-spiked samples (see the glossary entry).

VOA Trip Blanks: Volatile organics analysis (VOA) trip blanks are a type of field quality control sample, consisting of pure deionized distilled water in a clean, sealed sample container. Volatile organics analysis trip blanks accompany each batch of containers shipped to the sampling site and returned unopened to the laboratory. Trip blanks are used to identify contamination originating from container preparation methods, shipment, handling, storage, site conditions or the analytical laboratory.

Validation: For the purposes of environmental investigations, validation refers to a systematic process of reviewing data against a set of criteria to provide assurance that the data are acceptable for the 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, surveillance or technical review.

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1.0 PROJECT DESCRIPTION

1.1 OBJECTIVE

The objectives of the environmental investigations in the 100-DR-2 Operable Unit are defined in Section 1.1 of the work plan. Analytical data resulting from the sampling portion of the investigation will be validated and evaluated to determine the most feasible options for additional investigation, remediation, or closure.

1.2 BACKGROUND

The 100-DR-2 Operable Unit is located within the 100 Area of the Hanford Site, shown in Figure 1-1 of the work plan. Detailed background information regarding the history and present use of the unit is provided in Chapter 2 of the work plan.

1.3 SCOPE AND RELATIONSHIP TO WHC QA PROGRAM

This QAPjP applies specifically to the field activities and laboratory analyses performed as part of the LFI for the 100-DR-2 Operable Unit. It is prepared specifically for this phase of investigation, and is prepared in compliance with the requirements of the Westinghouse Hanford Company (WHC) *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990a). The QA program plan implements the overall QA program requirements defined by the *Quality Assurance Manual* (WHC 1988a), as applicable to environmental investigations, while accommodating the specific requirements for project plan format and content agreed on in the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1990). It contains a matrix of procedural resources from the QA manual (WHC 1988a), the *Environmental Investigations and Site Characterization Manual* (WHC 1988b), and other sources that have been drawn on to support this QAPjP.

A preliminary discussion of field work (i.e., location of sampling) is provided in Chapter 5 of the work plan. Final sampling locations, required sampling intervals, sample quantities, sampling frequency, and schedules for all technical activities addressed in this investigation shall be defined by investigation-specific descriptions of work prepared in compliance with EII 1.14, "Preparation of Descriptions of Work" (WHC 1988b). The description of work satisfies the requirements of the field sampling plan.

Distribution and revision control of the work plan and the QAPjP will be performed in compliance with Quality Requirement (QR) 6.0, "Document Control" and other applicable procedures as identified in the QA Program Index (QAPI) included in the QA program plan (WHC 1990a).

Interim changes to this QAPjP or the work plan shall be documented, reviewed, and approved as required by Section 6.6 of EII 1.9, "Work Plan Review" (WHC 1988b), and shall be documented in monthly unit managers' meeting minutes. QAPjP distribution shall routinely include all review/approval personnel indicated on the title page of the document and all other individuals designated by the WHC technical lead. All plans and procedures referenced in the QAPjP are available for regulatory review on request, at the direction of the technical lead.

1.4 PROJECT ACTIVITIES

Investigations to be conducted in the 100-DR-2 Operable Unit include source geological and vadose zone investigations, as well as an investigation made up of other miscellaneous tasks. More detailed discussions of individual tasks are contained in Chapter 5 of the work plan.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Chapter 7 of the *RCRA Facility Investigation/Corrective Measure Study Work Plan for the 100-DR-1 Operable Unit, Hanford Site, Richland, Washington* (DOE-RL 1992a) can be referenced for the applicable project organization structure.

2.1 QA OFFICER

The QA Officer is responsible for coordination/oversight of performance to the QAPjP requirements by means of internal auditing and surveillance techniques. The QA Officer has the necessary organizational independence and authority to identify conditions adverse to quality and to inform the technical lead of needed corrective action.

2.2 TECHNICAL LEAD

The Environmental Restoration Engineering Function of WHC has primary responsibility for conducting this investigation. Organizational charts, responsibility descriptions, and individual WHC field team descriptions are addressed in Chapter 7 of the 100-DR-1 Operable Unit Work Plan (DOE-RL 1992a) and in the governing project procedures identified herein.

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 QR 4.0, "Procurement Document Control", QR 7.0, "Control of Purchased Items and Services" (WHC 1988a), and other procedures as identified under criteria 4 and 7 of the QAPI included in QA program plan (WHC 1990a). Major participant contractor and subcontractor resources are discussed in Chapter 7 of the *Remedial*

Investigation/Feasibility Study Work Plan for the 100-BC-1 Operable Unit, Hanford Site, Richland, Washington (DOE-RL 1992b). All contractor or subcontractor plans and procedures shall be approved before use, and shall be available for regulatory review after WHC approval.

2.3 ANALYTICAL LABORATORIES

The WHC field sampling team will be responsible for screening all samples for radioactivity in compliance with EII 2.3, "Administration of Radiation Surveys to Support Environmental Characterization Work on the Hanford Site" (WHC 1988b).

All samples shall be screened for radiological activity prior to shipment to the analytical laboratory. If the total activity of the sample is ≥200 pCi/g or if the alpha activity of the sample ≥60 pCi/g, samples shall be packaged and shipped in compliance with Section 6.3 of EII 5.11, "Sample Packaging and Shipping" (WHC 1988b) and routed to a WHC or Hanford Site participant contractor or subcontractor laboratory equipped and qualified to handle the analysis of radioactive samples. Samples that do not exceed either of the above criteria may be routed to any approved participant contractor or subcontractor analytical laboratory.

All analyses shall be coordinated through Hanford Analytical Services Management (HASM) and shall be performed in compliance with WHC-approved laboratory QA plans and analytical procedures; all analytical laboratories shall be subject to the surveillance controls described by Quality Instruction (QI) 10.4 "Surveillance" (WHC 1988a). For subcontractors or participant contractors, applicable quality requirements shall be invoked as part of the approved procurement documentation or work order; see Sections 3 and 4.1.2 of this QAPjP. Services of alternate qualified laboratories shall be procured for radioactive sample analysis if onsite laboratory capacity is not available for the performance of split sample analysis, at the technical lead's discretion. If such an option is selected, the laboratory shall provide objective evidence of appropriate U.S. Nuclear Regulatory Commission or state radioactive materials handling licenses. The laboratory shall submit its QA plan and applicable analytical procedures for WHC approval prior to use, as noted in Section 4.1.2.

2.4 OTHER SUPPORT CONTRACTORS

Procurement of all other field services and supporting items, materials, or equipment shall comply with standard WHC procurement procedures as discussed in Sections 2.2 and 4.1 of this QAPjP. All work shall comply with WHC-approved QA plans/procedures, and is subject to the controls of QI 10.4, "Surveillance" (WHC 1988a). Applicable quality requirements shall be invoked as part of the approved procurement documentation or work order as noted in Section 4.1.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENTS

The rationale for establishing DQO and data needs for this investigation is presented in Sections 4.1.1 and 4.1.2 of the work plan.

All analytical parameters that have been selected for this investigation are included in Table QAPjP-1, and cross-referenced to analytical method requirements and minimum detection or quantitation limit values and minimum acceptable ranges for precision and accuracy, in both soil and water matrices.

The table covers a full suite of Comprehensive Environmental Response, Compensation, and Liability Act of 1980 target compound list/target analyte list, but for this investigation, a reduced analyte list is being used as discussed in Chapter 4 of the work plan. The specific methods used are identified in Table QAPjP-1. Precision and accuracy requirements are those specified in Table QAPjP-1 which are based on the requirements from *USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis: Multi-Media Multi-Concentration* (EPA 1991a) and *USEPA Contract Laboratory Program Statement of Work for Organic Analysis: Multi-Media, Multi-Concentration* (EPA 1991b). For non-CLP parameters *Test Methods for Evaluating Solid Waste* (EPA 1986), method detection limit, practical quantitation limit, and precision and accuracy ranges are provided that shall be considered minimum values that can be reliably achieved by analytical laboratories under routine conditions.

The requirements of Table QAPjP-1 shall be considered a minimum performance standard, and shall be incorporated into the agreements for services established with individual WHC, participant contractor, or subcontractor analytical laboratories. Any modification of Table QAPjP-1 requirements shall be justified by the requestor, shall be considered a formal modification of this QAPjP, and is subject to regulatory review and approval.

Goals for data representativeness will be addressed qualitatively by the specification of sampling depths and intervals, and the use of standardized techniques discussed in the description of work prepared for this investigation, as previously described in Section 1.3 of this QAPjP. Section 4.1 and Chapter 5 of the work plan can be referenced for a more detailed discussion of the DQO and field activities. Sampling locations will be specified in the description of work or work orders issued to the subcontractors or participating contractors responsible for conducting sampling activities. Objectives for the completeness of this investigation shall require that contractually or procedurally established requirements for precision and accuracy be met for at least 90% of the total number of requested determinations. Failure to meet this criterion shall be documented and evaluated in the validation process described in Chapter 8 of this QAPjP; corrective action shall be taken as warranted, as described in Chapter 13. Approved analytical procedures shall require the use of the reporting techniques and units specified in the EPA reference methods specified in Table QAPjP-1, to facilitate the comparability of data sets in terms of precision and accuracy.

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4.0 SAMPLING PROCEDURES

4.1 APPROVALS AND CONTROL

4.1.1 WHC Procedures

The WHC procedures cited in this QAPjP have been selected from the QAPI included in the QA program plan (WHC 1990a). Selected procedures include EII from the Environmental Investigations Manual (WHC 1988b) (the companion document is *Operational Health Physics Practices Manual* [WHC 1992]) and QR and QI from the QA manual (WHC 1988a). Procedure approval, revision, and distribution control requirements applicable to EII are addressed in EII 1.2, "Preparation and Revision of Environmental Investigations Instructions" (WHC 1988b); requirements applicable to QI and QR are addressed in QR 5.0, "Instructions, Procedures, and Drawings" (WHC 1988a). Other procedures applicable to the preparation, review, approval, and revision of other WHC organizations shall be as defined in the various procedures and manuals identified in the QAPI under criteria 5 and 6. All procedures are available for regulatory review on request, at the direction of the WHC technical lead.

4.1.2 Participant Contractor/Subcontractor Procedures

As previously noted in Section 2.2, participant contractor/subcontractor services shall be procured under QR 4.0, "Procurement Document Control", QR 7.0, "Control of Purchased Items and Services" (WHC 1988a), and other procedures as identified under criteria 4 and 7 of the QAPI included in the QA program plan (WHC 1990a). Submittal requirements of procedures for WHC review and approval before use shall be included in the procurement document or work order, as applicable, when such services require procedural controls. Analytical laboratories shall be required to submit the current version of their internal QA program plans, in addition to analytical procedures. All analytical laboratory plans and procedures shall be reviewed and approved before use by qualified personnel from the WHC analytical laboratories organization, or other qualified personnel, as directed by the technical lead. All reviewers shall be qualified under the requirements of EII 1.7, "Indoctrination, Training, and Qualification" (WHC 1988b). All participant contractor or subcontractor procedures, and plans/manuals shall be retained as project records in compliance with Section 9, *Document Control and Records Management Manual* (WHC 1990b). All such documents are available for regulatory review on request, at the direction of the WHC technical lead.

4.2 SAMPLING PROCEDURES

4.2.1 Sample Acquisition

Soil and sludge sampling shall be performed in accordance with EII 5.2, "Soil and Sediment Sampling" (WHC 1988b). All drilling activities shall be in compliance with EII 6.7, "Resource Protection Well and Test Borehole Drilling" (WHC 1988b). All boreholes shall be logged in compliance with EII 9.1, "Geologic Logging" (WHC 1988b). Sampling procedure applicability to individual project tasks is shown in Table QAPjP-2. Sampling depths and intervals will be identified in the description of work prepared for this investigation as noted in Section 1.3 of this QAPjP. Sample locations will be detailed in the descriptions of work, or work orders issued to the responsible subcontractors or participating contractors. Documentation requirements are defined within individual EII. Samples will be identified by a unique number as described in EII 5.10 "Sample Identification and Data Entry into HEIS Database" (WHC 1988b).

4.2.2 Sample Container Selection

Sample container types, preservation requirements, preparation requirements, and special handling requirements are defined in EII 5.2, "Soil and Sediment Sampling" (WHC 1988b); and EII 5.11, "Sample Packaging and Shipping" (WHC 1988b). Final requirements for sample container types, preservation requirements, etc., will be specified by HASM in the sample authorization form for the project.

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4.3 OTHER INVESTIGATIVE AND SUPPORTING PROCEDURES

Other procedures that will be required, if the task is required, in this phase of the investigation are identified in Table QAPjP-2 referenced to individual tasks as applicable. Other procedures not listed on Table QAPjP-2 that may be required will be documented in the description of work. At this time, no such procedures are anticipated. Documentation requirements shall be addressed within individual procedures/the data management plan, as appropriate. Analytical procedures required for Phase I of this investigation are listed in Table QAPjP-1. All computer software models that may be developed for this investigation shall be documented and verified in compliance with the procedures identified under criterion 3 of the QAPI included in the QA program plan (WHC 1990a). At this time, no such models are anticipated.

4.4 PROCEDURE CHANGES

Should deviations from established EII be required to accommodate unforeseen field situations, they may be authorized by the field team leader in accordance with the requirements specified in EII 1.4, "Deviation from Environmental Investigations Instructions" (WHC 1988b). Documentation, review, and disposition of instruction change authorization forms shall be defined by EII 1.4. Other types of procedure change requests shall be documented as required by QR 6.0, "Document Control" (WHC 1988a) or other procedures as identified under criterion 6 of the QAPI included in the QA program plan (WHC 1990a).

5.0 SAMPLE CUSTODY

Samples obtained during the course of this investigation shall be controlled as required by EII 5.1, "Chain of Custody" (WHC 1988b), from the point of origin to the analytical laboratory. Laboratory chain-of-custody procedures shall be reviewed and approved in compliance with the requirements of Section 4.1 of this QAPjP, and shall ensure the maintenance of sample integrity and identification throughout the analytical process. At the direction of the technical lead, requirements for the return of residual sample materials after completion of analysis shall be defined in accordance with procedures described in the procurement documentation to subcontractor or participant contractor laboratories. Chain-of-custody forms shall be initiated for returned residual samples as required by the approved procedures applicable within the laboratory. All analytical results shall be controlled as permanent project quality records as required by Section 9 (WHC 1990b).

6.0 CALIBRATION PROCEDURES

Calibration of all WHC measuring and test equipment, whether in existing inventory or purchased for this investigation, shall be controlled per QR 12.0, "Control of Measuring and Test Equipment" (WHC 1988a), other procedures as identified under criterion 12 of the QAPI included in the QA program plan (WHC 1990a), and/or specific requirements incorporated in the text of investigation-specific descriptions of work prepared in compliance with EII 1.14, "Preparation of Descriptions of Work" (WHC 1988b). Routine operational checks for WHC field equipment shall be as defined within applicable EII or procedures; similar information shall be provided in WHC-approved participant contractor or subcontractor procedures or included in the text of applicable descriptions of work as indicated above. All calibration requirements applicable to analytical laboratory equipment shall be as defined by standard analytical methods used, subject to WHC review and acceptance.

7.0 ANALYTICAL PROCEDURES

Analytical methods that have been selected for this investigation are listed in Table QAPjP-1, cross-referenced to the parameters of interest and the maximum detection or quantitation limit values and maximum acceptable ranges for precision and accuracy for both soil and water matrices. Where EPA CLP methods are specified, the contract required detection limit (CRDL) for inorganic parameters, the contract required quantitation limit (CRQL) for organic parameters, and the maximum precision and accuracy ranges specified for each parameter by the appropriate CLP statements of work apply without modification (EPA 1991a, 1991b). For non-CLP parameters, CRQL, and precision and accuracy ranges are provided that shall be considered maximum values that can be reliably achieved by analytical laboratories. To facilitate the comparability of data sets in terms of precision and accuracy, all analytical data shall be reported in the standard units specified in the applicable reference method. The reporting requirements so defined and the applicable requirements of Table QAPjP-1 shall be considered minimum performance standards that shall be incorporated into the agreements for services established with individual WHC, participant contractor, or subcontractor analytical laboratories. As previously noted in Chapter 4, any modification of Table QAPjP-1 requirements shall be justified by the requestor, shall be considered a formal modification of this QAPjP, and is subject to regulatory review and approval.

All analytical procedures approved for use in this investigation shall require the use of the standard units specified by the analytical methods referenced in Table QAPjP-1 to facilitate the comparability of data sets in terms of precision and accuracy. All approved procedures shall be retained in the project quality records and shall be available for review on request.

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8.0 DATA REDUCTION, VALIDATION, AND REPORTING

8.1 DATA REDUCTION AND DATA PACKAGE PREPARATION

Analytical laboratories shall be responsible for preparing a report summarizing the results of analyses and for preparing a detailed data package that includes identifying samples, sampling and analysis dates, raw analytical data, reduced data, data outliers, recovery percentages, QC check data, equipment calibration data, supporting chromatogram or spectrograms, and documentation of any nonconformances affecting the measurement system in use during the analysis of the particular group of samples. Data reduction schemes shall be contained within individual laboratory analytical methods, procedures/QA manuals, and submitted for WHC review and acceptance as discussed in Section 4.1. The completed data package shall be reviewed and approved by the analytical laboratory's QA manager, or other authorized person (or field team leader for field screening type analysis) before its submittal to the WHC technical lead. Completed data packages shall be submitted to HASM for verification, tracking, and data validation functions. The requirements of this section shall be included in procurement documentation or work orders, as appropriate, to comply with the standard WHC procurement control procedures noted in Section 4.1.

8.2 VALIDATION

Validation of the completed data package will be performed by qualified WHC personnel or by a qualified independent participant contractor. Ten percent of the data will be validated. Subcontracted validation responsibilities shall be defined in procurement documentation or work orders as appropriate. All validation shall be performed in compliance with the *Sample Management Administration Manual* (WHC 1990c), Section 2.2, for organics analyses, Section 2.1 for inorganics analyses, and Sections 2.3 and 2.4 for radionuclide analysis. No validation is proposed for the 100-DR-2 Operable Unit LFI samples.

8.3 FINAL REVIEW AND RECORDS MANAGEMENT CONSIDERATIONS

Verification and validation reports and supporting analytical data packages shall be subject to a final technical review by a qualified reviewer at the direction of the WHC technical lead, before submittal to regulatory agencies; prior to entry into the HEIS in compliance with EII 14.1, "Analytical Laboratory Data Management," (WHC 1988b); or before inclusion in reports or technical memoranda. Verification and validation reports, data packages, and review comments shall be retained as permanent project quality records in compliance with Section 9, records management manual (WHC 1990b).

8.4 REQUIREMENTS FOR HANDLING UNACCEPTABLE OR SUSPECT DATA

The analytical data flow and data management process is described in detail in EII 14.1, "Analytical Laboratory Data Management" (WHC 1988b). Data errors or procedural discrepancies related to laboratory analytical processes shall prompt data qualification by the validator, requests for reanalysis, or other appropriate corrective action by the responsible laboratory as required by governing HASM or approved subcontractor data validation procedures. If sample holding time requirements are compromised, insufficient sample material is available for reanalysis, or if any other condition prevents compliance with governing analytical methods and data validation protocols, the situation shall be formally documented as a nonconformance in compliance with QR 15.0, "Control of Nonconforming Items" (WHC 1988a). If problems are observed with validated data, either as part of the data assessment process described in Section 12 of this QAPjP or if separately observed by any of the operable unit managers, the data shall be documented as a nonconformance and corrective action initiated as previously noted; if the data have been entered in the HEIS, the HEIS Data Custodian shall be immediately notified so that the data may be flagged (in compliance with EII 14.1 [WHC 1988b] and the *HEIS User's Manual* [WHC 1990d]) as suspect, pending resolution of the nonconforming condition and completion of all required corrective actions.

9.0 IN-PROCESS QUALITY CONTROL

All analytical samples shall be subject to in-process QC measures in both the field and laboratory. Unless otherwise specified in the approved statements of work or work orders for sampling activities, or in applicable EII, the following minimum field quality control requirements shall apply. These requirements are adapted from *Test Methods for Evaluating Solid Waste* (EPA 1986), as modified by the proposed rule changes included in the Federal Register, 1989, Volume 54, No. 13, pp 3212-3228, and 1990, Volume 55, No. 27, pp 4440-4445.

- Field duplicate samples. For sampling activity under an individual sampling subtask, a minimum of 5% of the total collected samples shall be duplicated, or one duplicate shall be collected for every 20 samples, whichever is greater. Duplicate samples shall be retrieved from the same sampling location using the same equipment and sampling technique, and shall be placed into two identically prepared and preserved containers. All field duplicates shall be analyzed independently to provide an indication of field variability and analytical reproducibility.

- Split samples. Upon specific WHC or regulator request, and at the technical lead's direction, field or field duplicate samples may be split in the field and sent to an alternative laboratory as a performance audit of the primary laboratory. The number and frequency of split samples will be specified in the description of work.

- Blind samples. At the technical lead's discretion, blind reference samples may be introduced into any sampling round as a QC check of the primary laboratory.

- Equipment rinsate blanks. Equipment blanks shall consist of purified water (deionized or distilled) washed through decontaminated sampling equipment and placed in containers identical to those used for actual field samples. Equipment blanks are used to verify the adequacy of sampling equipment decontamination procedures, and shall be collected at the same frequency as field duplicate samples where applicable.

- Volatile organic analysis (VOA) trip blanks. Volatile organic analysis trip blanks consist of purified water (deionized or distilled) for water samples and silica sand for soil samples, added to one clean sample container, accompanying each batch (cooler) of containers shipped to the sampling facility. Trip blanks shall be returned unopened to the laboratory, and are prepared as a check on possible contamination originating from container preparation methods, shipment, handling, storage or site conditions. The trip blank shall be analyzed for volatile organic compounds only. In compliance with standard WHC procurement procedures, requirements for trip blank preparation shall be included in procurement documents of work orders to the sample container supplier/preparer.

Unless otherwise specified in WHC-approved analytical methods, internal QC checks performed by analytical laboratories shall meet the following minimum requirements.

- Matrix-spike/matrix-spike duplicate samples. Matrix-spiked samples require the addition of a known quantity of a representative analyte of interest to the sample as a measure of recovery percentage and as a test of analytical precision. Replicate samples are separate aliquots removed from the same sample container in the laboratory. Spike compound selection, quantities, and concentrations shall be described in the analytical procedures submitted for WHC review and acceptance. One sample shall be spiked per analytical batch, or once every 20 samples, whichever is more frequent.

- QC reference samples. A QC reference sample shall be prepared from an independent standard at a concentration other than that used for calibration, but within the calibration range. Reference samples are required for selected analytical methods as an independent check on analytical technique and methodology, and shall be run with every analytical batch, or every 20 samples, whichever is more frequent.

Other requirements specific to laboratory analytical equipment calibration are included in Chapter 6 of this QAPjP. All field screening instruments employed will be described in the description of work. For field screening gas chromatography (GC) analysis, at least one duplicate sample per shift shall be routed to a qualified laboratory as an overcheck on the proper use and functioning of field GC procedures and equipment. Duplicates shall be selected, whenever possible, from samples in which significant readings have been observed during field analysis. The minimum requirements of this section shall be invoked in procurement documents or work orders in compliance with standard WHC procedures as noted in Section 4.1 of this QAPjP.

10.0 PERFORMANCE AND SYSTEM AUDITS

Performance, system, and program audits are scheduled to begin early in the execution of this work plan and continue through work plan completion. Collectively, the audits address quality-affecting activities that include, but are not limited to,

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measurement system accuracy, intramural and extramural analytical laboratory services, field activities, and data collection, processing, validation, and management.

Performance audits of the accuracy of the total measurement system are implemented in accordance with EII 1.12 "Performance Audits" (WHC 1988b). System audit requirements are implemented in accordance with QI 10.4, "Surveillance" (WHC 1988a). Surveillances will be performed regularly throughout the course of the work plan activities. Additional performance and system "surveillances" may be scheduled as a consequence of corrective action requirements, or may be performed on request. All quality-affecting activities are subject to surveillance.

Inter-operable unit activities will also be evaluated as part of routine environmental restoration program-wide QA audits under the requirements of the QA manual (WHC 1988a). Program audits shall be conducted in accordance with QR 18.0, "Audits," QI 18.1, "Audit Programming and Scheduling," and QI 18.2, "Planning, Performing, Reporting, and Follow-up of Quality Audits" by auditors qualified in accordance with QI 2.5, "Qualification of Quality Assurance Personnel" (WHC 1988a).

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11.0 PREVENTIVE MAINTENANCE

Measurement and testing equipment used in the field and laboratories that directly affect the quality of the field and analytical data shall be subject to preventive maintenance measures that ensure minimization of measurement system downtime and corresponding schedule delays. 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 laboratory QA plans, subject to WHC review and acceptance as noted in Sections 2.1, 2.2, and 4.1.2 of this QAPjP. When samples are analyzed using EPA reference methods, the preventive maintenance requirements for laboratory analytical equipment are as defined in the procured laboratory's QA plan(s). Westinghouse Hanford Company field equipment shall be drawn from inventories subject to standard preventive maintenance and calibration procedures as noted under criterion 12 of the QAPI included in the QA program plan (WHC 1990a). Any field procedures submitted for WHC acceptance by participant contractors or subcontractors shall contain, as appropriate, provisions for preventive maintenance schedules and spare parts lists to ensure minimization of equipment downtime.

12.0 DATA ASSESSMENT PROCEDURES

All analytical data shall be compiled, reduced, and reviewed by the laboratory prior to presentation to HASM or subcontractor personnel for validation as described in

Section 8 of this QAPjP. Assessment of the validated data will follow the general guidelines established in Section 5.1.10 of the work plan; depending on the distribution and statistical characteristics of the validated data and other unit- or area-specific considerations, various statistical/probabilistic techniques may be selected for use in the process of data comparison or analysis. The selection of any such methodology shall be subject to the acceptance and authorization of the WHC technical lead. Methods shall be documented, signed, dated, retained as project records in compliance with Section 9 of the records management manual (WHC 1990b), and, as appropriate, considered in the risk assessment and field report preparation tasks described in Sections 5.1.11 and 5.1.13 of the work plan.

13.0 CORRECTIVE ACTION

13.1 GENERAL REQUIREMENTS FOR CORRECTIVE ACTION

Corrective action requests shall be documented and processed as required by QR 16.0, "Corrective Action" (WHC 1988a). Corrective action requests prepared under QR 16.0 requirements shall identify the affected requirement, the probable cause of the deviation, any data that may have been affected by the deviation, and the corrective action required both to resolve the immediate situation and to reduce or preclude its recurrence. Corrections of plans or procedures related to the overall measurement system that do not constitute nonconformances, but may be required as a result of data validation, data assessment, or routine review processes, shall be resolved as required by their governing procedures or shall be referred to the WHC technical lead for resolution and appropriate management action. All documentation related to surveillances, audits, and corrective action shall be maintained in compliance with EII 1.6, "Records Management" (WHC 1988a) and routed to the project quality records on completion or closure for retention in compliance with Section 9 of the records management manual (WHC 1990b), and shall be made available for operable unit manager review on request through the WHC technical lead.

13.2 CORRECTIVE ACTION REQUIREMENTS RELATED TO CALIBRATION ERRORS

Field measuring and test equipment found to be out of calibration shall be documented in compliance with QR 12.0, "Control of Measuring and Test Equipment" (WHC 1988a). Measuring devices shall be tagged, removed from service, and segregated pending resolution of the condition. Calibration errors related to laboratory analytical processes that may be observed in the data validation activities described in Chapter 8 shall prompt requests for appropriate corrective action.

13.3 CORRECTIVE ACTION REQUIREMENTS RELATED TO PURCHASED MATERIALS, ITEMS, OR EQUIPMENT

Purchased materials, items, and equipment found to be out of compliance with their governing procurement specifications shall be documented as a nonconformance in compliance with QR 15.0, "Control of Nonconforming Items" (WHC 1988a). Nonconforming items shall be tagged and segregated pending resolution of the nonconformance.

14.0 QUALITY ASSURANCE REPORTS

Project activities shall be regularly assessed by performance and system audits, surveillances, and program audits. Surveillance, nonconformance, audit, and corrective action documentation shall be routed to the project quality records on completion or closure of the activity. A report summarizing audit, surveillance, nonconformance, and corrective action, as well as any associated corrective actions, shall be prepared for the technical lead by QA at least semiannually. Such information will become part of the remedial investigation report. The final report shall include an assessment of the overall adequacy of the total measurement system with regard to the DQO of the investigation.

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Table QAPjP-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 100-DR-2 Operable Unit (Sheet 1 of 11)

Analytical Category	Analytical Parameters	Analytical Method	MDL or PQL, Soil[a]	Precision[b], Soil	Accuracy[b], Soil	MDL or PQL ppb, water[a]	Precision[b], Water	Accuracy[b], Water
Volatile Organic	Chloromethane	8240	10	c	c	10	c	c
SW-846	Bromomethane		10	c	c	10	c	c
MDL/PQL-ppb	Vinyl Chloride		10	c	c	10	c	c
	Chloroethane		10	c	c	10	c	c
	Methylene Chloride		5	c	c	5	c	c
	Acetone		100	c	c	100	c	c
	Carbon Disulfide		100	c	c	100	c	c
	1,1-Dichloroethene		5	c	c	5	c	c
	1,1-Dichloroethane		5	c	c	5	c	c
	1,2-Dichloroethene (total)		5	c	c	5	c	c
	Chloroform		5	c	c	5	c	c
	1,2-Dichloroethane		5	c	c	5	c	c
	2-Butanone		100	c	c	100	c	c
	1,1,1-Trichloroethane		5	c	c	5	c	c
	Carbon Tetrachloride		5	c	c	5	c	c
	Bromodichloromethane		5	c	c	5	c	c
	1,2-Dichloropropene		5	c	c	5	c	c
	Trichloroethene		5	c	c	5	c	c
	Dibromochloromethane		5	c	c	5	c	c

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Table QAPjP-1 Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 100-DR-2 Operable Unit (Sheet 2 of 11)

Analytical Category	Analytical Parameters	Analytical Method	MDL or PQL, Soil[a]	Precision[b], Soil	Accuracy[b], Soil	MDL or PQL ppb, water[a]	Precision[b], Water	Accuracy[b], Water
Volatile Organics (cont'd)	1,1,2-Trichloroethene		5	c	c	5	c	c
	Benzene		5	c	c	5	c	c
	trans-1,3-Dichloropropene		5	c	c	5	c	c
	cis-1,3-Dichloropropene		5	c	c	5	c	c
	Bromoform		5	c	c	5	c	c
	4-Methyl-2-pentanone		50	c	c	50	c	c
	2-Hexanone		50	c	c	50	c	c
	Tetrachloroethene		5	c	c	5	c	c
	Toluene		5	c	c	5	c	c
	1,1,2,2-Tetrachloroethane		5	c	c	5	c	c
	Chlorobenzene		5	c	c	5	c	c
	Ethyl Benzene		5	c	c	5	c	c
	Styrene		5	c	c	5	c	c
	Xylenes (total)		5		c	5	c	c
Semi-Volatile Organics SW-846 MDL/PQL-ppb	Phenol	8270	660	c	c	10	c	c
	bis(2-Chloroethyl) ether		660	c	c	10	c	c
	2-Chlorophenol		660	c	c	10	c	c
	1,3-Dichlorobenzene		660	c	c	10	c	c
	1,4-Dichlorobenzene		660	c	c	10	c	c
	1,2-Dichlorobenzene		660	c	c	10	c	c

Table QAPjP-1 Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 100-DR-2 Operable Unit (Sheet 3 of 11)

Analytical Category	Analytical Parameters	Analytical Method	MDL or PQL, Soil[a]	Precision[b], Soil	Accuracy[b], Soil	MDL or PQL ppb, water[a]	Precision[b], Water	Accuracy[b], Water
Semi-Volatile Organics (cont'd)	2-Methylphenol		660	c	c	10	c	c
	2,2'-oxybis (1-Chloropropane)		660	c	c	10	c	c
	4-Methylphenol		660	c	c	10	c	c
	N-Nitroso-di-n-dipropylamine		660	c	c	10	c	c
	Hexachloroethane		660	c	c	10	c	c
	Nitrobenzene		660	c	c	10	c	c
	Isophorone		660	c	c	10	c	c
	2-Nitrophenol		660	c	c	10	c	c
	2,4-Dimethylphenol		660	c	c	10	c	c
	bis(2-Chloroethoxy) methane		660	c	c	10	c	c
	2,4-Dichlorophenol		660	c	c	10	c	c
	1,2,4-Trichlorobenzene		660	c	c	10	c	c
	Naphthalene		660	c	c	10	c	c
	4-Chloroaniline		1300	c	c	20	c	c
	Hexachlorobutadiene		660	c	c	10	c	c
	4-Chloro-3-methylphenol		1300	c	c	20	c	c
	2-Methylnaphthalene		660	c	c	10	c	c
	Hexachlorocyclopentadiene		660	c	c	10	c	c
	2,4,6-Trichlorophenol		660	c	c	10	c	c
	2,4,5-Trichlorophenol		660	c	c	10	c	c

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Table QAPjP-1 Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 100-DR-2 Operable Unit (Sheet 4 of 11)

Analytical Category	Analytical Parameters	Analytical Method	MDL or PQL, Soil[a]	Precision[b], Soil	Accuracy[b], Soil	MDL or PQL ppb, water[a]	Precision[b], Water	Accuracy[b], Water
Semi-Volatile Organics (cont'd)	2-Chloronaphthalene		660	c	c	10	c	c
	2-Nitroanilien		3300	c	c	50	c	c
	Dimethylphthalate		660	c	c	10	c	c
	Acenaphthylene		660	c	c	10	c	c
	2,6-Dinitrotoluene		660	c	c	10	c	c
	3-Nitroaniline		3300	c	c	50	c	c
	Acenaphthene		660	c	c	10	c	c
	2,4-Dinitrophenol		3300	c	c	50	c	c
	4-Nitrophenol		3300	c	c	50	c	c
	Dibenzofuran		660	c	c	10	c	c
	2,4-Dinitrotoluene		660	c	c	10	c	c
	Diethylphthalate		660	c	c	10	c	c
	4-Chlorophenyl-phenylether		660	c	c	10	c	c
	Fluorene		660	c	c	10	c	c
	4-Nitroaniline		3300	c	c	50	c	c
	4,6-Dinitro-2-methylphenol		3300	c	c	50	c	c
	N-nitrosodiphenylamine		660	c	c	10	c	c
	4-Bromophenyl-phenylether		660	c	c	10	c	c
	Hexachlorobenzene		660	c	c	10	c	c
	Pentachlorophenol		3300	c	c	50	c	c

Table QAPjP-1 Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 100-DR-2 Operable Unit (Sheet 5 of 11)

Analytical Category	Analytical Parameters	Analytical Method	MDL or PQL, Soil[a]	Precision[b], Soil	Accuracy[b], Soil	MDL or PQL ppb, water[a]	Precision[b], Water	Accuracy[b], Water
Semi-Volatile Organics (cont'd)	Phenanthrene		660	c	c	10	c	c
	Anthracene		660	c	c	10	c	c
	Carbazole		660	c	c	10	c	c
	Di-n-butylphthalate		660	c	c	10	c	c
	Fluoranthene		660	c	c	10	c	c
	Pyrene		660	c	c	10	c	c
	Butylbenzylphthalate		660	c	c	10	c	c
	3,3'-Dichlorobenzidine		1300	c	c	20	c	c
	Benzo(a)anthracene		660	c	c	10	c	c
	Chrysene		660	c	c	10	c	c
	bis(2-Ethylhexyl)phthalate		660	c	c	10	c	c
	Di-n-octylphthalate		660	c	c	10	c	c
	Benzo(b)fluoranthene		660	c	c	10	c	c
	Benzo(k)fluoranthene		660	c	c	10	c	c
	Benzo(a)pyrene		660	c	c	10	c	c
	Indeno(1,2,3-cd)pyrene		660	c	c	10	c	c
Pesticides/Arochlors SW-846 MCL/PQL-ppb	Dibenzo(a,h)anthracene	8080	660	c	c	10	c	c
	Benzo(g,h,i)perylene		660	c	c	10	c	c
	alpha-BHC		2	c	c	0.03	c	c
	beta-BHC		4	c	c	0.06	c	c

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Table QAPjP-1 Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 100-DR-2 Operable Unit (Sheet 6 of 11)

Analytical Category	Analytical Parameters	Analytical Method	MDL or PQL, Soil[a]	Precision[b], Soil	Accuracy[b], Soil	MDL or PQL ppb, water[a]	Precision[b], Water	Accuracy[b], Water
Pesticides/Arochlors (cont'd)	delta-BHC		6	c	c	0.04	c	c
	gamma-BHC (Lindane)		2.7	c	c	0.04	c	c
	Heptachlor		2	c	c	0.03	c	c
	Aldrin		2.7	c	c	0.04	c	c
	Heptachlor epoxide		56	c	c	0.83	c	c
	Endosulfan I		9.4	c	c	0.14	c	c
	Dieldrin		1.3	c	c	0.02	c	c
	4,4'-DDE		2.7	c	c	0.04	c	c
	Endrin		4	c	c	0.06	c	c
	Endosulfan II		2.7	c	c	0.04	c	c
	4,4'-DDD		7.4	c	c	0.11	c	c
	Endosufan sulfate		44	c	c	0.66	c	c
	4,4'-DDT		8	c	c	0.12	c	c
	Methoxychlor		120	c	c	1.76	c	c
	Endrin ketone		3.3	c	c	0.10	c	c
	Endrin aldehyde		3.3	c	c	0.23	c	c
	alpha-Chlordane		1.7	c	c	0.05	c	c
	gamma-Chlordane		1.7	c	c	0.05	c	c
	Toxaphene		160.0	c	c	2.4	c	c
	Aroclor-1016		80	c	c	0.5	c	c

Table QAPjP-1 Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 100-DR-2 Operable Unit (Sheet 7 of 11)

Analytical Category	Analytical Parameters	Analytical Method	MDL or PQL, Soil[a]	Precision[b], Soil	Accuracy[b], Soil	MDL or PQL ppb, water[a]	Precision[b], Water	Accuracy[b], Water
Pesticides/Arochlors (cont'd)	Aroclor-1221		80	c	c	0.5	c	c
	Aroclor-1232		80	c	c	0.5	c	c
	Aroclor-1242		44	c	c	0.65	c	c
	Aroclor-1248		80	c	c	.5	c	c
	Aroclor-1254		160	c	c	1.0	c	c
	Aroclor-1260		160	c	c	1.0	c	c
Inorganics SW-846 MDL/PQL-ppm	Aluminum	6010	40	c	c	200	c	c
	Antimony	6010	12	c	c	60	c	c
	Arsenic	7060/GFAA	2	c	c	10	c	c
	Barium	6010	40	c	c	200	c	c
	Beryllium		1	c	c	5	c	c
	Cadmium		1	c	c	5	c	c
	Calcium		1000	c	c	5000	c	c
	Chromium		2	c	c	10	c	c
	Cobalt		10	c	c	50	c	c
	Copper		5	c	c	25	c	c
	Iron		20	c	c	100	c	c
	Lead	7421/GFAA	.6	c	c	3	c	c
	Magnesium	6010	1000	c	c	5000	c	c
	Manganese	6010	3	c	c	15	c	c

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Table QAPjP-1 Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 100-DR-2 Operable Unit (Sheet 8 of 11)

Analytical Category	Analytical Parameters	Analytical Method	MDL or PQL, Soil[a]	Precision[b], Soil	Accuracy[b], Soil	MDL or PQL ppb, water[a]	Precision[b], Water	Accuracy[b], Water
Inorganics (cont'd)	Mercury	7471/CVAA	.1	c	c	0.2	c	c
	Nickel	6010	8	c	c	40	c	c
	Potassium	6010	1000	c	c	5000	c	c
	Selenium	7741/GFAA	1	c	c	5	c	c
	Silver	6010	2	c	c	10	c	c
	Sodium	6010	1000	c	c	5000	c	c
	Thallium	7841/GFAA	2	c	c	10	c	c
	Vanadium	6010	10	c	c	50	c	c
	Zinc	6010	4	c	c	20	c	c
	Cyanide	9010	2.5	c	c	10	c	c
Anions MDL/PQL-ppm	Ammonia as Nitrogen	350.3[d]	N/A	N/A	N/A	30	±20	75-125
	Chloride	EPA 300/modified[e], 325.3[d] or 325.2[d]	N/A	N/A	N/A	10,000	±20	75-125
	Fluoride	EPA 300/modified[e], or 340.2	0.5	±35	75-125	100	±20	75-125
	Nitrate	EPA 300/modified[e], 352.1[d], 353.3[d], 353.2[d], or 354.1[d]	1.0	±35	75-125	100	±20	75-125

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Table QAPjP-1 Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 100-DR-2 Operable Unit (Sheet 9 of 11)

Analytical Category	Analytical Parameters	Analytical Method	MDL or PQL, Soil[a]	Precision[b], Soil	Accuracy[b], Soil	MDL or PQL ppb, water[a]	Precision[b], Water	Accuracy[b], Water
Anions (cont'd)	Phosphate	EPA 300/modified[c], 365.1[d], 365.2[d], 365.3[d]	N/A	N/A	N/A	500	±20	75-125
	Sulfate	EPA 300/modified[c], 375.2[d], 375.3[d], 375.4[d]	20.0	±35	75-125	2000	±20	75-125
	Sulfide	9030[f]	N/A	N/A	N/A	5	±20	75-125
Radionuclides	Hydrogen-3	Water 906.0[g]	N/A	N/A	N/A	400 pCi/L	±20	75-125
	Carbon-14	i	i	i	i	i	i	i
	Strontium-90	Sr-01[j]	1 pCi/g	±35	75-125	10 pCi/L	±20	75-125
	Technetium-99	Tc-01[j]	N/A	N/A	N/A	10 pCi/L	±20	75-125
	Alpha Spectrometry (uranium-235, uranium-238, plutonium-239, plutonium-240, and americium-241)	ASTM D 3084[k]	1 pCi/g	±35	75-125	3 pCi/L	±20	75-125
	Gross alpha	Water 900[g] Soil[h]	1 pCi/g	±35	75-125	3 pCi/L	±20	75-125

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Table QAPjP-1 Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 100-DR-2 Operable Unit (Sheet 10 of 11)

Analytical Category	Analytical Parameters	Analytical Method	MDL or PQL, Soil[a]	Precision[b], Soil	Accuracy[b], Soil	MDL or PQL ppb, water[a]	Precision[b], Water	Accuracy[b], Water
Radionuclides	Gross beta	Water 900[g] Soil[h]	4 pCi/g	±35	75-125	4 pCi/L	±20	75-125
(cont'd)	Gamma Spectrometry (report all identifiable and quantifiable isotopes)	Water 901.1[g] Soil[h]	0.5 pCi/g	±35	75-125	5 pCi/L	±20	75-125
Other groundwater parameters	Alkalinity	310.1[d]	N/A	N/A	N/A	10,000	±20	75-125
	Chemical Oxygen Demand	410.1[d]	N/A	N/A	N/A	1000	±20	N/A
	Specific Conductance	i	N/A	N/A	N/A	25	±20	N/A
	pH	i	N/A	N/A	N/A	N/A	N/A	N/A
	Temperature	i	N/A	N/A	N/A	N/A	±1°C	N/A
	Dissolved Oxygen	360.1[d]	N/A	N/A	N/A	100	±20	N/A
	Total Dissolved Solids	160.1[d]	N/A	N/A	N/A	10,000	±20	N/A
	Total Organic Carbon	415.1[d]	N/A	N/A	N/A	1000	±20	75-125
	Total Organic Halides	9020[f]	N/A	N/A	N/A	5	±20	75-125
	Turbidity	180.1[d]	N/A	N/A	N/A	0.05 NTU	±.05 NTU	N/A

Table QAPjP-1 Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 100-DR-2 Operable Unit (Sheet 11 of 11)

Analytical Category	Analytical Parameters	Analytical Method	MDL or PQL, Soil[a]	Precision[b], Soil	Accuracy[b], Soil	MDL or PQL ppb, water[a]	Precision[b], Water	Accuracy[b], Water

[a] For all SW-846 analytical categories, MDL or Program Quantitation Limits (PQL) refers to the Method Detection Limit specified in the US EPA SW-846 *Test Methods for Evaluating Solid Waste* (EPA 1986). Unless otherwise specified, all inorganic soil values are expressed in mg/Kg, and all organic soil values are expressed as μg/Kg. All MDL/PQL values for water are expressed in μg/L.

[b] Acceptable ranges for precision and accuracy for EPA Contract Laboratory Program (CLP) Target Compound List (TCL) organics and Target Analyte List (TAL) inorganic parameters shall be as specified for each analyte by the applicable CLP Statements of Work (SOWs; see EPA 1990a and 1990b). For all other parameters, the ranges provided shall be considered maximum values that can be reliably achieved by the laboratories under routine normal conditions. Precision is expressed as Relative Percent Difference (RPD); accuracy is expressed as percent recovery (%R). In all cases, these limits apply to sample results greater than five times the MDL or PQL, and shall be considered requirements in the absence of known or suspected interferences which may hinder achieving the limit by the analytical laboratory.

[c] As specified in the CLP SOWs (EPA 1991a and 1991b) for organic and inorganic analysis; precision and accuracy requirements shall be as specified therein without modification.

[d] Methods specified are from *Methods for Chemical Analysis of Water and Wastes* (Kopp and McKee 1983).

[e] Method specified is from *Determination of Inorganic Anions in Aqueous and Solid Samples by Ion Chromatography* (Lindahl 1984), and is a modification of EPA method 300.0

[f] Methods specified are from *Test Methods for Evaluating Solid Waste* (EPA 1986).

[g] Method specified is from *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (Krieger and Whittaker 1980).

[h] Method shall be based on the specified water method, modified to allow distillation of the parameter of interest in a soil sample and shall be submitted for Westinghouse Hanford review and acceptance prior to use.

[i] Methods, CRQLs, and maximum ranges for precision and accuracy shall be developed and approved in compliance with Westinghouse Hanford or Westinghouse Hanford accepted participant contractor or subcontractor procedures.

[j] Methods specified are from the *EML Procedures Manual* (Volchok and dePlanque 1982).

[k] Method specified is from the *1991 Annual Book of ASTM Standards* (ASTM 1991).

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Table QAPjP-2 Sampling and Investigative Procedures for the Limited Field Investigation in the 100-DR-2 Source Operable Unit (Sheet 1 of 3)

	Procedure Title or Subject[a,b]	Task 2 Source Investigation	Task 3 Geological Investigation[c]	Task 5 Vadose Zone Investigation	Task 7 Air Investigation
EII 1.1	Hazardous Waste Site Entry Requirements	X		X	X
EII 1.2	Preparation and Revision of Environmental Investigations Instructions	X		X	X
EII 1.4	Instruction Change Authorizations	X		X	X
EII 1.5	Field Logbooks	X		X	
EII 1.6	QA Record Processing	X		X	X
EII 1.7	Indoctrination, Training, and Qualification	X		X	X
EII 1.9	Primary and Secondary Document Review and Control	X		X	X
EII 1.10	Identifying, Evaluating, and Document Suspect Waste Sites	X			
EII 1.11	Technical Data Management	X		X	X
EII 1.12	Performance Audits	X		X	X
EII 1.13	Environmental Readiness Review	X		X	X
EII 1.14	Preparation of Descriptions of Work	X		X	
EII 2.1	Preparation of Hazardous Waste Operations Permits	X		X	X
EII 2.2	Occupational Health Monitoring	X		X	X

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Table QAPjP-2 Sampling and Investigative Procedures for the Limited Field Investigation in the 100-DR-2 Source Operable Unit (Sheet 2 of 3)

	Procedure Title or Subject[a,b]	Task 2 Source Investigation	Task 3 Geological Investigation[c]	Task 5 Vadose Zone Investigation	Task 7 Air Investigation
EII 2.3	Administration of Radiation Surveys to Support Environmental Characterization Work on the Hanford Site	X		X	
EII 3.2	Calibration and Control of Monitoring Instruments	X		X	X
EII 4.3	Control of CERCLA and Other Past-Practice Derived Waste	X		X	
EII 5.1	Chain of Custody	X		X	
EII 5.2	Soil and Sediment Sampling	X		X	
EII 5.4	Field Decontamination of Drilling, Well Development, and Sampling Equipment			X	
EII 5.5	1706 KE Laboratory Decontamination of RCRA/CERCLA Sampling Equipment	X		X	
EII 5.7A	Hanford Geotechnical Sample Library Control	X		X	
EII 5.10	Obtaining Sample Identification Numbers and Accessing HEIS Data	X		X	
EII 5.11	Sample Packaging and Shipping	X		X	
EII 5.12	Air Quality Sampling of Ambient and Downwind Air at Waste Sites				X
EII 6.1	Activity Reports of Field Operations	X		X	

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Table QAPjP-2 Sampling and Investigative Procedures for the Limited Field Investigation in the 100-DR-2 Source Operable Unit (Sheet 3 of 3)

	Procedure Title or Subject[a,b]	Task 2 Source Investigation	Task 3 Geological Investigation[c]	Task 5 Vadose Zone Investigation	Task 7 Air Investigation
EII 6.7	Resource Protection Well and Test Borehole Drilling			X	
EII 6.9	Groundwater Well and Borehole Identification and Tracking[d]			X	
EII 9.1	Geologic Logging			X	
EII 11.1	Geophysical Logging			X	
EII 14.1	Analytical Laboratory Data Management	X		X	X
[d]	Data Validation	X		X	

[a] Procedures are latest versions of Westinghouse Hanford Environmental Investigations Instructions (EII) from WHC-CM-7-7, Environmental Investigations and Site Characterization Manual (WHC 1988b), unless otherwise indicated.
[b] Companion document is Operational Health Physics Practice Manual, WHC-CM-4-12 (WHC 1992).
[c] Geologic activities will be conducted under the Task 3 Vadose Zone Investigation and related groundwater operable unit investigations.
[d] WHC-CM-5-3, Sample Management Administration Manual (WHC 1990c).

Legend:

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
HEIS = Hanford Environmental Information System
RCRA = Resource Conservation and Recovery Act of 1976

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APPENDIX B

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 (HSP) is to establish standard health and safety procedures for WHC employees and contractors engaged in remedial investigation activities in the 100-DR-2 Operable Unit. These activities will include surface investigation, drilling and sampling boreholes, and environmental sampling in areas of known chemical and radiological contamination. Appropriate site-specific safety documents [e.g., Hazardous Waste Operations Permit (HWOP) or Job Safety Analysis (JSA)] will be written for each task or group of tasks.

All employees of WHC or any other contractors who are participating in onsite activities in the 100-DR-2 Operable Unit shall read the site-specific safety document and attend a pre-job safety or tailgate safety meeting to review and discuss the task.

1.2 DESIGNATED SAFETY PERSONNEL

The field team leader and site safety officer are responsible for site safety and health. Specific individuals will be assigned on a task-by-task basis by project management, and their names will be properly recorded before the task is initiated.

All activities onsite must be cleared through the field team leader. The field team leader has responsibility for the following:

- allocating and administering resources to successfully comply with all technical and health and safety requirements
- verifying that all permits, supporting documentation, and clearances are in place (e.g., electrical outage requests, welding permits, excavation permits, HWOP or JSA, sampling plan, radiation work permits [RWP], and onsite/offsite radiation shipping records)
- providing technical advice during routine operations and emergencies
- informing the appropriate site management and safety personnel of the activities to be performed each day
- coordinating resolution of any conflicts that may arise between RWPs and the implementation of the HWOP or JSA with health physics
- handling emergency response situations as may be required
- conducting pre-job and daily tailgate safety meetings

- interacting with adjacent building occupants and/or inquisitive public.

The site safety officer is responsible for implementing the HWOP at the site. The site safety officer shall do the following.

- Monitor chemical, physical, and (in conjunction with the health physics technician) radiation hazards to assess the degree of hazard present; monitoring shall specifically include organic vapor detection, radiation screening, and confined space evaluation where appropriate.
- Determine protection levels, clothing, and equipment needed to ensure the safety of personnel in conjunction with the health physics department.
- Monitor the performance of all personnel to ensure that the required safety procedures are followed.
- Halt operations immediately, if necessary, because of safety or health concerns.
- Conduct safety briefings as necessary.
- Assist the field team leader in conducting safety briefings as necessary.

The health physics technician is responsible for ensuring that all radiological monitoring and protection procedures are being followed as specified in *Radiation Protection* (WHC 1988a) and in the appropriate RWP. Westinghouse Hanford Company Industrial Safety and Fire Protection personnel will provide safety overview during drilling operations consistent with WHC policy and, as requested, will provide technical advice. Also, downwind sampling for hazardous materials and radiological contaminants and other analyses may be requested from appropriate contractor personnel as required.

The ultimate responsibility and authority for employee's health and safety lies with the employee and the employee's colleagues. Each employee is responsible for exercising the utmost care and good judgment in protecting his or her personal 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 previously. In the event of an immediately dangerous or life-threatening situation, the employee automatically has temporary "stop work" authority and the responsibility to immediately notify the field team leader or site safety officer. When work is temporarily halted because of a safety or health concern, personnel will exit the exclusion zone and meet at a predetermined place in the support zone. The field team leader, site safety officer, and health physics technician will determine the next course of action.

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1.3 MEDICAL SURVEILLANCE

All field team members engaged in operable unit activities at sites governed by an HWOP must have baseline physical examinations and be participants in Westinghouse Hanford Company (or an equivalent) hazardous waste worker medical surveillance program.

Medical examinations will be designed to identify any pre-existing conditions that 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 personal health. The physician shall determine the existence of conditions that may reduce the effectiveness or prevent the employee's use of respiratory protection. 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 applicable to the employee's fitness for the work required.

1.4 TRAINING

Before engaging in any onsite remedial investigation activities, each team member is required to have received 40 hours of health and safety training related to hazardous waste site operations and at least 8 hours of refresher training each year thereafter, as specified in 29 CFR 1910.120. In addition, each inexperienced employee (never having performed site characterization) will be directly supervised by a trained/experienced person for a minimum of 24 hours of field experience.

The field team leader and the site safety officer who are directly responsible for employees engaged in hazardous waste operations shall receive an additional 8 hours of training (in addition to the refresher training previously discussed) as specified in WAC 296-62-3040(4).

1.5 TRAINING FOR VISITORS

For the purposes of this plan, a visitor is defined as any person visiting the Hanford Site, who is not a WHC employee or a WHC contractor directly involved in the RCRA/CERCLA facility investigation activities, including but not limited to those engaged in surveillance, inspection, or observation activities.

Visitors who must, for whatever reason, enter a controlled (either contamination reduction or exclusion) zone, shall be subject to all of the applicable training, respirator fit testing, and medical surveillance requirements discussed in EII 1.1 and Appendix B to EII 1.1 *Environmental Investigations and Site Characterization Manual* (WHC 1988b).

All visitors shall be informed of potential hazards and emergency procedures by their escorts and shall conform to EII 1.1 (WHC 1988b).

1.6 RADIATION DOSIMETRY

All personnel engaged in onsite activities shall be assigned dosimeters according to the requirements of the RWP applicable to that activity. All visitors shall be assigned basic dosimeters, as a minimum, that will be exchanged annually.

1.7 REQUIREMENTS FOR THE USE OF RESPIRATORY PROTECTION

All employees of WHC and subcontractors 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 the Hanford Environmental Health Foundation (HEHF) or other 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).

Before using a negative pressure respirator, each employee must have been fit-tested (within the previous year) for the specific make, model, and size according to WHC fit-testing procedures. Beards (including a few days' growth), large sideburns, or moustaches that may interfere with a proper respirator seal are not permitted.

Subcontractors must provide evidence to WHC that personnel are participants in a medical surveillance and respiratory protection program that complies with 29 CFR 1910.120 and 29 CFR 1910.134, respectively.

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2.0 GENERAL PROCEDURES

The following personal hygiene and work practice guidelines are intended to prevent injuries and adverse health effects. A hazardous waste site poses a multitude of health and safety concerns because of the variety and number of hazardous substances present. These guidelines represent the minimum standard procedures for reducing potential risks associated with this project and are to be followed by all job-site employees <u>at all times</u>.

2.1 GENERAL WORK SAFETY PRACTICES

2.1.1 Work Practices

The following work practices must be observed.

- Eating, drinking, smoking, taking medications, chewing gum, and similar actions are prohibited within the exclusion zone. All sanitation facilities shall be located outside the exclusion zone; decontamination is required before using such facilities.

- Personnel shall avoid direct contact with contaminated materials unless necessary for sample collecting or required observation. Remote handling of such things as casings and auger flights will be practiced whenever practical.

- While operating in the controlled zone, personnel shall use the "buddy system" where appropriate, or be in visual contact with someone outside of the controlled zone.

- The buddy system will be used where appropriate for manual lifting.

- Requirements of WHC radiation protection and RWP manuals shall be followed for all work involving radioactive materials or conducted within a radiologically controlled area.

- Onsite work operations shall only be carried out during daylight hours, unless the entire control zone is adequately illuminated with artificial lighting. A new tour (shift) will operate the drilling rig after completion of each shift.

- Do not handle soil, waste samples, or any other potentially contaminated items unless wearing the protective gloves specified in the HWOP or JSA.

- Whenever possible, stand upwind of excavations, boreholes, well casings, drilling spoils, and the like, as indicated by an onsite windsock.

- Stand clear of trenches during excavation. Always approach an excavation from upwind.

- Be alert to potentially changing exposure conditions as evident by such indications as perceptible odors, unusual appearance of excavated soils, or oily sheen on water.

- Do not enter any test pit or trench deeper than 4 ft unless in accordance with procedures specified in the HWOP.

- Do not under any circumstances enter or ride in or on any backhoe bucket, materials hoist, or any other similar device not specifically designed for carrying passengers.

- All drilling team members must make a conscientious effort to remain aware of their own and others' positions in regards to rotating equipment, cat heads, or u-joints. Drilling operations members must be extremely careful when assembling, lifting, and carrying flights or pipe to avoid pinch-point injuries and collisions.

- Tools and equipment will be kept off the ground whenever possible to avoid tripping hazards and the spread of contamination.

- Personnel not involved in operation of the drill rig or monitoring activities shall remain a safe distance from the rig as indicated by the field team leader.

- Follow all provisions of each site-specific hazardous work permit as addressed in the HWOP, including cutting and welding, confined space entry, and excavation.

- Catalytic converters on the underside of vehicles are sufficiently hot to ignite dry prairie grass. Team members should not drive over dry grass that is higher than the ground clearance of the vehicle and should be aware of the potential fire hazard posed by catalytic converters at all times. Never allow a running or hot vehicle to sit in a stationary location over dry grass or other combustible materials.

- Follow all provisions of each site-specific RWP.

- Team members will attempt to minimize truck tire disturbance of all stabilized sites.

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2.1.2 Personal Protective Equipment

- Personal protective equipment will be selected specifically for the hazards identified in the HWOP. The site safety officer in conjunction with Westinghouse Hanford Company Health Physics and Industrial Hygiene and Safety is responsible for choosing the appropriate type and level of protection required for different activities at the job site.

- Levels of protection shall be appropriate to the hazard to avoid either excessive exposure or additional hazards imposed by excessive levels of protection. The HWOP will contain provisions for adjusting the level of protection as necessary. These personal protective equipment specifications must be followed at all times, as directed by the field team leader, health physics technician, and site safety officer.

- Each employee must have a hard hat, safety glasses, and substantial protective footwear available to wear as specified in the HWOP or JSA.

- The exclusion zone around drilling or other noisy operations will be posted "Hearing Protection Required" and team members will have noise control training

- Personnel should 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 protective equipment.

- Personnel should be alert to the symptoms of fatigue, heat stress, and cold stress and their effects on the normal caution and judgment of personnel.

- Life jackets must be worn and employees shall use the buddy system for any activities over water (e.g., water column sampling of the Columbia River). Additional rescue equipment as required by Occupational Safety and Health Administration (OSHA), Washington Industrial Safety and Health Act (WISHA), or standards for working over water will be available and used.

2.1.3 Personal Decontamination

- The HWOP will describe in detail methods of personnel decontamination, including the use of contamination control corridors and step-off pads when appropriate.

- Thoroughly wash hands and face before eating or putting anything in the mouth to avoid hand-to-mouth contamination.

- At the end of each work day or each job, disposable clothing shall be removed and placed in (chemical contamination) drums, plastic-lined boxes or other containers as appropriate. Clothing that can be cleaned may be sent to the Hanford Site Laundry.

- Individuals are expected to thoroughly shower before leaving the work site or Hanford Site if directed to do so by the health physics technician, site safety officer, or field team leader.

2.1.4 Emergency Preparation

- A multipurpose dry chemical fire extinguisher, a fire shovel, a complete field first-aid kit, and a portable pressurized spray wash unit shall be available at every site where there is potential for personnel contamination.

- Prearranged hand signals or other means of emergency communication will be established when respiratory protection equipment is to be worn, because this equipment seriously impairs speech.

- The Hanford Fire Department shall be initially notified before the start of the site investigation project. This notification shall include the location and nature of the various types of field work activities as described in the work plan. A site location map shall be included in this notification.

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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 4 ft deep. If confined spaces are to be entered as part of the work operations, a hazardous work permit (filled out for confined space entry) must be obtained from Industrial Safety and Fire Protection.

The identified remedial investigation activities on the 100-DR-2 Operable Unit should not require confined space entry. Nevertheless, the hazards associated with confined spaces are of such severity that all employees should be familiar with the safe work discussed in the following paragraphs.

No employee shall enter any test pit or trench deeper than 4 ft unless the sides are shored or laid back to a stable slope as specified in OSHA 29 CFR 1926.652 or equivalent state occupational health and safety regulations.

When an employee is required to enter a pit or trench 4 ft deep or more, 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.

Before entering any confined space, <u>including any test pit</u>, the atmosphere will be tested for flammable gases, oxygen deficiency, and organic vapors. If other specific contamination, such as radioactive materials or other gases and vapors may be present, additional testing for those substances shall be conducted. Depending on the situation, the space may require ventilation and retesting before entry.

An 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 previously and the action levels for airborne contaminants (see "Warnings and Action Levels" in HWOP).

No employee shall enter any test pit requiring the use of level B protection, unless a backup person also equipped with a pressure-demand self-contained breathing apparatus is present. No backup person shall attempt any emergency rescue unless a second backup person equipped with self contained breathing apparatus is present, or the appropriate emergency response authorities have been notified and additional help is on the way.

3.0 SITE BACKGROUND

Specific details on the 100-DR-2 Operable Unit background and known and suspected contamination are described in Chapters 2.0 and 3.0 of the work plan. The 100-DR-2 Operable Unit is situated within the 100 D/DR Area of the DOE Hanford Site, in the south-central portion of the state of Washington. The 100 D/DR Area is located in Benton County along the south bank of the Columbia River in the north-central part of the Hanford Site, approximately 50 km (31 mi) north-northwest of the city of Richland, Washington. The 100-DR-2 Operable Unit encompasses an area south of the 100-DR-1 Operable Unit which is bounded on the south and east by the 100-DR-3 Operable Unit. The 100-DR-2 Operable Unit extends eastward from a boundary common to all three operable units to a point just east of the 118-DR-2 (105-DR) Reactor Building. It lies predominantly within the northeast quadrant of Section 22 and the northwest quadrant of Section 23 of T.14 N., R.26 E., and is located within latitude 46°41' and 46°41'10" north and longitude 119°33' and 119°32' west.

The 100 D/DR Area at the Hanford Site was used by the U.S. Government between 1944 and 1967 to produce plutonium for nuclear weapons. These operations resulted in the release of chemical and radioactive wastes into the soil, air, and water of the area. For cleanup purposes, the 100 D/DR Area has been divided into four operable units, three of which cover the surface (100-DR-1, 100-DR-2, and 100-DR-3) while the fourth (100-HR-3) covers the groundwater beneath and between the 100 H and 100 D/DR areas. The 100-DR-2 Operable Unit contains the important facilities involved in plutonium production at the 100 D Area, including the reactor and its cooling system.

The 100 D/DR Area support facilities for the DR Reactor included an access road, a rail spur, warehouse, a substation, maintenance shops, solid waste burial grounds, a large water treatment plant with water intake and storage structures, a process effluent system, and a subsurface sanitary sewage disposal system. Most of the aboveground facilities have undergone some degree of decommissioning, and in many instances facilities no longer exist.

Table 2-1 of the work plan lists the waste transfer, treatment, storage, and related facilities in the 100-DR-2 Operable Unit, and the waste received or produced. Section 3.1 of the work plan summarizes the known and suspected contamination at the operable unit. The layout of the 100-DR-2 Operable Unit is shown in Figure 2-2 of the work plan.

4.0 SCOPE OF WORK AND POTENTIAL HAZARDS

While the information presented in Section 3.1 of the work plan 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 liquid disposal facilities are largely unknown. The emphasis of the LFI in the 100-DR-2 Operable Unit will be to characterize the nature and extent of contamination in the vadose (unsaturated subsurface soil) zone.

4.1 WORK TASKS

Work tasks are described in Chapter 5.0 of the work plan.

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4.2 POTENTIAL HAZARDS

Onsite tasks will involve noninvasive surface sampling procedures and invasive soil sampling either directly in or immediately adjacent to areas known or suspected to contain potentially hazardous chemical substances, toxic metals, and radioactive materials.

Surface radiological contamination and fugitive dust will be the potential hazards of primary concern during noninvasive mapping and sampling activities.

Existing data indicate that hazardous substances may be encountered during invasive sampling; these include radionuclides, heavy metals, and corrosives. In addition, volatile organics may also be associated with certain facilities such as the solvent storage buildings or underground storage tanks.

Potential hazards include the following:

- external radiation (gamma and to a lesser extent, beta) from radioactive materials in the soil
- internal radiation resulting from radionuclides present in contaminated soil entering the body by ingestion or through open cuts and scratches

- internal radiation resulting from inhalation of particulates (dust) contaminated with radioactive materials
- inhalation of toxic vapors or gases such as volatile organics or ammonia
- inhalation or ingestion of particulates (dust) contaminated with inorganic or organic chemicals, and toxic metals
- dermal exposure to soil or groundwater contaminated with radionuclides
- dermal exposure to soil or groundwater contaminated with inorganic or organic chemicals, and toxic metals
- physical hazards such as noise, heat stress, and cold stress
- slips, trips, falls, bumps, cuts, pinch points, falling objects, other overhead hazards, crushing injuries, and other hazards typical of a construction-related job site
- unknown or unexpected underground utilities
- biological hazards; snakes, spiders, etc.

4.3 ASSESSMENT AND MITIGATION OF POTENTIAL HAZARDS

The likelihood of significant exposure (100 mR/h 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 by inhalation or inadvertent ingestion of contaminated dust is a realistic concern and must be continuously evaluated by the health physics technician. Appropriate respiratory protection, protective clothing, and decontamination procedures will be implemented as necessary to reduce potential inhalation, ingestion, and dermal exposure to acceptable levels.

Dermal exposure to toxic chemical substances is not expected to pose a significant problem for the identified tasks given the use of the designated protective clothing. The appropriate level of personal protective clothing and respiratory protection will vary from work site to work site.

5.0 ENVIRONMENTAL AND PERSONAL MONITORING

The site safety officer or authorized delegate shall be present at all times during work activities which require an HWOP, and shall be in charge of all environmental/personal monitoring equipment. Industrial Hygiene and Safety shall review all activities involving or potentially involving radiological exposure or contamination control, and shall prescribe the appropriate level of technical support and/or monitoring requirements. Other equipment deemed necessary by the site safety officer or Industrial Hygiene and Safety shall be obtained at their direction; work will not be initiated or continued until such equipment is in place. These instruments are to be used only by persons who are trained in their usage and who understand their limitations. No work shall be done unless instrumentation is available and in proper working order.

Air sampling may be required downwind of the referenced waste sites to monitor particulates and vapors before job startup. Siting of such sampling devices will be determined by Health Physics, the site safety officer, and HEHF, if appropriate. Any time personnel exposure monitoring, other than radiological, is required to determine exposure levels, it must be done by HEHF. Discrete sampling of ambient air within the work zone and breathing zones will be conducted using a direct-reading instrument, as specified in the site-specific safety document, and other methods as deemed appropriate (e.g., pumps with tubes, O_2 meters). The following standards will be used in determining critical levels:

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- "Radionuclide Concentrations in Air," in Chapter XI, *Environment, Safety and Health Program for DOE Operations* (DOE 1986)
- "Air Contaminants - Permissible Exposure Limits," in 29 CFR 1910.1000
- *Threshold Limit Values and Biological Exposure Indices for 1990-1991* (ACGIH 1991)
- Occupational Safety and Health Standards, 29 CFR 1910.1000
- *Pocket Guide to Chemical Hazards* (NIOSH 1991), which provides National Institute for Occupational Safety and Health- (NIOSH) recommended exposure limits for substances that do not have either a threshold limit value or a permissible exposure limit
- "Part H--Air Contaminants," in *Occupational Health Standards*, WAC 296-62-075.

5.1 AIRBORNE RADIOACTIVE AND RADIATION MONITORING

An onsite health physics technician will monitor airborne radioactive contamination levels and external radiation levels. Action levels will be consistent with derived air concentrations and applicable guidelines as specified in the radiation protection manual (WHC 1988a).

Appropriate respiratory protection shall be required when conditions are such that the airborne contamination levels may exceed an 8-hour derived air concentration (e.g., the presence of high levels of uncontained, loose contamination on exposed surfaces or operations that may raise excessive levels of dust contaminated with airborne radioactive materials, such as excavation or drilling under extremely dry conditions).

Specific conditions requiring the use of respiratory protection because of radioactive materials in air will be incorporated into the RWP. If, in the judgement of the health physics technician, any of these conditions arise, work shall cease until appropriate respiratory protection is provided.

6.0 PERSONAL PROTECTIVE EQUIPMENT

Feasible engineering and/or work practice controls shall be used to control employee exposure to health and safety hazards. Where such controls are not feasible, personal protective clothing and respiratory protection shall be selected to limit exposure to anticipated chemical and radiological hazards. The initial level of personal protective equipment, when required, will be specified in the site-specific safety document for each task or group of tasks.

7.0 SITE CONTROL

The field team leader, site safety officer, and health physics technician are designated to coordinate access control and security on the site. Special site control measures will be necessary to restrict public access. The zones will be clearly marked with rope and/or appropriate signs. The size and shape of the control zone will be dictated by the types of hazards expected, the climatic conditions, and specific operations required.

Control zone boundaries may be increased or decreased based on results of field monitoring, environmental changes, or work technique changes. The site RWP and the contractor's standard operating procedures for radiation protection may also dictate the boundary size and shape. All team members must be surveyed for radioactive contamination when leaving the controlled zone if in a radiation zone.

The onsite command post and staging area will be established near the upwind side of the control zone as determined by an onsite windsock. Exact location for the command post is to be determined just before start of work. Vehicle access, availability of utilities (power and telephone), wind direction, and proximity to sample locations should be considered in establishing a command post location.

8.0 DECONTAMINATION PROCEDURES

Remedial investigation activities will require entry into areas of known chemical and radiological contamination. Consequently, it is possible that personnel and equipment could be contaminated with hazardous chemical and radiological substances.

During site activities, potential sources of contamination may include airborne vapors, gases, dust, mists, and aerosols; splashes and spills; walking through contaminated areas; and handling contaminated equipment. Personnel who enter the exclusion zone will be required to go through the appropriate decontamination procedures when leaving the zone. Decontamination procedures shall be consistent with EII 5.4, "Field Decontamination of Drilling, Well Development, and Sampling Equipment," and EII 5.5, "Decontamination of Equipment for RCRA/CERCLA Sampling" (WHC 1988b), or other approved decontamination procedures.

9.0 CONTINGENCY AND EMERGENCY RESPONSE PLANS

As a general rule, in the event of an unanticipated, potentially hazardous situation indicated by instrument readings, visible contamination, unusual or excessive odors, or other indications, team members shall temporarily cease operations and move upwind to a predesignated safe area as specified in the site-specific safety documentation.

10.0 REFERENCES

ACGIH, 1991, *Threshold Limit Values and Biological Exposure Indices for 1990-1991*, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.

DOE, 1986, *Environment, Safety & Health Program for DOE Operations*, DOE Order 5480.1B, U.S. Department of Energy, Washington, D.C.

NIOSH, 1991, *Pocket Guide to Chemical Hazards, National Institute for Occupational Safety and Health*, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Washington, D.C.

WHC, 1988a, *Radiation Protection*, WHC-CM-4-10, Westinghouse Hanford Company, Richland, Washington.

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

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ATTACHMENT 1

METRIC CONVERSION CHART

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ATTACHMENT I

METRIC CONVERSION CHART

The following conversion chart is provided to the reader as a tool to aid in conversion.

Into Metric Units			Out of Metric Units		
If you know	Multipy By	To Get	If you know	Multiply By	To Get
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Volume			**Volume**		
gallons	3.8	liters	liters	0.264	gallons

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