DOE/RL-89-12
Revision 1

Hanford Site Groundwater Protection Management Program

United States
Department of Energy
Richland, Washington

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Hanford Site Groundwater Protection Management Program

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EXECUTIVE SUMMARY

Groundwater protection is a national priority that is promulgated in a variety of environmental regulations at local, state, and federal levels. To effectively coordinate and ensure compliance with applicable regulations, the U.S. Department of Energy has issued DOE Order 5400.1[1] (now under revision) that requires all U.S. Department of Energy facilities to prepare separate groundwater protection program descriptions and plans. This document describes the Groundwater Protection Management Program for the Hanford Site located in the state of Washington.

DOE Order 5400.1 specifies that the Groundwater Protection Management Program covers the following general topical areas: (1) documentation of the groundwater regime, (2) design and implementation of a groundwater monitoring program to support resource management and comply with applicable laws and regulations, (3) a management program for groundwater protection and remediation, (4) a summary and identification of areas that may be contaminated with hazardous waste, (5) strategies for controlling these sources, (6) a remedial action program, and (7) decontamination and decommissioning and related remedial action requirements.

Many of the above elements are covered by existing programs at the Hanford Site; thus, one of the primary purposes of this document is to provide a framework for coordination of existing groundwater protection activities. Additionally, it describes how information needs are identified and can be incorporated into existing or proposed new programs. The Groundwater Protection Management Program provides the general scope, philosophy, and strategies for groundwater protection/management at the Hanford Site. Subtier documents provide the detailed plans for implementing groundwater-related activities and programs. Related schedule and budget information are provided in the 5-year plan for environmental restoration and waste management at the Hanford Site.

The basic groundwater protection strategy for the Hanford Site involves long- and near-term actions. Near-term actions include gradual elimination of liquid waste disposal (to ground) with a target date of 1995. Long-term protection will be accomplished by removal, stabilization, and/or treatment of stored waste and waste released to the ground, and use of engineered barriers to restrict infiltration over disposal sites. Institutional control will also be used to allow attenuation of existing contaminant plumes. These actions are now part of the formal *Hanford Federal Facility Agreement and Consent Order*[2] (Tri-Party Agreement) involving the Washington State Department of Ecology, the U.S. Department of Energy, and the U.S. Environmental Protection Agency.

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[1]DOE, 1988, *General Environmental Protection Program*, DOE Order 5400.1, U.S. Department of Energy, Washington, D.C.

[2]Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Washington, D.C.

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ACRONYMS

ACL	alternative concentration limit
BAT/AKART	Best Available Technology or All Known and Reasonable
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CIP	Contamination Indicator Parameter
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DST	double-shell tank
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FS	feasibility study
FY	fiscal year
GPMP	Groundwater Protection Management Program
GWG	Geohydrologic Working Group
HEIS	Hanford Environmental Information System
HLW	high-level waste
NEPA	*National Environmental Policy Act of 1969*
NPDES	National Pollution Discharge Elimination System
PNL	Pacific Northwest Laboratory
RCRA	*Resource Conservation and Recovery Act of 1976*
RCW	*Revised Code of Washington*
RI	remedial investigation
RL	DOE, Richland Operations Office
SARA	*Superfund Amendments and Reauthorization Act of 1986*
SST	single-shell tank
SWDP	State Waste Discharge Permit Program
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TRU	transuranic
TSD	treatment, storage, or disposal
UST	underground storage tank
WAC	*Washington Administrative Code*
WHC	Westinghouse Hanford Company
WHPP	Washington State Wellhead Protection Program

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1.0 INTRODUCTION

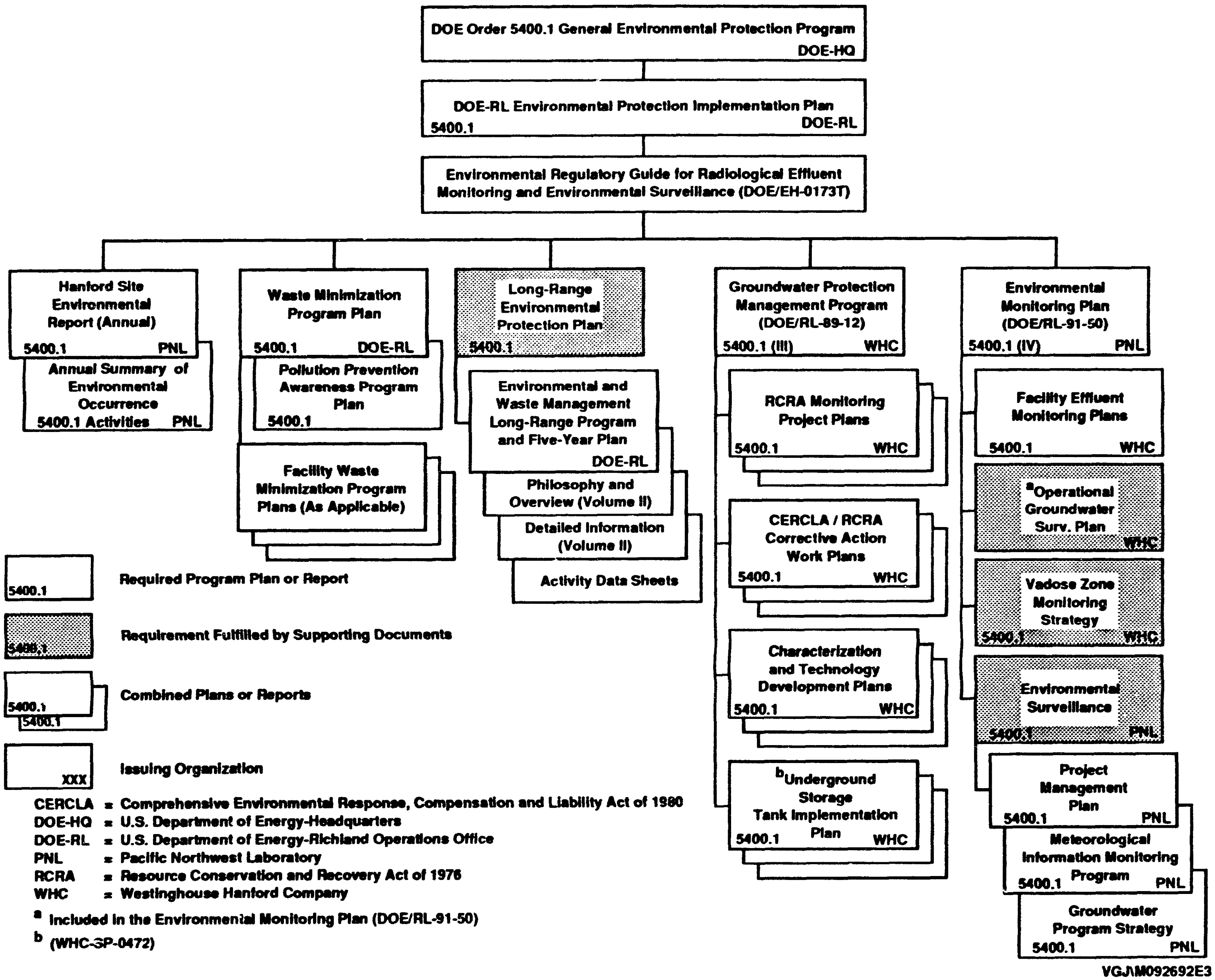
This Groundwater Protection Management Program (GPMP) for the Hanford Site fulfills U.S. Department of Energy (DOE) environmental planning requirements outlined in DOE Order 5400.1, *General Environmental Protection Program* (DOE 1988, p. III-2 and presently under revision). The relationship of the GPMP to other environmental planning documents for the Hanford Site is illustrated in Figure 1-1. Responsibility for implementing DOE's groundwater protection policies is shared by DOE-Headquarters and the DOE, Richland Operations Office (RL) with its contractors. Many of the required activities are already included under DOE's general environmental protection policy and orders to satisfy legally applicable requirements. The primary focus of this document is on development of a framework for coordination of existing groundwater protection programs and activities, and on the process for identifying and correcting program deficiencies.

1.1 REGULATORY REQUIREMENTS

A number of existing state and federal environmental regulations include requirements that lead to, or explicitly require groundwater-related plans and programs. Thus, to a large extent, a program that satisfies the above need will be an integration of existing DOE/contractor plans, policies, and procedures that are responsive to: the Washington State Department of Ecology (Ecology) regulations, the U.S. Environmental Protection Agency (EPA) regulations, the state of Washington compliance orders, Consent Orders between Ecology and EPA, and the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA)-related DOE orders. A summary of federal regulatory requirements related to groundwater protection are shown in Table 1-1. In addition, the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) (Tri-Party Agreement) involving EPA, Ecology, and DOE identifies timetables for waste cleanup, which specifies that the groundwater protection provisions of *Washington Administrative Code* (WAC) 173-303, "Dangerous Waste Regulations," apply to the Hanford Site.

1.2 U.S. DEPARTMENT OF ENERGY REQUIREMENTS

DOE Order 5400.1 (DOE 1988) specifies seven general program elements that must be included in a site GPMP. The relationship between these program element requirements and existing Hanford Site environmental documentation is illustrated in Figure 1-2. The matrix diagram shows the program element, corresponding documentation where the subject is addressed, and/or the section number in the GPMP where the subject is discussed. Areas of deficiency or need for additional information are identified in the diagram.



CERCLA = Comprehensive Environmental Response, Compensation and Liability Act of 1980
DOE-HQ = U.S. Department of Energy-Headquarters
DOE-RL = U.S. Department of Energy-Richland Operations Office
PNL = Pacific Northwest Laboratory
RCRA = Resource Conservation and Recovery Act of 1976
WHC = Westinghouse Hanford Company

[a] Included in the Environmental Monitoring Plan (DOE/RL-91-50)
[b] (WHC-SP-0472)

Figure 1-1. Relationship Between the Groundwater Protection Management Program and Other Environmental Protection Programs and Plans Required by DOE Order 5400.1 (DOE 1988).

Table 1-1. Federal Groundwater Protection-Related Regulations.

Act	Purpose of act	Relevance to groundwater	Key regulations
Resource Conservation and Recovery Act (RCRA)	Protect human health and the environment, conserve material and energy resources through comprehensive management of solid and hazardous waste.	Establishes "cradle to grave" regulatory structure for the management of solid and hazardous solid waste. Regulations require impermeable liners and groundwater monitoring at new, replacement, or expanded landfills and surface impoundments.	40 CFR 260, 40 CFR 264-265, 40 CFR 267
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)	Establish program for the cleanup of hazardous waste contamination from spills or abandoned hazardous waste disposal sites.	Requires cleanup in accordance with applicable or relevant and appropriate groundwater standards.	40 CFR 300-373
Safe Drinking Water Act (SDWA)	Establish national drinking water standards, protect groundwater against contamination, restrict underground injection.	Establishes underground injection control programs, programs to protect "sole or principal source aquifers," and state wellhead protection area programs.	40 CFR 144-149
Clean Water Act (CWA)	Restore and maintain chemical, physical, and biological integrity of Nation's waters.	Requires consideration of groundwater in individual and regional wastewater treatment facility planning, and issuance of federal construction grants for treatment works. Regulates runoff, spills, leaks, and drainage "associated with" a class of regulated point sources.	40 CFR 122-125 and 40 CFR 129-130
Nuclear Waste Policy Act (NWPA)	Establish schedule for the siting, construction, and operation of high-level radioactive waste repository.	Requires U.S. Environmental Protection Agency (EPA) to issue generally applicable environmental protection standards (as authorized by the Atomic Energy Act) for releases from radioactive materials in repositories.	40 CFR 191[a]
Low-Level Radioactive Waste Policy Act	Outline procedures for establishment and operation of regional low-level radioactive waste disposal facilities.	Indirectly relevant.	10 CFR 61[b]
Uranium Mill Tailings Radiation Control Act	Establish federal standards, regulations, and remedial action program for uranium mill tailings.	Protection of groundwater from radioactive and nonradioactive hazardous substances must be ensured.	40 CFR 192
Toxic Substances Control Act (TSCA)	Regulate chemical substances and mixtures that present an unreasonable risk of injury to human health and the environment.	Establishes requirements relating to the manufacture, processing, distribution, use, or disposal of certain chemical substances or mixtures.	40 CFR 761
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	Regulate pesticides that present unreasonable risk of injury to human health and the environment.	Establishes requirements for the sale, distribution, application, storage, and disposal of pesticides.	40 CFR 162-165
Atomic Energy Act (1954), as amended	The U.S. Department of Energy (DOE) is obligated "to regulate its own activities, so as to provide radiation protection for both workers and the public."	"It is the policy of DOE to conduce effluent monitoring and environmental surveillance programs that are adequate to determine whether the public and the environment are adequately protected during DOE operations and whether operations are in compliance with DOE and other applicable Federal, State, and local radiation standards and requirements. It is also DOE policy that Departmental monitoring and surveillance programs be capable of detecting and quantifying unplanned releases and meet high standards of quality and credibility. It is DOE's objective that all DOE operations properly and accurately measure radionuclides in their effluents and in ambient environmental media."	DOE Orders 5400.1 and 5400.5

Note: See Section 9.0, "References," for reference information.

[a]Subpart B of these standards includes groundwater protection provisions that have been vacated and remanded to EPA by the U.S. Court of Appeals.

[b]U.S. Nuclear Regulatory Commission regulations established under the authority of the AEA. The EPA is developing generally applicable environmental standards (designated 40 CFR 193) under its AEA authority. Both contain groundwater protection provisions.

Figure 1-2. Correlation of Existing Programs, Plans, and Information with Program Element Requirements in DOE Order 5400.1 (DOE 1988).

Requirements	Programs and Plans							Information Sources					
Program Element (5400.1, III)	Tri-Party Agreement Action Plan	Hanford Waste Management Plan	Hanford Site Groundwater Surveillance Program	Hanford Site Groundwater Monitoring Program	RCRA Groundwater Monitoring Program	D & D Program/CERCLA Related	RCRA Permitting Plan	Waste Information Data System	Defense Waste EIS	Site Characterization Report (Hydrology)	Hanford Groundwater Data Base	Additional Data and/or Information Needed?	Groundwater Protection Management Program Section
Documentation of Groundwater Regime			●	●	●			●	●	●	●	Yes	5.1, 5.3, 5.4
Groundwater Monitoring Program for Regulatory Compliance/Resource Mgmt.	●		●	●	●							Yes	5.1
Management Program for Groundwater Protection and Remediation	●	●				●						Yes	All
Summary of Hazardous Waste Sites	●						●	●	●			No	
Strategies for Controlling Hazardous Waste Sites	●	●										Yes	6.0
Remedial Action Program	●											No	
D & D/Remediation	●												7.0

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1.3 PLANNING DOCUMENTS

As shown in Figure 1-1, the GPMP is supported by four major areas of planning documentation: The *Resource Conservation and Recovery Act of 1976* (RCRA) groundwater monitoring project plans, the Corrective Action Work Plans, the Characterization and Technology Development Plans, and the Underground Storage Tank Implementation Plan.

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2.0 GROUNDWATER/RESOURCE MANAGEMENT PHILOSOPHY AND GENERAL INFORMATION NEEDS

Several state and federal regulations require groundwater protection activities, each with a different overall objective. Common to all, however, is the fundamental need to understand the hydrogeologic system and the dynamic processes involved. Accordingly, the GPMP is based on the belief that a common approach or process should be used regardless of the specific groundwater-related regulation or requirement. This process is illustrated in Figure 2-1 showing the relationship between site mission, regulations, groundwater protection strategy, geotechnical information needs (characterization, modeling, and monitoring), and corrective action or remediation.

Acquisition of geotechnical information is the central focus of groundwater management. Groundwater management at the Hanford Site involves the various activities shown in Figure 2-2. Acquisition of basic hydrogeologic and related information as well as contaminant monitoring results is needed for an understanding of the regulated system. Thus, regardless of whether CERCLA activities, RCRA activities, state-implemented programs, or operational activities are being addressed, the same general information base is needed, as well as a common process for acquiring it.

Figure 2-1. Relationship Between Groundwater Protection Regulatory Requirements and Groundwater Management and Compliance Activities.

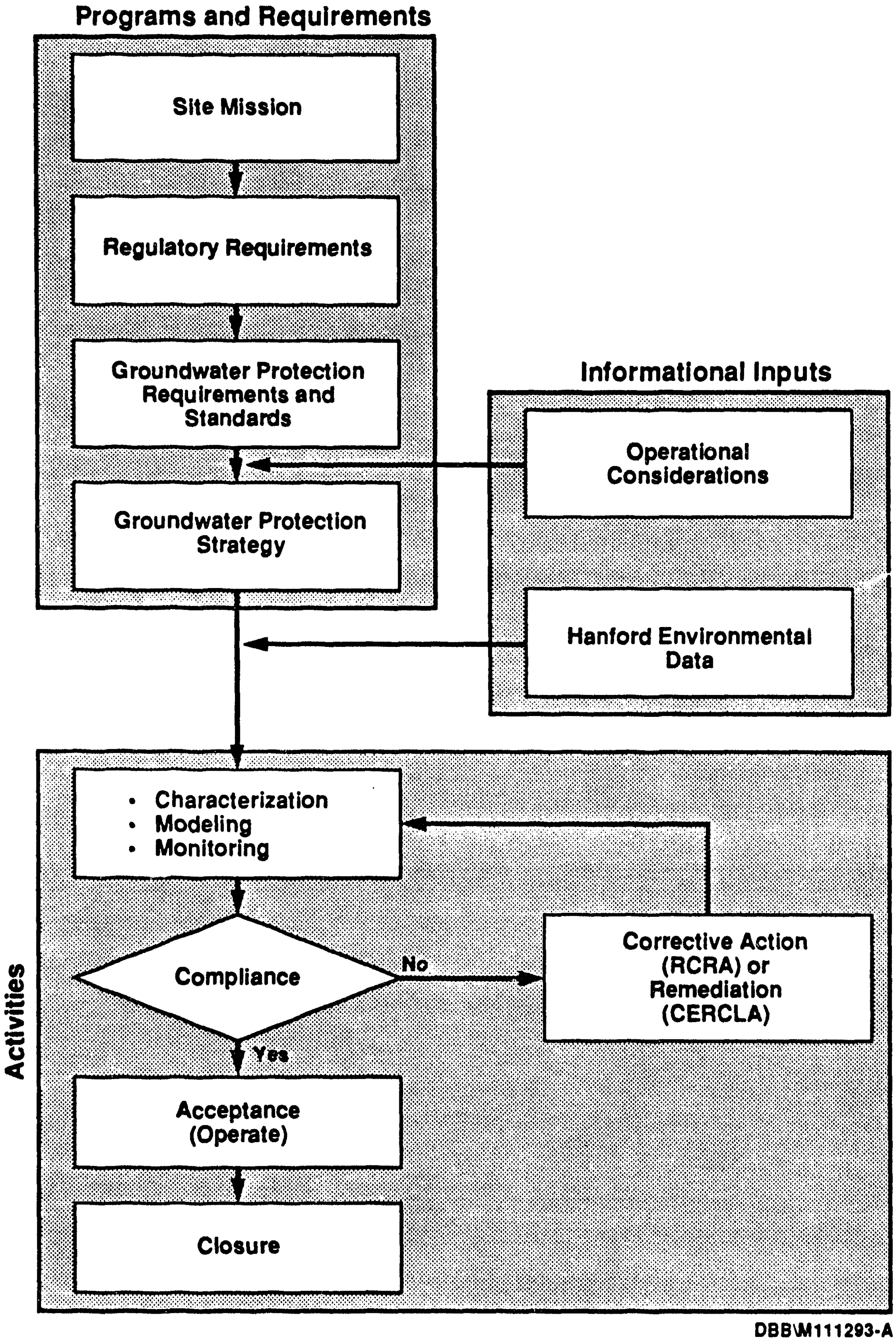
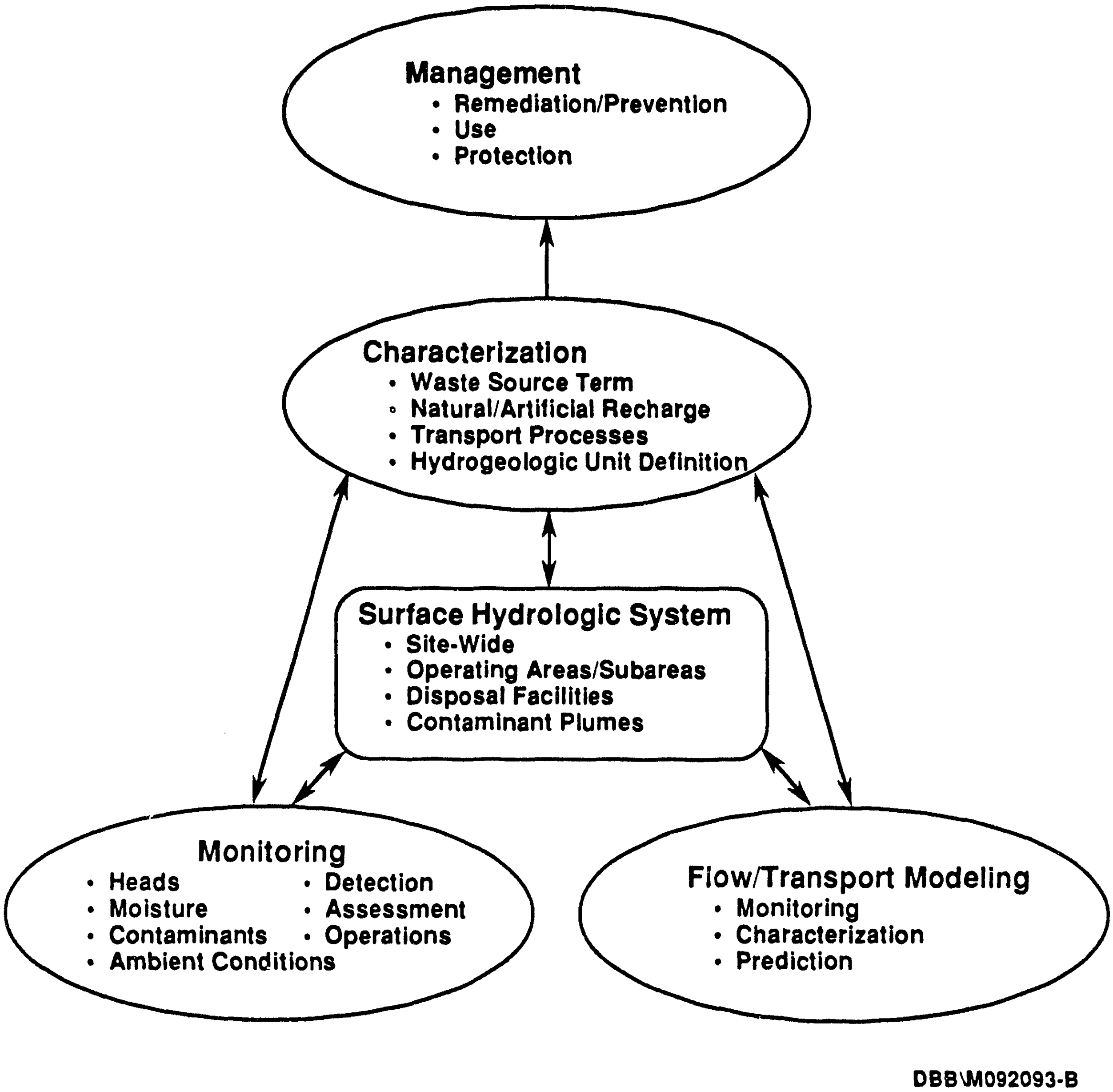


Figure 2-2. Groundwater Management Activities and Interrelationships.



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3.0 GENERAL PROGRAM OBJECTIVES

Within the general objective to ensure adequate environmental protection at all DOE facilities, site-specific objectives for groundwater protection at the Hanford Site include the following:

- Protect the suprabasalt (or unconfined) aquifer from further contamination
- Evaluate upper confined aquifers for existing contamination and potential pathways and interconnectivity with unconfined aquifer
- Manage groundwater (recharge and withdrawal) to minimize adverse impacts of existing contamination
- Assess constraints on offsite migration of contaminants
- Ensure compliance with applicable state of Washington regulations (and federal statutes by reference)
- Determine vadose zone monitoring needs
- Periodically review monitoring programs to ensure cost-effective use of resources (e.g., implement provisions of WAC 173-303-645(b) for "tailoring" monitoring program to site-specific conditions)
- Establish process for identifying information needs.

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4.0 GROUNDWATER PROTECTION STRATEGY

Groundwater protection involves general, DOE-wide as well as site-specific policy and strategy elements. The general strategy elements are described below. Ecology and Hanford Site (DOE and contractor) policy and standards focus on near-term controls and remediation or corrective action during the period of "institutional control." Long-term protection guidelines and strategy, emphasizing engineered barriers or physical controls, as distinct from actions during the institutional control period, are also described.

4.1 GENERAL POLICY AND STRATEGY

Prevention of groundwater contamination is eminently preferable to remediation. However, contamination that has already occurred as a result of past defense-production activities must be addressed. Thus, the DOE general policy is to prevent further groundwater degradation and to clean up existing contamination consistent with current or potential usefulness. Primary reliance will be on physical rather than institutional control for long-term protection.

To accomplish the above objectives, a general strategy that combines source control/elimination with remediation is required. Specific elements of the general DOE strategy from DOE Order 5400.1 (DOE 1988) are listed below.

- Comply with all legally applicable waste management and groundwater protection requirements.
- Voluntarily conform to the EPA's groundwater protection strategy and implementation guidance.
- Systematically review and practice source control to ensure that contaminant releases are as low as reasonably achievable.
- Cooperate with federal and state authorities to promote speedy implementation of RCRA and CERCLA/*Superfund Amendments and Reauthorization Act of 1986* (SARA).
- Inform and cooperate with the public on groundwater quality issues.
- Establish DOE groundwater protection standards for new facilities and remedial actions.
- Perform and periodically revise groundwater protection plans for major facilities.

Site-specific strategy elements to accommodate the unique nature of the Hanford Site operations include the following.

- Manage (treat) waste and effluents to minimize or eliminate releases to groundwater.

- Establish design criteria for early warning, vadose zone monitoring programs, and conduct appropriate groundwater monitoring programs.
- Control artificial recharge and groundwater withdrawals to minimize movement of contaminant plumes.
- Manage soil and vegetative cover to minimize infiltration of direct precipitation over waste sites.
- Provide for acquisition of technical data (aquifer and vadose zone properties and groundwater quality).
- Provide centralized data storage and retrieval.
- Use performance assessment/engineered barriers for risk-based, long-term groundwater protection (in-place stabilization options).

Some of the above strategy elements are partially covered by existing programs within either Westinghouse Hanford Company (WHC) or Pacific Northwest Laboratory (PNL) programs in support of RL directives.

4.1.1 Groundwater Protection/Cleanup Standards

4.1.1.1 Remedial Action. Groundwater protection standards for the Hanford Site are based on a policy of nondegradation of groundwater, as defined by the state of Washington groundwater regulations and EPA guidelines. Foremost among remediation and related regulations are the groundwater cleanup standards of "Model Toxics Control Act-Cleanup," WAC 173-340-720, and the associated statistical guidance (Ecology 1992). Additional WACs affecting groundwater remediation and protection are discussed in Section 4.2. The policy of nondegradation prohibits additional or incremental increase in contaminant levels in groundwater, and requires restoration of contaminated groundwater to drinking water standards, "background" levels, or negotiated alternative concentration limits (ACL). Restoration may be preempted if it can be demonstrated that imposed standards would not be exceeded in groundwater during the postclosure period as a result of contaminant interception/attenuation in the vadose zone.

In addition, the proposed revision of 40 *Code of Federal Regulations* (CFR) 191 and 40 CFR 193 considers the drinking water standard as a primary design performance standard. If engineered barriers are used as part of the cleanup/closure strategy, they must be designed so as to control waste release rates such that the drinking water standard is not exceeded in groundwater.

4.1.1.2 Potential Impact. As indicated previously, the EPA rule governing high-level waste (HLW) and transuranic (TRU) waste disposal is under revision and is expected to include a groundwater protection standard.

The remanded rule required that disposal systems for HLW and TRU waste not cause potential exposures above 4 mrem/yr (drinking water pathway only) for special sources of groundwater, or 25 mrem/yr (all pathways) for significant sources of groundwater for a period of 1,000 years outside of the controlled area (up to 5 km beyond the waste area). Waste previously disposed of was excluded.

Waste types potentially subject to the remanded rule included double-shell tanks (DST), single-shell tanks (SST), and retrievably stored TRU waste. Of these, only SST waste might be disposed of in place (decision deferred subject to further analysis and development). Stored TRU waste and the HLW portion of DST waste are to be disposed of offsite. Pre-1970 unsegregated waste and TRU-contaminated soil are excluded as "previously disposed of." Appendix R of the defense waste Environmental Impact Statement (EIS) (DOE 1987) shows that for SST waste, the exposure limits might be exceeded, but not for several thousand years. Thus, it is expected that the remanded rule will have little impact beyond the need for the same additional data, model development, and documentation as that required to support additional decisions and actions under the *National Environmental Policy Act of 1969* (NEPA), RCRA, and/or CERCLA.

In connection with the draft 40 CFR 193, it has been suggested that the intention of the EPA is to apply the 4-mrem/yr limit as total (including background and existing plumes) rather than as an increment attributable only to disposal actions under the rule. The limit would become "no additional radioactivity" for areas already above the 4-mrem/yr groundwater limit. This would forbid disposal in such areas because it is not possible to prove "zero" addition with high confidence for several millennia. There are some areas on the Hanford Site where the unconfined aquifer is contaminated above the 4-mrem/yr limit. This could lead to a prohibition on in-place disposal of SST waste, even if all other conditions were met. However, models of contamination plume migration may demonstrate that plumes are separated in space and/or time, thus averting exceedance of standards.

One important point regarding long-term planning and information needs for groundwater protection is that barrier design and performance validation may be unnecessary if clean closure is required to enforce the nondegradation groundwater rule. That is, if the contaminated soil is removed to background levels or other appropriate cleanup standards, then the need for complex barriers to restrict infiltration becomes unnecessary and clean closure technology should be emphasized rather than surface barriers.

4.1.1.3 Remedial Period. The general DOE-Headquarters guidance is that remedial actions should be completed as rapidly as possible but within 100 years. This implies an institutional control period of 100 years during which contamination within a large portion of the unconfined aquifer would be attenuated because of dispersion and transport to the river. The Hanford Site proposes to use the institutional control provision and control of access to the uppermost aquifer as part of its groundwater protection and remediation strategy.

4.1.1.4 Point of Compliance. Compliance points specify the locations at which compliance with groundwater contamination standards is enforced. The compliance point works in concert with standards; "compliance point" relates to the extent of the protected environment; "standards" refer to the level of protection. Compliance points may be useful as part of the specifications for the design of new facilities (at least where complete containment of contaminants is not reasonably achievable). Monitoring is conducted at the compliance point to demonstrate compliance and to help provide early warning of any groundwater contamination.

Regulatory agencies have established different compliance point conventions in different rulemakings (e.g., 40 CFR 264, 40 CFR 61). Some conventions permit a horizontal and vertical "buffer zone" between a contaminant source, such as a waste disposal area, and the compliance point. In effect, this incorporates the absorbing and diluting properties of adjacent earth and groundwater as part of the disposal system. The RCRA convention is most restrictive, however, and virtually forbids buffer zones. The RCRA regulations provide an almost equivalent feature (i.e., an alternate concentration limit) only as a site-specific variance, where a contaminant release "...will not pose a substantial present or potential hazard..."

The DOE's policy is to conform to such established conventions as they apply to its operations and facilities. When DOE has the discretion, it will choose compliance points as close to the contaminant source as is reasonably achievable, but not outside the boundaries of its facilities.

4.1.2 Variances

Most environmental standards include provisions for "tailoring" regulations to site-specific hydrogeologic conditions. This is especially important at the Hanford Site where recharge is low because of the arid climate and the distance to groundwater is great beneath a major portion of the area in which waste sites are located. For example, there is little to be gained by installing groundwater monitoring wells in areas where past experience (Routson and Johnson 1988) and performance assessment demonstrates long travel times to groundwater (>50 years). In these locations, vadose zone and/or leachate collection monitoring are more relevant as an "early warning" monitoring system for groundwater protection. Reliance on groundwater monitoring in these cases is potentially misleading because a slow-moving leachate would not be detected until the entire vadose zone beneath a waste site is contaminated.

Other special cases at the Hanford Site involve potentially rapid removal of existing groundwater contamination by natural flushing processes, especially for waste sites located near the Columbia River. Similarly, existing contaminant plumes in highly transmissive sands and gravels downgradient from the 200 East Area will attenuate within the institutional control period because of natural dispersion and transport processes. Allowance for such processes will be considered part of the remedial action strategy.

The site-specific hydrogeology and waste form or disposal conditions must be analyzed in a systematic manner before reaching a decision on an appropriate subsurface monitoring system for each waste site. If these analyses are in conflict with regulatory interpretations, they will be resolved by negotiation with EPA and Ecology in accordance with procedures established in the Tri-Party Agreement. Such requests for deviation from prescriptive regulatory requirements must be supported with performance assessments and alternative subsurface monitoring plans.

4.2 STATE OF WASHINGTON GROUNDWATER REGULATIONS

Since the last version of this document was produced, the state has finalized several new WACs, or revised versions thereof, regulating groundwater quality and quantity. Additional new codes are in various stages of formulation or review. These regulations and their implications for groundwater management are summarized in Table 4-1.

Ecology administers most of the new codes that affect the management and protection of the state's groundwater. These include WAC 173-200, "Water Quality Standards for Ground Waters for the State of Washington," WAC 173-360, "Underground Storage Tank Regulations," and WAC 173-340, "Model Toxics Control Act-Cleanup." Also, in accordance with Tri-Party Agreement Milestone M-17-13, WAC 173-240, "Submission of Plans and Reports for Construction of Wastewater Facilities," and WAC 173-216, "State Waste Discharge Permit Program," sites receiving liquid effluents must be assessed for impact on groundwater quality and satisfy the appropriate permitting requirements. Although the Hanford Site Solid Waste Landfill is managed under the RCRA program, actual requirements for groundwater monitoring for this facility are governed by WAC 173-304, "Minimum Functional Standards for Solid Waste Handling."

Rules addressing hydraulic continuity between surface water and groundwater are undergoing formulation and public review under the direction of Ecology, Water Resources Program. Although hydraulic continuity regulations will focus on degree of exchange of quantities of surface water and groundwater, quality impairment will also be addressed as provided in the empowering laws (*Revised Code of Washington* [RCW]), including "Water Resources Act of 1971" (RCW 90.54) and "Regulation of Public Ground Waters" (RCW 90.44). Water resources laws also authorize other potentially pertinent administrative codes, such as WAC 173-154, "Protection of Upper Aquifer Zones," and WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells."

The federal *Endangered Species Act of 1973* has recently triggered the implementation of state emergency rules protecting salmonids on the main stems of the Columbia River and Snake River (WAC 173-563 and WAC 173-564). Ecology has suspended the issuance of surface water rights/permits on these rivers, and any groundwater adjudged to be in hydraulic continuity with the rivers.

Mostly as a result of the "Growth Management Act" (Department of Community Development 1990), other Washington State agencies have recently or will soon implement rules directly or peripherally affecting statewide groundwater management. The Washington State Department of Health has assumed the role of lead agency for administering the Washington State Wellhead Protection Program (WHPP); no specific administrative code yet exists. For now, other state and local agencies will have "source-specific" jurisdictions over the implementation of the WHPP and regulation of sources of potential contamination to wells (e.g., Ecology has regulatory responsibility for underground storage tanks and dangerous waste generators). The Washington State Department of Community Development administers WAC 365-190, "Minimum Guidelines to Classify Agriculture, Forest, Mineral Lands, and Critical Areas." These guidelines contain provisions for protection of "aquifer recharge areas" (under a general heading of "Critical Areas").

Table 4-1. Washington State Groundwater-Related Regulations.

Regulation (latest version)	Responsible state agency	Purpose of regulation	Relevance to groundwater
"Water Quality Standards for Ground Waters for the State of Washington" (WAC 173-200) (1990)	Ecology	Establishes minimum quality standards for groundwater. Implements RCW 90.48 and RCW 90.54.	Imposes groundwater quality criteria for primary and secondary contaminants and some radionuclides.
"Water Quality Standards for Surface Waters of the State of Washington" (WAC 173-201) (1988)	Ecology	Establishes water quality standards and classes for surface waters of Washington State.	Surface water and groundwater are often in direct communication.
"Underground Storage Tank Regulations" (WAC 173-360) (1990)	Ecology	Regulates installation, monitoring, and mitigation of deficiencies in underground storage tanks. Radioactive and mixed waste are exempt.	Requires owners/operators of underground storage tanks to monitor groundwater quality.
"Dangerous Waste Regulations" (WAC 173-303) (1991)	Ecology	Implements rules for designating, monitoring, and managing dangerous waste.	Requires owners/operators of facilities to conduct groundwater quality monitoring and response program.
"Minimum Functional Standards for Solid Waste Handling" (WAC 173-304) (1988)	Ecology	Establishes minimum standards for disposal of solid waste - does not include dangerous or radioactive waste.	Imposes design standards and groundwater monitoring requirements to protect groundwater from leachate.
"State Waste Discharge Permit Program" (WAC 173-216) (1993)	Ecology	Implements permit program applying to discharge of waste to surface waters and groundwaters under RCW 90.48.	Controls discharge of waste to groundwater.
"Model Toxics Control Act-Cleanup" (WAC 173-340) (1992)	Ecology	Governs the characterization and cleanup of hazardous substance releases.	Requires groundwater system characterization and groundwater quality assessment at regulated sites.
"Submission of Plans and Reports for Construction of Wastewater Facilities" (WAC 173-240) (1983)	Ecology	Implements RCW 90.48 - requires submission of plan and reports for construction or modification of wastewater facilities.	Requires "geohydrologic" evaluation in engineering report.
"Ground Water Management Areas and Programs" (WAC 173-100) (1988)	Ecology	Allows Ecology to designate areas with peculiar need for groundwater management; also a funding mechanism.	Forges cooperative management program for groundwater between local, state, tribal, and federal interests.
"Minimum Standards for Construction and Maintenance of Wells" (WAC 173-160) (1993)	Ecology	Sets standards for drilling and water well construction.	Protects groundwater quality from impairment by intermingling of groundwaters or wellhead surface contamination.
"Water Resources Act of 1971" (RCW 90.54) (1991)	Ecology	Statutory authority for regulation of water resources.	Groundwater recognized as integral to protection of state waters.
"Regulation of Public Ground Waters" (RCW 90.44) (1989)	Ecology	Statutory authority for regulation of groundwater/water rights.	Prohibits misuse of groundwater through waste or degradation of quality.
"Underground Injection Control Plan" (WAC 173-218) (1990)	Ecology	Establishes procedures/practices implementing requirements of RCW 90.48 and federal "Safe Drinking Water Act of 1974."	Controls the discharge of waste or harmful fluids to groundwater through wells.
"Protection of Withdrawal Facilities Associated with Ground Water Rights" (WAC 173-150) (1990)	Ecology	Protects availability and quality of groundwater to the facilities of holders of groundwater rights.	Protects groundwater right holders from impairment by contamination or depletion.
"Protection of Upper Aquifer Zones" (WAC 173-154) (1988)	Ecology	Protection of the occurrence and availability of groundwater within the upper aquifers.	Protects near-surface groundwater from depletion or quality impairment.
"Minimum Guidelines to Classify Agriculture, Forest, Mineral Lands and Critical Areas" (WAC 365-190) (1991)	Community Development	Directs local governments to classify lands as part of the "Growth Management Act" (Department of Community Development 1990)	Requires cities and counties to classify aquifer recharge areas.
"On-Site Sewage Disposal" (WAC 246-272) (1990)	Health	Regulates onsite septic systems.	Establishes zone of separation between drainfields and groundwater.
"Wellhead Protection Program" (no established codes as of 6/92).	Health	Administers to other agencies through existing, source-specific regulations.	Seeks to prevent contamination of groundwater via routes near wellheads.

4.3 GROUNDWATER ISSUES

The Tri-Party Agreement defined a cleanup schedule for hazardous waste at the Hanford Site (Ecology et al. 1989). The groundwater protection/monitoring aspects of the Tri-Party Agreement must be technically defensible and not simply "prescriptive" (see Section 4.1.2). For example, in many cases groundwater monitoring wells may not be the most effective approach for assessing potential groundwater contamination and may not provide the desired or expected early warning system envisioned by the regulatory requirements (WAC 173-303-645, "Releases From Solid Waste Management Units"). In many cases at the Hanford Site, only a vadose monitoring system will provide this type of information. Thus, a systematic approach is needed to design the most appropriate subsurface monitoring facilities (e.g., use of performance assessment models of waste sites).

Near-term emphasis is on: (1) characterizing the occurrence and distribution of existing vadose zone and groundwater contaminants and on defining the groundwater flow system, and (2) determining if a vadose zone monitoring system would better serve the need of compliance point monitoring and groundwater protection.

4.4 GROUNDWATER PROTECTION AND MONITORING

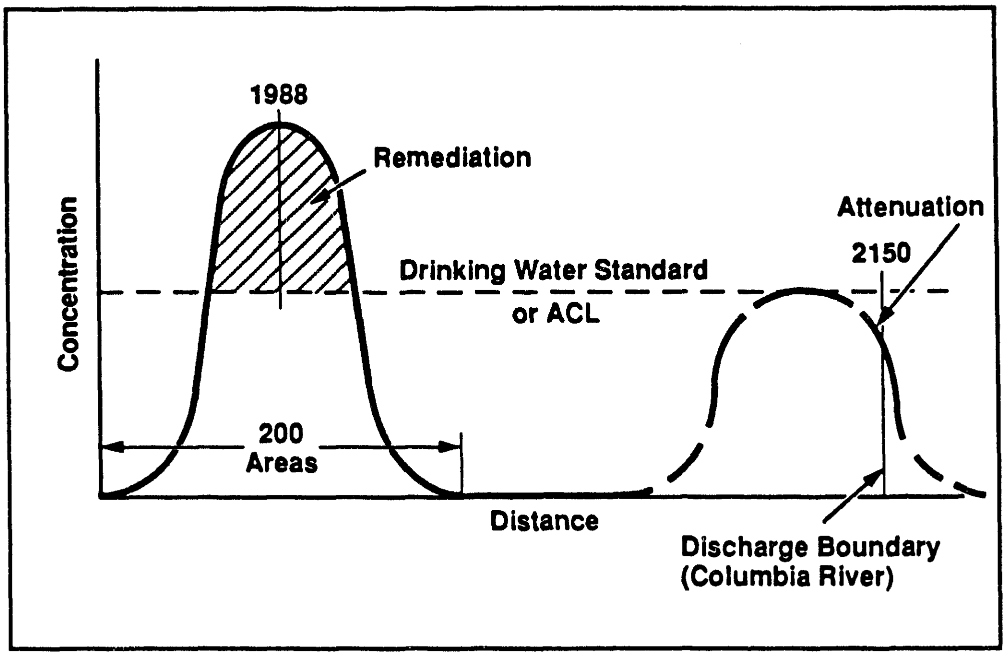
Effluent monitoring is used to determine the character of waters discharged to the ground. Groundwater monitoring programs are instituted to verify compliance with regulations and orders and to track past contaminant releases that may require remediation through the CERCLA process. Results of these activities are published annually in effluent and groundwater monitoring reports.

Groundwater monitoring is the key activity for ensuring adequacy of groundwater protection measures and strategies. The basic strategy for "near-term" groundwater protection at the Hanford Site is summarized as follows.

- Reduce or eliminate contaminants in liquid effluent to limit releases to drinking water standards.
- Allowance for radioactive decay during the period of "institutional control."
- Remediation and/or attenuation to meet drinking water standards (or ACLs) at the end of the period of institutional control (assumed to be the year 2150).

This strategy is illustrated in Figure 4-1. The bell-shaped distribution of hypothetical contaminants represents the centerline concentration(s) of a plume moving toward the Columbia River during the institutional control period. The objective concentration (horizontal dashed line indicating either the maximum contaminant level or drinking water standard) is shown for reference. The portion of the plume that requires remediation is shown as the shaded area of the initial (1988) concentration-distance distribution curve. The dashed bell-shaped curve at the discharge boundary (Columbia River) illustrates possible contaminant attenuation caused by dispersion and/or

Figure 4-1. Proposed Hanford Site Groundwater Protection and Remediation Strategy.



radioactive decay. Thus, depending on the nature and concentration of the contaminant, remediation in the near term to reduce contaminant levels to either drinking water standards or a negotiated ACL will take advantage of decay and dilution to ensure compliance with CERCLA requirements.

4.5 LONG-TERM PROTECTION GUIDELINES

Many constituents that have been disposed (or leaked) into the vadose zone from past Hanford Site operations will remain indefinitely because they are either chemically stable or have a very long half-life. Because stability of human institutions cannot be predicted, institutional control is unacceptable for long-term protection. Thus, DOE's policy is to rely primarily on physical control methods (or source removal) for long-term groundwater protection. Institutional controls will be limited to 100 years as discussed previously. Both risk and control (or performance) assessments will be used to project long-term performance of disposal methods. The projection period used will be at least 1,000 years.

Engineered barrier designs will be used with other technologies (e.g., hydraulic control of contaminant plumes) to maintain contaminant concentrations in groundwater at less than drinking water standards during the projection period. For radionuclides, the design performance standard may be based on a dose rate (drinking water pathway) standard of 4 mrem/yr from all sources (see Section 4.1.2). For nonradioactive contaminants, state-imposed drinking water standards or ACLs will be design performance criteria.

Demonstration of compliance with the above requirements will be based on performance assessments that require realistic predictive models and assignment or determination of input parameters such as net infiltration rate, climatic changes (precipitation), and sorptive properties of soils and sediments. These factors are part of the ongoing Hanford Site performance assessment and barrier development programs.

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5.0 GROUNDWATER PROGRAMS

This section describes (1) existing groundwater protection, management, and related monitoring programs; (2) associated hydrogeologic characterization needs/guidelines; and (3) a strategy and policy for integrating the various groundwater monitoring and management activities at the Hanford Site.

5.1 GROUNDWATER SURVEILLANCE AND MONITORING PROGRAMS

Groundwater monitoring, consisting of chemical constituent analyses and water level measurements, is a key element of any groundwater protection program. At the Hanford Site, this currently involves (1) sitewide surveillance to track contaminant plume movement from past disposal operations, (2) compliance or operational monitoring of active liquid waste disposal sites, (3) permit-related monitoring for RCRA-regulated facilities, (4) CERCLA-related remedial investigation studies, (5) Washington State 216 Permit monitoring, and (6) Washington underground storage tank (UST) monitoring.

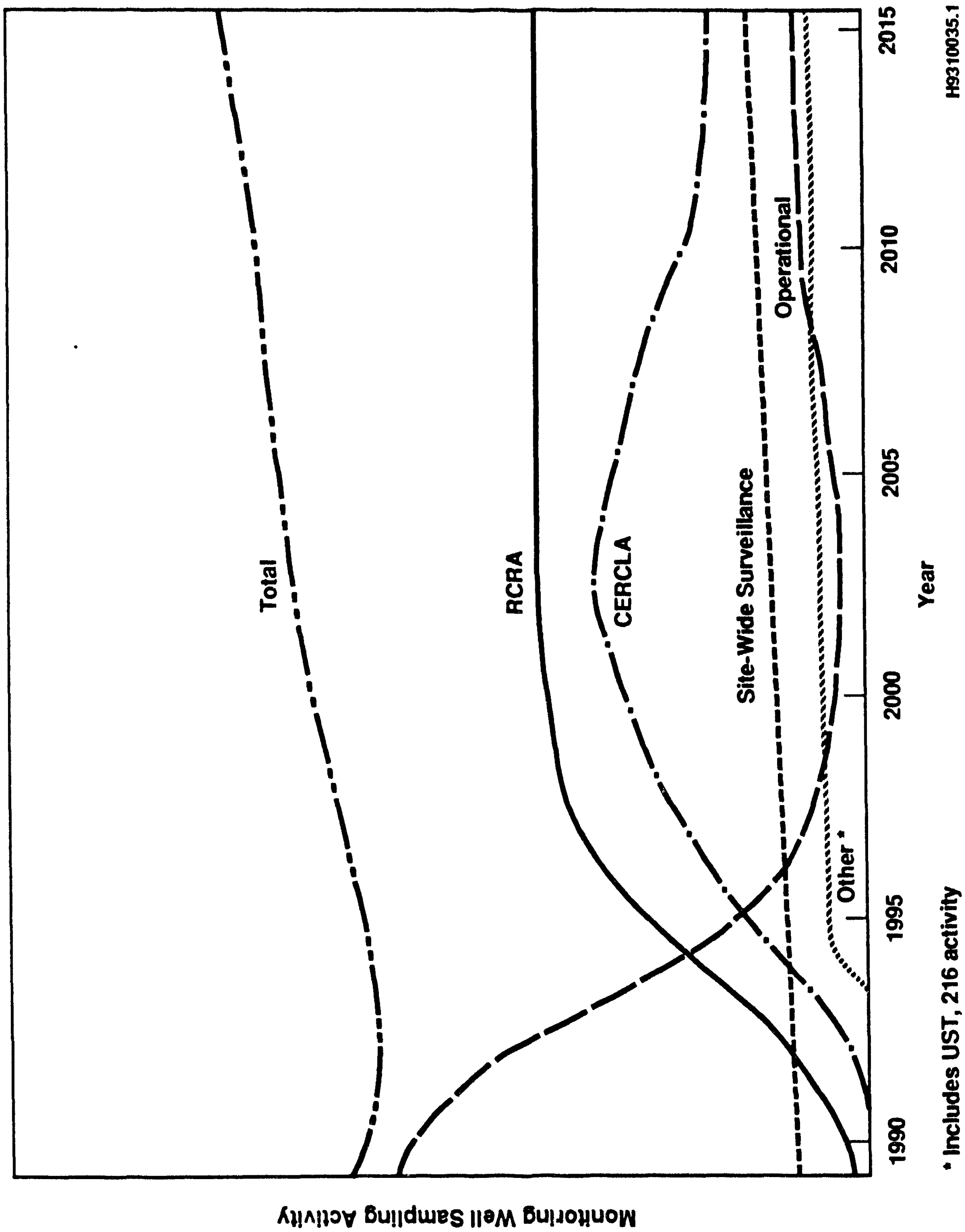
PNL is responsible for the sitewide groundwater surveillance (monitoring) program at the Hanford Site. This program provides an integrated assessment of the impact of site operations on the groundwater system. Assessment is performed independently of programs administered by the site operating contractor. The need for an independent assessment of groundwater quality on the site will remain throughout the period of cleanup activities and during the postclosure monitoring phase.

WHC has responsibility for operational, RCRA, CERCLA, 216 Permit, and UST groundwater programs. Operational monitoring primarily assesses the performance of liquid waste disposal systems (soil column) for which monitoring wells were located immediately adjacent to the facility. In the future these programs will shift to an independent assessment and reporting of data acquired for RCRA and CERCLA programs. This will occur as operational monitoring activities diminish in response to cleanup milestones and schedules for elimination of soil column disposal of liquid waste streams. As CERCLA characterization proceeds, some wells no longer needed for that program may become designated to the operational program. This changing relationship is illustrated in Figure 5-1. These phases represent a natural evolution of compliance monitoring, discovery, characterization, remediation (or corrective action), and cleanup verification. The transition among these phases will require aggressive coordination among the various organizations and programs over the next 30 years until final cleanup and closure of Hanford Site waste sites.

5.1.1 Program Strategy

Battelle-Northwest, the operator of PNL for the DOE, is responsible for environmental oversight of the Hanford Site operations. The plan for conducting groundwater environmental surveillance on the Hanford Site has been developed by Battelle-Northwest and is summarized in the following paragraphs.

Figure 5-1. Projected Relative Change in Groundwater Monitoring Activities at the Hanford Site, 1989 to 2015.



Environmental surveillance is conducted to monitor any effects of DOE activities upon the environmental and natural resources at the Hanford Site and adjoining areas. DOE Order 5400.1 (DOE 1988) requires an environmental surveillance screening program be undertaken at DOE sites to determine the need for a permanent surveillance system. The environmental surveillance program is designed to satisfy the following program objectives.

- Verify compliance with applicable environmental laws and regulations.
- Verify compliance with environmental commitments made in EISs, environmental assessments, safety analysis reports, or other official DOE documents.
- Characterize and define trends in the physical, chemical, and biological condition of environmental media.
- Establish baselines of environmental quality.
- Provide a continuing assessment of pollution abatement programs.
- Identify and quantify new or existing environmental quality problems.

The strategy for the environmental surveillance program is as follows.

- Review applicable environmental laws, regulations, and DOE orders to determine program requirements.
- Conduct a groundwater sampling, analysis, and interpretation program that will meet environmental surveillance requirements.
- Review groundwater monitoring programs conducted to meet other monitoring needs (e.g., operational monitoring, monitoring for compliance with RCRA and CERCLA regulations) on the Hanford Site and in the surrounding area.
- Identify additional data collection and analysis needed to meet environmental surveillance requirements.

Use of data gathered by other programs will allow the environmental surveillance program to meet the requirements set forth in the DOE orders in a cost-effective way.

At the present time, approximately 800 monitoring wells on the Hanford Site are used to assess the impact of specific facilities and to track the movement of contaminant plumes from past disposal practices. Many of the wells used in this assessment are selected from the operational monitoring networks to define sitewide distribution patterns of chemical and radiological contaminants.

5.1.2 RCRA Groundwater Monitoring

The RCRA groundwater monitoring program currently involves site-specific monitoring and/or well installation at 20 facilities (including the Hanford Site Solid Waste Landfill). Over 250 new RCRA-compliant monitoring wells have been installed for this purpose since 1987. Groundwater monitoring networks for several additional facilities have been prioritized and scheduled in the overall plan for meeting RCRA permitting needs at the Hanford Site. This plan has been incorporated in the Tri-Party Agreement action plan schedule. A key issue for the groundwater monitoring portion involves distinguishing past-practice, multiple-source contaminant plumes from RCRA site-specific contaminants. Recent negotiations with regulators to expedite and streamline CERCLA investigations should help resolve these problems.

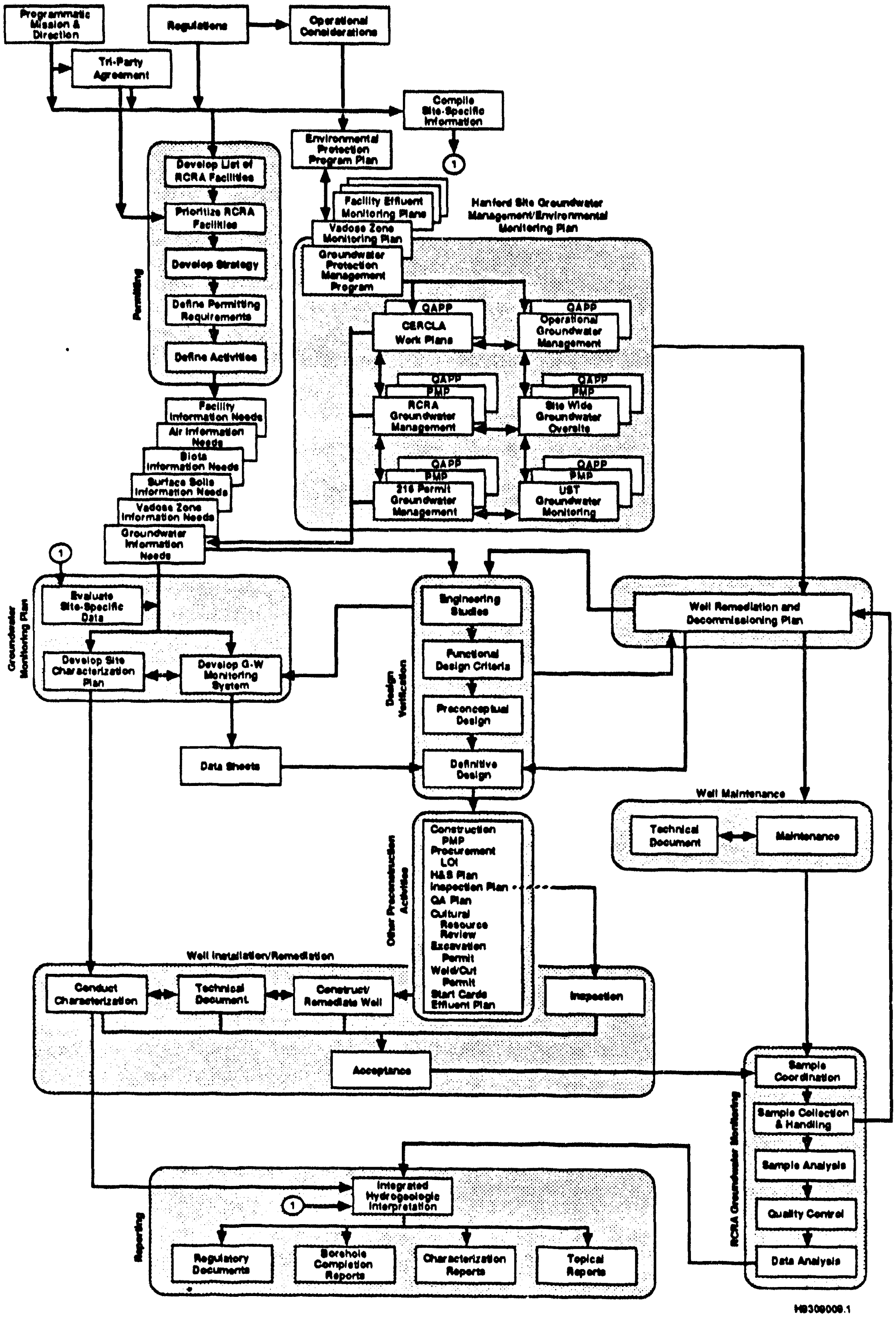
Implementation of RCRA at the Hanford Site involves preparation of groundwater compliance monitoring plans for each regulated unit (identified and prioritized in the action plan). The plans include specifications for well location, construction, hydrogeologic characterization, sampling and analysis, and parameters dictated by the groundwater protection plan outlined in WAC 173-303 and 40 CFR 265, Subpart F. The focus of these plans is on detection and assessment monitoring at the waste source or waste management area boundary. The intent of these requirements is to determine if groundwater contamination has occurred from these facilities and what, if any, corrective action may be indicated. A detailed listing of these plans is included in the groundwater monitoring plans summary document, updated annually (see Figure 1-1).

The overall process involved in implementing the RCRA groundwater protection provisions of 40 CFR 265 and 40 CFR 264 is summarized in Figure 5-2. The GPMP provides direction to the six major groundwater protection programs, each of which interacts with the RCRA groundwater program. Coordination among these programs is effected through WHC functional organizations, such as the Well Administrator Team (see Section 5.4.1) and integrated organizations such as the Geohydrologic Working Group (GWG). Information needs are derived from the permitting process and hydrogeologic requirements identified in the six subtier plans. The middle of the diagram illustrates the flow of information needed to comply with RCRA-related groundwater requirements and WHC procedural requirements. The lower portion of the diagram illustrates the interrelationship of activities leading to the final output as quarterly and annual monitoring reports and characterization data for permit-related documents (i.e., RCRA closure and postclosure plans).

5.1.3 Operational Monitoring

Operational groundwater monitoring has been carried out at the Hanford Site since the early days of site activity. The initial objective of this monitoring was to evaluate the impact of disposal operations on the environment, with the specific objective of determining when it was necessary to replace a soil column disposal facility. Historically, the operational monitoring program has been directed toward radionuclide monitoring, although

Figure 5-2. Hanford Site RCRA Groundwater Program Process Flowsheet.



attention was given to nitrate because of its widespread use and mobility in groundwater. Monitoring for hazardous chemicals has been phased into the program over the past several years. Approximately 300 wells are used for operational groundwater monitoring (Johnson 1993).

Operational monitoring, which may be considered "near-field" monitoring, addresses groundwater conditions in and adjacent to reactor and chemical processing operations in the 100, 200, 300, 400, and 1100 Areas. Sitewide surveillance monitoring provides more widespread coverage than operational monitoring, but also allows independent evaluation of operational groundwater monitoring results.

Currently, the operational program serves as a mechanism for the integrating and reporting of groundwater-related activities originating within other programs (RCRA, CERCLA, 216, etc.) on the Hanford Site. Geological, geochemical, and hydrological information is continually compiled and presented annually in the *Westinghouse Hanford Company Operation Groundwater Status Report* (WHC 1993b). Ongoing objectives of the operational groundwater monitoring program include:

- Identify sources of groundwater contamination and maintain surveillance of these sources
- Establish baseline conditions of groundwater quality and quantity
- Evaluate impact of disposal operations on the groundwater flow system
- Determine if active disposal facilities are causing contamination of the groundwater above standards
- Provide capability for early detection of leakage from inactive disposal facilities contaminating the groundwater
- Identify and track existing contaminant plumes
- Demonstrate compliance with all applicable regulations and DOE orders
- Coordinate with RCRA, CERCLA, and other monitoring to avoid gaps and duplication in data coverage
- Keep WHC management and DOE informed on the status of the groundwater in the operating areas
- Provide a technical basis for decision making relative to disposal practices and the management/protection of groundwater
- Conduct the program in a cost-effective manner.

Strategies for meeting the requirements of operational groundwater monitoring are:

- Maintain knowledge of existing federal and state regulations and DOE orders
- Monitor water levels of aquifers to determine directions of flow and hydraulic gradients for estimation of near-field dispersal rates and directions
- Select existing wells or identify need for new wells for monitoring active/inactive disposal facilities in operating areas in coordination with RCRA, CERCLA, and surveillance monitoring
- Review operating history of inactive facilities and effluent characteristics of active facilities
- Develop sampling/analysis plan for operational monitoring network in coordination with RCRA and CERCLA monitoring. Assess appropriateness of regulatory lists (WAC 173-303-9905, "Dangerous Waste Constituents List," WAC 173-360, "Underground Storage Tank Regulations," WAC 173-216, "State Waste Discharge Permit Program," and 40 CFR 264, Appendix IX) for inclusion in operational monitoring
- Oversee sample collection, analysis, and interpretation of analytical results
- Identify trends associated with individual wells and track the formation and movement of contaminant plumes
- Provide groundwater information to management in the form of notes, reports, and/or presentations
- Integrate monitoring information with that obtained by hydrologic characterization and flow/transport modeling to provide technical basis for decision making
- Coordinate all activities with RCRA, CERCLA, 216 Permit, and UST monitoring and PNL sitewide groundwater surveillance
- Maintain an awareness of costs and seek improved methods of operation to reduce costs while maintaining or enhancing the integrity of the program.

Sampling frequencies, locations, and parameters are based on operational needs and are updated at least annually in the operational groundwater monitoring plan.

The flowsheet for the operational program is shown in Figure 5-3. Output is in the form of technical reports and quarterly and annual monitoring reports to demonstrate compliance with DOE and WHC administrative limits. However, as discussed earlier, the operational groundwater program is in a transitional phase as RCRA and CERCLA programs progress.

Figure 5-3. Hanford Site Operational Groundwater Program Process Flowsheet. (2 sheets)

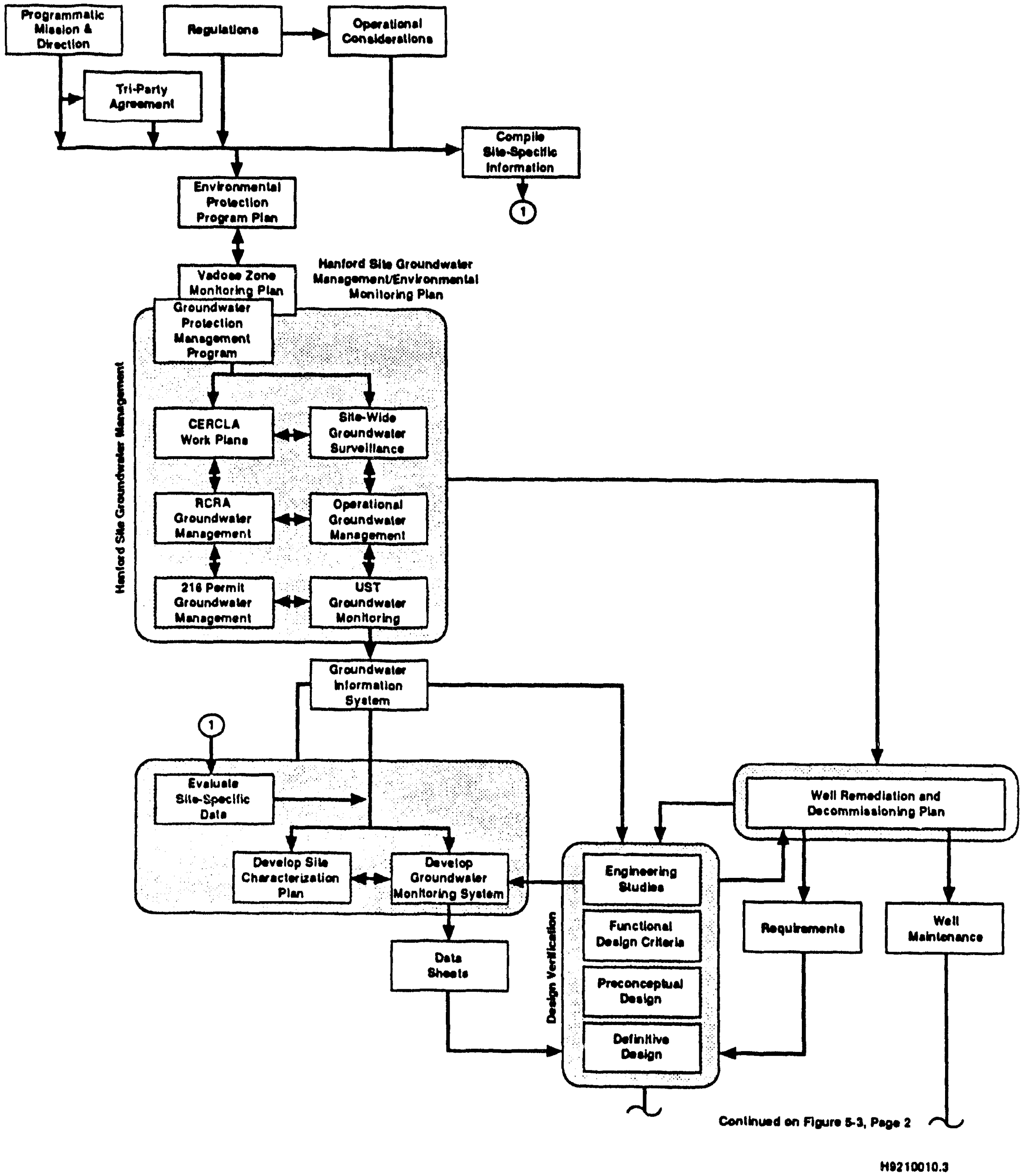
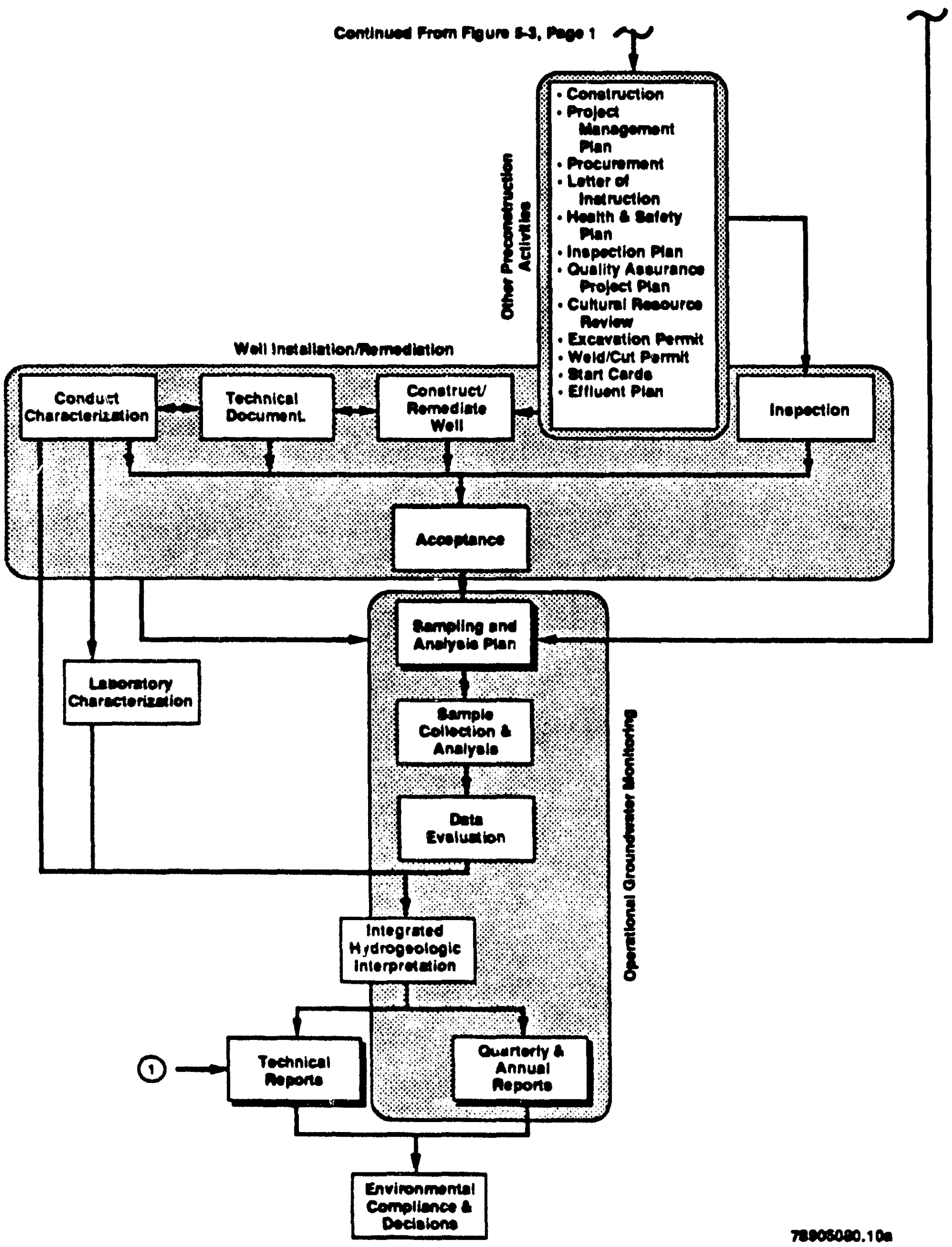


Figure 5-3. Hanford Site Operational Groundwater Program Process Flowsheet. (2 sheets)



5.1.4 Groundwater Characterization Under CERCLA

A strategy for CERCLA actions at the Hanford Site is illustrated in Figure 5-4. Groundwater monitoring and related site characterization for operable units (groupings of regulated units) are treated separately to allow for the difference between the more localized contaminants in the soil column at the sources and the more widespread distribution of groundwater contaminant plumes that may result from one or more individual sources. The concept of the *groundwater operable unit* has been adopted to separate characterization of the specific waste site or unit from groundwater characterization. Monitoring wells are located so as to define the nature and extent of the contaminant plume, rather than tightly grouped at the individual waste source as for RCRA sites. Groundwater operable units are described in Appendix D of the Tri-Party Agreement.

The CERCLA process (Figure 5-5) is similar to the RCRA process described, except the permitting function is replaced by project scoping and a site-specific work plan function that specifies data needs as coordinated through the GPMP and the Hanford Site Groundwater Management/Environmental Monitoring Plan. Another important difference between the RCRA and CERCLA activities at the Hanford Site is the mechanism of program implementation. For example, CERCLA work is often conducted by subcontractors with overall project management controlled by DOE and the prime contractor (WHC); whereas, the RCRA groundwater program is usually conducted by the operating contractor (also WHC) for the facilities involved. The final CERCLA output is in the form of technical reports and remedial investigation reports that are used to support feasibility studies for remediation.

5.1.5 216 Waste Discharge Permit Program

In December 1991, Ecology and DOE signed Consent Order No. DE 91NM-177, also known as the Liquid Effluent Consent Order (Ecology and DOE 1992). Under this order, permits administered by WAC 173-216, "State Waste Discharge Permit Program" (SWDP or 216 Permit) or National Pollution Discharge Elimination System (NPDES), are required for certain liquid waste streams. The order also affects the practice of discharging liquid effluents to the ground at the Hanford Site. This order is distinct from, though consistent with, the Tri-Party Agreement.

Two key provisions of the Liquid Effluent Consent Order are:

- DOE agrees to abide by all applicable state water quality criteria (e.g., WAC 173-200 and 173-201), provided those criteria are consistent with Ecology's statutory authority and are applied on a nondiscriminatory basis statewide.
- DOE agrees to secure permits for effluent streams discharged at the Hanford Site, as required by applicable law.

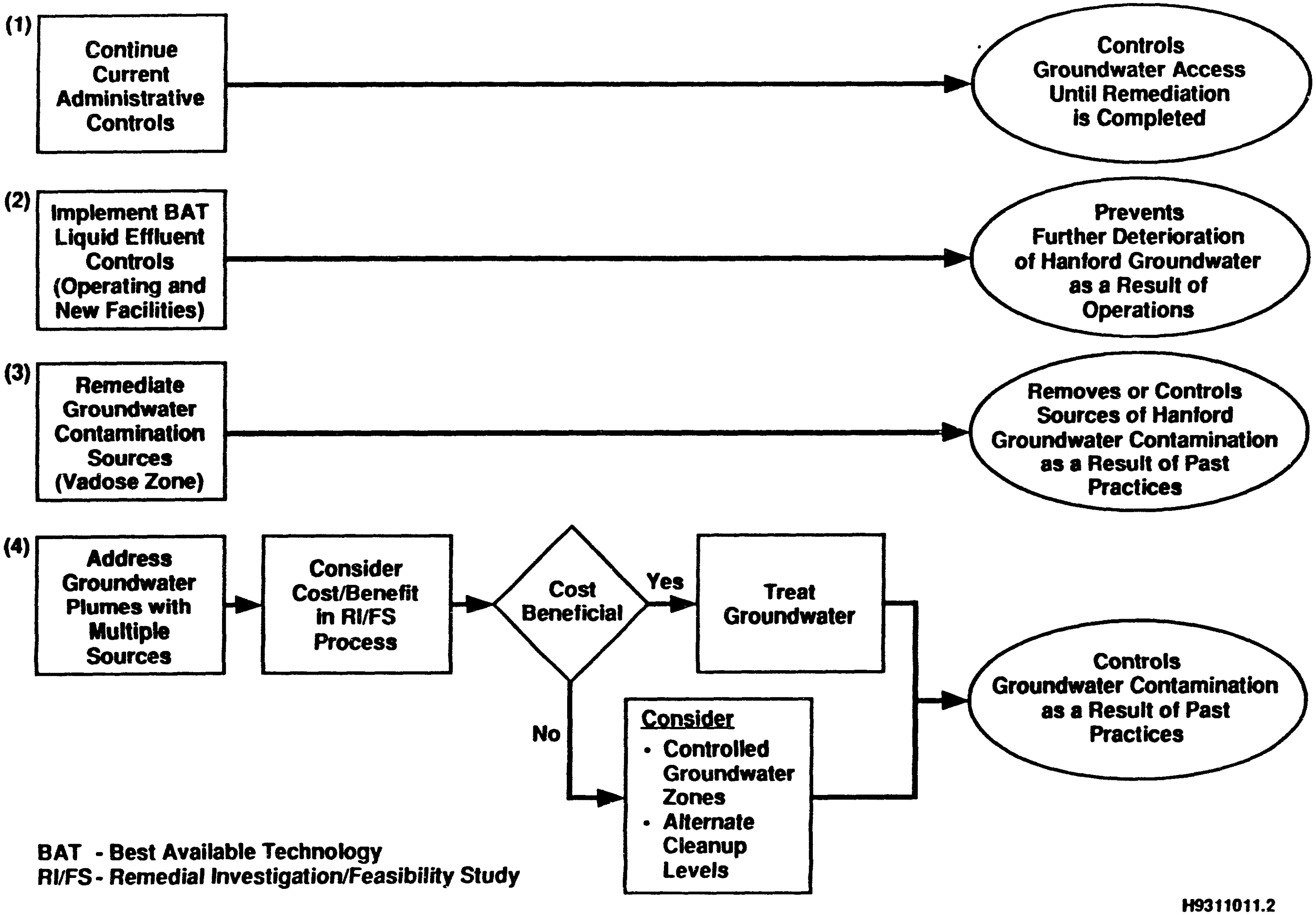


Figure 5-4. Strategy for CERCLA Groundwater Remediation and Related Actions at the Hanford Site.

Figure 5-5. Hanford Site CERCLA Groundwater Program Process Flowsheet. (2 sheets)

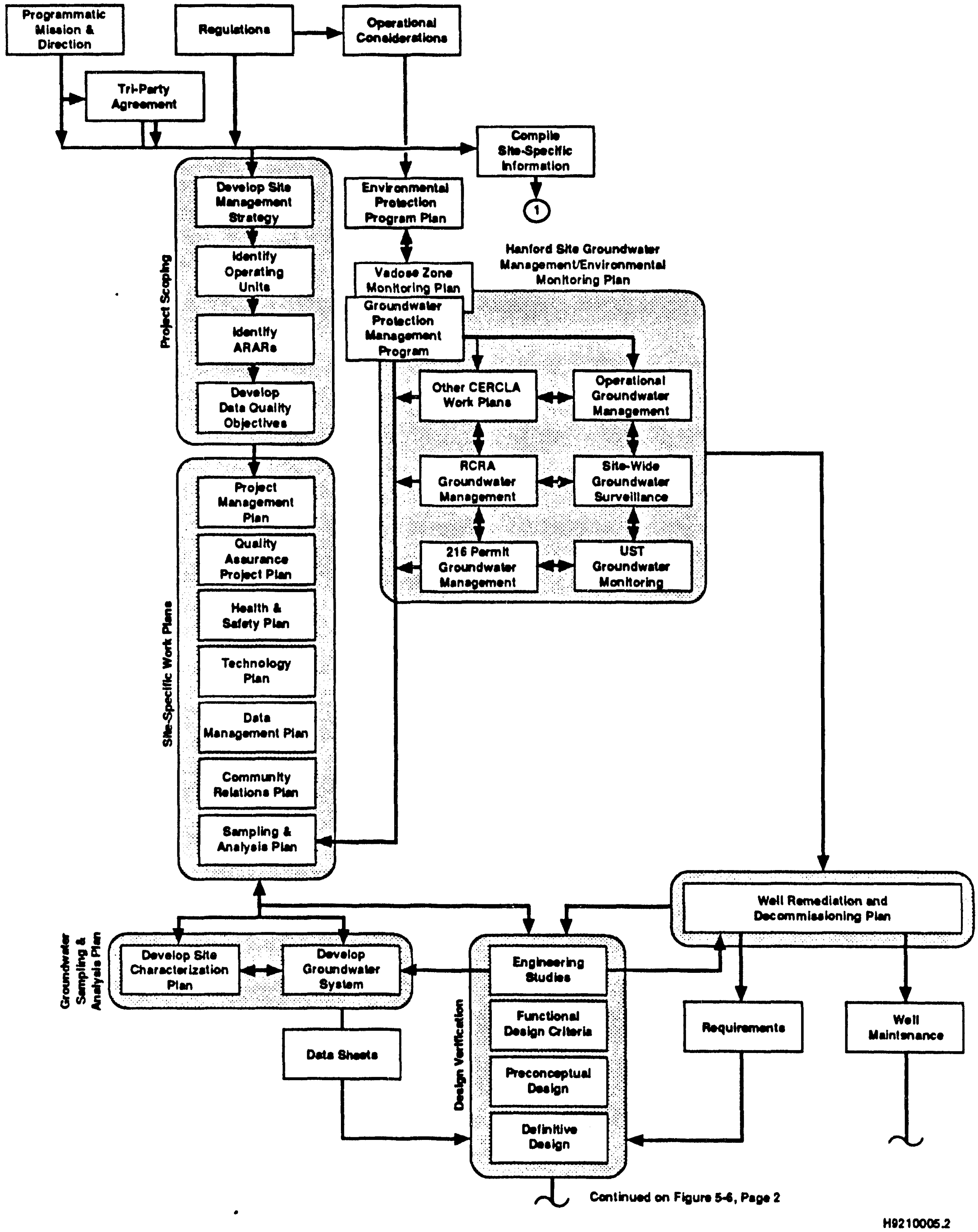
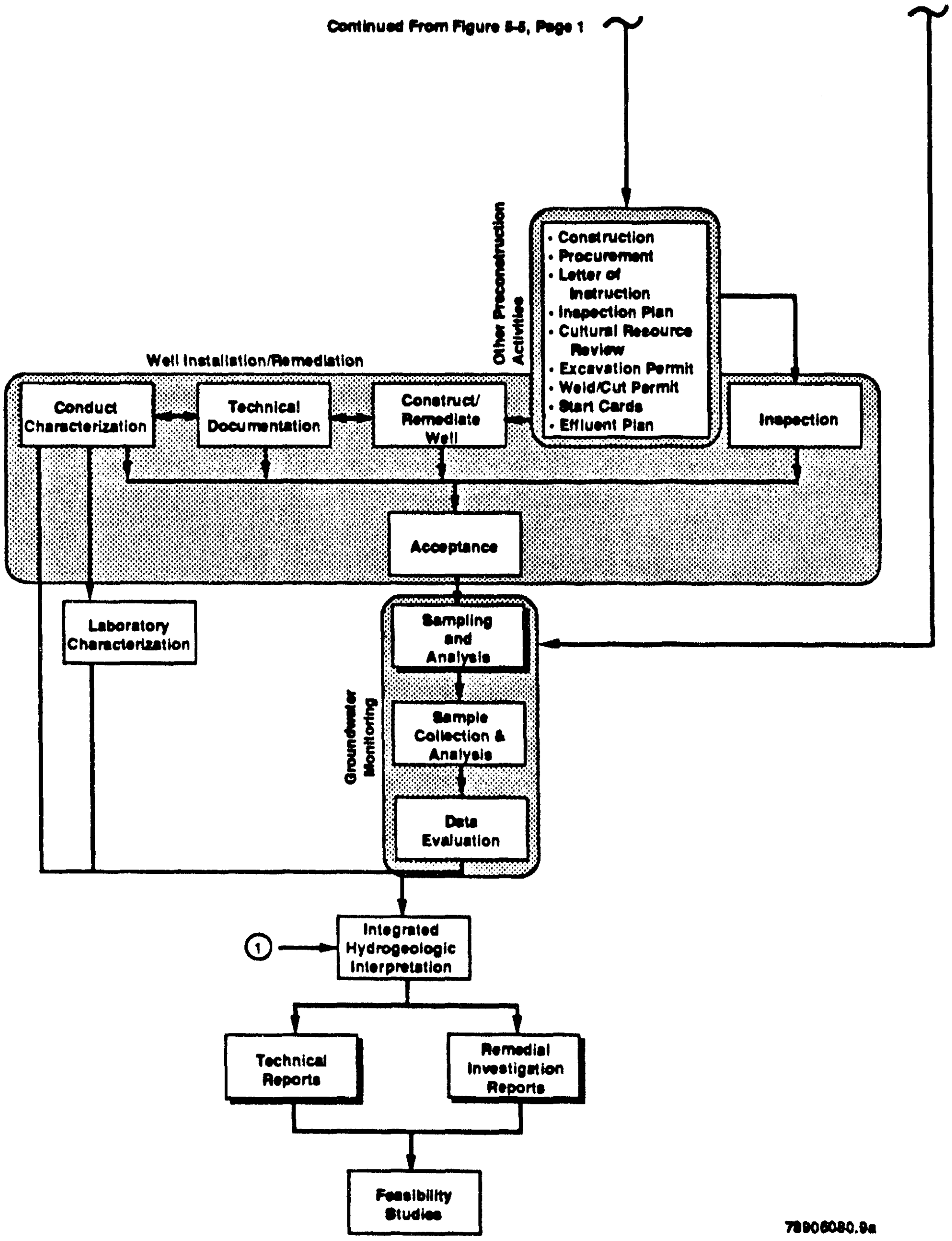


Figure 5-5. Hanford Site CERCLA Groundwater Program Process Flowsheet. (2 sheets)



A 216 Permit requires submittal of an engineering report of Best Available Technology or All Known and Reasonable Technology (BAT/AKART) (WAC 173-204-130). The engineering report must include a geohydrologic evaluation of the liquid effluent receiving site. Also sampling and analysis plans are required for liquid effluents, and groundwater impact assessments are required for some specific disposal sites.

Related to the 216 Permit program are monitoring requirements attendant to Tri-Party Agreement Milestone M-17-00, "Complete liquid effluent treatment facilities/upgrades for all Phase I streams." Under this milestone, disposal to the soil column of all untreated effluents will cease as of June 1995. Treated Effluent Disposal Basins receiving treated effluents will incorporate groundwater monitoring required by the 216 Permit program as part of their operation.

5.1.6 Underground Storage Tanks Program

In October 1991, Ecology finalized "Underground Storage Tank Regulations" (WAC 173-360), which controls the underground storage of petroleum products and "other regulated substances." However, radioactive, hazardous (subject to Subtitle C of the federal *Solid Waste Disposal Act of 1974*) and mixed waste are exempt from these regulations. Sections 345(6)(g) and 520 of WAC 173-360 set provisions for groundwater monitoring in conjunction with USTs. Recent agreements between DOE and Ecology have acknowledged this state code as the underlying authority for groundwater monitoring and other applicable activities concerning USTs.

5.1.7 Support Needs

The groundwater surveillance, characterization, and monitoring programs described above are dependent on reliable sampling and analysis methods and collection of critical data to support cleanup/closure decisions or demonstrate compliance. The sampling and analysis results are in turn dependent on proper well installation, adequate well development ("cleanup pumping" before sampling), sampling equipment, and site-specific sediment and hydrochemical data.

With the increasing number of groundwater monitoring wells drilled, the disposing of potentially contaminated purge water was soon recognized as a major issue. In October 1990, Ecology, EPA, and DOE reached an agreement regarding the strategy for handling and disposing of these waters (WHC 1990). This agreement provides procedures and criteria for disposal of waters extracted from monitoring wells during sampling, maintenance, testing, and development.

5.1.8 Subsurface Data Collection Criteria

Some general criteria are common to all activities requiring subsurface measurements. To ensure maximum use is made of each borehole (to support performance assessment needs as well as monitoring activities), the following guidelines are adopted.

- Monitoring well locations are selected using all available groundwater data, local hydraulic gradient information, source locations, and waste characteristics. Plume modeling is applied to determine an appropriate array of initial well locations.

- The probability of encountering contaminants with densities greater than water (e.g., dense, nonaqueous-phase liquids) is evaluated. For example, carbon tetrachloride is known to occur widely in the subsurface within and near the 200 West Area of the Hanford Site. Vertical distribution of contaminants will, in part, govern well design.

- In addition to Contamination Indicator Parameters and water quality parameters, site-specific indicators are chosen based on the records of waste composition for waste sites likely to have contributed to vadose zone or groundwater contamination. Other groundwater sampling requirements are as directed in WAC 173-303-645. Chemical characterization of the groundwater should also include an assessment of the possible presence of colloidal phases and basic geochemical characteristics (pH, redox, major ion composition) for geochemical modeling predictions of contaminant stability.

- It will be necessary at many waste sites to demonstrate compliance with long-term groundwater protection standards (RCRA). This will require knowledge about the lithology beneath the waste site and reactivity of the contaminants with the sediments. Thus, sediment samples are acquired during the drilling of every monitoring well for possible analysis.

5.2 VADOSE ZONE CHARACTERIZATION AND MONITORING

The vadose zone (unsaturated soil and sedimentary deposits above the water table) contains the radioactive/hazardous mixed waste of concern as a potential source of contaminants to groundwater at the Hanford Site. The depth distribution of contaminants from releases, discharges, and leaks is of primary concern to operational programs and remedial investigations for RCRA/CERCLA activities. Primary areas of interest are: (1) the recharge or infiltration rates at waste sites (the driving force for downward movement of contaminants), (2) physical and chemical characteristics of the sediment/soil column, which, along with recharge is needed for predicting contaminant mobility and calculation of engineered barrier design/performance requirements, and (3) vadose zone monitoring of subsurface waste storage and disposal sites to provide early warning of waste movement that could potentially cause future groundwater contamination problems.

5.2.1 Net Infiltration

The net infiltration of precipitation is dependent on climate and soil/sediment texture. These variables are being evaluated experimentally and with transport models at the Hanford Site in connection with the performance assessment and engineered barriers programs. Because compliance with groundwater protection standards will be based on performance assessment models, model validation is of particular concern to the GPMP. This information is critical to demonstrate with "reasonable assurance" that infiltration rates, the most important variable in contaminant transport models, are credible for Hanford Site conditions.

Near-term validation plans include the use of old spill sites as "tracer experiments" to gain greater confidence in short-term (months), small-scale collection lysimeter results. The change in contaminant depth-distribution over tens of years will be evaluated at suitable waste sites for this purpose (Routson and Johnson 1988). Natural analogs such as the caliche layers in many soil profiles at the Hanford Site are also being evaluated as long-term indicators of net infiltration (during the past 10,000 years).

5.2.2 Contaminant Mobility and Engineered Barriers

Engineered barriers at the Hanford Site represent long-term groundwater protection measures (see Section 4.5). These structures have been under development for several years (Adams and Wing 1986; DOE 1987) at the Hanford Site and are intended to minimize human and biological intrusion, erosion, release of noxious gases from waste zones, and to inhibit the infiltration of moisture (Figures 5-6 and 5-7).

As discussed in Section 4.5, a groundwater protection, drinking water standard may be used as a design performance standard for barriers in the revised 40 CFR 191 rule governing HLW and TRU radioactive waste disposal. In-place stabilization options that rely on waste form/barrier must demonstrate compliance (over a 1,000-year period) with the dose equivalent drinking water standard of 4 mrem/yr (including background). Other input data requirements are waste composition, chemical properties and spatial variability of vadose zone sediments, waste reactivity with vadose zone sediments, and net infiltration capacity and physical properties of the soil column. With appropriate performance assessment models and reasonable input data, the infiltration rate that will maintain groundwater concentrations below the drinking water standard over 1,000 years can be calculated.

The Barrier Development Program has been in existence since fiscal year (FY) 1986. Since then, the emphasis of the program's efforts has been on the development and testing of various barrier components. For the most part, these development and testing efforts have been performed either in the laboratory or on relatively small-scale field plots. Although not completely resolved, issues pertaining to protective barrier performance with respect to water infiltration, biointrusion, erosion and deposition, human interference, physical stability, and climate change are being addressed. During FY 1992, a full-scale prototype barrier was designed. This prototype is planned for construction in FY 1994. The design and construction of a prototype barrier forces all of the various components of the barrier to be brought together

Figure 5-6. Engineered Barrier Functional Performance.

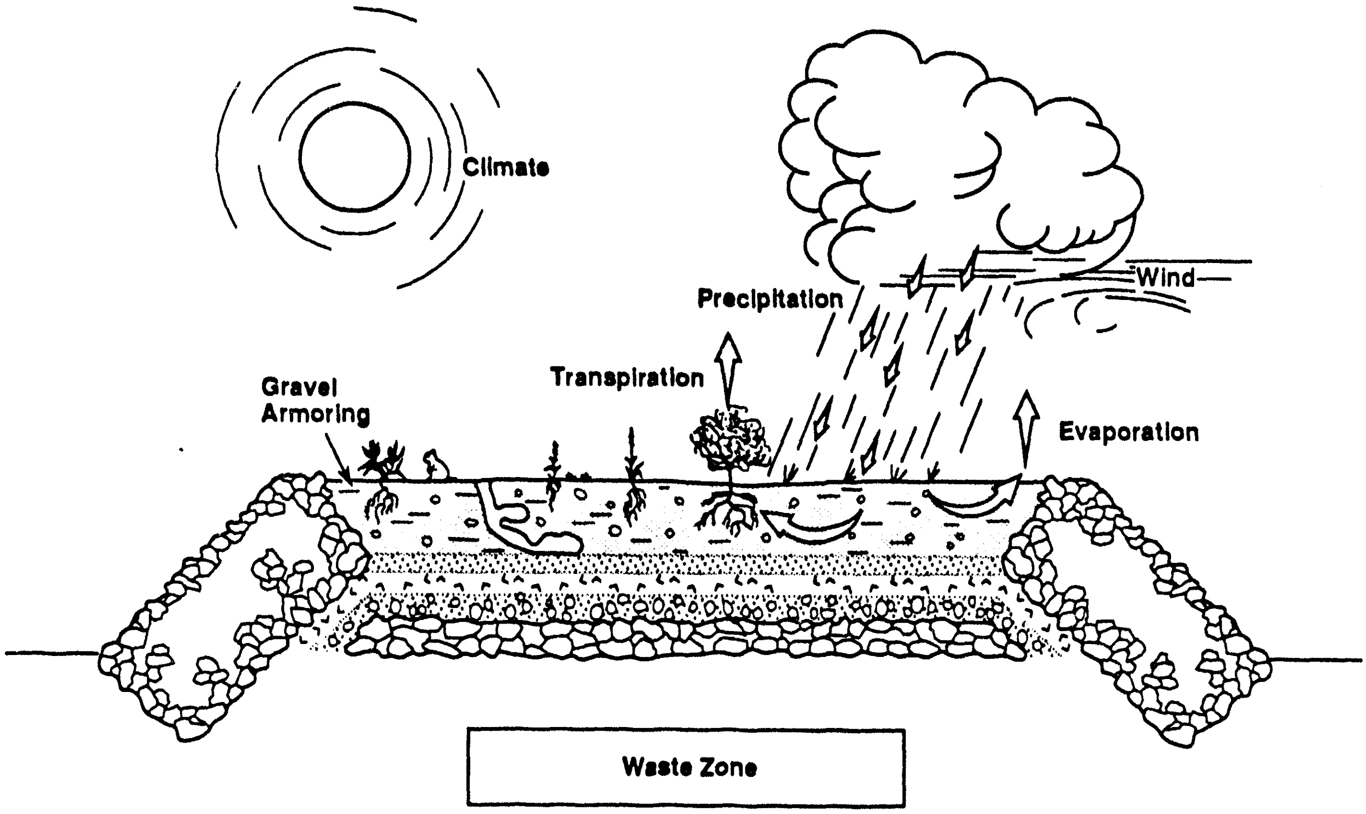
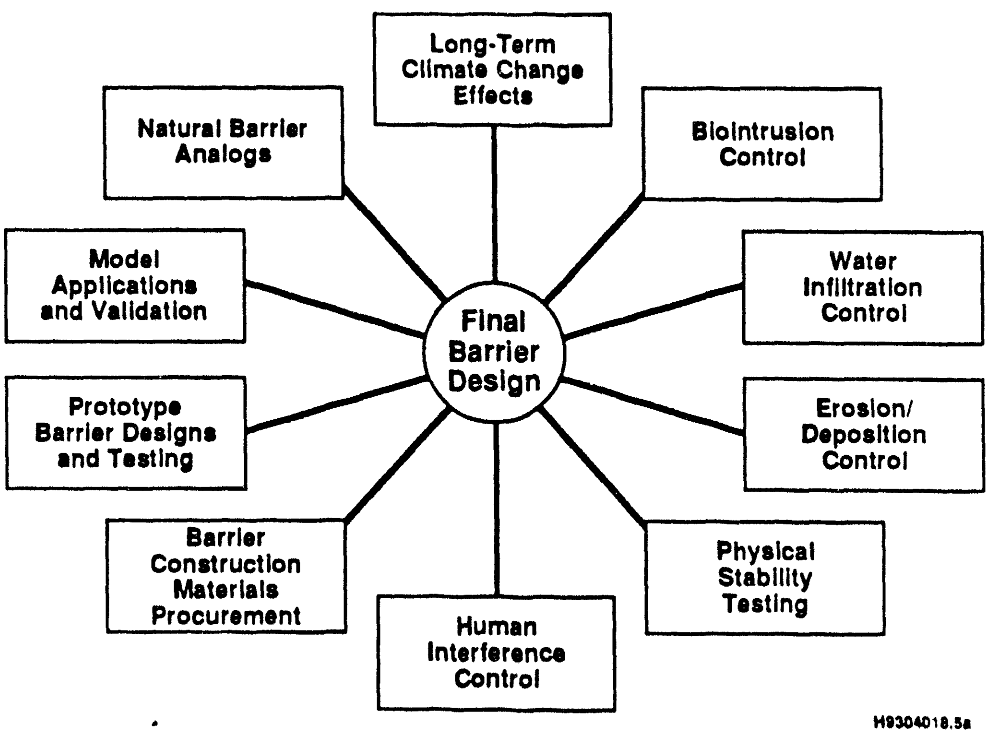


Figure 5-7. Engineered Barrier Development Tasks.



into an integrated system. This integration is particularly important because some of the components of the protective barrier have had to be developed independently of other barrier components. The prototype will also provide engineers and scientists with a capability for testing the performance of a full-scale barrier, something that has not been possible with the relatively small-scale tests and experiments that have been conducted to date in the program. The Barrier Development Program is expected to be completed in the late 1990's.

Some of the information for the above purposes is being acquired in connection with the Barrier Development and Performance Assessment Programs. Background radionuclide concentrations are in part available from groundwater monitoring activities and past repository studies. Additional information is acquired through special sampling and characterization efforts.

To predict contaminant movement via performance assessment modeling, information in addition to contaminant concentrations is required. Soils are characterized and archived, to the extent possible, to maximize understanding of variability of chemical and physical properties of soils that control contaminant transport. By collecting and archiving as much of the soil column as possible during the drilling of monitoring wells, samples will be available for characterization and later use in laboratory evaluation. To advance this strategy, the *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes* (DOE-RL 1993) was completed in early FY 1993. Likewise, groundwater quality background studies are presented in *Hanford Site Groundwater Background* (DOE-RL 1992b).

5.2.3 Vadose Zone Monitoring Strategy

Radionuclides and hazardous waste were discharged or placed in various cribs, ponds, ditches, and burial grounds at the Hanford Site. When effluent is discharged from impoundment or infiltration facilities into the surrounding sediment, the radionuclides and hazardous constituents that precipitate out of solution, are adsorbed on the sediment or, in the case of highly mobile species, slowly migrate both horizontally and downward. The greatest portion of these hazardous constituents is retained within the unsaturated zone (vadose zone) above the unconfined aquifer.

There are two main objectives to this program: (1) to protect the groundwater from contamination (short term) and (2) to provide contaminant characterization and migration information for performance assessment modeling (long-term groundwater protection assessment).

Monitoring to protect the groundwater is particularly important for active facilities where large volumes of effluent can be expected until discharge to the soil column is eliminated in 1995. Vadose zone characterization and monitoring are essential activities required to support the Hanford Site defense waste EIS (DOE 1987). Vadose zone monitoring is also required to satisfy data needs for performance assessment modeling for the waste sites. These models require data on the concentration and location of contaminants over long periods of time (several years), and will be used to confirm computer modeling of specific contaminant migration.

Vadose zone monitoring will determine the concentrations, area/distribution and movement of radionuclides, and nonradioactive hazardous constituents retained within the vadose zone. Initially, the focus will be mostly on the gamma-emitting component of the radioactive waste. This monitoring is required by DOE Order 5820.2A, *Radioactive Waste Management* (DOE 1984). The plan is also required to provide data for performance assessment modeling needed to satisfy the requirements of RCRA, CERCLA, and to address comments received from Ecology in a Notice of Deficiency in 1990 on the Single-Shell Tank (SST) Closure/Corrective Action Work Plan. Improvements to vadose zone monitoring will also respond to concerns of reports of the General Accounting Office and the DOE Tiger Team regarding the fate of waste leaked to the soils from the SSTs. A joint Cooperative Research and Development Agreement between PNL and WHC has been approved. The Cooperative Research and Development Agreement will adapt commercial geophysical logging techniques to the Hanford Site using two commercial logging companies.

5.2.3.1 Radionuclide Monitoring Techniques. Radionuclide monitoring at active and inactive waste sites will be accomplished with a combination of borehole geophysical logging techniques. Existing and new wells provide access to the contaminated zones. Logging probes will be lowered into these wells to measure responses that can be used to interpret the radionuclide concentration and distribution as well as the sediment moisture profile. Soil moisture will be monitored because water is the main driving mechanism for the migration of radionuclides and hazardous waste. Logs are analyzed and archived for comparison at a later date. Log data are supplemented with actual sampling, where needed, to measure the concentration of radionuclides more accurately.

5.2.3.2 Hazardous Chemical Monitoring. Hazardous, nonradioactive contaminants are more difficult to monitor than the radioactive contaminants. This type of monitoring will employ a combination of soil gas sampling and analysis and actual sediment sampling. Because of the expense of drilling and sampling, it is expected that hazardous chemical monitoring will be more of a characterization effort as opposed to a regular monitoring task.

5.2.3.3 General Monitoring Plan. A vadose zone monitoring strategy is now in preparation by WHC. The plan will identify monitoring requirements, monitoring technology, the requirements of the various monitoring methods, monitoring frequencies, site priorities, and monitoring well criteria. This plan will establish the basis for monitoring and provide guidelines for preparation of site-specific monitoring plans and Data Quality Objectives.

5.2.3.4 Site-Specific Monitoring Plans. Because each waste site is unique (i.e., site geometry, geology, hydrology, and waste constituents), site-specific vadose zone monitoring plans will be required. For isolated, inactive sites with relatively innocuous contaminants, a monitoring frequency of once every 5 years may be adequate. All untreated liquid effluent discharges to soils will cease by June 1995, at which time monitoring will change to satisfy the Data Quality Objectives for design, testing, and assessment of environmental restoration.

5.3 PASCO BASIN CONCEPTUAL HYDROLOGIC MODEL

Management of groundwater resources requires a conceptual model of surface water and groundwater regimes on a basinwide scale. Figure 5-8 is a simplified version of such a conceptual model for the Hanford Site. The strategy for the continued development of conceptual and numerical models involves collection and analysis of the following types of information:

- Geohydrologic framework (stratigraphic and structural relationships, hydrostratigraphic units, etc.)
- Hydrochemical facies
- Physical parameters of aquifers (hydraulic conductivity, head distributions, flow dynamics, volumetric flow rates, net infiltration, etc.)
- Recharge/discharge boundaries (both natural and artificial).

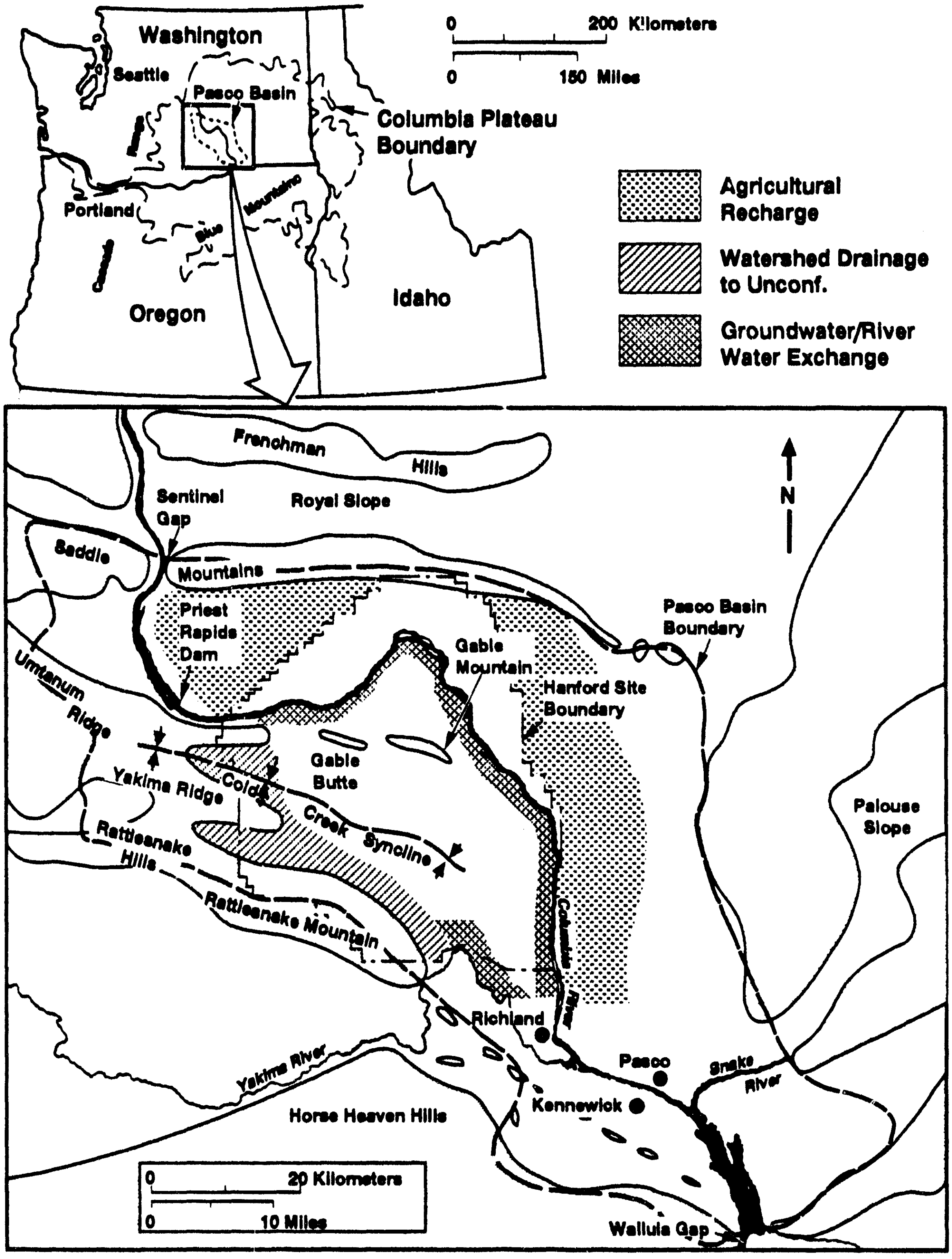
This information is used to assess groundwater movement, surface water/ groundwater interactions, and to evaluate manmade surface and subsurface perturbations on the system (wastewater discharge, irrigation withdrawals, etc.).

Much information is available as a result of past defense waste and nuclear repository characterization studies and ongoing studies conducted by state and federal natural resource agencies. A significant portion of the data acquisition and model development has been documented in site characterization reports and plans (DOE 1987; DOE-RL 1988). These documents also provide detailed descriptions of additional data requirements that will be used as guidance (where applicable to surface water/groundwater interactions and evaluation of the unconfined and uppermost confined aquifer systems). Hydrologic models to assess contaminant transport in the vadose zone and in groundwater have been developed and are used and upgraded as needed.

Existing data acquisition plans to define the hydrologic regimes within the Pasco Basin are still valid and are taken into consideration when defining and prioritizing future data needs to support current basinwide characterization efforts. Current plans focus on acquiring critical groundwater protection/management information that includes, but is not limited to, the following.

- Recharge data to better quantify groundwater transport in the unconfined aquifer (the aquifer beneath the Hanford Site most vulnerable to contamination).
- Effects of agricultural recharge (i.e., impact of Columbia River Irrigation Project activities) on confined-system flow dynamics beneath the Hanford Site.

Figure 5-8. Major Surface Water Features of the Pasco Basin that Influence the Groundwater Regime Beneath the Hanford Site.



- Interconnectivity and potential for groundwater exchange between unconfined and confined aquifers.
- Intercommunication and exchange between the Columbia River and the unconfined aquifer (100 Areas).

Opportunities for cooperative research efforts involving DOE contractors, universities, and the U.S. Geological Survey are routinely sought to ensure coordination with related programs underway in the region, and to avoid duplication of efforts.

5.4 INTEGRATION OF PROGRAMS

The various programs involving groundwater-related information needs must be effectively coordinated to: (1) avoid duplication of efforts, (2) minimize costs, (3) avoid inadvertent conflicts, (4) maximize use of boreholes and wells, (5) ensure the timely acquisition of critical information, and (6) complete mission objectives. Strategy elements to address these objectives include, but are not limited to, the following.

- A centralized database management system to facilitate dissemination and storage of existing and future data.
- The Well Administrator Team is established to coordinate locating, use and well maintenance, and well ownership (for activity funding purposes).
- The GWG of onsite and offsite peers is established to periodically review sitewide groundwater-related data and needs, and to make recommendations for improving groundwater resource management at the Hanford Site.

Organizational and administrative aspects of the above are discussed in the *Environmental Protection Implementation Plan* (DOE-RL 1992a). Conceptual and technical aspects are discussed in the following sections.

5.4.1 Well Administrator Team

The Well Administrator Team is a multilateral organizational element with a central role in monitoring well oversight. Regular participants in bimonthly meetings and the Well Administrator Team efforts include RL, WHC, PNL, Washington Public Power Supply System, and the U.S. Army Corps of Engineers.

Currently, over 3,000 vadose zone and groundwater monitoring wells exist on the Hanford Site (Chamness and Merz 1993). Many new monitoring wells (roughly 300) meeting regulatory standards have been drilled since 1987. Additional new wells may be needed to meet regulatory requirements for CERCLA, RCRA, and operable unit groundwater monitoring. Most older monitoring wells were installed for either operational purposes or for the sitewide environmental surveillance program conducted by PNL. Some of the older wells meet specifications, but most require replacement or modification for meeting new standards. Many wells that are beginning to go dry, because of reduced effluent discharge and lowering water tables, may also be modified, abandoned, or replaced.

WHC (Environmental Field Services) is functionally responsible for the management, field direction, and documentation of groundwater well remediation on the Hanford Site. Strategy for well remediation and decommissioning activities is described in the *Hanford Well Remediation and Decommissioning Plan* (WHC 1993a).

5.4.2 Geohydrologic Working Group

To provide a broad perspective and maximize hydrogeologic information acquisition, senior technical staff representatives from organizations involved in Hanford Site characterization studies meet periodically as the GWG. Agendas include technical exchange presentations of topics in the subject area and panel discussion of additional data needs. Outside technical experts are invited to provide independent review and assessment of program progress and direction. Recommendations for any new information needs or changes in direction are prepared by the GWG and reviewed in conjunction with the Well Administrator Team for consideration in future funding for the necessary actions.

5.4.3 Hanford Environmental Information System

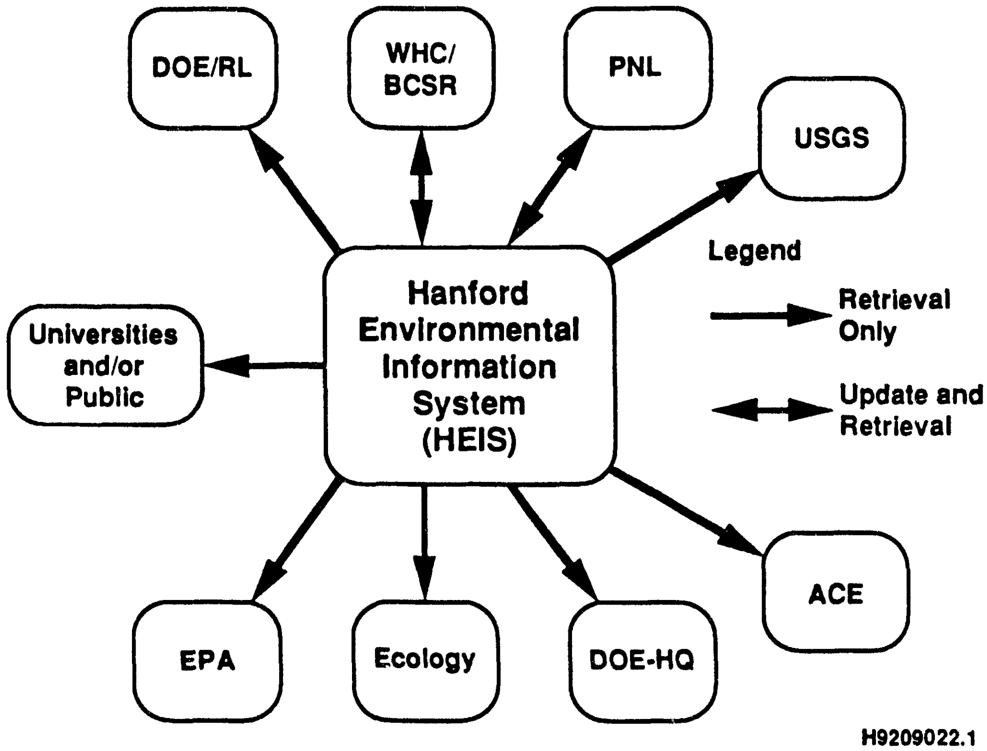
The Hanford Environmental Information System (HEIS) is a consolidated set of automated resources that effectively manage the data gathered during environmental monitoring and restoration of the Hanford Site. The HEIS includes an integrated database that provides consistent and current data to all users and promotes sharing of data by the entire user community (Figure 5-9).

Data stored in the HEIS are collected under several regulatory programs. Currently these include CERCLA, RCRA, and the Ground-Water Environmental Surveillance Project, managed by PNL.

As the title suggests, the HEIS is an information system with an inclusive database. Although the database is the nucleus of the system, the HEIS also provides user access software: menu-driven data entry, reporting, extraction, and browsing facilities; an ad hoc query facility; two-dimensional graphics; and a geographic information system.

The HEIS serves as a central repository for all groundwater data collected on the Hanford Site. Information on water levels, groundwater chemistry, sampling, and monitoring well activity and ownership are available on HEIS for incorporation into smaller, user-tailored databases.

Figure 5-9. Hanford Environmental Information System User Community.



6.0 IDENTIFICATION AND CONTROL OF HAZARDOUS WASTE SOURCES

Section III of DOE Order 5400.1 (DOE 1988) specifies inclusion of programs dealing with identification of hazardous waste areas and strategies for controlling these potential sources of groundwater contamination. This requirement is met by existing documents such as the Hanford Site defense waste EIS (DOE 1987) and the Tri-Party Agreement. This agreement includes a detailed action plan that identifies and prioritizes waste sites for cleanup actions. The strategy for controlling waste sources as a groundwater protection measure places emphasis first on terminating liquid waste disposal to ground by 1995. This is a major near-term groundwater protection provision of the agreement. Long-term groundwater protection is addressed by removal and solidification of high-level liquid waste stored in underground tanks, and cleanup and closure of inactive waste units. Generalized prioritization and major milestones are shown in Figure 6-1. Detailed waste site priorities are listed in the master plan and schedule of the Action Plan of the Tri-Party Agreement.

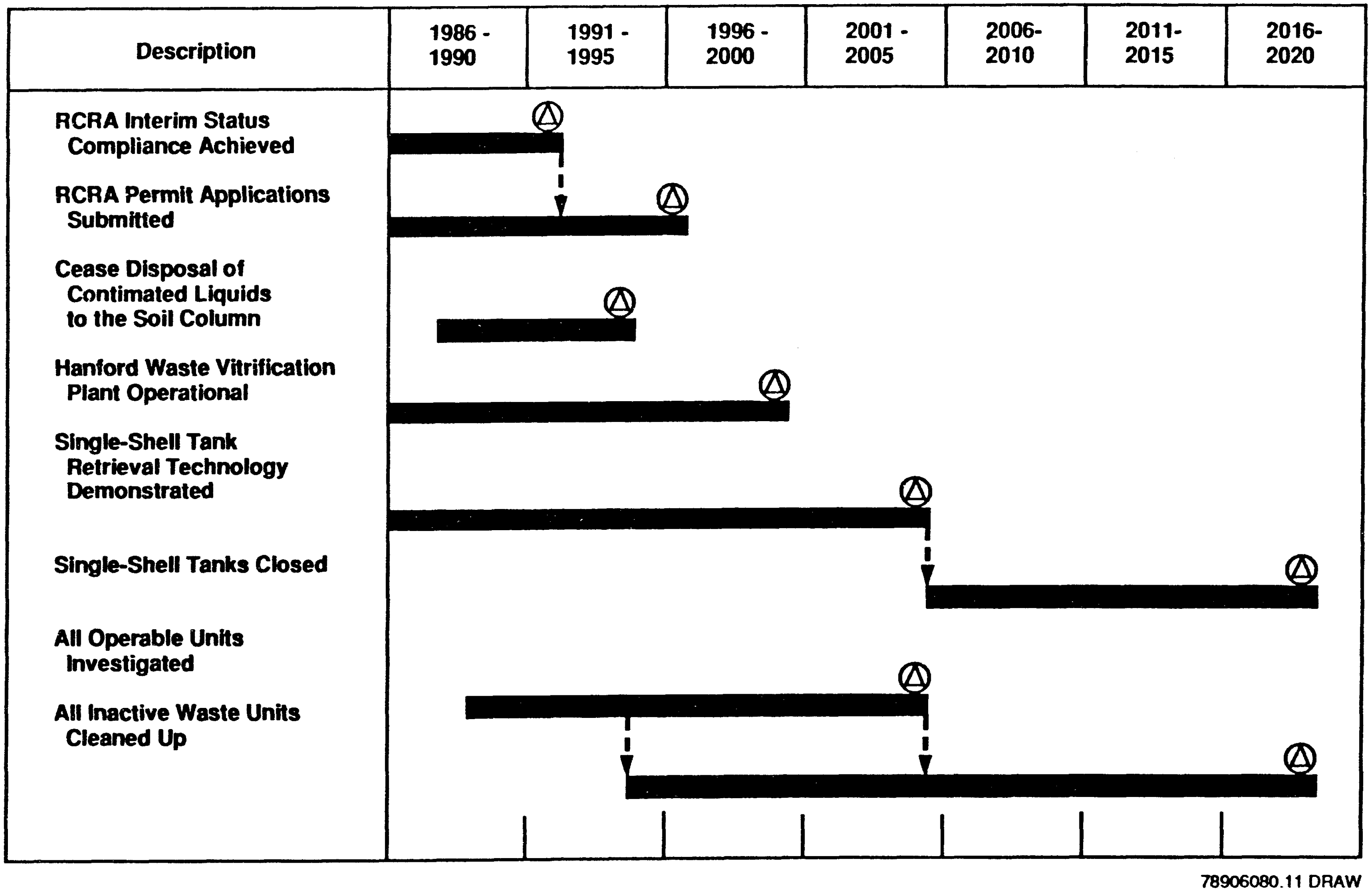


Figure 6-1. Major Milestones Identified in Tri-Party Agreement Action Plan.

7.0 DECONTAMINATION AND DECOMMISSIONING ACTIVITIES

In addition to hazardous waste control under RCRA/CERCLA and current waste management activities, surplus buildings and other structures (reactors, support buildings, etc.) contaminated with radioactive materials must be dismantled and decontaminated. The majority of these facilities were built in the 1940's as part of the Manhattan Project and are mainly located in the 100 and 200 Areas. These facilities include eight plutonium production reactors, two chemical separations/processing plants, and ancillary support structures that contain residual radioactive contamination. There are 115 such structures currently identified. Dismantling and decontamination is conducted under the Hanford surplus facilities program.

Generally, decontamination and decommissioning can be considered a source-control strategy for groundwater protection. Removal of these sources diminishes the potential for long-term groundwater contamination. Groundwater protection provisions also needing consideration during decontamination and decommissioning include wash or rinse water containment and long-term leachability of residual contaminants in the soil column. These are especially important for locations near the Columbia River where the vadose zone is of limited thickness. Other special source considerations include the presence of the long-lived radionuclides in the graphite cores of the old plutonium production reactors (e.g., ^{14}C and ^{36}Cl [half-lives of 5,700 and 200,000 years, respectively]). If these are removed and disposed of on the 200 Areas Plateau, some type of engineered barrier system may be needed. Such groundwater protection considerations have been made in the EIS, such as for the decommissioned plutonium production reactors. Additionally, the groundwater protection provisions of 40 CFR 193, "Environmental Standards for the Management, Storage, and Land Disposal of Low-Level Radioactive Waste and Naturally Occurring and Accelerator-Produced Radioactive Waste," and state regulations (see Section 4.2) will apply.

Most of the cleanup and verification (or postclosure monitoring) is conducted under NEPA, for which project plans are prepared for each waste site or structure. Groundwater monitoring plans do not appear to be required as a standard course of action for the decontamination and decommissioning program as described above. They may be needed in special cases, however, if large amounts of rinsate or decontamination water are likely to be discharged to the ground or if long-term performance assessments indicate the likelihood of transport to groundwater.

Groundwater-related activities in the Hanford surplus facilities program will be coordinated with the Well Administrator Team and GWG to ensure consistency with other groundwater programs.

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8.0 IMPLEMENTATION SCHEDULE

Many of the activities satisfying the GPMP elements specified in DOE Order 5400.1 (III) are also addressed in plans and schedules associated with the Tri-Party Agreement milestones. However, some data needs and activities are not covered by existing plans. The schedule outline of Table 8-1 addresses the additional information and organizational needs, as discussed previously, and within Tiger Team audit findings.

Implementation of GPMP elements will be jointly coordinated by the GWG and through RL oversight. The two groups will meet regularly to ensure implementation occurs and that requirements of the plan are met. This bilateral entity will replace the formerly proposed Office of Groundwater Protection Management. Implementation of those activities not included in Tri-Party Agreement milestones, state regulations, or safety issues will depend on funding availability.

Table 8-1. GPMP Activities and Implementation Schedule.

Program element	Administrating entity(s)	Date(s) of implementation
1. Program Integration:		
A. Prepare groundwater sections of annual Integrated Hanford Site Environmental Monitoring Plan.	PNL	Annually, in November
B. Review/revise Groundwater Protection Management Program document.	WHC, RL	Annually (review) and triennially (revision)
C Prepare annual groundwater quality/status report.	WHC, PNL	Annually, beginning in FY 1993
D. Prepare Operational Groundwater Status Report	WHC	Annually
E. Participate in Well Administrator Team.	PNL, RL, WHC, U.S. Geological Survey, U.S. Army Corps of Engineers	Bimonthly, ongoing
F. Participate in Geohydrologic Working Group meetings.	PNL, RL, WHC, U.S. Geological Survey	Monthly, ongoing
2. Characterization of Geohydrologic Regime:		
A. Evaluate existing, unincorporated data; both older and current work on geology and hydrogeology of the Pasco Basin.	WHC, PNL	Continuous, ongoing
B. Drill new hydrogeologic characterization boreholes.	PNL, WHC	Ongoing and currently proposed
C. Conduct borehole logging.	WHC, PNL	Continuous, beginning in FY 1993
D. Evaluate recharge-discharge boundaries, surface runoff, infiltration, and conduct vadose zone monitoring.	PNL, WHC	Continuous, ongoing
E. Conduct sitewide conceptual/numerical groundwater modeling.	WHC	Continuous, ongoing
F. Conduct surface geologic mapping.	WHC	Continuous, ongoing
G. Evaluate water-level data from deep basalt piezometers (in conjunction with (A) and (B) above.	PNL, WHC	Continuous, ongoing

FY = fiscal year.
PNL = Pacific Northwest Laboratory.
RL = U.S. Department of Energy, Richland Operations Office.
WHC = Westinghouse Hanford Company.

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APPENDIX A

HANFORD SITE AGREEMENT MANAGEMENT STRUCTURE

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HANFORD SITE AGREEMENT MANAGEMENT STRUCTURE

A1.0 GENERAL SITE INFORMATION

A1.1 ORGANIZATION AND ADMINISTRATION

The U.S. Department of Energy (DOE) Assistant Secretary of Defense Programs is responsible for managing waste that is either generated by defense programs or is accepted through negotiations with other government entities. The Assistant Secretary of Defense Programs has the authority for establishing policy for the management of DOE waste and ensuring that DOE waste within the purview of defense programs is managed according to the requirements of DOE Order 5820.2A (DOE 1984).

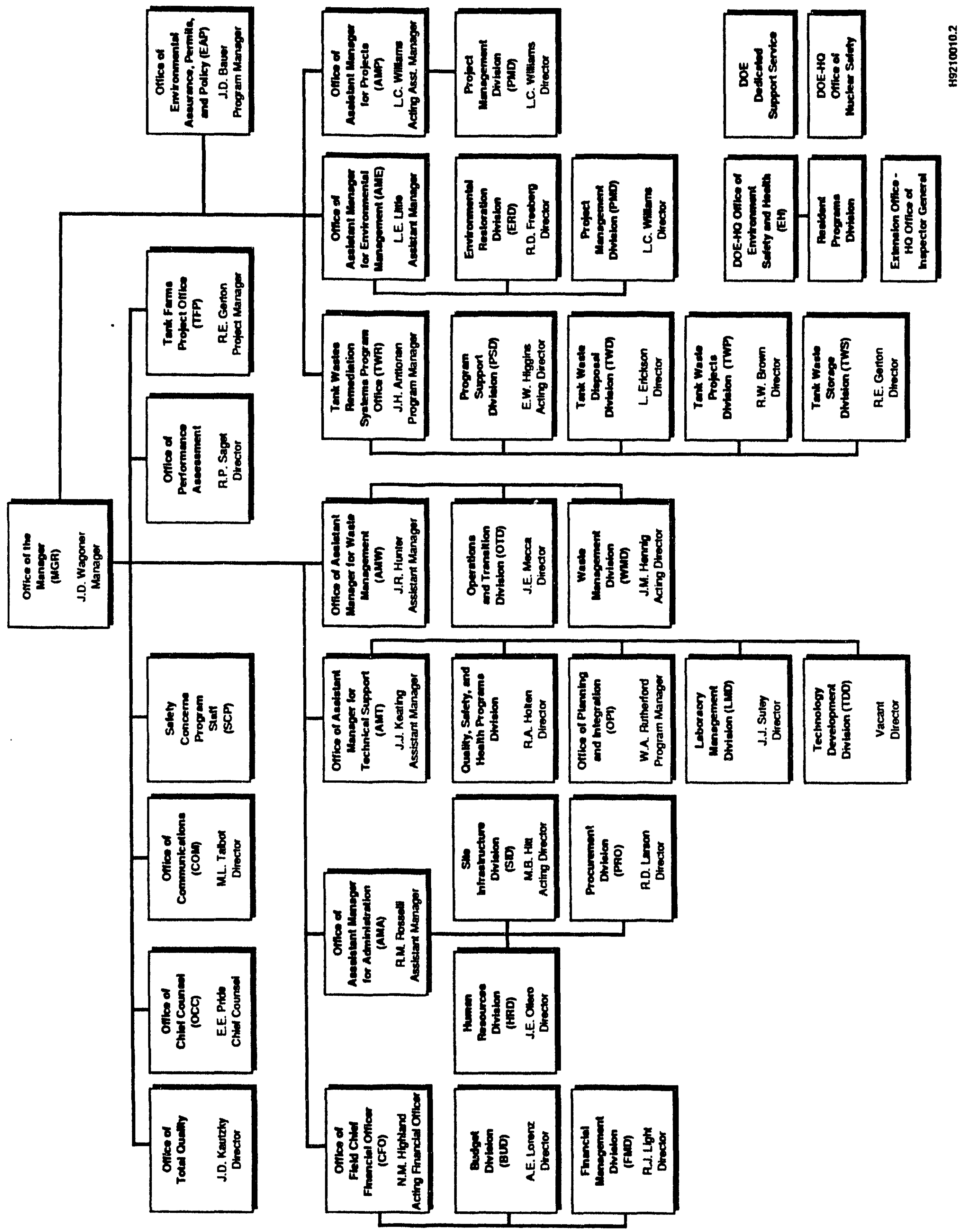
The Hanford Site is administered by the DOE through the DOE, Richland Operations Office (RL), located in Richland, Washington. The Manager, RL, is responsible for all activities that affect the treatment, storage, or disposal (TSD) of waste at the Hanford Site. This responsibility is delegated to the Assistant Manager for Operations, and further to the Director of Waste Management Division. The Deputy Manager for Environment is responsible for ensuring compliance with environmental statutes and regulations through the Office of Environmental Assurance, Permits and Policy. Figure A-1 illustrates the RL organization.

Three prime contractors operate the Hanford Site: the Hanford Environmental Health Foundation, Pacific Northwest Laboratory (PNL), and Westinghouse Hanford Company (WHC). Boeing Computer Services, Richland is contracted to RL along with WHC. Kaiser Engineers Hanford is subcontracted to WHC. All of these contractors generate regulated waste; it is either radioactive and subject to the requirements pursuant to the *Atomic Energy Act of 1954* as amended, or it is hazardous and subject to the regulations pursuant to the *Resource Conservation and Recovery Act of 1976* (RCRA), as amended. Only PNL and WHC are responsible for managing the TSD of regulated waste.

WHC, as the Operating and Engineering Contractor for the Hanford Site, is directly responsible for the management of regulated waste. PNL is responsible for portions of the research and development associated with the management of regulated waste and has the lead responsibility for away-from-facility environmental monitoring.

The WHC organizational structure is shown in Figure A-2. Facility Operations is the principal organization with responsibility and authority for the operation of facilities for regulated waste. Restoration and Remediation is responsible for the strategy and negotiations associated with obtaining regulatory permits for certain facilities, for coordination of permit application preparation, and for regulatory compliance activities. Environmental Safety, Health, and Quality Assurance is responsible for oversight in all activities.

Figure A-1. U.S. Department of Energy, Richland Operations Office Organizational Structure.



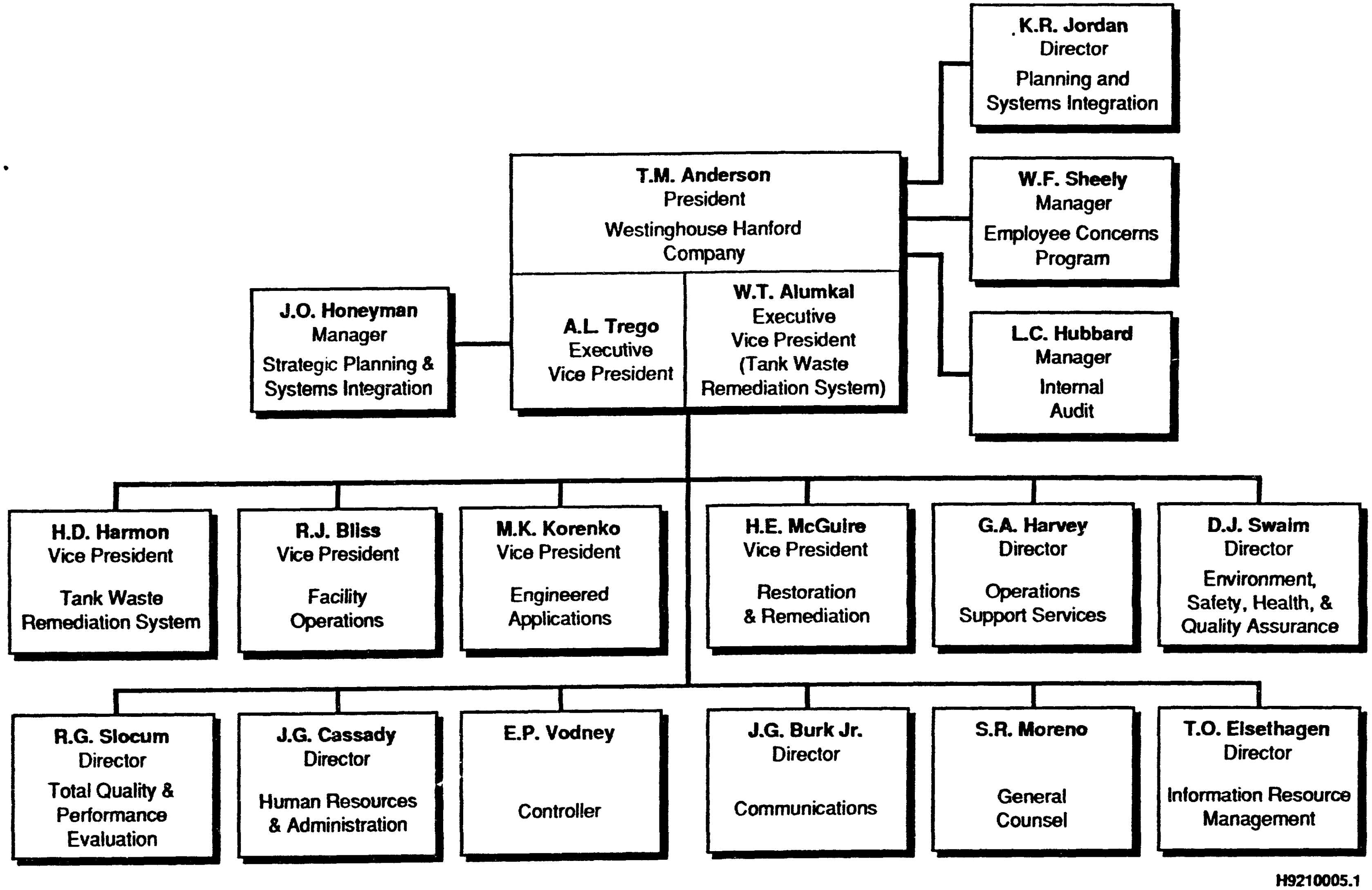


Figure A-2. Westinghouse Hanford Company Organizational Structure.

The PNL organizational structure is shown in Figure A-3. Much of the research and development for the Hanford Waste Vitrification Plant and the Grout Treatment Facility, two major treatment facilities at the Hanford Site, is accomplished by PNL. To a lesser extent, three other departments contribute to some technical aspects for regulated waste: Earth and Environmental Sciences Center, Material and Chemical Sciences Center, and Office of Technology Planning and Analysis. The PNL also has specific responsibilities for environmental surveillance and monitoring. Facilities and Operations has responsibility for storage of mixed waste or hazardous waste generated by PNL.

RL, in association with the Hanford Site contractors, interfaces with several governmental agencies both at the federal and state levels. These agencies include the U.S. Environmental Protection Agency (EPA), the EPA regional office in Seattle, Washington, the Washington State Department of Ecology (Ecology), and the U.S. Nuclear Regulatory Commission (NRC).

EPA has authorized Ecology to regulate the TSD of hazardous waste and the hazardous constituents of mixed waste and remedial actions at inactive sites and facilities at the Hanford Site. RL has agreed with EPA and Ecology to cover RCRA regulatory actions and *Comprehensive Environmental Response, Compensation, and Liability Act of 1980/Superfund Amendments and Reauthorization Act of 1986* (CERCLA/SARA) remedial actions. This agreement establishes the basis for a long-term regulatory compliance strategy.

The NRC has licensing jurisdiction for facilities expressly authorized for disposal of high-level waste. Coordination is maintained with the NRC, as appropriate, to ensure compliance with applicable regulations.

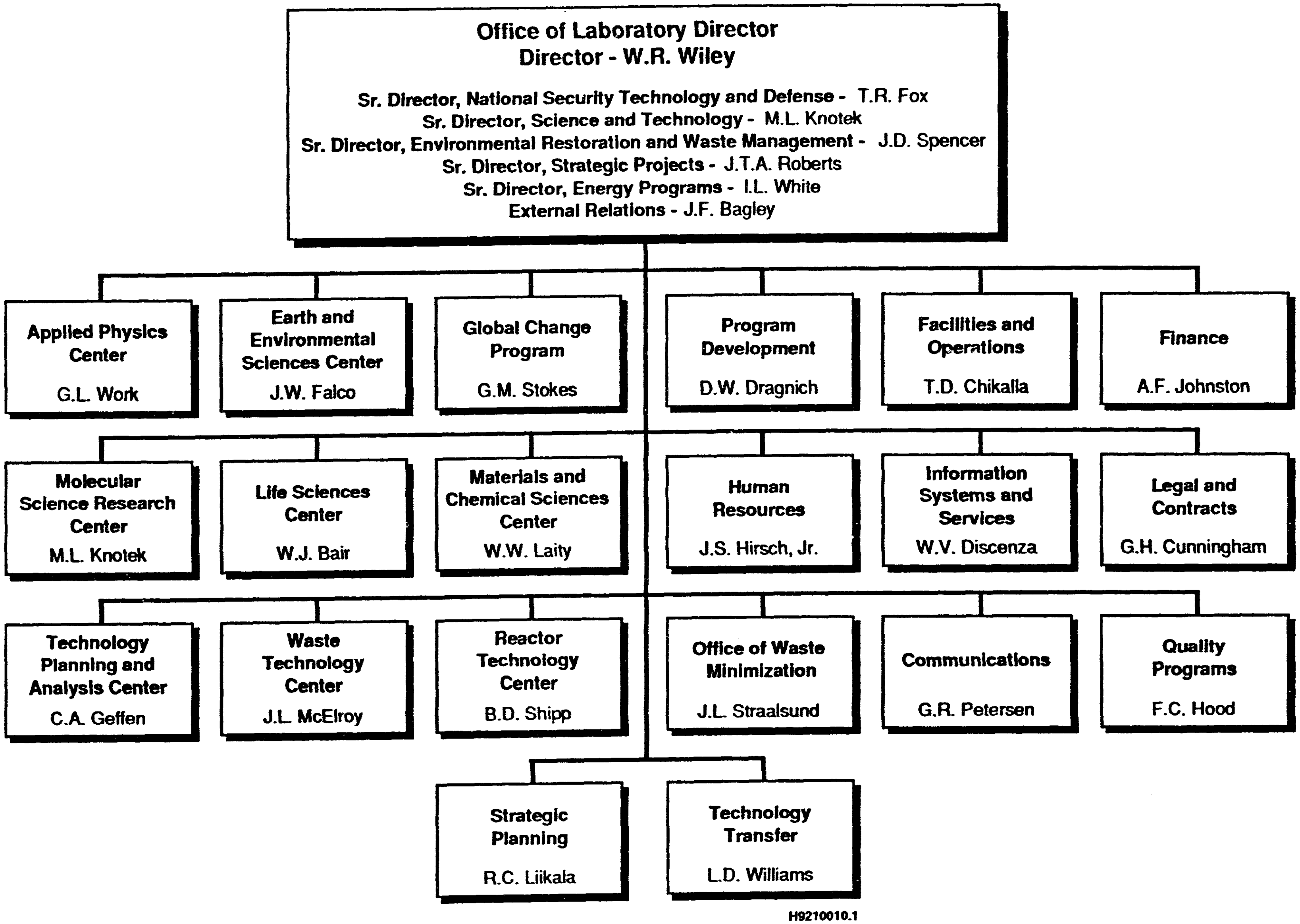


Figure A-3. Pacific Northwest Laboratory Organizational Structure.

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A2.0 TRI-PARTY AGREEMENT PROJECT MANAGEMENT DESCRIPTION

A2.1 PROJECT MANAGERS

The EPA, DOE, and Ecology shall each designate one individual who will serve as project manager and the primary point of contact for all activities to be carried out under this action plan.

The primary responsibilities for the project managers are as follow:

- Implement the scope, terms, and conditions of this action plan
- Approve annual work schedule updates and other revisions
- Direct and provide guidance to unit managers
- Maintain effective communication among the project managers and report status to respective management.

Subject to the limitations set forth in Article XXXVII of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989), in addition to other authorities and responsibilities, Ecology and EPA project managers, or their designated representative(s), shall have authority to: (1) take samples, request split samples of the DOE samples, and ensure that work is performed properly and pursuant to EPA protocols as well as pursuant to the attachments and plans incorporated into this agreement; (2) observe all activities performed pursuant to this agreement, take photographs, and make sure other reports are prepared on the progress of the work as the project manager deems appropriate; and (3) review records, files, and documents relevant to this agreement. In addition, the project manager for EPA or Ecology has authority to require changes to any procedural, design, or specification document that is referenced in a supporting work plan. Such required changes will be subject to the appropriate dispute resolution process as specified in the Tri-Party Agreement.

The DOE project manager or his or her representative shall be physically present on the Hanford Site or reasonably available to supervise work performed at the Hanford Site pursuant to this agreement and shall be available to EPA and Ecology project managers for the pendency of this agreement.

Other authorities and responsibilities are identified in the context of this action plan. The project managers may delegate their authority and responsibilities to the unit managers as appropriate. Table A-1 provides a listing of Hanford Site technical resources.

A2.2 UNIT MANAGERS

EPA, DOE, and Ecology shall each designate an individual as a unit manager for each operable unit, each TSD group/unit, or other specific Tri-Party Agreement activity in which they participate. Unit managers will

Table A-1. Hanford Site Remedial Investigation/Feasibility Study Technical Resources.

Subject/activity	Technical resources	
	Remedial investigation	Feasibility study
Hydrology and geology	WHC/Geosciences; PNL/Earth and Environmental Sciences Center	WHC/Geosciences
Toxicology and risk/ endangerment assessment	WHC/Environmental Technology; PNL/Earth and Environmental Sciences Center; PNL/Life Sciences Center	WHC/Environmental Technology
Environmental chemistry	WHC/Geosciences; PNL/Earth and Environmental Sciences Center	WHC/Geosciences
Geotechnical and civil engineering	WHC/Geosciences (Planning) Environmental Field Services	NA
Geotechnical and civil engineering	NA	WHC/Environmental Engineering; PNL/Waste Technology Center
Groundwater treatment engineering	NA	WHC/Environmental Engineering; PNL/Waste Technology Center
Waste stabilization and treatment	NA	WHC/Environmental Engineering; PNL/Waste Technology Center
Surveying	Kaiser Engineers Hanford	NA
Soil and water sampling and analysis	WHC/Environmental Engineering; Westinghouse Office of Sampling Management; PNL/Earth and Environmental Sciences Center; PNL/Materials and Chemical Sciences Center	NA
Drilling and well installation	WHC/Geosciences Environmental Field Services; Kaiser Engineers Hanford	NA
Radiation monitoring	WHC/Operational Health Physics	NA

NA = Not applicable.
PNL = Pacific Northwest Laboratory.
WHC = Westinghouse Hanford Company.

only be identified for those areas where effort is ongoing or planned in the near future. A listing of currently assigned unit managers from all three parties shall be maintained and distributed to all parties by the DOE project manager. Each unit manager shall represent his/her respective party and keep his/her project manager informed on the status and any problems that arise.

In general, EPA and Ecology will both assign a unit manager to each operable unit or separate TSD group/unit. The unit manager from the lead regulatory agency (see Section 5.6 of main document for discussion of lead regulatory agency) shall be responsible for regulatory oversight of all activities required by this action plan for that operable unit or TSD group/unit.

The unit manager from the supporting regulatory agency shall serve as a liaison for his/her agency and shall stay informed of the general status of issues and problems encountered at the operable unit. The unit manager for the supporting regulatory agency shall be responsible for making decisions related to issues for which the supporting regulatory agency maintains authority. All such decisions shall be made in consideration of recommendations made by the unit manager for the lead regulatory agency.

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A3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES FOR CERCLA ACTIVITIES

The project organization is shown in Figure A-4. The following paragraphs describe the responsibilities of the individuals shown in Figure A-4.

Project Managers. EPA, DOE, and Ecology will each designate one individual as project manager who will serve as the primary point of contact for all activities to be carried out under the Tri-Party Agreement and Action Plan.

Unit Managers. EPA, DOE, and Ecology will each designate an individual as a unit manager for each operable unit or separate TSD group/unit. The unit manager from the lead regulatory agency will be responsible for regulatory oversight of all activities required. The unit from the supporting regulatory agency will be responsible for making decisions related to issues for which the supporting regulatory agency maintains authority. All such decisions will be made in consideration of recommendations by the unit manager from the lead regulatory agency. The unit manager from DOE will be responsible for maintaining and controlling the schedule and budget and keeping the EPA and Ecology unit managers informed as to the status of these activities, particularly the status of agreements and commitments.

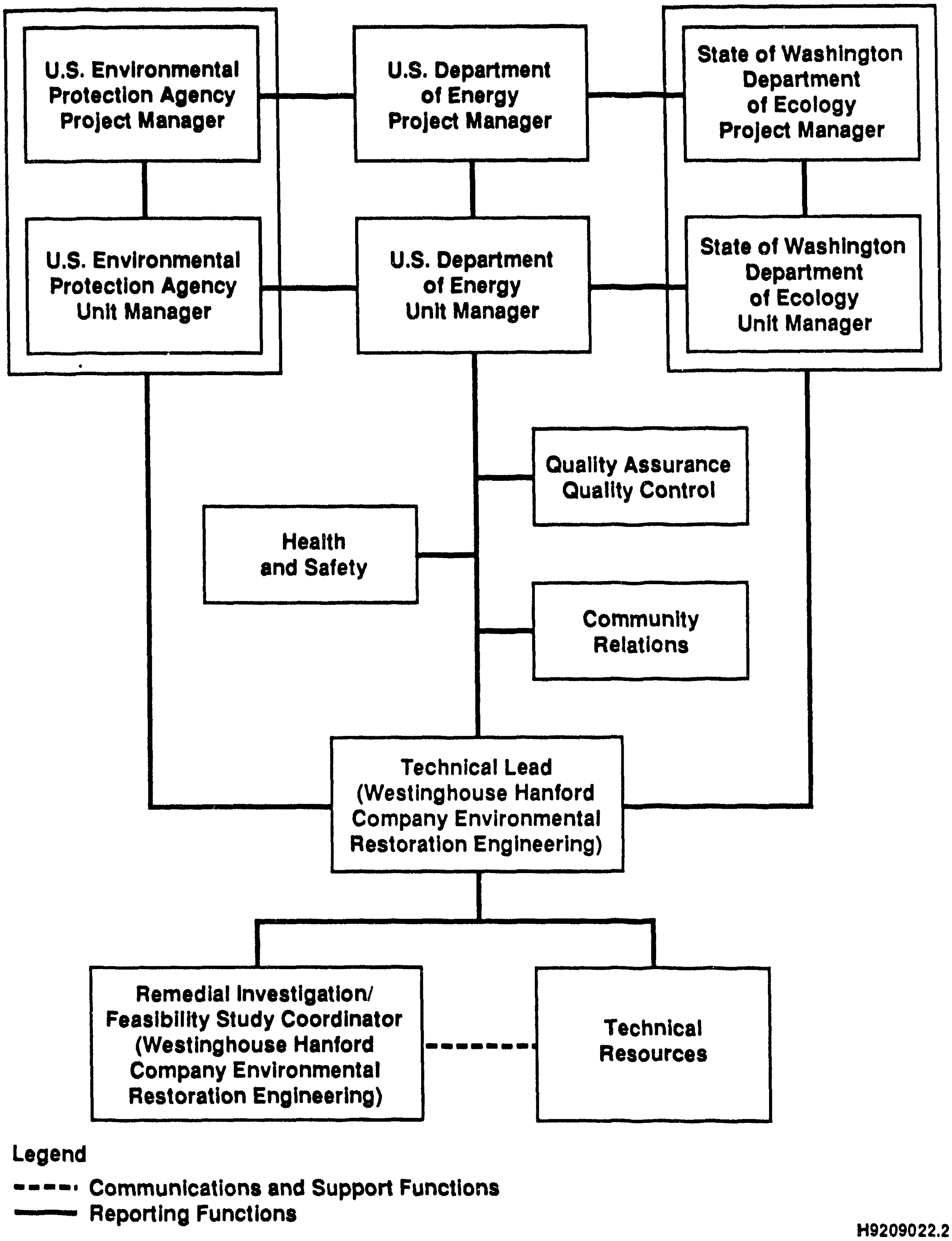
Quality Assurance Officer. The Quality Assurance Officer is responsible for monitoring overall Environmental Restoration Program activities through establishment of Hanford Site quality assurance auditing program controls that may be appropriately applied to the remedial activities. The Quality Assurance Officer is specifically vested with the organizational independence and authority to identify conditions adverse to quality, and to systematically seek effective corrective action.

Health and Safety Officer. The Health and Safety Officer is responsible for monitoring all potential health and safety hazards, including those associated with radioactive, volatile, and/or toxic compounds during sample handling and sampling decontamination activities. The Health and Safety Officer has the responsibility and authority to halt field activities resulting from unacceptable health and safety hazards.

Technical Lead. The technical lead will be a designated person within the Westinghouse Hanford Environmental Restoration Engineering Group. The responsibilities of the technical lead will be to plan, authorize, and control work so that it can be completed on schedule and within budget, and to ensure that all planning and work performance activities are technically sound.

Remedial Investigation/Feasibility Study Coordinators. The remedial investigation (RI) and feasibility study (FS) coordinators will be responsible for coordinating all activities related to the RI and FS, respectively, including data collection, analysis, and reporting. The RI/FS coordinators will be responsible for keeping the technical lead informed to the RI and FS work status and any problems that may arise.

Figure A-4. Project Organization.



A4.0 REFERENCES

Atomic Energy Act of 1954, 42 USC 2011 et seq.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601 et seq.

DOE, 1984, *Radioactive Waste Management - Guidance Document*, DOE Order 5820.2A, U.S. Department of Energy, Washington, D.C.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., Washington State Department of Ecology, U.S. Environmental Protection Agency, and the U.S. Department of Energy, Washington, D.C.

Resource Conservation and Recovery Act of 1976, 42 USC 6901 et seq.

Superfund Amendments and Reauthorization Act of 1986, 42 USC 6921 et seq.

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