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T Plant Source Aggregate Area Management Study Report

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T PLANT SOURCE AAMS EXECUTIVE SUMMARY

This report presents the results of an aggregate area management study (AAMS) for the T Plant Aggregate Area in the 200 Areas of the U.S. Department of Energy (DOE) Hanford Site in Washington State. This scoping level study provides the basis for initiating Remedial Investigation/Feasibility Study (RI/FS) activities under CERCLA or RCRA Facility Investigations (RFI) and Corrective Measures Studies (CMS) under RCRA. This report also integrates select RCRA treatment, storage or disposal (TSD) closure activities with CERCLA and RCRA past practice investigations.

Through the experience gained to date on developing work plans, closure plans and permit applications at the Hanford Site, the parties to the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) have recognized that all past practice investigations must be managed and implemented under one characterization and remediation strategy, regardless of the regulatory agency lead (as defined in the Tri-Party Agreement). In particular, the parties have identified a need for greater efficiency over the existing RI/FS and RFI/CMS investigative approaches, and have determined that, to expedite the ultimate goal of cleanup, much more emphasis needs to be placed on initiating and completing waste site cleanup through interim measures.

This streamlined approach is described and justified in The *Hanford Federal Facility Agreement and Consent Order Change Package*, dated May 16, 1991 (Ecology et al. 1991). To implement this approach, the three parties have developed the *Hanford Site Past-Practice Strategy* (DOE/RL 1992) for streamlining the past practice remedial action process. This strategy provides new concepts for:

- Accelerating decision-making by maximizing the use of existing data consistent with data quality objectives

- Undertaking expedited response actions and/or interim remedial measures, as appropriate, to either remove threats to human health and welfare and the environment, or to reduce risk by reducing toxicity, mobility, or volume of contaminants.

The *Hanford Site Past-Practice Strategy* (DOE/RL 1992) describes the concepts and framework for the RI/FS (or RFI/CMS) process in a manner that has a bias-for-action through optimizing the use of interim remedial actions, culminating with decisions on final remedies on both an operable-unit and aggregate-area scale. The strategy focuses on reaching early decisions to initiate and complete cleanup projects, maximizing the use of existing data, coupled with focused short time-frame investigations, where necessary. As more data become available on contamination problems and associated risks, the details of the longer term investigations and studies will be better defined.

The strategy includes three paths for interim decision-making and a final remedy-selection process for the operable unit that incorporates the three paths and integrates sites not addressed in those paths. The three paths for interim decision-making include the expedited response action (ERA), interim remedial measure (IRM) and limited field investigation (LFI) paths. The strategy requires that aggregate area management study reports (AAMSRs) be prepared to provide an evaluation of existing site data to support initial path decisions. This AAMSR is one of ten reports that will be prepared for each of the ten aggregate areas defined in the 200 Areas.

The near-term past practice strategy for the 200 Areas provides for ERAs, IRMs, and LFIs for individual waste management units, waste management unit groups and groundwater plumes, and recommends separate source and groundwater operable units. Initial site-specific recommendations for each of the waste management units within the T Plant Aggregate Area are provided in the report. The goal of this initial focus is to establish whether interim remedial measures are justified. Waste management units identified as candidate ERAs in Section 9 of the AAMS will be further evaluated following the *Site Selection Process for Expedited Response Actions at the Hanford Site* (WHC-MR-0290).

While these elements may mitigate specific contamination problems through interim actions, the process of final remedy selection must be completed for the operable unit or aggregate area to reach closure. The aggregation of information obtained from the LFIs and interim actions may be sufficient to perform the cumulative risk assessment and to define the final remedy for the operable unit or aggregate area. If the data are not sufficient, additional investigations and studies will be performed to the extent necessary to support final remedy selection. These investigations would be performed within the framework and process defined for RI/FS programs.

Several integration issues exist that are generic to the overall past practice process for the 200 Areas and include the following:

Future Work Plan Scope. Although the current practice for implementing RI/FS (RFI/CMS) activities is through operable unit based work plans, individual LFI/IRMs may be more efficiently implemented using LFI/IRM-specific work plans.

Groundwater Operable Units. A general strategy recommended for the 200 Areas is to define separate operable units for groundwater affected by 200 Areas source terms. This requires that groundwater be removed from the scope of existing source operable units and new groundwater-specific operable units be established. Recommendations for groundwater operable units will be developed in the groundwater AAMSRs.

Work Plan Prioritization. Although priorities are established in the AAMSR for operable units within the aggregate area, priorities between aggregate areas have yet to be established. The integration of priorities at the 200 Areas level is considered a prerequisite for establishing a schedule for past practice activities in the 200 Area.

It is intended that these integration issues be resolved following the completion of all ten AAMSRs (Draft A) scheduled for September 1992. Resolution of these issues will be based on a decisions/consensus process among EPA, Ecology, and DOE. Following resolution of these issues a schedule for past practice activities in the 200 Areas will be prepared.

Background, environmental setting, and known contamination data are provided in Sections 2.0, 3.0, and 4.1. This information provides the basis for development of the preliminary conceptual model in Section 4.2 and for assessing health and environmental concerns in Section 5.0. Preliminary ARARs (Section 6.0) and preliminary remedial action technologies (Section 7.0) are also developed based on this data. Section 8.0, provides a discussion of the data quality objectives. Data needs identified in Section 8.0 are based on data gaps determined during the development of the conceptual model, human health and environmental concerns, ARARs, and remedial action technologies. Recommendations in Section 9.0 are developed using all the information provided in the sections which precede it.

The Hanford Site, operated by the DOE, occupies about 1,450 km^2 (560 mi^2) of the southeastern part of Washington north of the confluence of the Yakima and Columbia Rivers. The Hanford Site was established in 1943 to produce plutonium for nuclear weapons using production reactors and chemical processing plants. The T Plant Aggregate Area is located within the 200 West Area, near the middle of the Hanford Site. There are seven operable units within the T Plant Aggregate Area. Two of those operable units are associated with the Single-Shell Tank Farms.

The T Plant Aggregate Area contains a large variety of waste disposal and storage facilities. High-level wastes were stored in underground single-shell tanks. Low-level wastes such as cooling and condensate water were allowed to infiltrate into the ground through cribs, ditches, and open ponds. Based on construction, purpose, or origin, the T Plant Aggregate Area waste management units fall into one of ten subgroups as follows:

- 0 - Plants, Buildings and Storage Areas
- 49 - Tanks and Vaults
- 16 - Cribs and Drains
- 2 - Reverse Wells
- 22 - Ponds, Ditches and Trenches
- 6 - Septic Tanks and Associated Drain Fields
- 14 - Transfer Facilities, Diversion Boxes and Pipelines

- 1 - Basin
- 5 - Burial Sites
- 40 - Unplanned Releases.

Detailed descriptions of these waste management units are provided in Section 2.3.

There are several ongoing programs that affect buildings and waste management units in the T Plant Aggregate Area (Section 2.7). These programs include RCRA, the Hanford Surplus Facilities Program, the Radiation Area Remedial Action (RARA) Program, the Hanford Site Single-Shell Tank Program, and the Defense Waste Management Program. Seventy-one units (primarily single-shell tanks and associated transfer facilities) fall completely within the scope of one of these programs and, therefore, recommendations on these units will be made by the respective programs rather than in this AAMS. An additional ten waste management units will be partially addressed by an ongoing program in addition to the actions recommended in the T Plant AAMS.

Discussions of surface hydrology and geology are provided on a regional, Hanford Site, and aggregate area basis in Section 3.0. The interpretation is based on a limited number of wells and this limitation does not support a detailed delineation of waste management unit specific features. The section also describes the flora and fauna, land use, water use, and human resources of the 200 West Area and vicinity. Groundwater of the 200 West Area is described in detail in a separate Groundwater AAMSR.

A preliminary site conceptual model is presented in Section 4.0. Section 4.1 presents the chemical and radiological data that are available for the different media types (including surface soil, vadose zone soil, air, surface water and biota) and site-specific data for each waste management unit and unplanned release.

A preliminary assessment of potential impacts to human health and the environment is presented in Section 4.2. This assessment includes a discussion of release mechanisms, potential transport pathways, and a preliminary conceptual model of human exposure based on these pathways. Physical, radiological, and toxicological characteristics of the known and suspected contaminants at the aggregate area are also discussed.

Health and environmental concerns are presented in Section 5.0. The preliminary qualitative evaluation of potential human health concerns is intended to provide input to the waste management unit recommendation process. The evaluation includes 1) an identification of contaminants of potential concern for each exposure pathway that is likely to occur within the U Plant Aggregate Area, 2) identification of exposure pathways applicable to individual waste management units and 3) estimates of relative hazard based on four available indicators of risk; the CERCLA Hazard Ranking System (HRS) and modified HRS

(mHRS), surface radiation survey data, and Westinghouse Environmental Protection Group site scoring.

Potentially applicable or relevant and appropriate requirements (ARARs) to be used in developing and assessing various remedial action alternatives at the T Plant Aggregate Area are discussed in Section 6.0. Specific potential requirements pertaining to hazardous and radiological waste management, remediation of contaminated soils, surface water protection, and air quality are discussed.

Preliminary remedial action technologies are presented in Section 7.0. The process includes identification of remedial action objectives (RAOs), determination of general response actions, and identification of specific process options associated with each option type. The process options are screened based on their effectiveness, implementability and cost. The screened process options are combined into alternatives and the alternatives are described.

Data quality is addressed in Section 8.0. Identification of chemical and radiological constituents associated with the units and their concentrations, with a view to determine the contaminants of concern and their action levels, is a major requirement to execute the *Hanford Site Past-Practice Strategy*. There was found to be a limited amount of data in this regard. The section provides a summary of data needs identified for each of the waste management units in the T Plant Aggregate Area. The data needs provide the basis for development of detailed data quality objectives in subsequent work plans.

Section 9.0 provides management recommendations for the T Plant Aggregate Area based on the *Hanford Site Past-Practice Strategy*. Criteria for selecting appropriate *Hanford Site Past-Practice Strategy* paths (ERA, IRM, and final remedy selection) for individual waste management units and unplanned releases in the T Plant Aggregate Area are developed in Section 9.1. As a result of the data evaluation process, no waste management unit were recommended for an ERA, no units were recommended for IRMs, 34 units were recommended for LFIs which could lead to IRMs and 37 units were recommended for final remedy selection. A discussion of the data evaluation process is provided in Section 9.2. Table ES-1 provides a summary of the results of the data evaluation assessment of each unit. Table ES-2 provides the decision matrix patterns each unit followed in reaching the recommendation. Recommendations for redefining operable unit boundaries and prioritizing operable units for work plan development are provided in Section 9.3. All recommendations for future characterization needs will be more fully developed and implemented through work plans. Sections 9.4 and 9.5 provide recommendations for focused feasibility and treatability studies, respectively.

Table ES-1. Summary of the Results of Remediation Process Pathway Assessment. (Sheet 1 of 5)

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
Tanks and Vaults							
241-T-361 Settling Tank					X	X	HSFP
Cribs and Drains							
216-T-6 Crib		X	X			X	RARA - cave-in potential
216-T-7TF Crib and Tile Field		X	X			X	RARA - cave-in potential
216-T-8 Crib		X	X			X	RARA - cave-in potential
216-T-18 Crib		X	X				
216-T-19TF Crib and Tile Field		X	X			X	RARA - cave-in potential
216-T-26 Crib		X	X				
216-T-27 Crib		X	X				
216-T-28 Crib		X	X				
219-T-29 Crib					X		
216-T-31 French Drain				X			Exhumed
216-T-32 Crib		X	X			X	RARA - cave-in potential
216-T-33 Crib		X	X				
216-T-34 Crib		X	X				
216-T-35 Crib		X	X				
216-T-36 Crib		X	X				
216-W-LWC Crib		X	X				Groundwater Contamination

Table ES-1. Summary of the Results of Remediation Process Pathway Assessment. (Sheet 2 of 5)

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
Reverse Wells							
216-T-2 Reverse Well		X	X				
216-T-3 Reverse Well		X	X				
Ponds, Ditches, and Trenches							
216-T-4A Pond					X		
216-T-4B Pond					X		Active - close by 6/95
216-T-1 Ditch		X	X				Active - close by 6/95
216-T-4-1D Ditch		X	X				
216-T-4-2 Ditch		X	X			X	Groundwater Contamination
200-W Powerhouse Pond					X		Active - close by 6/95
216-T-5 Trench		X	X				
216-T-9 Trench		X	X				
216-T-10 Trench					X		Exhumed
216-T-11 Trench					X		Exhumed
216-T-12 Trench		X	X				
216-T-13 Trench					X		Exhumed
216-T-14 Trench		X	X			X	Surface Contamination
216-T-15 Trench		X	X			X	Surface Contamination
216-T-16 Trench		X	X			X	Surface Contamination
216-T-17 Trench		X	X			X	Surface Contamination

Table ES-1. Summary of the Results of Remediation Process Pathway Assessment. (Sheet 3 of 5)

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
216-T-20 Trench		X	X				
216-T-21 Trench		X	X				
216-T-22 Trench		X	X				
216-T-23 Trench		X	X				
216-T-24 Trench		X	X				
216-T-25 Trench		X	X				
Septic Tanks and Associated Drain Fields							
2607-W1 Septic Tank					X		Active - HSSP
2607-W2 Septic Tank					X		Active - HSSP
2607-W3 Septic Tank					X		Active - HSSP
2607-W4 Septic Tank					X		Active - HSSP
Basins							
207-T Retention Basin					X		
Burial Sites							
200-W Ash Disposal Basin					X		Active - DWMP
200-W Ash Pit Demolition Site							
200-W Burning Pit					X		
200-W Powerhouse Ash Pit					X		Active - DWMP
218-W-8 Burial Ground					X		

Table ES-1. Summary of the Results of Remediation Process Pathway Assessment. (Sheet 4 of 5)

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
Unplanned Releases							
UN-200-W-2					X		
UN-200-W-3					X		
UN-200-W-4					X		
UN-200-W-7 (1)							
UN-200-W-8					X		
UN-200-W-12					X		
UN-200-W-14					X		
UN-200-W-27					X		
UN-200-W-29					X		
UN-200-W-38 (1)							
UN-200-W-58					X		
UN-200-W-63					X		Exhumed/covered
UN-200-W-65					X		
UN-200-W-67					X		
UN-200-W-73					X		
UN-200-W-77				X			Exhumed
UN-200-W-85				X			Exhumed
UN-200-W-88				X			Exhumed
UN-200-W-98		X	X				

Table ES-1. Summary of the Results of Remediation Process Pathway Assessment. (Sheet 5 of 5)

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
UN-200-W-99		X	X				
UN-200-W-102					X		
UN-200-W-113 (1)							
UN-200-W-135					X		
UN-200-W-137					X		

Notes:

ERA - Expediated Response Action
DWM - Defense Waste Management
HSFP - Hanford Surplus Facilities Program
HSSP - Hanford Site Services Program
IRM - Interim Remedial Measure
LFI - Limited Field Investigation
NFA - No Further Action
OPS - Operational Programs
RA - Risk Assessment
RARA - Radiation Area Remedial Action Program
RI - Remedial Investigation

(1) This unplanned release is associated with another waste management unit and therefore will not be remediated separately.

Table ES-2. T Plant Aggregate Area Data Evaluation Decision Matrix. (Sheet 1 of 5)

Waste Management Unit	ERA EVALUATION PATHWAY								IRM EVALUATION PATHWAY			LH PATH	FINAL REMEDY
	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Technology Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data?	Data Adequate?
Tanks and Vaults													
241-T-361 Settling Tank	Y	Y	Y	Y	Y	Y	N	Y	N	-	-	-	N
Cribs and Drains													
216-T-6 Crib	Y	Y	Y	Y	Y	Y	N	Y	N	-	-	-	N
216-T-7TF Crib and Tile Field	Y	Y	Y	Y	Y	Y	N	Y	Y	N	-	Y	-
216-T-8 Crib	Y	Y	Y	Y	Y	Y	N	Y	Y	N	-	Y	-
216-T-18 Crib	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-19TF Crib and Tile Field	Y	Y	Y	Y	Y	Y	N	Y	Y	N	-	Y	-
216-T-26 Crib	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-27 Crib	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-28 Crib	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
219-T-29 Crib	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-31 French Drain	N	N	-	-	-	-	-	-	N	-	-	-	Y
216-T-32 Crib	Y	Y	Y	Y	Y	Y	N	Y	N	-	-	-	N
216-T-33 Crib	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-34 Crib	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-35 Crib	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-36 Crib	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-W-LWC Crib	Y	Y	Y	Y	N	-	-		Y	N	-	Y	-

Table ES-2. T Plant Aggregate Area Data Evaluation Decision Matrix. (Sheet 2 of 5)

Waste Management Unit	ERA EVALUATION PATHWAY								IRM EVALUATION PATHWAY			LFI PATH	FINAL REMEDY
	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Technology Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data?	Data Adequate?
Reverse Wells													
216-T-2 Reverse Well	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-3 Reverse Well	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
Ponds, Ditches, and Trenches													
216-T-4A Pond	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-4B Pond	Y	Y	Y	Y	N	-	-	Y	N	-	-	-	N
216-T-1 Ditch	Y	Y	Y	Y	N	-	-	Y	Y	N	-	Y	-
216-T-4-1D Ditch	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-4-2 Ditch	Y	Y	Y	Y	N	-	-	Y	N	-	-	-	N
200-W Powerhouse Pond	N	N	-	-	-	-	-	Y	N	-	-	-	N
216-T-5 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-9 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-10 Trench	N	N	-	-	-	-	-	-	N	-	-	-	N
216-T-11 Trench	N	N	-	-	-	-	-	-	N	-	-	-	N
216-T-12 Trench	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-13 Trench	N	N	-	-	-	-	-	-	N	-	-	-	N
216-T-14 Trench	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-15 Trench	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-16 Trench	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-17 Trench	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-

Table ES-2. T Plant Aggregate Area Data Evaluation Decision Matrix. (Sheet 3 of 5)

Waste Management Unit	ERA EVALUATION PATHWAY								IRM EVALUATION PATHWAY			LFI PATH	FINAL REMEDY
	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Technology Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data?	Data Adequate?
216-T-20 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-21 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-22 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-23 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-24 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-25 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
Septic Tanks and Associated Drain Fields													
2607-W1 Septic Tank	N	N	-	-	-	-	-	-	N	-	-	-	N
2607-W2 Septic Tank	N	N	-	-	-	-	-	-	N	-	-	-	N
2607-W3 Septic Tank	N	N	-	-	-	-	-	-	N	-	-	-	N
2607-W4 Septic Tank	N	N	-	-	-	-	-	-	N	-	-	-	N
Basins													
207-T Retention Basin	N	Y	Y	Y	N	-	-	-	N	-	-	-	N
Burial Sites													
200-W Ash Disposal Basin	N	N	-	-	-	-	-	-	N	-	-	-	N
200-W Ash Pit Demolition Site													
200-W Burning Pit	N	N	-	-	-	-	-	-	N	-	-	-	N
200-W Powerhouse Ash Pit	N	N	-	-	-	-	-	-	N	-	-	-	N
218-W-8 Burial Ground	N	N	-	-	-	-	-	-	N	-	-	-	N

Table ES-2. T Plant Aggregate Area Data Evaluation Decision Matrix. (Sheet 4 of 5)

Waste Management Unit	ERA EVALUATION PATHWAY								IRM EVALUATION PATHWAY			LFI PATH	FINAL REMEDY
	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Technology Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data?	Data Adequate?
Unplanned Releases													
UN-200-W-2	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-3	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-4	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-7[1]	-	-	-	-	-	-	-	-	-	-	-	-	-
UN-200-W-8	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-12	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-14	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-27	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-29	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-38[1]	-	-	-	-	-	-	-	-	-	-	-	-	-
UN-200-W-58	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-63	N	N	-	-	-	-	-	-	N	-	-	-	Y
UN-200-W-65	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-67	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-73	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-77	N	N	-	-	-	-	-	-	N	-	-	-	Y
UN-200-W-85	N	N	-	-	-	-	-	-	N	-	-	-	Y
UN-200-W-88	N	N	-	-	-	-	-	-	N	-	-	-	Y
UN-200-W-98	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
UN-200-W-99	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-

Table ES-2. T Plant Aggregate Area Data Evaluation Decision Matrix. (Sheet 5 of 5)

Waste Management Unit	ERA EVALUATION PATHWAY								IRM EVALUATION PATHWAY			LFI PATH	FINAL REMEDY
	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Technology Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data?	Data Adequate?
UN-200-W-102	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-113[1]	-	-	-	-	-	-	-	-	-	-	-	-	-
UN-200-W-135	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-137	Y	Y	N	-	-	-	-	-	N	-	-	-	N

[1] This unplanned release is associated with another waste management unit and therefore will not be remediated separately.

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ACRONYMS AND ABBREVIATIONS

AAMS	aggregate area management study
AAMSR	aggregate area management study report
AEA	Atomic Energy Act
AKART	all known, available, and reasonable treatment
ALARA	as low as reasonably achievable
AR	administrative record
ARAR	applicable or relevent and appropriate requirment
ARCL	allowable residual contamination level method
ASIL	allowable ambient source impact level
BAT	best available treatment
BDAT	best demonstrated available treatment
BWIP	Basalt Waste Isolation Project
CCWE	constituent concentrations in waste extract
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH-TRU	contact-handled transuranic
CLP	Contract Laboratory Program
CMS	Corrective Measures Study
CRP	Community Relations Plan
CSTF	Containment Systems Test Facility
CWA	Clean Water Act
DCG	Derived Concentration Guide
DMP	Data Management Plan
DOD	U. S. Department of Defense
DOE	U. S. Department of Energy
DOE-RL	U. S. Department of Energy, Richland Field Office
DQO	data quality objective
Ecology	Washington State Department of Ecology
EDMC	Environmental Data Management Center
EF	engineered facility
EHPSS	Environmental Health and Pesticide Services Section
EII	Environmental Investigations Instructions
EIMP	Environmental Information Management Plan
EIS	environmental impact statement
ENS	insufficient data
EPA	U. S. Environmental Protection Agency
ER	environmental restoration
ERA	expedited response action
ERRA	Environmental Restoration Remedial Action
ES&H	Environment, Safety, and Health
FFS	focused feasibility studies
FOMP	Field Office Management Plan
FRS	final remedy selection
FS	feasibility study

ACRONYMS AND ABBREVIATIONS

FWQC	Federal Water Quality Criteria
GIS	geographic information system
Health	Washington State Department of Health
HEDL	Hanford Environmental Developmental Laboratory
HEHF	Hanford Environmental Health Foundation
HEIS	Hanford Environmental Information System
HEPA	high efficiency particulate air
HISS	Hanford Inactive Site Survey
HLAN	Hanford Local Area Network
HMS	Hanford Meteorological Station
HRS	Hazard Ranking System
HSP	health and safety plan
HWOP	Hazardous Waste Operations Permit
ICRP	International Commission on Radiological Protection
IRM	interim remedial measure
JSA	Job Safety Analysis
KEH	Kaiser Engineers Hanford
LDR	land disposal restriction
LFI	limited field investigation
LLRW	low-level radioactive waste
LSC	liquid scintillation counting
MBIK	methyl isobutyl ketone
MCLs	maximum contaminant levels
MCS	Management Control System
MEPAS	Multimedia Environmental Pollution Assessment System
mHRS	modified Hazard Ranking System
msl	mean sea level
MTCA	Model Toxics Control Act
NAAQS	National Primary and Secondary Ambient Air Quality Standards
NAD	North American Datum
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutant
NFA	no further action
NIOSH	National Institute for Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSPS	New Source Performance Standards
OPS	existing operational programs
OSHA	Occupational Safety and Health Administration
OSM	Office of Sample Management
PA	preliminary assessment

ACRONYMS AND ABBREVIATIONS

PARCC	precision, accuracy, representativeness, completeness, and comparibility
PMP	Project Management Plan
PNL	Pacific Northwest Laboratory
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAO	remedial action objective
RARA	Radiation Area Remedial Action
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RFI	RCRA Facility Investigation
RHO	Rockwell Hanford Operations
RI	remedial investigation
RLS	Radionuclide Logging System
ROD	Record of Decision
RWP	Radiation Work Permit
SARA	Superfund Amendments and Reauthorization Act
SCBA	self-contained breathing apparatus
SDWA	Safe Drinking Water Act
SI	site inspection
SST	single-shell tank
SWMU	solid waste management unit
T-BACT	best available control technology for air toxics
TAP	Toxic Air Pollutant
TBC	To-be-Considered Material
TCLP	Toxic Characteristic Leaching Procedure
TLD	thermoluminescent dosimeter
TOC	total organic carbon
TR	training records
TRAC	Tracks Radioactive Components
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
TRU	transuranic
TRUSAF	Transuranic Waste Storage and Assay Facility
TSD	treatment, storage, or disposal
USC	U.S. Code
USGS	United States Geological Survey
VOCs	Volatile organic compounds
WAC	Washington Administrative Code
Westinghouse Hanford	Westinghouse Hanford Company
WIDS	Waste Information Data System

ACRONYMS AND ABBREVIATIONS

WIPP	Waste Isolation Pilot Plant
WISHA	Washington Industrial Safety and Health Act
WMP	Waste Management Plan
WPCA	Washington State Water Pollution Control Act
WPPSS	Washington Public Power Supply System

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1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Hanford Site in Washington State is organized into numerically designated operational areas including the 100, 200, 300, 400, 600, and 1100 Areas (Figure 1-1). The U.S. Environmental Protection Agency (EPA), in November 1989, included the 200 Areas of the Hanford Site on the National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980. Inclusion on the NPL initiates the Remedial Investigation (RI) and Feasibility Study (FS) process for characterizing the nature and extent of contamination, assessing risks to human health and the environment, and selection of remedial actions.

This report presents the results of an aggregate area management study (AAMS) for the T Plant Aggregate Area located in the 200 Areas. The study provides the basis for initiating RI/FS under CERCLA or under the Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFI) and Corrective Measures Studies (CMS). This report also integrates RCRA treatment, storage or disposal (TSD) closure activities with CERCLA and RCRA past practice investigations.

This chapter describes the overall AAMS approach for the 200 Areas, defines the purpose, objectives and scope of the AAMS, and summarizes the quality assurance (QA) program and contents of the report.

1.1 OVERVIEW

The 200 Areas, located near the center of the Hanford Site, encompasses the 200 West, East and North Areas which contain reactor fuel processing and waste management facilities.

Under the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement), signed by the Washington State Department of Ecology (Ecology), DOE, and EPA (Ecology et al. 1990), the 200 NPL Site encompasses the 200 Areas and selected portions of the 600 Area. The 200 NPL Site is divided into 8 waste area groups largely corresponding to the major processing plants (e.g., B Plant and T Plant), and a number of isolated operable units located in the surrounding 600 Area. Each waste area group is further subdivided into one or more operable units based on waste disposal information, location, facility type, and other site characteristics. The 200 NPL site includes a total of 44 operable units including 20 in the 200 East Area, 17 in the 200 West Area, 1 in the 200 North Area, and 6 isolated operable units. The intent of defining operable units was to group associated waste management units together, so that they could be effectively characterized and remediated under one work plan.

The Tri-Party Agreement also defines approximately 25 RCRA TSD groups within the 200 Areas which will be closed or permitted (for operation or postclosure care) in accordance with the Washington State Dangerous Waste Regulations (WAC 173-303). The TSD facilities are often associated with an operable unit and are required to be addressed concurrently with past-practice activities under the Tri-Party Agreement.

This AAMS is one of ten studies that will provide the basis for past practice activities for operable units in the 200 Areas. In addition, the AAMS will be collectively used in the initial development of an area-wide groundwater model, and conduct of an initial site-wide risk assessment. Recent changes to the Tri-Party Agreement (Ecology et al. 1991), and the *Hanford Site Past-Practice Strategy* document (DOE/RL 1992) establish the need and provide the framework for conducting AAMS in the 200 Areas.

1.1.1 Tri-Party Agreement

The Tri-Party Agreement was developed and signed by representatives from the EPA, Ecology, and DOE in May 1989, and revised in 1990 and 1991. The scope of the agreement covers all CERCLA past practice, RCRA past practice, and RCRA TSD activities on the Hanford Site. The purpose of the Tri-Party Agreement is to ensure that the environmental impacts of past and present activities are investigated and appropriately remediated to protect human health and the environment. To accomplish this, the Tri-Party Agreement provides a framework and schedule for developing, prioritizing, implementing and monitoring appropriate response actions.

The 1991 revision to the Tri-Party Agreement requires that an aggregate area approach be implemented in the 200 Areas based on the *Hanford Site Past-Practice Strategy* DOE/RL 1992). This strategy requires the conduct of AAMS which are similar in nature to an RI/FS scoping study. The Tri-Party Agreement change package (Ecology et al. 1991) specifies that 10 Aggregate Area Management Study Reports (AAMSR) (major milestone M-27-00) are to be prepared for the 200 Areas. Further definition of aggregate areas and the AAMS approach is provided in Sections 1.2 and 1.3.

1.1.2 Hanford Site Past Practice Strategy

The *Hanford Site Past-Practice Strategy* was developed between Ecology, EPA, and DOE to streamline the existing RI/FS and RFI/CMS processes. A primary objective of this strategy is to develop a process to meet the statutory requirements and integrate CERCLA RI/FS and RCRA Past Practice RFI/CMS guidance into a singular process for the Hanford Site that ensures protection of human health and welfare and the environment. The strategy refines the existing past practice decision-making process as defined in the Tri-Party Agreement. The fundamental principle of the strategy is a bias-for-action by optimizing the use of existing data, integrating past practice with RCRA TSD closure investigations,

focusing the RI/FS process, conducting interim remedial actions, and reaching early decisions to initiate and complete cleanup projects on both operable-unit and aggregate-area scale. The ultimate goal is the comprehensive cleanup or closure of all contaminated areas at the Hanford Site at the earliest possible date in the most effective manner.

The process under this strategy is a continuum of activities whereby the effort is refined based upon knowledge gained as work progresses. Whereas the strategy is intended to streamline investigations and documentation to promote the use of interim actions to accelerate cleanup, it is consistent with RI/FS and RFI/CMS processes. An important element of this strategy is the application of the observational approach, in which characterization data are collected concurrently with cleanup.

For the 200 Areas the first step in the strategy is the evaluation of existing information presented in AAMSR. Based on this information, decisions are made regarding which strategy path(s) to pursue for further actions in the aggregate area. The strategy includes three paths for interim decision making and a final remedy-selection process that incorporates the three paths and integrates sites not addressed in those paths. As shown on Figure 1-2, the three paths for decision making are the following:

- Expedited response action (ERA) path, where an existing or near-term unacceptable health or environmental risk from a site is determined or suspected, and a rapid response is necessary to mitigate the problem

- Interim remedial measure (IRM) path, where existing data are sufficient to indicate that the site poses a risk through one or more pathways and additional investigations are not needed to screen the likely range of remedial alternatives for interim actions; if a determination is made that an IRM is justified, the process proceeds to select an IRM remedy and a focused FS, if needed, to select a remedy

- Limited field investigation (LFI) path, where minimum site data are needed to support IRM or other decisions, and is obtained in a less formal manner than that needed to support a final Record of Decision (ROD). Data generated from a LFI may be sufficient to directly support an interim ROD. Regardless of the scope of the LFI, it is a part of the RI process, and not a substitute for it.

The process of final remedy selection must be completed for the aggregate area to reach closure. The aggregation of information obtained from LFI and interim actions may be sufficient to perform the cumulative risk assessment and to define the final remedy for the aggregate area or associated operable units. If the data are not sufficient, additional investigations and studies will be performed to the extent necessary to support final remedy selection. These investigations would be performed within the framework and process defined for RI/FS or RFI/CMS programs.

1.2 200 NPL SITE AGGREGATE AREA MANAGEMENT STUDY PROGRAM

The overall approach and scope of the 200 Areas AAMS program is based on the Tri-Party Agreement and the *Hanford Site Past-Practice Strategy*.

1.2.1 Overall Approach

As defined in the 1991 revision to the Tri-Party Agreement, the AAMS program for the 200 Areas consists of conducting a series of ten AAMS for eight source (Figures 1-3 and 1-4) and two groundwater aggregate areas delineated in the 200 East, West, and North Areas. Table 1-1 lists the aggregate areas, the type of study and associated operable units. With the exception of 200-IU-6, isolated operable units associated with the 200 NPL site (Figure 1-5) are not included in the AAMS program. Generally, the quantity of existing information associated with isolated operable units is not considered sufficient to require study on an aggregate area basis prior to work plan development. Operable unit 200-IU-6 is addressed as part of the B Plant AAMS because of similarities in waste management units (i.e., ponds).

The eight source AAMS are designed to evaluate source terms on a plant-wide scale. Source AAMS are conducted for the following aggregate areas (waste area groups) which largely correspond to the major processing plants including the following:

- U Plant
- Z Plant
- S Plant
- T Plant
- PUREX
- B Plant
- Semi-Works
- 200 North.

The groundwater beneath the 200 Areas is investigated under two groundwater AAMS on an Area-wide scale (i.e., 200 West and 200 East Areas). Groundwater aggregate areas were delineated to encompass the geography necessary to define and understand the local hydrologic regime, and the distribution, migration and interaction of contaminants emanating

from source terms. The groundwater aggregate areas are considered an appropriate scale for developing conceptual and numerical groundwater models.

The U.S. Department of Energy, Richland Field Office (DOE/RL) functions as the "lead agency" for the 200 AAMS program. Depending on the specific AAMS, EPA and/or Ecology function as the "Lead Regulatory Agency" (Table 1-1). Through periodic (monthly) meetings information is transferred and regulators are informed of the progress of the AAMS such that decisions established under the *Hanford Site Past-Practice Strategy* (e.g., is an ERA justified?) (Figure 1-2) can be quickly and collectively made between the three parties. These meetings will continually refine the scope of AAMS as new information is evaluated, decisions are made and actions taken. Completion milestones for AAMS are defined in Ecology et al. (1991) and duplicated in Table 1-1. All AAMSR are submitted as Secondary Documents which are defined in the Tri-Party Agreement as informational documents.

1.2.2 Process Overview

Each AAMS consists of three steps: (1) the analysis of existing data and formulation of a preliminary conceptual model, (2) identification of data needs and evaluation of remedial technologies, and (3) conduct of limited field characterization activities. Steps 1 and 2 are components of an AAMSR. Step 3 is a parallel effort for which separate reports will be produced.

The first and primary task of the AAMS investigation process involves the search, compilation and evaluation of existing data. Information collected for these purposes includes the following:

- Facility and process descriptions and operational histories for waste sources
- Waste disposal records defining dates of disposal, waste types, and waste quantities
- Sampling events of waste effluents and effected media
- Site conditions including the site physiography, geology, hydrology, meteorology, ecology, demography, and archaeology
- Environmental monitoring data for affected media including air, surface water, sediment, soil, groundwater and biota.

Collectively this information is used to identify contaminants of concern, determine the scope of future characterization efforts, and to develop a preliminary conceptual model of the aggregate area. Although data collection objectives are similar, the types of information collected depend on whether the study is a source or groundwater AAMS. The data

collection step serves to avoid duplication of previous efforts and facilitates a more focused investigation by the identification of data gaps.

Topical reports referred to as Technical Baseline Reports are initially prepared to summarize facility information. These reports describe individual waste management units and unplanned releases contained in the aggregate area as identified in the Waste Information Data System (WIDS) (WHC 1991a). The reports are based on review of current and historical Hanford Site reports, engineering drawings and photographs and are supplemented with site inspections and employee interviews. Information contained in the reports is summarized in the AAMSR. Other topical reports are used as sources of information in the AAMSR. These reports are as follows:

- T Plant Geologic and Geophysics Data Package
- Z Plant Geologic and Geophysics Data Package
- U Plant Geologic and Geophysics Data Package
- S Plant Geologic and Geophysics Data Package
- PUREX Geologic and Geophysics Data Package
- B Plant Geologic and Geophysics Data Package
- 200 N Geologic and Geophysics Data Package
- Semiworks Geologic and Geophysics Data Package
- Hydrologic Model for the 200 West Groundwater Aggregate Area
- Hydrologic Model for the 200 East Groundwater Aggregate Area
- Unconfined Aquifer Hydrologic Test Data Package for the 200 West Groundwater Aggregate Area
- Unconfined Aquifer Hydrologic Test Data Package for the 200 East Groundwater Aggregate Area
- Confined Aquifer Hydrologic Test Data Package for the 200 Groundwater Aggregate Area Management Studies
- Groundwater Field Characterization Report
- 200 West Area Borehole Geophysics Field Characterization

- 200 East Area Borehole Geophysics Field Characterization

The general scope of the topical reports related to this AAMSR is described in Section 8.0.

Information on waste sources, pathways, and receptors is used to develop a preliminary conceptual model of the aggregate area. In the preliminary conceptual model, the release mechanisms and transport pathways are identified. If the conceptual understanding of the site is considered inadequate, limited field characterization activities can be undertaken as part of the study. Field screening activities occurring in parallel with and as part of the AAMS process include the following:

- Expanded groundwater monitoring programs (non Contract Laboratory Program) at approximately 80 select existing wells to identify contaminants of concern and refine groundwater plume maps

- In situ assaying of gamma-emitting radionuclides at approximately 10 selected existing boreholes per aggregate area to develop radioelement concentration profiles in the vadose zone.

Wells, boreholes, and analytes are selected based on a review of existing environmental data which will be is undertaken early in the AAMS process. Field characterization results will be presented later in topical reports.

After the preliminary conceptual model is developed, health and environmental concerns are identified. The purpose of this determination is to provide one basis for determining recommendations and prioritization for subsequent actions at waste management units. Potential applicable or relevant and appropriate requirements (ARARs) and potential remedial technologies are identified. In cases where the existing information is sufficient, the *Hanford Site Past-Practice Strategy* allows for a focused FS or CMS to be initiated prior to the completion of the study.

Data needs are identified by evaluating the sufficiency of existing data and by determining what additional data are necessary to adequately characterize the aggregate area, refine the preliminary conceptual model and potential ARARs, and/or narrow the range of remedial alternatives. Determinations are made regarding the level of uncertainty associated with existing data and the need to verify or supplement the data. If additional data are needed, the intended data uses are identified, data quality objectives (DQO) established and data priorities set.

Each AAMSR results in management recommendations for the aggregate area including the following:

- The need for ERA, IRM, and LFI or whether to retain in the final remedy selection path
- Definition and prioritization of operable units
- Prioritization of work plan activities
- Integration of RCRA TSD closure activities
- The conduct of field characterization activities
- The need for treatability studies.
- Identification of waste management units addressed entirely under other operational programs

The waste management units recommended for ERA, IRM, or LFI actions are considered higher priority units that require rapid response. Lower priority waste management units will generally follow the conventional process for RI/FS. In spite of this distinction in the priority of sites, RI/FS activities will be conducted for all the waste management units. In the case of the higher priority waste management units, rapid response operations will be followed by conventional RI/FS activities, although these activities may be modified because of knowledge gained through the remediation activities. In the case of the lower priority waste management units, an area-wide RI/FS will be prepared which encompasses these sites.

Based on the AAMSR, a decision is made on whether the study has provided sufficient information to forego further field investigations and prepare a FS. An RI/FS work plan (which may be limited to LFI activities) will be developed and executed. The background information normally required to support the preparation of a work plan (e.g., site description, conceptual model, DQO, etc.) is developed in the AAMSR. The future work plans will reference information from the AAMSR. They will also include the rationale for sampling and analysis, will present detailed, unit-specific DQO, and will further develop physical site models as the data allows. In some cases, there may be insufficient data to support any further analysis than is provided in the AAMSR, so an added level of detail in the work plan may not be feasible.

All ten AAMS are scheduled to be completed by September 1992. This will facilitate a coordinated approach to prioritizing and implementing future past practice activities for the entire 200 Areas.

1.3 PURPOSE, SCOPE, AND OBJECTIVES

The purpose of conducting an AAMS is to compile and evaluate the existing body of knowledge and conduct limited field characterization work to support the *Hanford Site Past-Practice Strategy* decision-making process for an aggregate area. The AAMS process is similar in nature to the RI/FS scoping process prior to work plan development and is intended to maximize the use of existing data to allow a more limited and focused RI/FS. Deliverables for an AAMS consist of the AAMSR and health and safety, project management, and data management plans.

Specific objectives of the AAMS include the following:

- Assemble and interpret existing data including operational and environmental data
- Describe site conditions
- Conduct limited new site characterization work if data or interpretation uncertainty could be reduced by the work (results from this work may not be available for the AAMSR, but will be included in subsequent topical reports).
- Develop a preliminary conceptual model
- Identify contaminants of concern, and their distribution
- Identify potential ARARs
- Define preliminary remedial action objectives, screen potential remedial technologies, and if possible provide recommendations for focused FS
- Recommend treatability studies to support the evaluation of remedial action alternatives
- Define data needs, establish general DQO and set data priorities
- Provide recommendations for ERA, IRM, LFI or other actions
- Redefine and prioritize, as data allow, operable unit boundaries
- Define and prioritize, as data allow, work plan and other past practice activities with emphasis on supporting early cleanup actions and records of decisions
- Integrate RCRA TSD closure activities with past practice activities.

Information on single-shell and double-shell tanks is presented in Sections 2.0 and 4.0. The AAMSR is not intended to address remediation related to the tanks. Nonetheless, the tank information is presented because known and suspected releases from the tanks may influence the interpretation of contamination data at nearby waste management units. Information on other facilities and buildings is also presented for this same reason. However because these structures are addressed by other programs, the AAMSR does not include recommendations for further action at these structures.

Depending on whether an aggregate area is a source or groundwater aggregate area, the scope of the AAMS will varies. Source AAMS focus on source terms, and the environmental media of interest include air, biota, surface water, surface soil, and the unsaturated subsurface soil. Accordingly, detailed descriptions of facilities and operational information are provided in the source AAMSR. In contrast, groundwater AAMS focus on the saturated subsurface and on groundwater contamination data. Descriptions of facilities in the groundwater AAMSR are limited to liquid disposal facilities and reference is made to source AAMSR for detailed descriptions. The description of site conditions in source AAMSR concentrate on site physiography, meteorology, surface water hydrology, vadose zone geology, ecology, and demography. Groundwater AAMSR summarize regional geohydrologic conditions and contain detailed information regarding the local geohydrology on an area-wide scale. Correspondingly, other sections of the AAMSR vary depending on the environmental media of concern.

1.4 QUALITY ASSURANCE

A limited amount of field characterization work is performed in parallel with preparation of the AAMS report. To help ensure that data collected are of sufficient quality to support decisions.

All work will be performed in compliance with Westinghouse Hanford's existing QA manual, WHC-CM-4-2 (WHC 1988a) and with procedures outlined in the QA program plan, WHC-EP-0383 (WHC 1990a) specific to CERCLA RI/FS activities. This QA program plan describes the various plans, procedures, and instructions that will be used by Westinghouse Hanford to implement the QA requirements. Standard EPA guidance documents such as the *Contract Laboratory Program Statement of Work for Organic Analysis* (EPA 1988) will also be followed.

1.5 ORGANIZATION OF REPORT

In addition to this introduction, the AAMSR consists of the following nine sections and appendices:

- Section 2.0, Facility, Process and Operational History Descriptions, describes the major facilities, waste management units and unplanned releases within the aggregate area. A chronology of waste disposal activities is established and waste generating processes are summarized.

- Section 3.0, Site Conditions, describes the physical, environmental, and sociological setting including, geology, hydrology, ecology, meteorology, and demography.

- Section 4.0, Preliminary Conceptual Model, summarizes the conceptual understanding of the aggregate area with respect to types and extent of contamination, exposure pathways and receptors.

- Section 5.0, Health and Environmental Concerns, identifies chemicals used or disposed within the aggregate area that could be of concern regarding public health and/or the environment and describes and applies the screening process for determining the relative priority of follow-up action at each waste management unit.

- Section 6.0, Potentially Applicable or Relevant and Appropriate Requirements, identifies federal and state standards, requirements, criteria, or limitations that may be considered relevant to the aggregate area.

- Section 7.0, Preliminary Remedial Action Technologies, identifies and screens potential remedial technologies and establishes remedial action objectives for environmental media.

- Section 8.0, Data Quality Objectives, reviews QA criteria on existing data, identifies data gaps or deficiencies, and identifies broad data needs for field characterization and risk assessment. The DQO and data priorities are established.

- Section 9.0, Recommendations, provides guidance for future past practice activities based on the results of the AAMS. Recommendations are provided for ERA at problem sites, IRM, LFI, refining operable unit boundaries, prioritizing work plans, and conducting field investigations and treatability studies.

- Section 10.0, References, list reports and documents cited in the AAMSR.

- Appendix A, Supplemental Data, provides supplemental data supporting the AAMSR.

The following plans are included and will be used to support past practice activities in the aggregate area:

- Appendix B: Health and Safety Plan
- Appendix C: Project Management Plan
- Appendix D: Information Management Overview

Community relations requirements for the U Plant Aggregate Area can be found in the *Community Relations Plan for the Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989).

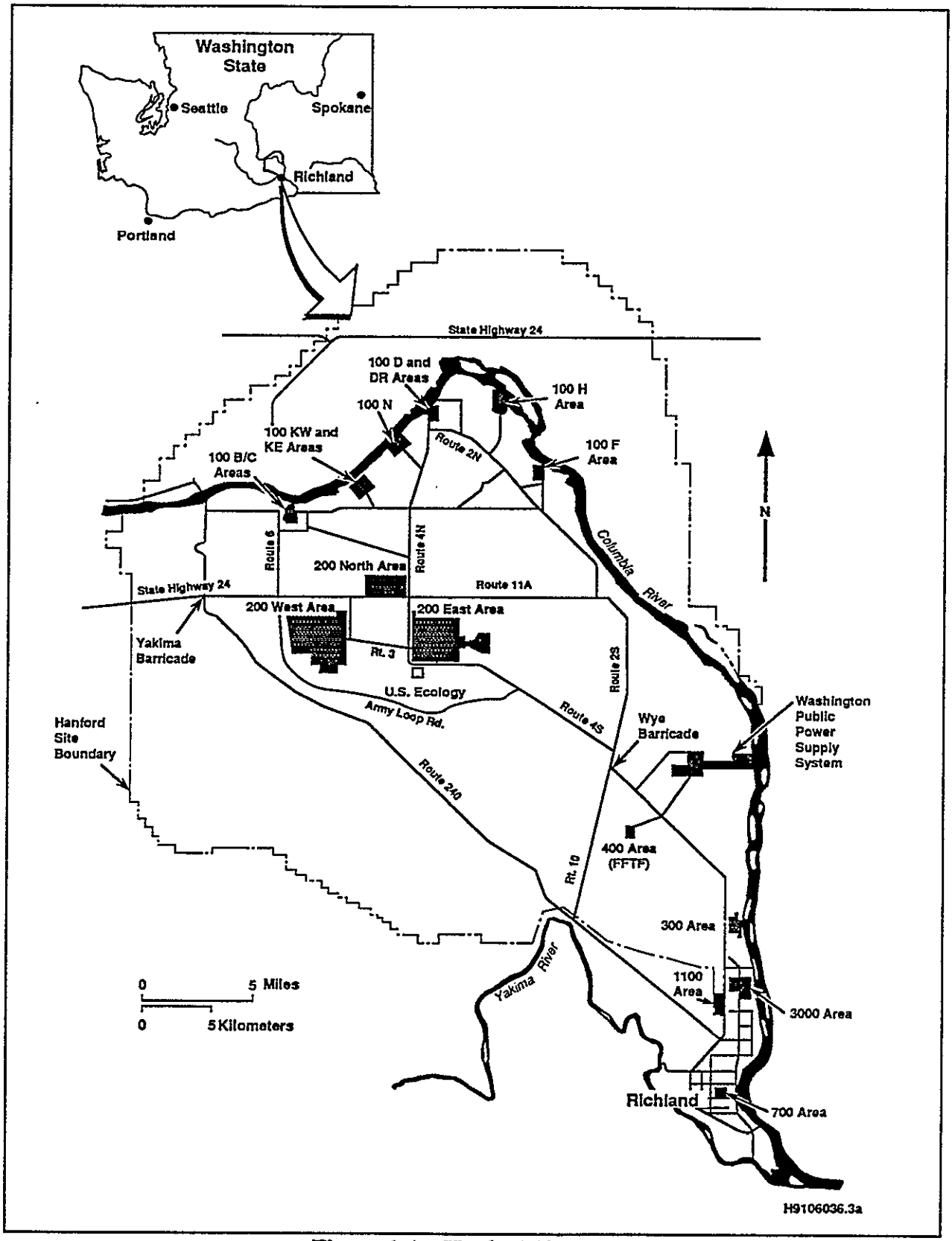


Figure 1-1. Hanford Site Map.

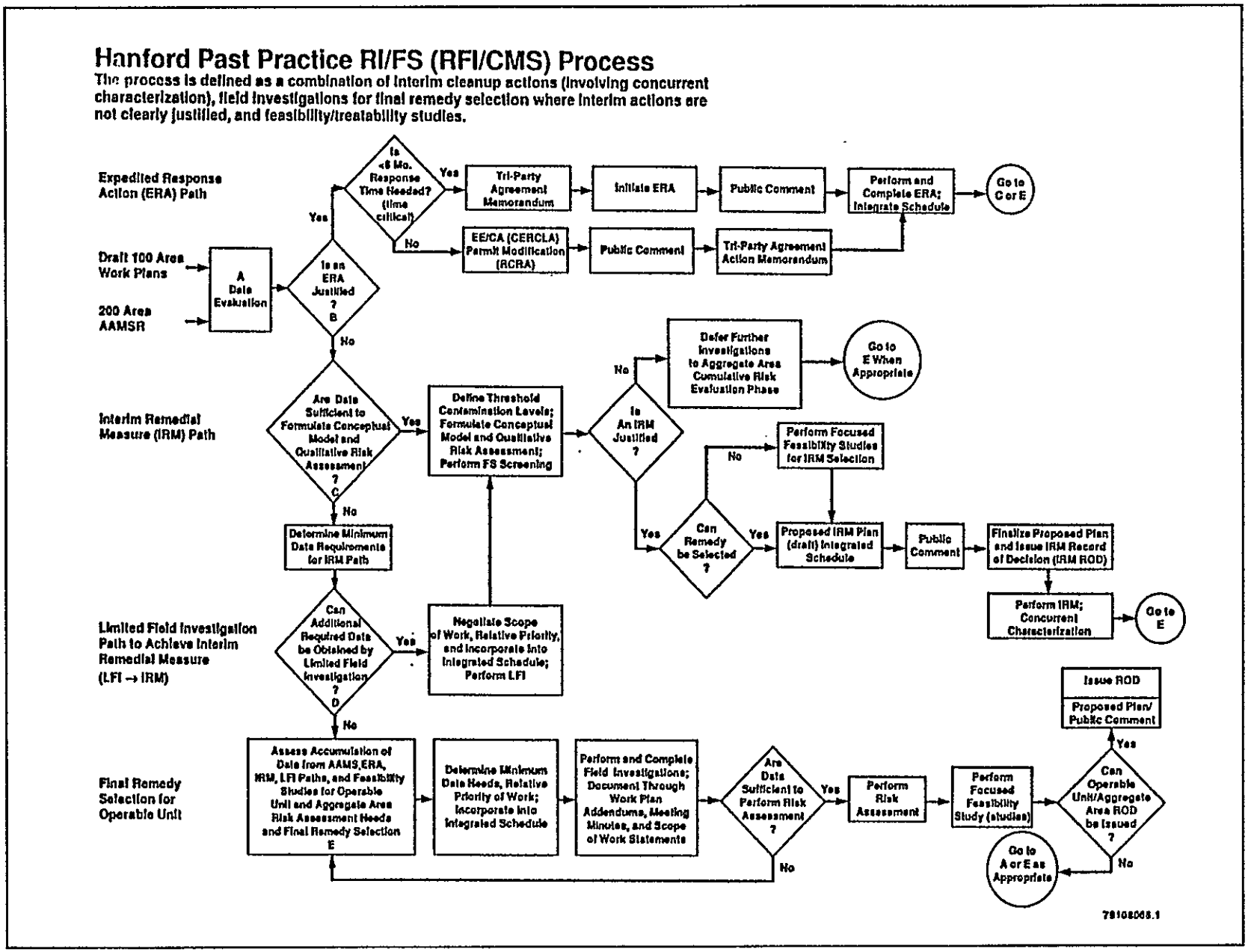


Figure 1-2. Hanford Past-Practice Investigation Strategy Flow Chart.

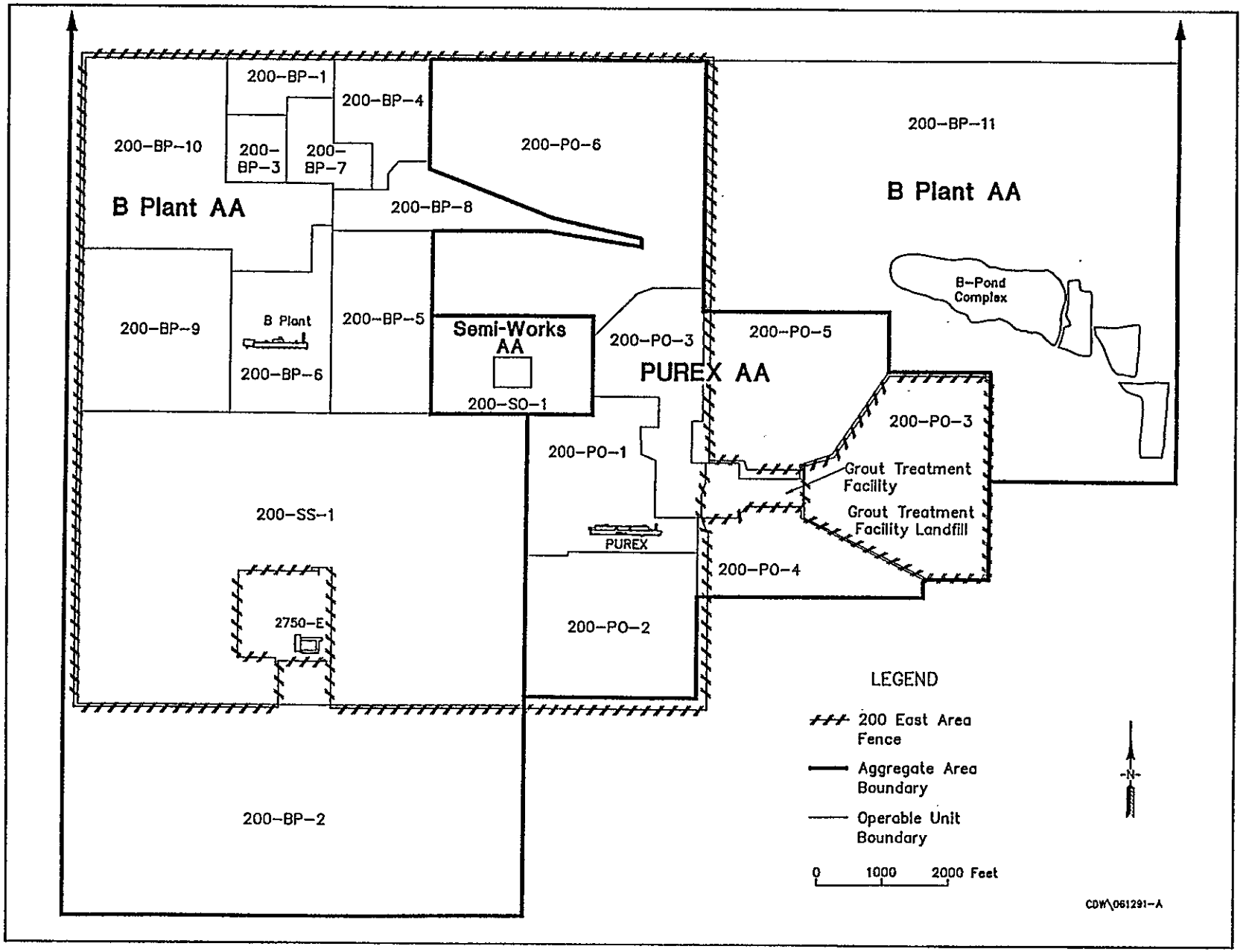


Figure 1-3. 200 East Aggregate Area.

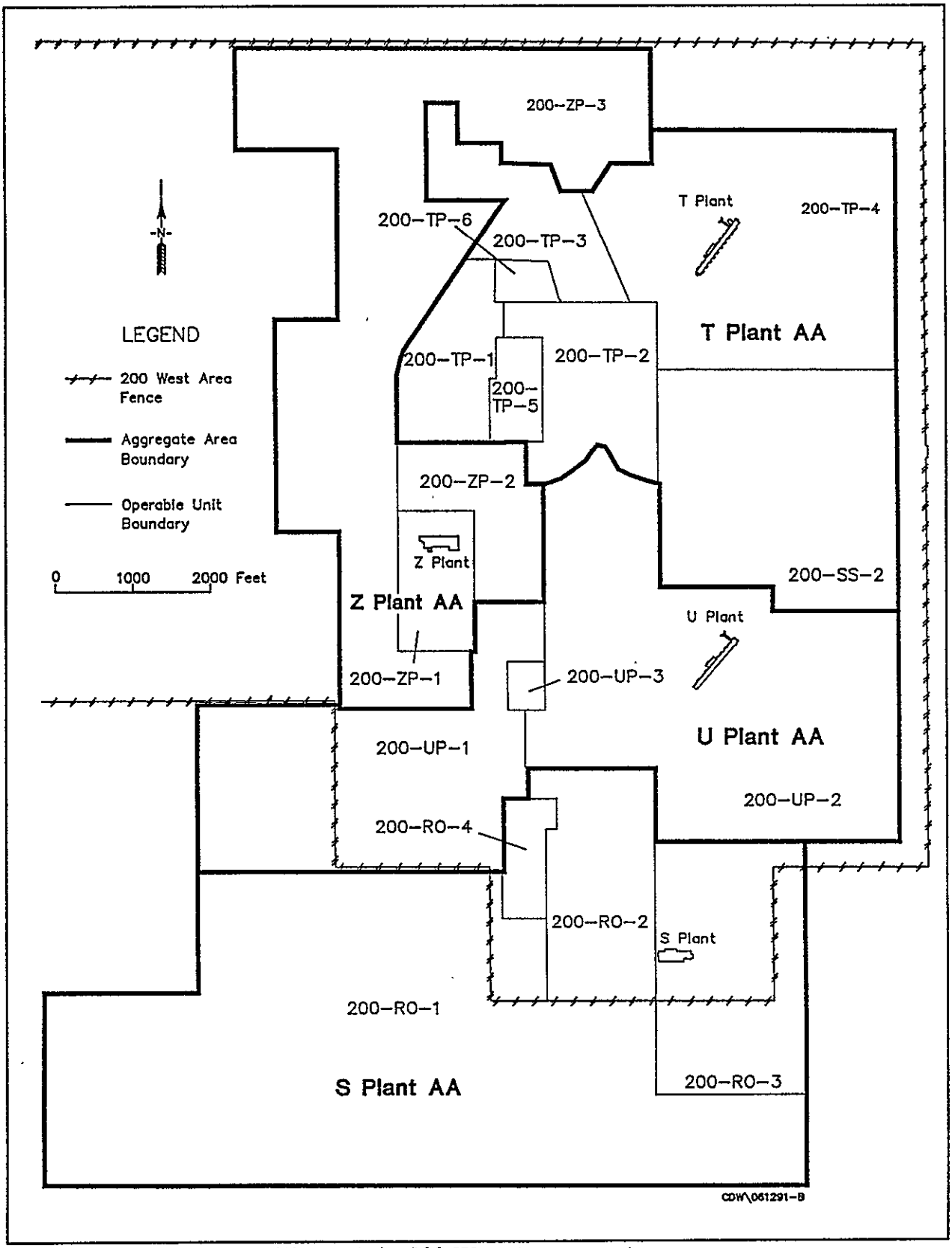


Figure 1-4. 200 West Aggregate Area.

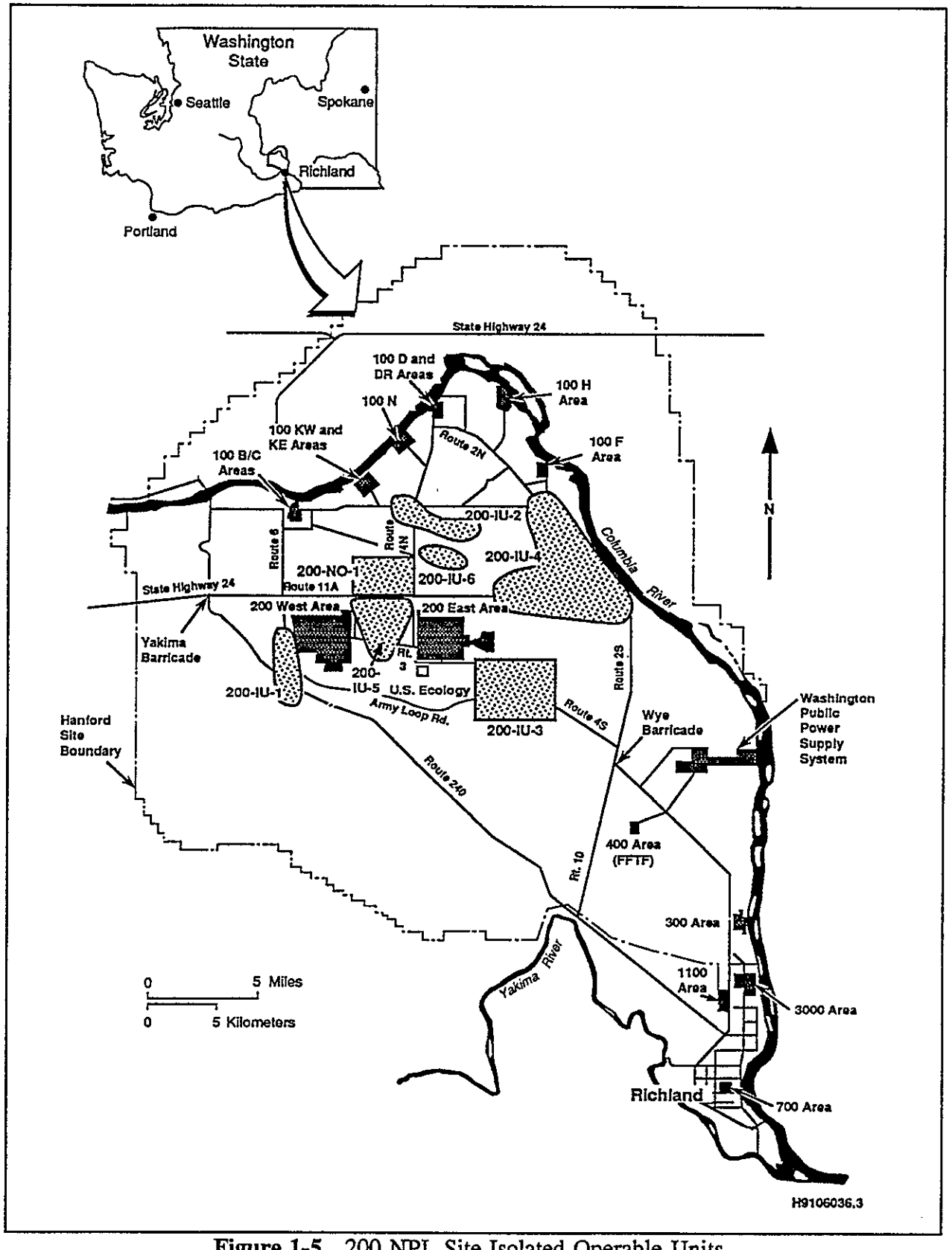


Figure 1-5. 200 NPL Site Isolated Operable Units.

Table 1-1. Overall Aggregate Area Management Study (AAMS) Schedule for 200 NPL Site.

AAMS Title	Operable Units	AAMS Type	Lead Regulatory Agency	M-27-00 Interim Milestones
U Plant	200-UP-1 200-UP-2 200-UP-3	Source	Ecology	M-27-02, January 1992
Z Plant	200-ZP-1 200-ZP-2 200-ZP-3	Source	EPA	M-27-03, February 1992
S Plant	200-RO-1 200-RO-2 200-RO-3 200-RO-4	Source	Ecology	M-27-04, March 1992
T Plant	200-TP-1 200-TP-2 200-TP-3 200-TP-4 200-TP-5 200-TP-6 200-SS-2	Source	EPA	M-27-05, April 1992
PUREX	200-PO-1 200-PO-2 200-PO-3 200-PO-4 200-PO-5 200-PO-6	Source	Ecology	M-27-06, May 1992
B Plant	200-BP-1 200-BP-2 200-BP-3 200-BP-4 200-BP-5 200-BP-6 200-BP-7 200-BP-8 200-BP-9 200-BP-10 200-BP-11 200-IU-6 200-SS-1	Source	EPA	M-27-07, June 1992
Semi-Works	200-SO-1	Source	Ecology	M-27-08, July 1992
200 North	200-NO-1	Source	EPA	M-27-09, August 1992
200 West	NA	Ground Water	EPA/Ecology	M-27-10, September 1992
200 East	NA	Ground Water	EPA/Ecology	M-27-11, September 1992

2.0 FACILITY, PROCESS AND OPERATIONAL HISTORY DESCRIPTIONS

Section 2.0 of the Aggregate Area Management Study (AAMS) presents historical data on the T Plant Aggregate Area and detailed physical descriptions of the individual waste management units and unplanned releases. These descriptions include historical data on waste sources and disposal practices, and are based on a review of current and historical Hanford Site reports, engineering drawings, site inspections, and employee interviews. Section 3.0 describes the environmental setting of the waste management units. The waste types and volumes are qualitatively and quantitatively assessed at each site in Section 4.0. Data from these three sections are used to identify contaminants of concern (Section 5.0), potential applicable or relevant and appropriate requirements (ARARs) (Section 6.0) and current data gaps (Section 8.0).

This section describes the location of the T Plant Aggregate Area (Section 2.1), summarizes the history of operations (Section 2.2), describes the facilities, buildings and structures of the T Plant Aggregate Area (Section 2.3), and describes T Plant Aggregate Area waste generating processes (Section 2.4). Section 2.5 discusses interactions with other aggregate areas or operable units. Sections 2.6 and 2.7 discuss interactions with Resource Conservation and Recovery Act (RCRA) programs and other Hanford Site programs.

2.1 LOCATION

The Hanford Site, operated by the U.S. Department of Energy (DOE), occupies about 1,450 km^2 (560 mi^2) of the southeastern part of Washington State north of the confluence of the Yakima and Columbia Rivers (Figure 1-1). The 200 West Area is a controlled area of approximately 8.3 km^2 (3.2 mi^2) near the middle of the Hanford Site. The 200 West Area is about 8 km (5 mi) from the Columbia River and 11 km (6.8 mi) from the nearest Hanford boundary. There are 18 operable units grouped into four aggregate areas in the 200 West Area (Figure 1-4). The T Plant Aggregate Area (consisting of operable units 200-TP-1, 200-TP-2, 200-TP-3, 200-TP-4, 200-TP-5, 200-TP-6 and 200-SS-2) lies in the northern portion of the 200 West Area (Figure 1-4). The location of the buildings and waste management units are shown on Plate 1. Plate 2 shows the topography of the U Plant Aggregate Area. The media sampling locations are depicted on Plate 3.

2.2 HISTORY OF OPERATIONS

The Hanford Site, established in 1943, was originally designed, built, and operated to produce plutonium for nuclear weapons using production reactors and chemical reprocessing plants (DOE-RL 1988). In March 1943, construction began on three reactor facilities and three chemical processing facilities. After World War II, six more reactors were built. Beginning in the 1950s, waste management, energy research and development, isotope use, and other activities were added to the Hanford operation. In early 1964, a decision was

made to begin shut down of the reactors. Eight of the reactors were shut down by 1971. The N Reactor operated in steam production mode from about 1971 to 1980 for electricity production; in weapons grade material production mode from 1980 to 1987; and was placed on cold standby status in October 1989. Westinghouse Hanford Company was notified September 20, 1991 that they should cease preservation and proceed with activities leading to a decision on ultimate decommissioning of the reactor. These activities are scoped within an N Reactor shutdown program which is scheduled to be completed in 1999.

Operations in the 200 Areas (West and East) are related mainly to nuclear fuel separation. Spent nuclear fuel is fuel that has been withdrawn from a nuclear reactor following irradiation. The 200 West Area consists of four main processing areas (Figure 1-4):

- S Plant and T Plant, where initial processing to separate uranium and plutonium from irradiated fuel rods took place
- U Plant, where uranium recovery operations took place
- Z Plant, where plutonium finishing operations took place.

The 200 Areas also contain nonradioactive support facilities, including transportation maintenance buildings, service stations, and coal-fired powerhouses for process steam production, steam transmission lines, raw water treatment plants, water storage tanks, electrical maintenance facilities, and subsurface sewage disposal systems (DOE-RL 1988).

Built in 1944, T Plant was the first chemical separation facility completed at the Hanford Site. The primary goal of T Plant operations was to produce purified plutonium nitrate for use in nuclear weapons. This process was initiated in one of the several Hanford production reactors, where uranium-bearing fuel rods were irradiated to create plutonium. The irradiated rods were then transferred to T Plant, where a bismuth phosphate chemical separation process was used to extract the plutonium product. The 221-T Building, also known as the T Plant or T Canyon Building, housed the first operational, full-scale, bismuth phosphate plutonium separations facility in the world. This building is one of five Hanford Site "Canyon" buildings, so called because of their large size and the canyon-like appearance of their upper galleries.

The bismuth phosphate process performed at T Plant involved dissolving the jacketed fuel rods in nitric acid and conducting multiple purification operations on the resultant aqueous nitrate solution. Chemical separation was achieved by varying the valent states of plutonium (Pu) from +4 (the reduced state) to +6 (the oxidized, or hexavalent, state); no attempt to recover uranium was made in this process. Sodium nitrite solution was added to a batch of dissolver solution to ensure that the plutonium present had a valence of +4. After adding bismuth nitrate and phosphoric acid to this solution, the resulting precipitate was separated by centrifugation, and the solution was sent to the T Plant 241 Tank Farm for disposal. The precipitate was washed in the centrifuge and dissolved in strong nitric acid.

The valence of the plutonium was then adjusted to +6 by adding a dichromate solution, and the precipitate of bismuth phosphate was again formed. At this stage of the process, the precipitate held some of the fission products which were not extracted in the first liquid waste stream, but the plutonium remained in solution. These precipitation cycles were repeated twice.

The product resulting from this chemical separation process was a dilute plutonium solution. This solution was then transferred to the 224-T Bulk Reduction Building (also known as the "concentration building"), where it was purified using the lanthanum fluoride process and reduced in volume. At this final stage of the process, the original 1250-L (330-gal) batch of Plutonium solution that had entered the 224-T Building was concentrated down to 30 L (8 gal) of purified plutonium nitrate. This concentrated batch was then transferred to the 231 T Building, located in the Z Plant Aggregate Area, for final treatment (Ballinger and Hall 1989). The plutonium product resulting from the sequential processes performed in Buildings 221-T, 224-T, and 231 formed the material used to develop the world's first atomic weapon at the Los Alamos Labs located in New Mexico.

The T Plant complex presently serves as a decontamination facility for the Hanford Site.

2.3 FACILITIES, BUILDINGS AND STRUCTURES

The T Plant Aggregate Area contains a large variety of waste disposal and storage facilities that were associated with T Plant and, to a lesser extent, Z Plant Aggregate Area operations. Radiologically contaminated processing wastes were discharged to the soil column through cribs, trenches, and other facilities. Wastes which were not normally contaminated, but have the potential to contain radionuclides, such as cooling waster and condensate water, were allowed to infiltrate into the ground through ponds and open ditches. Radiologically contaminated waste types are defined in DOE Order 5820.2(A) (DOE 1988a):

- High-level waste is highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of transuranic (TRU) waste and fission products in concentrations as to require permanent isolation.

- TRU waste is defined as: without regard to source or form, radioactive waste that at the end of institutional control periods is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g. Regarding the Waste Isolation Pilot Plant, high-level waste and spent nuclear fuel as defined by this Order are specifically excluded by this definition.

- Low-level waste is radioactive waste not classified as high-level waste, TRU waste, spent nuclear fuel, or byproduct materials as defined by the Order.

Based on construction, purpose, or origin, the T Plant Aggregate Area waste management units fall into one of 10 subgroups as follows:

- Plants, Buildings, and Storage Areas (Section 2.3.1)
- Tanks and Vaults (Section 2.3.2)
- Cribs and Drains (Section 2.3.3)
- Reverse Wells (Section 2.3.4)
- Ponds, Ditches and Trenches (Section 2.3.5)
- Septic Tanks and Associated Drain Fields (Section 2.3.6)
- Transfer Facilities, Diversion Boxes, and Pipelines (Section 2.3.7)
- Basins (Section 2.3.8)
- Burial Sites (Section 2.3.9)
- Unplanned Releases (Section 2.3.10)

Table 2-1 presents a list of the waste management units within the aggregate area. In addition, the aggregate area contains several unplanned release sites. The locations of these waste management units are shown on separate figures for each waste management group and Plate 1. Figure 2-1 summarizes the operational history of each of the waste management units. Tables 2-2 and 2-3 summarize data available regarding the quantity and types of wastes disposed of to the waste management units. These data have been compiled from the Waste Information Data System (WIDS) inventory sheets (WHC 1991a), the Hanford Inactive Site Survey (HISS) database, and the Tank Farm Surveillance Report (Hanlon 1992). These inventories include all of the contaminants reported in the databases, but do not necessarily include all of the contaminants disposed of at each site. In the following sections, each waste management unit is described within the context of one of the waste management unit types.

2.3.1 Plants, Buildings, and Storage Areas

Plants and buildings are not generally identified as past practice waste management units according to the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) and will generally be addressed under the Hanford Surplus Facilities Program.

The program is responsible for the surveillance, maintenance, and decommissioning of surplus facilities within the Westinghouse-Hanford Environmental Restoration Programs. Section 2.7 details the interaction of the Hanford programs. Because several of the T Plant Aggregate Area plants and buildings were the primary generators of waste disposed of within the T Plant Aggregate Area, a description of these is provided in Sections 2.3.1.1 and 2.3.1.2. Some plants and buildings are or contain RCRA treatment, storage, or disposal (TSD) facilities. A description of such facilities is provided in Section 2.6. The locations of plants, buildings, and storage areas in the aggregate area are shown on Figure 2-2.

The 221-T Building (T Plant) and the 224-T Building were the primary generators of waste within the aggregate area. These plants, and the buildings associated with them, will be described in the following sections.

Other buildings and structures located within the aggregate area are not addressed in this document because they are not thought to have released contaminants and will be closed through a separate decontamination and decommissioning process. These structures include:

- 211-T Building (bulk chemical storage area)
- 221-TA Building (contains two ventilation supply fans for Building 221-T)
- 222-T Laboratory Building (originally built as a process analysis laboratory; currently houses staff from one Health Protection Technologists (HPT) group and two operations groups)
- 242-T Building (houses the evaporator works for the T Plant tank farms)
- 271-T Building (adjacent to the 221-T Building, 271-T is the original bismuth phosphate office and support facility)
- 282-W Reservoir Building (powerhouse facility)
- 283-W Water Filtration Plant Building (powerhouse facility)
- 284-W Boiler House (supplies steam to both the 200 West Area and to a 200 East Area boiler house)
- 291-T Building (houses the sand filters and stack for the 221-T Building)
- 2706-T (Equipment Decontamination Building)
- 2724-W Laundry (used for both radioactively and nonradioactively contaminated laundry; Crib 216-W-LWC is the dedicated crib for associated wastewater; prior to 1981, wastewater was discharged to the 216-U-14 Ditch)

2.3.1.1 221-T (Canyon) Building. The 221-T Building is the original bismuth phosphate separation plant built in 1944. This facility was used to chemically extract plutonium contained in irradiated uranium fuel rods discharged from Hanford Site reactors. The first batch of irradiated fuel rods was dissolved in the 221-T Building on December 26, 1944. This building is one of five Hanford "Canyon" buildings and is the central feature and key operational facility of the T Plant Aggregate Area.

The first "hot" semi-works studies at Hanford were performed in the head-end (Cells A and B) of the 221-T Building from September to December 1944. In this semi-works plant, full scale experiments were performed with irradiated fuel to determine product yields of the bismuth phosphate process. This semi-works plant was placed on standby status in January 1945, and all T Plant semi-works personnel were transferred to the 321 Building (located outside the T Plant Aggregate Area boundary). This facility was re-activated in February 1945 for experimental work with ammonium silico-fluoride. However, because the latter process step increased product losses, the T Plant semi-works was terminated on March 15, 1945.

The 221-T Building was deactivated in 1956 concurrent with the phase-out of the bismuth phosphate process plants. The T (and B) Plant plutonium separation methodology was replaced by the reduction/oxidation (REDOX) process and, ultimately, plutonium/uranium extraction (PUREX) process methods. The 221-T Building was converted to a decontamination and equipment refurbishment facility in 1957. After removing most of the original process equipment, the 221-T head-end was partially decontaminated and stabilized. Between 1964 and 1990, the 221-T Building head-end housed a series of testing programs, discussed in the following paragraphs.

In 1964, tests using iodine and radioactive cesium were performed in a new containment vessel fabricated in the 221-T head-end dissolver cells and canyon. This modified facility was also referred to as the Containment Systems Test Facility (CSTF) and the T Plant laboratory. Tests using radioactive cobalt were also conducted during this time. The CSTF testing program, managed by Pacific Northwest Laboratory (PNL), was completed in 1969.

Between 1976 and 1985, liquid-metal reactor safety tests using nonradioactive sodium, lithium and sodium iodide were conducted by Westinghouse Hanford Company (Westinghouse Hanford) in the 221-T CSTF. Between 1985 and 1990, light-water reactor tests were conducted in 221-T using nonradioactive cesium, manganese, zinc, lithium sulfate, iodine and hydrogen iodide.

The 221-T Building is constructed entirely of reinforced concrete; dimensions are 266 x 26 x 31 m (875 x 85 x 102 ft). Process equipment is contained in small rooms, called cells, which are arranged in rows in an area spanned by a traveling crane. The cells are topped with 1.2-m (4-ft) thick concrete blocks which are removable by crane to provide access to the cell beneath. Above the blocks is a space equal in height to the cell depth, which provides headroom for manipulating the process equipment during maintenance

operations. Heavy concrete shielding walls enclose this space up to the level of the crane rails, giving the appearance of a canyon.

The 221-T Building currently provides services in radioactive decontamination, reclamation, and decommissioning of process equipment.

2.3.1.2 224-T Building. Building 224-T was originally used to purify plutonium nitrate using the lanthanum fluoride process. Like 221-T, this building was also deactivated in 1956 following phase-out of the bismuth-phosphate plants. Building 224-T remained inactive until the early 1970s, when it was modified to store plutonium scrap in liquid and solid forms.

This scrap was removed in 1985, when the building was officially designated the Transuranic Waste Storage and Assay Facility (TRUSAF). The TRUSAF operation consists of nondestructive assay and nondestructive examination on newly generated contact-handled transuranic (CH-TRU) solid waste. These analyses are used to overview sealed, certified CH-TRU solid waste packages, in order to verify general compliance with the Waste Isolation Pilot Plant Waste Acceptance Criteria requirements.

2.3.2 Tanks and Vaults

Tanks and vaults were constructed to handle and store liquid wastes generated by uranium and plutonium processing activities. Several types of tanks are present in the aggregate area including catch tanks, settling tanks and storage tanks. The seven catch tanks in the T Plant Aggregate Area are generally associated with diversion boxes and other transfer units, and were designed to accept overflows and spills. A single settling tank, 241-T-361, was used for settling suspended solids in fluid wastes prior to transfer to cribs. Storage tanks were used to collect and store large quantities of liquid wastes.

The T Plant Aggregate Area includes 40 single-shell tanks (SSTs) comprising three tank farms: 241-T, 241-TX and 241-TY. Each tank farm is enclosed within a chain-link fence and posted with surface contamination warning signs, as observed during a site visit in September 1991. The 241-T Tank Farm consists of twelve 2,017,000 L (533,000 gal) and four 208,200 L (55,000 gal) buried SSTs containing high-level mixed waste (Cramer 1987). These tanks are numbered 241-T-101 through 241-T-112 and 241-T-201 through 241-T-204, as listed in Table 2-4. The 241-TX Tank Farm includes eighteen 2,869,000 L (758,000 gal) buried SSTs containing high-level mixed waste, numbered 241-TX-101 through 241-TX-118. The 241-TY Tank Farm consists of six 2,869,000 L (758,000 gal) buried SSTs containing high-level mixed waste and numbered 241-TY-101 through 241-TY-106. Figure 2-3 shows the layout of these tank farms, indicating the assumed tank integrity. Table 2-4 summarizes available information for each single-shell tank and lists associated waste volumes. Figure 2-4 depicts a typical 2,017,000 L (533,000 gal) tank.

All of the tanks within the 241-T, 241-TX and 241-TY Tank Farms will be addressed by the SST closure program. The structure and the related contamination in the tank farms

will be described in this report, but investigation and remediation strategies will be deferred to the SST closure program.

Interim isolation and stabilization have been performed on the tanks to varying degrees, as listed in the individual tank descriptions. Interim isolation is the sealing of all accesses to the tank that are not required for long-term surveillance. The sealing should provide a barrier against inadvertent addition of liquid. The administrative designation of partially interim isolated reflects the completion of the effort required for interim isolation with the exception of isolation of risers and piping required for pumping or other methods of stabilization (Hanlon 1992). Interim stabilization is the removal of as much liquid as possible through use of a salt well and a jet pump. A salt well is a slotted riser pipe inserted into the salt cake of a tank and into which a pump is placed. A tank is considered interim stabilized if it contains less than 189,000 L (50,000 gal) of drainable interstitial liquid and less than 19,000 L (5,000 gal) of supernatant liquid. In all cases of interim stabilization, interstitial liquids remain with the volume and vary according to waste volume, liquid type and other factors.

Chemical inventories for the SSTs have been modeled with the Tracks Radioactive Components (TRAC) computer code developed by Westinghouse Hanford. This program calculated tank inventories for 68 radioactive constituents and 30 chemical constituents. The estimates were based on the historical records of the quantities of material initially placed in the tanks from nuclear fuel production and later modified by tank transfers and radioactive decay. The TRAC inventory system is limited, however, in that it requires continuous input and user support and detailed knowledge of chemical processes in each plant. Consequently, it is difficult to use and is sometimes incomplete. Despite these limitations, the TRAC inventories represent the best current information on the contents of the tanks in the T Plant Aggregate Area.

A summary of the TRAC inventory data is presented in Table 2-5 for the 241-T, 241-TX and 241-TY Tank Farms. The table presents an estimate of the quantity of radionuclides and chemical constituents for the major analytes by tank farm. A complete inventory of analytes by tank is given in Appendix A.

2.3.2.1 241-T-101 Single-Shell Tank. The 241-T -101 SST is located in the 241-T Tank Farm, which is approximately 610 m (2,000) ft west of the 221-T Building and directly north of the 241-TY Tank Farm and 23rd Street. This inactive unit operated from December 1944 until 1979 and received the following wastes: bismuth phosphate metal waste, tributyl phosphate waste, REDOX coating waste, and supernatant containing coating waste, REDOX ion-exchanges waste, REDOX high level waste, PNL waste, B-Plant low-level waste, decontamination waste, evaporator bottoms, and 224-U waste from 241-BX, 241-SX, and 241-T Tanks (WHC 1991a).

This unit has a capacity of 2,017,000 L (533,000 gal) and is composed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with approximately 2.7 m (9 ft) of overburden. The tank has a dished bottom, an operating depth

of 5.2 m (17 ft), and a diameter of 22.9 m (75 ft). Structures associated with the tank include six active radiation monitoring wells, temperature sensors, and liquid level gages (WHC 1991a). The tank is currently partially interim isolated and of sound integrity.

A review of the shift logs, internal memos, and drilling and gamma logs for drywells around the unit suggest that a spill of an estimated volume of 1,500,000 L (400,000 gal) occurred some time prior to 1973. The duration and quantity of the release is unknown. Based on one vadose monitoring well, high-level liquid wastes penetrated up to 37.2 m (122 ft) beneath the surface (WHC 1991a).

As of December 1991, this unit contained less than 1 kg moles of ferrocyanide at a maximum temperature of 23 °C (73 °F). Hanlon 1992 indicates that the tank contains 114,000 L (30,000 gal) of supernatant liquid, 390,000 L (103,000 gal) of sludge for a total waste volume of 504,000 L (133,000 gal).

2.3.2.2 241-T-102 Single-Shell Tank. The 241-T-102 SST is located within the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T Building and directly north of the 241-TY Tank Farm and 23rd Street. This inactive waste management unit operated from September 1945 until 1974 or 1976. During this time, the tank received bismuth phosphate metal waste, REDOX coating waste, and supernatant containing REDOX high-level waste, evaporator bottoms, coating waste, B-Plant ion exchange waste, and B-Plant low-level waste from 241-C and 241-T Tank Farms (WHC 1991a).

Tank 241-T-102 has a capacity of 2,017,000 L (533,000 gal) and is composed of a carbon steel liner within a reinforced concrete shell. The unit is entirely below grade, with the tank bottom located at 11.3 m (37 ft) below grade and the upper surface located beneath 2.7 m (9 ft) of overburden. The unit has a dished bottom, an operating depth of 5.2 m (17 ft) and a diameter of 22.9 m (75 ft). Structures associated with the tank include seven active radiation monitoring wells, a temperature sensor and a liquid level gage (WHC 1991a). The tank is interim isolated and of sound integrity.

Hanlon 1992 indicates that the tank contains 49,200 L (13,000 gal) of supernatant liquid, and 72,000 L (19,000 gal) of sludge for a total waste volume of 121,200 L (32,000 gal).

2.3.2.3 241-T-103 Single-Shell Tank. The 241-T-103 SST is located within the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T building and directly north of the 241-TY Tank Farm and 23rd Street. Active from March 1946 to 1974, this tank received bismuth phosphate metal waste, coating waste, and supernatant containing B Plant low-level waste, REDOX ion exchange waste, and evaporator bottoms from the 241-C and 241-T Tank Farms (WHC 1991a). The 241-T-103 Tank was taken out of service due to a liquid level decrease of 0.76 cm (0.30 in.). Radiation readings in accompanying drywells are attributed to the 241-T-106 Tank leak. The tank is thought to have questionable integrity and is an assumed leaker (Hanlon 1992).

This tank has a capacity of 2,017,000 L (533,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom surface at 11.3 m (37 ft) below grade and the upper surface covered by 2.7 m (9 ft) of overburden. Tank 241-T-103 has a diameter of 22.9 m (75 ft), a dished bottom, and an operating depth of 5.2 m (17 ft). Associated structures include six active radiation monitoring wells, a temperature sensor, and a liquid level gage (WHC 1991a). This tank is interim isolated.

One unplanned release (UPR-200-W-147) is associated with Tank 241-T-103. While monitoring wells were being drilled to track the extent of the 241-T-106 Tank leak, contamination was encountered near the 241-T-103 Tank. Subsequent investigations revealed that a leak resulted from a failed grout seal in a spare entry line. The volume of the leak has been determined to be about 5,000 L (1,320 gal). The data show that radioactivity has preferentially moved toward the southeast. The greatest depth to which the liquid waste penetrated is about 25 m (82 ft) below the ground surface and is about 37 m (121.4 ft) above the water table (Cramer 1987).

Hanlon 1992 indicates that the tank contains 15,100 L (4,000 gal) of supernatant liquid and 87,000 L (23,000 gal) of sludge, for a total waste volume of 102,200 L (27,000 gal).

2.3.2.4 241-T-104 Single-Shell Tank. Tank 241-T-104 is located within the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T Building and directly north of the 241-TY Tank Farm and 23rd Street.

Active from March 1946 to 1974, this tank received bismuth phosphate first-cycle waste. This tank was removed from service when it became filled with solids (WHC 1991a). Hanlon 1992 indicates that this tank contains 11,400 L (3,000 gal) of supernatant liquid and 1,673,000 L (442,000 gal) of sludge, for a total waste volume of 1,684,400 L (445,000 gal).

Tank 241-T-104 has a capacity of 2,017,00 (533,000 gal) and is composed of a carbon steel liner within a reinforced concrete shell. The unit is entirely below grade, with the tank bottom located at 11.3 m (37 ft) below grade and the upper surface located beneath 2.7 m (9 ft) of overburden. The unit has a dished bottom, an operating depth of 5.2 m (17 ft) and a diameter of 22.9 m (75 ft). Structures associated with the tank include 5 active radiation monitoring wells, a temperature sensor and a liquid level gage (WHC 1991a). The tank is partially interim isolated and of sound integrity.

2.3.2.5 241-T-105 Single-Shell Tank. The 241-T-105 SST is located within the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T building and directly north of the 241-TY Tank Farm and 23rd Street.

From 1945 until 1974, this tank received bismuth phosphate first-cycle and second-cycle waste; REDOX coating waste, decontamination waste, Hanford Laboratory operation waste, and supernatant containing B Plant low-level waste, bismuth phosphate first-cycle waste, decontamination waste, and ion exchange waste from 241-BX, 241-S, and 241-T

Tanks (WHC 1991a). According to Hanlon 1992, the tank contains 370,900 L (98,000 gal) of sludge and no supernatant liquid.

This tank has a capacity of 2,017,000 L (533,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom surface at 11.3 m (37 ft) below grade and the upper surface covered by 2.7 m (9 ft) of overburden. Tank 241-T-105 has a diameter of 22.9 m (75 ft), a dished bottom, and an operating depth of 5.2 m (17 ft). Associated structures include three active radiation monitoring wells, a temperature sensor, a salt well screen, a plummet, and a liquid level gage (WHC 1991a). This tanks is interim isolated and of sound integrity.

2.3.2.6 241-T-106 Single-Shell Tank. Tank 241-T-106 is located within the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T Building and directly north of the 241-TY Tank Farm and 23rd Street. Active from June 1947 until 1973, this tank received bismuth phosphate first-cycle waste and supernatant containing coating waste, B Plant low-level waste, and ion-exchange waste from 241-S, 241-T and 241-U Tank Farms (WHC 1991a).

Tank 241-T-106 has a capacity of 2,017,000 L (533,000) gal and is composed of a carbon steel liner within a reinforced concrete shell. The unit is entirely below grade, with the tank bottom located at 11.3 m (37 ft) below grade and the upper surface located beneath 2.7 m (9 ft) of overburden. The unit has a dished bottom, an operating depth of 5.2 m (17 ft) and a diameter of 22.9 m (75 ft). Structures associated with the tank include nine active radiation monitoring wells, a temperature sensor, a plummet, and a liquid level gage (WHC 1991a). The tank is interim isolated and an assumed leaker.

Tank 241-T-106 was removed from service due to unplanned release UPR-200-W-148 which is believed to have started on April 20, 1973 during a routine filling operation. The leak was not detected until June 8, 1973. Upon investigation of the leak, it was determined that the total loss of fluid to the ground had been 435,300 L (115,000 gal), containing approximately 40,000 Ci of ^{137}Cs, 14,000 Ci if ^{90}Sr, 4 Ci of plutonium, and various fission products. It is estimated the leak contaminated over 25,000 m^3 of soil. The unit was pumped to a minimum heel in June 1973 and was further pumped down to a residual layer of less than 15.2 cm (6 in.) in July 1974 (WHC 1990c).

According to Hanlon 1992, this tank contains 7,600 L (2,000 gal) of supernatant liquid and 71,900 L (19,000 gal) of sludge, for a total waste volume of 79,500 L (21,000 gal).

2.3.2.7 241-T-107 Single-Shell Tank. The 241-T-107 SST is located within the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T building and directly north of the 241-TY Tank Farm and 23rd Street. Active from 1944 or 1945 until April 1976, this tank received the following wastes: bismuth phosphate first-cycle waste, tributyl phosphate, and supernatant containing bismuth phosphate first-cycle waste, tributyl phosphate waste, ion-exchange waste, and coating waste from the 241-C, 241-BX, and 241-T Tank Farms (WHC 1991a).

Tank 241-T-107 has a capacity of 2,017,000 L (533,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom surface at 11.3 m (37 ft) below grade and the upper surface covered by 2.7 m (9 ft) of overburden. Tank 241-T-107 has a diameter of 22.9 m (75 ft), a dished bottom, and an operating depth of 5.2 m (17 ft). Associated structures include three active radiation monitoring wells, a temperature sensor, a salt well screen, a plummet, and a liquid level gage (WHC 1991a). This tank is partially interim isolated and an assumed leaker.

According to Hanlon 1992, the tank contains 34,100 L (9,000 gal) of supernatant liquid and 647,200 L (171,000 gal) of sludge, for a total waste volume of 681,300 L (180,000 gal). In December 1991, Tank 241-T-107 contained 5 kg moles of ferrocyanide at a maximum temperature of 21 °C (70 °F) (Hanlon 1992).

2.3.2.8 241-T-108 Single-Shell Tank. Tank 241-T-108 is located within the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T Building and directly north of the 241-TY Tank Farm and 23rd Street.

Active from September 1945 until 1974, this tank received tributyl phosphate waste, bismuth phosphate fist-cycle waste, Hanford Laboratory operations waste, and supernatant containing tributyl phosphate waste, B Plant low-level waste, bismuth phosphate first-cycle waste, ion-exchange waste, and evaporator bottoms from the 241-T and 241-TX Tank Farms (WHC 1991a).

Tank 241-T-108 has a capacity of 2,017,000 L (533,000 gal) and is composed of a carbon steel liner within a reinforced concrete shell. The unit is entirely below grade, with the tank bottom located at 11.3 m (37 ft) below grade and the upper surface located beneath 2.7 m (9 ft) of overburden. The unit has a dished bottom, an operating depth of 5.2 m (17 ft) and a diameter of 22.9 m (75 ft). Structures associated with the tank include six active radiation monitoring wells, a temperature sensor, and a liquid level gage. A center riser was installed to permit installation of a salt well pump that extended to the low point of the dished bottom (WHC 1991a). The tank is interim isolated and an assumed leaker.

This unit was removed from service due to questionable integrity when the liquid level decreased by 0.76 cm (0.30 in.). In 1978 studies were made with the conclusion that all drywell activity is associated with the 241-T-106 Tank leak. In 1979 additional wells were drilled because activity in one of the established drywells continued to increase. The source of the increase was evaluated with the conclusion that Tank 241-T-106 release was a questionable source of the activity increase (WHC 1990c, WHC 1991a). According to the December 1991 Tank Farm Surveillance Report (Hanlon 1992), the tank contains 166,500 L (44,000 gal) of sludge and no supernatant liquid.

2.3.2.9 241-T-109 Single-Shell Tank. The 241-T-109 SST is located within the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T building and directly north of the 241-TY Tank Farm and 23rd Street.

Active from December 1945 until 1974, this tank received the following wastes: bismuth phosphate first-cycle waste, tributyl phosphate waste, evaporator bottoms, and supernatant containing tributyl phosphate waste, B Plant low-level waste, bismuth phosphate first-cycle waste, ion-exchange waste, and PNL waste from the 241-T and 241-TX Tank Farms (WHC 1991a).

This tank has a capacity of 2,017,000 L (533,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom surface at 11.3 m (37 ft) below grade and the upper surface covered by 2.7 m (9 ft) of overburden. Tank 241-T-109 has a diameter of 22.9 m (75 ft), a dished bottom, and an operating depth of 5.2 (17 ft). Associated structures include six active radiation monitoring wells, a temperature sensor, a salt well screen, a plummet, and a liquid level gage (WHC 1991a). This tanks is interim isolated and an assumed leaker.

The integrity of this unit was questioned when increasing activity was found in drywells. Since 1976, activity in all drywells has steadily decreased (WHC 1990c). According to Hanlon 1992, this tank contained 219,500 L (58,000 gal) of sludge and no supernatant liquids.

2.3.2.10 241-T-110 Single-Shell Tank. Tank 241-T-110 is located within the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T Building and directly north of the 241-TY Tank Farm and 23rd Street. From December 1944 until 1976, this tank received bismuth phosphate second-cycle waste and 224-U Building waste. As indicated in Table 2-4, this unit has the potential for hydrogen or other flammable gas generation (WHC 1991a). The highest temperature in this tank in December 1991 was 18 °C (65 °F), which does not exceed the applicable maximum temperature criteria or surveillance frequency limits (Hanlon 1992).

Tank 241-T-110 has a capacity of 2,017,000 L (533,000 gal) and is composed of a carbon steel liner within a reinforced concrete shell. The unit is entirely below grade, with the tank bottom located at 11.3 m (37 ft) below grade and the upper surface located beneath 2.7 m (9 ft) of overburden. The unit has a dished bottom, an operating depth of 5.2 m (17 ft) and a diameter of 22.9 m (75 ft). Structures associated with the tank include five active radiation monitoring wells, a temperature sensor, a salt well screen, and a liquid level gage (WHC 1991a). The tank is partially interim isolated and of sound integrity.

Hanlon 1992 indicates that the tank contains 11,400 L (3,000 gal) of supernatant liquid and 1,423,200 L (376,000 gal) of sludge, for a total waste volume of 1,434,500 L (379,000 gal).

2.3.2.11 241-T-111 Single-Shell Tank. The 241-T-111 SST is located within the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T Building and directly north of the 241-TY Tank Farm and 23rd Street. Active from October 1945 until March 1974, this tank has received bismuth phosphate second-cycle waste and 224-U Building waste (WHC 1991a).

This tank has a capacity of 2,017,000 L (533,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom surface at 11.3 m (37 ft) below grade and the upper surface covered by 2.7 m (9 ft) of overburden. Tank 241-T-111 has a diameter of 22.9 m (75 ft), a dished bottom, and an operating depth of 5.2 m (17 ft). Associated structures include six active radiation monitoring wells, a temperature sensor, a salt well screen, and a liquid level gage (WHC 1991a). This tank is partially interim isolated and an assumed leaker.

Tank 241-T-111 was categorized as having questionable integrity after an unexplained liquid level decrease of 0.76 cm (0.30 in.) in 1974 (WHC 1991a). Hanlon 1992 indicates that the tank contains 7,600 L (2,000 gal) supernatant liquid and 1,726,000 L (456,000 gal) of sludge, for a total waste volume of 1,733,500 L (458,000 gal).

2.3.2.12 241-T-112 Single-Shell Tank. Tank 241-T-112 is located within the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T building and directly north of the 241-TY Tank Farm and 23rd Street. Active from January 1946 until 1977, this tank received bismuth phosphate second-cycle waste, PNL waste, decontamination waste, and supernatant containing B Plant low-level waste and ion-exchange waste from the 241-T Tanks (WHC 1991a).

Tank 241-T-112 has a capacity of 2,017,000 l (533,000 gal) and is composed of a carbon steel liner within a reinforced concrete shell. The unit is entirely below grade, with the tank bottom located at 11.3 m (37 ft) below grade and the upper surface located beneath 2.7 m (9 ft) of overburden. The unit has a dished bottom, an operating depth of 5.2 m (17 ft) and a diameter of 22.9 m (75 ft). Structures associated with the tank include three active radiation monitoring wells, a temperature sensor, and a liquid level gage (WHC 1991a). The tank is interim isolated and of sound integrity.

According to Hanlon 1992, this tank contains 26,500 L (7,000 gal) of supernatant liquid and 227,100 L (60,000 gal) of sludge, for a total waste volume of 253,600 L (67,000 gal).

2.3.2.13 241-T-201 Single-Shell Tank. Tank 241-T-201 is located in the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T Building and directly north of the 241-TY Tank Farm and 23rd Street. From 1952 to 1976, the tank received 224-U Building waste; the tank is currently inactive (WHC 1991a).

The tank has a capacity of 208,200 L (55,000 gal) and is composed of a steel liner within a concrete shell. The inner structure of the unit is 7.6 m (25 ft) tall. The unit is completely below grade, with the bottom located at 11.3 m (37 ft) below grade and the top located under 3.4 m (11 ft) of overburden. The tank has a dished bottom and a diameter of 6.1 m (20 ft). Associated structures include one active radiation monitoring well, a temperature sensor, a salt well screen, and a liquid level gage (WHC 1991a). The tank is interim isolated and of sound integrity.

According to the December 1991 Tank Farm Surveillance Report (Hanlon 1992), this tank contains 3,800 L (1,000 gal) of supernatant liquid and 106,000 L (28,000 gal) of sludge, for a total waste volume of 109,800 (29,000 gal).

2.3.2.14 241-T-202 Single-Shell Tank. Tank 241-T-202 is located in the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T Building and directly north of the 241-TY Tank Farm and 23rd Street. From 1952 until April 1976, this inactive tank received 224-U Building waste (WHC 1991a).

The tank has a capacity of 208,200 L (55,000 gal) and is composed of a steel liner within a concrete shell. The inner structure of the unit is 7.6 m (25 ft) tall. The unit is completely below grade, with the bottom located at 11.3 m (37 ft) below grade and the top located under 3.4 m (11 ft) of overburden. The tank has a dished bottom and a diameter of 6.1 m (20 ft). Associated structures include a temperature sensor, a salt well screen, and a liquid level gage. No active radiation monitoring wells are associated with tank 241-T-202 (WHC 1991a). The tank is interim isolated and of sound integrity.

In-tank photographs and surface measurements confirm liquid level increases from intrusions during the mid-1970s (WHC 1990c). Hanlon 1992 indicates that this tank contains 79,500 L (21,000 gal) of sludge and no supernatant liquid.

2.3.2.15 241-T-203 Single-Shell Tank. The 241-T-203 SST is located within the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T Building and directly north of the 241-TY Tank Farm and 23rd Street. In operation from 1952 to April 1976, this tank received waste from the 224-U Building (WHC 1991a).

This tank has a capacity of 208,200 L (55,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom surface at 11.3 m (37 ft) below grade and the upper surface covered by 3.4 m (11 ft) of overburden. Tank 241-T-111 has a diameter of 6.1 m (20 ft), a dished bottom, and an inner structure 7.6 m (25 ft) tall. Associated structures include one active radiation monitoring well, a temperature sensor, a salt well screen, and a liquid level gage (WHC 1991a). This tank is interim isolated and of sound integrity. According to Hanlon 1992, this tank contains 132,500 L (35,000 gal) of sludge and no supernatant liquid.

2.3.2.16 241-T-204 Single-Shell Tank. Tank 241-T-204 is located in the 241-T Tank Farm, which is approximately 610 m (2,000 ft) west of the 221-T Building and directly north of the 241-TY Tank Farm and 23rd Street. In 1976, this tank received waste from the 224-U Building; it is currently inactive (WHC 1991a).

The tank has a capacity of 208,200 L (55,000 gal) and is composed of a steel liner within a concrete shell. The inner structure of the unit is 7.6 m (25 ft) tall. The unit is completely below grade, with the bottom located at 11.3 m (37 ft) below grade and top located under 3.4 m (11 ft) of overburden. The tank has a dished bottom and a diameter of 6.1 m (20 ft). Associated structures include a temperature sensor, a salt well screen, and a

liquid level gage. No active radiation monitoring wells are associated with this tank (WHC 1991a). The tank is interim isolated and of sound integrity.

Hanlon 1992 indicates that this tank contains 143,800 L (38,000 gal) of sludge and no supernatant liquid.

2.3.2.17 241-TX-101 Single-Shell Tank. The 241-TX-101 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

Active from July 1949 until 1980, this tank received bismuth phosphate metal waste and supernatant waste. The supernatant wastes contained REDOX high-level waste and coating waste, tributyl phosphate waste, bismuth phosphate first-cycle waste, REDOX and waste fractionization ion exchange waste, B Plant high- and low-level waste, noncomplexed waste, PUREX low-level waste, organic wash waste, partial neutralization feed, and evaporator bottoms and decontamination waste from 241-C, 241-BX, 241-SX, and 241-TX Tanks (WHC 1991a).

This tank has a capacity of 2,869,000 (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include four active radiation monitoring wells, a temperature sensor, a salt well screen, and a liquid level gage (WHC 1991a). Tank 241-TX-101 is interim isolated and of sound integrity.

Although the cover blocks for this tank were sealed in January 1982, intrusions of precipitation, via the 241-TXR-152 Diversion Box, became evident in October 1982 (WHC 1991a). Hanlon 1992 indicates that this tank contains 18,900 L (5,000 gal) of supernatant and 317,900 L (84,000 gal) of sludge, for a total waste volume of 329,300 L (87,000 gal).

2.3.2.18 241-TX-102 Single-Shell Tank. The 241-TX-102 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

From January 1950 until 1977, this tank received the following wastes: bismuth phosphate metal waste, 242-T Evaporator waste, and supernatant containing REDOX high-level waste and evaporator bottoms from 241-TX Tanks (WHC 1991a). According to Hanlon 1992, this tank contains 427,700 L (113,000 gal) of salt cake, and no supernatant or sludge.

Tank 241-TX-102 has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m

(8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include 6 active radiation monitoring wells, air lift circulators, a temperature sensor, a salt well screen, a salt receiver, and a liquid level gage (WHC 1991a). Tank 241-TX-102 is interim isolated and of sound integrity.

2.3.2.19 241-TX-103 Single-Shell Tank. The 241-TX-103 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

Tank 241-TX-103 was active from July 1959 until 1980. During this time, the tank received bismuth phosphate metal waste, 242-T Evaporator waste, and supernatant. The supernatant contained bismuth phosphate metal waste, noncomplexed waste, tributyl phosphate waste, and partial neutralization feed from the 241-TX Tanks (WHC 1991a).

This tank has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include six active radiation monitoring wells, a temperature sensor, a salt well screen, a salt receiver, a plummet, and a liquid level gage (WHC 1991a). Tank 241-TX-102 is interim isolated and of sound integrity.

In 1977, two exploratory drywells, 51-03-01 and 51-03-11, were drilled to acquire additional data to evaluate high scintillometer measurements in Well 51-03-12 at the 15.5-m (51-ft) level (see 241-TX-107). Activity in drywells associated with the 241-TX-107 leak plume appear to have stabilized (1981) with the exception of well 51-03-09, which has low-level activity, approximately 100 ct/s, at the 18.3- and 21-m (60- and 69-ft) levels (WHC 1990c). Hanlon 1992 indicates that the tank contains 594,200 L (157,000 gal) of sludge and no supernatant.

2.3.2.20 241-TX-104 Single-Shell Tank. The 241-TX-1041 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

Tank 241-TX-104 remained active from November 1950 until 1977. During this time, it received bismuth phosphate metal waste, 242-T Evaporator waste, and supernatant waste containing REDOX ion-exchange and high-level waste, PUREX organic wash waste, bismuth phosphate metal waste, B Plant low-level waste, and tributyl phosphate from 241-TY and 241-TX tanks (WHC 1991a).

This tank has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of

overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include seven active radiation monitoring wells, a temperature sensor, a salt receiver, and a liquid level gage (WHC 1991a). Tank 241-TX-104 is interim isolated and of sound integrity.

According to Hanlon 1992, this tank contains 3,800 L (1,000 gal) of supernatant and 242,200 L (64,000 gal) of salt cake, for a total waste volume of 246,000 L (65,000 gal).

2.3.2.21 241-TX-105 Single-Shell Tank. The 241-TX-105 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

Tank 241-TX-105 was active from March 1951 until 1977, during which it received the following wastes: bismuth phosphate metal waste, 242-T Evaporator waste, and supernatant containing REDOX ion-exchange and high-level waste and PUREX organic waste from 241-BX and 241-SX tank farms (WHC 1991a).

This tank has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include six active radiation monitoring wells, a temperature sensor, air lift circulators, a salt receiver, a salt well screen, and a liquid level gage (WHC 1991a). Tank 241-TX-105 is interim isolated and an assumed leaker.

The unit was classified as questionable integrity in 1977 due to activity in five of the six drywells associated with the tank (WHC 1991a). According to Hanlon 1992, this tank contains 2,305,100 L (609,000 gal) of salt cake and no sludge or supernatant.

Tank 241-TX-105 contains concentrations of organic salts greater than 3% by weight total organic compounds (TOC). The temperature in this tank is monitored weekly because of its potential for release of high-level waste from uncontrolled increases in temperature or pressure. The maximum temperature reading in the tank in December 1991 was 38 °C (101 °F) (Hanlon 1992).

2.3.2.22 241-TX-106 Single-Shell Tank. The 241-TX-106 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

Tank 241-TX-106 was active from June 1951 to 1977. During this time, the tank received bismuth phosphate metal waste, tributyl phosphate waste, 242-T Evaporator waste, and supernatant. The supernatant contained REDOX ion exchange and high-level waste, PUREX organic wash waste, bismuth phosphate metal waste, evaporator bottoms, and

coating waste from 241-TX Tanks (WHC 1991a). According to Hanlon 1992, this tank contains 1,714,600 L (453,000 gal) of salt cake and no supernatant or sludge.

This tank has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include five active radiation monitoring wells, a temperature sensor, air lift circulators, a salt receiver, a salt well screen, and a liquid level gage (WHC 1991a). Tank 241-TX-106 is interim isolated and of sound integrity.

2.3.2.23 241-TX-107 Single-Shell Tank. The 241-TX-107 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm. Active from 1950 to 1977, tank 241-TX-107 received bismuth phosphate metal waste, 242-T Evaporator waste, and supernatant that contained bismuth phosphate metal waste and REDOX high-level waste from 241-TX Tanks (WHC 1991a).

This tank has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include seven active radiation monitoring wells, a temperature sensor, an open hole pump, a salt receiver, and a liquid level gage (WHC 1991a). Tank 241-TX-107 is interim isolated and an assumed leaker.

Unplanned release UPR-200-W-149 is associated with this tank. It is estimated that 9,400 L (2,500 gal) leaked from the tank (Hanlon 1992). During July 1977, after the tank was first classified as possibly leaking, the tank was pumped to a minimum level to remove as much of the supernatant material as possible (WHC 1991a).

Hanlon 1992 indicates that the tank contains 7600 L (2,000 gal) of supernatant and 128,500 L (34,000 gal) of salt cake, for a total waste volume of 136,300 L (36,000 gal).

2.3.2.24 241-TX-108 Single-Shell Tank. The 241-TX-108 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

This tank operated from 1950 to 1977 to receive bismuth phosphate metal waste, REDOX high-level waste, 242-T Evaporator waste, and supernatant. The supernatant contained decontamination waste, tributyl phosphate waste, and evaporator bottoms from 241-TX and 241-TY Tanks (WHC 1991a). According to Hanlon 1992, tank 241-TX-108 contains 507,200 L (134,000 gal) of salt cake.

This tank has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include three active radiation monitoring wells, a temperature sensor, a salt receiver, a salt well screen, a plummet, and a liquid level gage (WHC 1991a). Tank 241-TX-108 is interim isolated and of sound integrity.

2.3.2.25 241-TX-109 Single-Shell Tank. The 241-TX-109 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

Tank 241-TX-109 was active from 1949 or 1959 to 1977. During this time, it received bismuth phosphate first-cycle waste, 242-T Evaporator waste, and supernatant containing bismuth phosphate first-cycle waste and evaporator bottoms from 241-T, 241-TX, and 241-TY Tanks (WHC 1991a).

This tank has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include six active radiation monitoring wells, a temperature sensor, a salt receiver, a salt well screen, a plummet, and a liquid level gage (WHC 1991a). Tank 241-TX-109 is interim isolated and of sound integrity. Hanlon 1992 indicates that the tank contains 1,451,500 L (384,000 gal) of salt cake.

2.3.2.26 241-TX-110 Single-Shell Tank. The 241-TX-110 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm. Operating from September 1949 to 1977, this tank received bismuth phosphate first-cycle waste and 242-T Evaporator waste (WHC 1991a).

This tank has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include six active radiation monitoring wells, air lift circulators, a temperature sensor, a salt receiver, a salt well screen, and a liquid level gage (WHC 1991a). Tank 241-TX-110 is interim isolated and an assumed leaker.

In March 1974 the liquid level in tank 241-TX-110 was reportedly 1.3 cm (0.5 in.) lower than expected. The tank was removed from service for observation. During the observation period no further declines in fluid level were observed and drywells showed no

readings above normal background. The decline in water level was assumed to be associated with loss to the offgas system (WHC 1990c). According to Hanlon 1992, Tank 241-TX-110 contains 1,748,700 L (462,000 gal) of salt cake.

2.3.2.27 241-TX-111 Single-Shell Tank. The 241-TX-111 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm. Active from March 1950 to 1977, this tank received bismuth phosphate first-cycle waste, 242-T Evaporator waste, and supernatant containing tributyl phosphate waste from 241-TX Tanks (WHC 1991a).

This tank has a capacity of 2,859,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include five active radiation monitoring wells, air lift circulators, a temperature sensor, a salt receiver, a salt well screen, and a liquid level gage (WHC 1991a). Tank 241-TX-111 is interim isolated and of sound integrity.

Hanlon 1992 indicates that this tank contains 1,400,500 L (370,000 gal) of salt cake and no sludge or supernatant.

2.3.2.28 241-TX-112 Single-Shell Tank. The 241-TX-112 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

Active from August 1950 until 1974, tank 241-TX-112 received 242-T Evaporator waste, bismuth phosphate first-cycle waste, and supernatant containing evaporator bottoms from 241-TX Tanks during that time (WHC 1991a). Hanlon 1992 indicates that Tank 241-TX-112 contains 2,456,500 L (649,000 gal) of salt cake and no supernatant or liquid.

This tank has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include six active radiation monitoring wells, air lift circulators, a temperature sensor, a salt receiver, a salt well screen, and liquid level gages (WHC 1991a). Tank 241-TX-112 is interim isolated and of sound integrity.

2.3.2.29 241-TX-113 Single-Shell Tank. The 241-TX-113 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm. Active from December 1950 until 1971, this tank received 242-T Evaporator waste and supernatant containing evaporator bottoms from 241-TX Tanks (WHC 1991a).

This tank has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include three active radiation monitoring wells, air lift circulators, a temperature sensor, a salt well screen, and liquid level gages (WHC 1991a). Tank 241-TX-113 is interim isolated and an assumed leaker.

Unplanned release, UN-200-W-129, is associated with Tank 241-TX-113. In January 1971, while leak testing a new jumper assembly, an employee closed a valve in a pump pit and as he did, a caustic radioactive solution sprayed up through the pit cover. The employee was decontaminated, the area was surveyed, and the pump pit was hosed down (Radiation Occurrence Report, 11 January 1971). According to Hanlon 1992, the tank contains 2,297,500 L (607,000 gal) of salt cake, and no supernatant or sludge.

2.3.2.30 241-TX-114 Single-Shell Tank. The 241-TX-114 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

From April 1951 to 1971, the tank received 242-T Evaporator waste and supernatant containing bismuth phosphate first-cycle waste and evaporator bottoms from 241-TX Tanks. As salt filled this tank, it was removed from service. A prototype electrical immersion heater was installed in 1964 and no plans exist for its removal (WHC 1991a).

Tank 241-TX-114 has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include three active radiation monitoring wells, air lift circulators, a temperature sensor, a salt receiver, a salt well screen, and liquid level gages (WHC 1991a). Tank 241-TX-114 is interim isolated and an assumed leaker.

All the drywells surrounding this tank have activity at 13.1 m (43 ft). Well 51-14-04 displayed an extensive profile change below the 14.6 m (48-ft) level in 1977 and 1978 (WHC 1991a). Hanlon 1992 indicates that 2,025,000 L (535,000 gal) of salt cake, an no sludge or supernatant, are contained in the tank.

2.3.2.31 214-TX-115 Single-Shell Tank. The 241-TX-115 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

Active from 1951 to 1977, this tank received 242-T Evaporator waste, tributyl phosphate waste, coating waste, decontamination waste, and supernatant containing bismuth

phosphate metal waste, decontamination waste, coating waste, and evaporator bottoms from 241-U, 241-S, 241-T, and 241-TX Tanks (WHC 1991a).

Tank 241-TX-115 has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include four active radiation monitoring wells, a temperature sensor, a salt receiver, a salt well screen, and liquid level gages (WHC 1991a). Tank 241-TX-114 is interim isolated and an assumed leaker.

Tank 214-TX-115 was designated a "dormant" leaker in February 1975 because of increasing radiation peaks observed in near-by drywells (WHC 1990c). The tank is filled with salt cake to a depth of 6.1 m (20 ft), containing the second greatest quantity of waste in the tank farm (only 241-TX-112 contains more waste) (WHC 1991a).

Liquid observation well (LOW) scans revealed an interstitial liquid level (ILL) increase in excess of the established 12.2 cm (4.8 in.) increase criteria in both May 1987 and March 1991. An intrusion investigation is being conducted for this tank. Scans are conducted every six weeks. As of the September 1991 scan, no further increase of the ILL had been observed since the March 1991 level (Hanlon 1992). According to the Tank Farm Surveillance Report for December 1991 (Hanlon 1992), Tank 241-TX-115 contains 2,422,400 L (640,000 gal) of salt cake. The tank contains no supernatant or sludge.

2.3.2.32 241-TX-116 Single-Shell Tank. The 241-TX-116 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

Tank 241-TX-116 was active from 1951 to 1969. During this time, it received supernatant containing evaporator bottoms from 241-TX Tanks. In October 1970, 116,400 kg (256,000 lb) of diatomaceous earth were added to this tank and approximately 378,500 L (100,000 gal) of supernatant fluid removed in an unsuccessful stabilization attempt. Radiation monitoring of Drywell 51-16-11 in 1975 suggested that the tank was still leaking. An additional attempt to remove the remaining fluid was unsuccessful (WHC 1990c, Hanlon 1992, WHC 1991a).

Tank 241-TX-116 has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include three active radiation monitoring wells, a temperature sensor, a salt receiver, a salt well screen, and liquid level gages (WHC 1991a). Tank 241-TX-116 is interim isolated and an assumed leaker.

According to Hanlon 1992, the tank contains 2,388,300 L (631,000 gal) of salt cake and no supernatant or sludge.

2.3.2.33 241-TX-117 Single-Shell Tank. The 241-TX-117 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

Operation of tank 241-TX-117 began in April 1951 and ceased in 1969. During this time, the tank received supernatant containing first-cycle waste and evaporator bottoms from 241-TX Tanks (WHC 1991a).

Tank 241-TX-117 has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include four active radiation monitoring wells, a temperature sensor, a salt receiver, a salt well screen, and liquid level gages (WHC 1991a). Tank 241-TX-117 is interim isolated and an assumed leaker.

Photographs taken of the inside of Tank 241-TX-117 in November 1969 show a radial crack in the concrete dome of the tank. In October 1970, 39,100 kg (86,000 lb) of diatomaceous earth was added to this tank in an unsuccessful stabilization attempt (WHC 1991a, Hanlon 1992). Hanlon 1992 indicates that this tank contains 2,369,400 L (626,000 gal) of salt cake, and no supernatant or sludge.

2.3.2.34 241-TX-118 Single-Shell Tank. The 241-TX-118 SST is located in the 241-TX Tank Farm, which is approximately 760 m (2,500 ft) southwest of the 221-T Building and directly south of the 241-TY Tank Farm.

This tank operated from April 1951 to November 1980. During this time, it received 242-T Evaporator feed tank waste, 234-Z and 235-Z Buildings waste, caustic solution; tributyl phosphate waste, decontamination waste, and supernatant. The supernatant contained tributyl phosphate waste, bismuth phosphate first-cycle waste, evaporator bottoms, decontamination waste, partial neutralization feed, and coating waste from 241-T, 241-TX, 241-TY, and 241-U Tanks (WHC 1991a).

Tank 241-TX-118 has a capacity of 2,869,000 L (758,000 gal) and is constructed of a carbon steel liner within a reinforced concrete shell. The tank is located entirely below grade, with the bottom at 13.7 m (45 ft) below grade and the top surface covered by 2.4 m (8 ft) of overburden. The inner structure of the tank is 11.3 m (37 ft) high. The tank has a dished bottom, a diameter of 22.9 m (75 ft), and an operating depth of 7 m (23 ft). Associated structures include seven active radiation monitoring wells, a temperature sensor, a salt receiver, a salt well screen, a plummet, and liquid level gages (WHC 1991a). Tank 241-TX-118 is interim isolated and of sound integrity.

According to Hanlon 1992, the tank contains 1,313,400 L (347,000 gal) of salt cake. In addition, the tank contains greater than 10% by weight of TOC of organic salts. The temperature of the tank is monitored weekly because of its potential for release of high-level waste from an uncontrolled increase in temperature or pressure. The tank also contained less than 1 kg mole of ferrocyanide at a maximum temperature of 26 °C (78 °F) in December 1991 (Hanlon 1992).

2.3.2.35 241-TY-101 Single-Shell Tank. Tank 241-TY-101 is located in the 241-TY Tank Farm, which is approximately 730 m (2,400 ft) southwest of the 221-T Building and directly north of the 241-TX Tank Farm.

Operations began in 1953 at this unit and ceased in 1973. During this time, the tank received bismuth phosphate first-cycle waste and supernatant containing bismuth phosphate first-cycle waste, tributyl phosphate waste, and evaporator bottoms from 241-TY, 241-TX, and 241-S Tank Farms (WHC 1991a). The integrity of this unit was questioned when a liquid level increase exceeded 0.76 cm (0.30 in.) (WHC 1991a).

Tank 241-TY-101 has a capacity of 2,869,000 L (758,000 gal) and is carbon steel lined, with a reinforced concrete shell, dome, and base. The liner is 7.3 m (24 ft) high. The tank has a dished bottom and is covered by 1.9 m (6.25 ft) of overburden. The operating depth is 7 m (23 ft) and the diameter is 22.9 m (75 ft). Associated structures include three active radiation monitoring wells, a temperature sensor, a jet pump with screen, a liquid level gage, a plummet (WHC 1991a). Tank 241-TY-101 is interim isolated and an assumed leaker.

Hanlon 1992 indicates that this tank contains 446,600 L (118,000 gal) of sludge. In December 1991, the tank contained 23 kg moles of ferrocyanide, at a maximum temperature of 22 °C (71 °F) (Hanlon 1992).

2.3.2.36 241-TY-102 Single-Shell Tank. Tank 241-TY-102 is located in the 241-TY Tank Farm, which is approximately 730 m (2,400 ft) southwest of the 221-T Building and directly north of the 241-TX Tank Farm. Active from 1953 to 1979, this tank received supernatant containing B Plant low-level waste, REDOX high-level waste, PUREX organic wash waste, REDOX ion-exchange waste, and evaporator bottoms from 241-TX and 241-TY tanks (WHC 1991a).

Tank 241-TY-102 has a capacity of 2,869,000 L (758,000 gal) and is carbon steel lined, with a reinforced concrete shell, dome, and base. The liner is 7.3 m (24 ft) high. The tank has a dished bottom and is covered by 1.9 m (6.25 ft) of overburden. The operating depth is 7 m (23 ft) and the diameter 22.9 m (75 ft). Associated structures include five active radiation monitoring wells, a temperature sensor, an open hole pump, and a liquid level gage (WHC 1991a). Tank 241-TY-102 is interim isolated and of sound integrity.

Tank 241-TY-102 is the only tank in the TY tank farm containing salt cake. Drywell 52-02-11 was drilled in May 1975 to test the validity of using resistivity measurements as a

method of leak detection by injecting a salt solution ($NaNO_3$) and monitoring formation response (WHC 1991a). In January 1989 the activity in the well increased from approximately 70 ct/s at a depth of 12.2 m (40 ft) to about 160 ct/s, and then stabilized (WHC 1991a).

Hanlon 1992 indicates that the tank contains 242,200 L (64,000 gal) of salt cake, with no sludge or supernatant.

2.3.2.37 241-TY-103 Single-Shell Tank. Tank 241-TY-103 is located in the 241-TY Tank Farm, which is approximately 730 m (2,400 ft) southwest of the 221-T Building and directly north of the 241-TX Tank Farm.

Operations began at Tank 241-TY-103 in July 1953 and ceased in 1973. During this time, the tank received bismuth phosphate first-cycle waste, tributyl phosphate waste, and supernatant. The supernatant contained bismuth phosphate first-cycle waste, tributyl phosphate waste, PUREX organic wash waste, REDOX ion exchange waste, coating waste, evaporator bottoms, and decontamination waste from 241-BX, 241-T, 241-TX, 241-TY, and 241-AX Tanks (WHC 1991a).

Tank 241-TY-103 has a capacity of 2,869,000 L (758,000 gal) and is carbon steel lined, with a reinforced concrete shell, dome, and base. The liner is 7.3 m (24 ft) high. The tank has a dished bottom and is covered by 1.9 m (6.25 ft) of overburden. The operating depth is 7 m (23 ft) and the diameter 22.9 m (75 ft). Associated structures include three active radiation monitoring wells, a temperature sensor, a salt well screen with jet pump, a plummet, and a liquid level gage (WHC 1991a). Tank 241-TY-103 is interim isolated and an assumed leaker.

In February 1976, overflow of the 241-TX-155 Diversion Box catch tank flowed back into Tank 241-TY-103, depositing 3.3 cm (1.3 in.) of sludge waste. Based on the liquid level decrease, approximately 11,400 L (3,000 gal) were estimated to have leaked from the tank, with an activity of 700 Ci ^{137}Cs (Hanlon 1992). Drywells showed a significant increase that was attributable to this flooding event (UPR-200-W-150). The unit was removed from service in October 1973 because two drywells, 52-03-06 and 52-03-03, had shown radiation increases, suggesting leakage from this unit or 241-TY-105 (WHC 1991a).

Hanlon 1992 indicates that the tank contains 613,200 L (162,000 gal) of sludge. In December 1991, Tank 241-TY-103 contained 28 kb mole of ferrocyanide, at a maximum temperature of 21 °C (69 °F) (Hanlon 1992).

2.3.2.38 241-TY-104 Single-Shell Tank. Tank 241-TY-104 is located in the 241-TY Tank Farm, which is approximately 730 m (2,400 ft) southwest of the 221-T Building and directly north of the 241-TX Tank Farm.

Operations began at this tank in August 1953 and were terminated in March 1974. During this time, the tank received tributyl phosphate waste and supernatant. The

supernatant contained REDOX ion-exchange waste, PUREX organic wash waste, bismuth phosphate first-cycle waste, tributyl phosphate waste, and decontamination waste from 241-TX and 241-TY Tank Farms (WHC 1991a).

Tank 241-TY-104 has a capacity of 2,869,000 L (758,000 gal) and is carbon steel lined, with a reinforced concrete shell, dome, and base. The liner is 7.3 m (24 ft) high. The tank has a dished bottom and is covered by 1.9 m (6.25 ft) of overburden. The operating depth is 7 m (23 ft) and the diameter is 22.9 m (75 ft). Associated structures include five active radiation monitoring wells, a temperature sensor, a salt well screen, and a liquid level gage (WHC 1991a). Tank 241-TY-104 is interim isolated and an assumed leaker.

This unit was removed from service when the liquid level decreased in excess of the 0.76-cm (0.30-in.) limit. In 1974, approximately 5,300 L (1,400 gal) of supernatant leaked from the tank (UPR-200-W-151). The leak consisted of REDOX ion-exchange waste, PUREX organic wash waste, bismuth phosphate first-cycle waste, tributyl phosphate waste, and decontamination waste from the 241-TX and -TY Tank Farms. The leak was noticed when the liquid level dropped more than the 0.76-cm (0.3-in.) limit. The P-10 Salt well was pumped as a cleanup effort for this unplanned release (Cramer 1987).

Hanlon 1992 indicates that the tank contains 11,400 L (3,000 gal) of supernatant and 162,800 L (43,000 gal) of sludge, for a total waste volume of 174,100 L (46,000 gal). In December 1991, Tank 241-TY-104 contained 12 kg moles of ferrocyanide at a maximum temperature of 21 °C (70 °F) (Hanlon 1992).

2.3.2.39 241-TY-105 Single-Shell Tank. Tank 241-TY-105 is located in the 241-TY Tank Farm, which is approximately 730 m (2,400 ft) southwest of the 221-T Building and directly north of the 241-TX Tank Farm. Active from January 1953 until September 1960, this tank received tributyl phosphate waste (WHC 1991a).

Tank 241-TY-105 has a capacity of 2,869,000 L (758,000 gal) and is carbon steel lined, with a reinforced concrete shell, dome, and base. The liner is 7.3 m (24 ft) high. The tank has a dished bottom and is covered by 1.9 m (6.25 ft) of overburden. The operating depth is 7 m (23 feet) and the diameter is 22.9 m (75 ft). Associated structures include one active radiation monitoring well, a temperature sensor, a jet pump with screen, and a liquid level gage (WHC 1991a). Tank 241-TY-105 is interim isolated and an assumed leaker.

Unplanned release UPR-200-W-152 is associated with this tank. In 1960 tributyl phosphate was released. Based on the liquid level decrease in the tank, the leak is estimated at 132,500 L (35,000 gal) with an activity of 4,000 Ci of ^{137}Cs (Hanlon 1992). Two drywells are associated with this unit. The radioactivity in both drywells may be the result of interstitial liquid leakage (WHC 1991a). Hanlon 1992 indicates that the tank contains 874,300 L (231,000 gal) of sludge.

2.3.2.40 241-TY-106 Single-Shell Tank. Tank 241-TY-106 is located in the 241-TY Tank Farm, which is approximately 730 m (2,400 ft) southwest of the 221-T Building and directly north of the 241-TX Tank Farm. Operations began at this unit in June 1953 and ceased in 1959. During this time, the tank received tributyl phosphate waste (WHC 1991a).

Tank 241-TY-106 has a capacity of 2,869,000 L (758,000) gal and is carbon steel lined, with a reinforced concrete shell, dome, and base. The liner is 7.3 m (24 ft) high. The tank has a dished bottom and is covered by 1.9 m (6.25 ft) of overburden. The operating depth is 7 m (23 ft) and the diameter is 22.9 m (75 ft). Associated structures include five active radiation monitoring wells, a temperature sensor, and a liquid level gage (WHC 1991a). Tank 241-TY-106 is interim isolated and an assumed leaker.

Due to unplanned release UPR-200-W-153, Tank 241-TY-106 was removed from service. The release was discovered when routine surveillance of radiation drywells indicated a change of profile in Drywell 52-06-05 (which now appears to have stabilized). The waste involved was identified as tributyl phosphate containing 2,000 Ci of ^{137}Cs. The leak volume is estimated at 75,700 L (20,000 gal) based on the liquid level decrease in the tank (Hanlon 1992). The tank was stabilized with diatomaceous earth in 1969 (Cramer 1987).

The December 1991 Tank Farm Surveillance Report (Hanlon 1992) indicates that Tank 241-TY-106 contains 64,300 L (17,000 gal) of sludge.

2.3.2.41 241-T-361 Settling Tank. This inactive tank is located about 213.5 m (700 ft) southwest of the 221-T Building. The 241-T-361 Settling Tank received radioactive contaminated liquid from T Plant processes and is now estimated to hold 105,980 L (28,000 gal) of sludge containing approximately 2 kg (4.4 lb) of plutonium (15,500 Ci beta/gamma). This unit was isolated in 1985 (Cramer 1987). The settling tank is enclosed within a light chain boundary and is posted with surface and underground contamination warning signs, as observed during a site visit in September 1991.

2.3.2.42 244-TX Receiver Tank. This active double contained receiver tank receives waste from the T Farm, TX Farm, TY Farm, and Z Plant. In September 1991, this tank contained 98,480 L (26,019 gal) of waste (Hanlon 1992). No Information was found to indicate that this tank has released any waste to soil.

2.3.2.43 Catch Tank 241-T-301. This inactive tank is located east of the 241-T-252 Diversion Box, south of the 241-T-112 Tank. It collects overflow from the 241-T-252 and the 241-T-151 Diversion Boxes. The catch tank is surrounded by a chain-link fence and is marked by a metal post with a plaque, as observed during a site visit in September 1991.

2.3.2.44 Catch Tank 241-T-302. This inactive catch tank is located adjacent to the 241-T-152 Diversion Box, from which it is designed to accept any overflow. The catch tank is surrounded by a chain-link fence and is marked by a metal post with a plaque, as observed during a site visit in September 1991.

2.3.2.45 Catch Tank 241-TX-302A. This tank is located approximately 15.3 m (50 ft) south of Diversion Box 241-TX-153, inside the barricade for the 241-TX Tank Farm. During its period of operation (1949-1982), the tank was used to accept any overflow of solutions from processing and decontamination operations (WHC 1991a). The unit is connected to Diversion Box 241-TX-153. The site is currently not marked or posted, as observed during a site visit in September 1991.

2.3.2.46 Catch Tank 241-TX-302B. This tank was active from 1949 to 1982 and accepts overflow from the 241-TX-155 Diversion Box. The tank is enclosed within the light chain boundary surrounding 241-TX-155 and is marked by surface contamination warning signs and three yellow pipes, as observed during a site visit in September 1991. Two pipes are stubbed 0.31 m (1 ft) above the ground; one pipe is equipped with a fluid level recorder. Unplanned release UPR-200-W-131 is associated with this site (see Section 2.3.10).

2.3.2.47 Catch Tank 241-TX-302C. The 241-TX-302C Catch Tank is an active waste site located just east of the 221-T Building. This unit is used to accept overflow of radioactive waste solutions resulting from processing and decontamination operations (Cramer 1987). The tank currently holds 9,652 L (2,550 gal) of liquid waste and is associated with the 241-TX-154 Diversion Box and the 241-TX Tank Farm (WHC 1991a). Two unplanned releases, UPR-200-W-21 and UPR-200-W-160, are associated with this site. These releases are addressed in Section 2.3.10 and summarized below.

The UPR-200-W-21 release occurred in July 1953 and consisted of a cave-in over a process line near the 241-TX-154 Diversion Box. This cave-in resulted in contamination of a large area between the 221-T and 222-T Buildings; reported dose rates were 25 R/hour. A jumper leak in the 241-TX-154 Diversion Box in turn caused the 214-TX-302C Catch Tank to overflow (Maxfield 1979). The area was covered with blacktop and posted with underground contamination warning signs (Stenner et al. 1988).

The UPR-200-W-160 release occurred on December 30, 1955 when several thousand gallons of metal waste and rainwater were released due to failure of an underground transfer line from the 241-TX-302C Catch Tank to the 241-U-101 metal waste storage tank (Maxfield 1979). The liquid was forced through several feet of soil onto the surface surrounding the 241-TX-302 Catch Tank, between buildings 221-T and 222-T, and including the area within the double fences of the 224-T Building. The area was backfilled and sprayed with tar and posted as a radiation zone (WHC 1991a).

2.3.2.48 Catch Tank 241-TY-302A. Catch tank 241-TY-302A is located approximately 19.2 m (63 ft) north of Diversion Box 241-TY-153, inside the chain-link fence barrier of the TY Tank Farm. During its period of operation (1953-1988), this unit was used to accept overflow of waste solutions from processing and decontamination operations. The tank is associated with Diversion Box 241-TY-153 and the TY Tank Farm, and has been isolated and stabilized with a spray covering to prevent infiltration of precipitation. The catch tank is surrounded by a chain-link fence and posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.2.49 Catch Tank 241-TY-302B. The 241-TY-302B Tank is located approximately 51.9 m (170 ft) east of Tank 241-TY-101. Like 241-TY-302A, this tank was used to accept overflow of waste solutions from processing and decontamination operations, and is connected to Diversion Box 241-T-151 and the TY encasements. The unit has been isolated and stabilized with a spray covering to prevent infiltration of precipitation. The tank currently has no barrier and is not marked or posted, as observed during a site visit in September 1991.

2.3.3 Cribs and Drains

The cribs and drains were all designed to inject or percolate wastewater into the ground without exposing it to the open air. The locations of cribs and drains in the aggregate area are shown in Figure 2-5. French drains and reverse wells inject wastewater into the ground at a greater depth than the cribs. They are generally constructed of steel or concrete pipe and may either be open or filled with gravel. A typical french drain is illustrated in Figure 2-6. Cribs are shallow excavations that are either backfilled with permeable material or held open by wood structures. Both types of cribs are covered with an impermeable layer. Water flows directly into the backfilled material or covered open space and percolates into the vadose zone soils. A typical crib is illustrated in Figure 2-7. The T Plant Aggregate Area contains 15 cribs and one French drain.

The cribs and drains typically received low-level waste for disposal. The following sections describe each crib and drain in the T Plant Aggregate Area individually.

2.3.3.1 216-T-6 Crib. This crib is actually a pair of cribs (216-T-6-1 and 216-T-6-2) located about 46 m (150 ft) north of 23rd Street and 380 m (1,250) ft west of the 224-T Building, just west of the 216-T-3 Reverse Well. The cribs are marked by two 4.3 x 4.3 m (14 x 14 ft) light chain barricades enclosed within a 61 x 24 m (200 x 80 ft) barricade. The barricades are labelled with cave-in potential, and underground and surface radiation warning signs, as observed during a site visit in September 1991.

The two cribs were built in August 1946 and were active until June 1951 (WHC 1991a). [Maxfield (1979) cites an operational period of 8/46 through 10/47.] During this period, the cribs received 4.5×10^7 L (1.19×10^7 gal) of waste (WHC 1991a). Each wooden crib is 4.3 x 4.3 m (14 x 14 ft), and 19 m (62 ft) apart, with the liquid release point 4.9 m (16 ft) below grade. Crib 216-T-6-1 was designed such that any overflow would discharge into Crib 216-T-6-2.

This crib pair received primarily cell drainage from Building 221-T (Tank 5-6). This unit also received waste from Building 224-T via the overflow from the 241-T-361 Settling Tank. After the 241-T-361 Settling Tank was deactivated, the 224-T Building effluent was rerouted to the 216-T-32 Crib in October 1946. The cribs were deactivated by blanking the pipe south of the 241-T-361 Settling Tank and re-routing 221-T Cell drainage to Crib 16-T-7 (WHC 1991a).

2.3.3.2 216-T-7-TF Crib and Tile Field. This crib and tile field are located 15.2 m (50 ft) north of 23rd Street and 305 m (1,000 ft) west of the 207-T Retention Basin. The crib is located within the 241-T Tank Farm chain link fence barricade. The tile field is located outside the tank farm fence and is surrounded by a light chain fence extending west from the tank farm (WHC 1991a). The fence is labelled with both underground and surface contamination signs, as observed during a site visit in September 1991.

The 216-T-7-TF Crib operated between April 1948 and November 1955. During this period, the unit received second-cycle supernatant and cell drainage from Building 221-T. From June 1952 to November 1955, this crib also received waste from Building 224-T after sludge buildup in Tanks 201 through 204-T resulted in the closing of Crib 216-T-32. The site was deactivated by capping the pipeline to the crib and re-routing the effluent to the 216-T-19 Crib (WHC 1991a). During its period of operation, the 216-T-7-TF Crib and tile field received 1.10×10^8 L (2.91×10^7) of waste containing 5.18×10^6 kg (1.14×10^7 lb) of inorganic compounds. The site was deactivated in 1955 when it reached the prescribed radionuclide disposal guide limit.

2.3.3.3 216-T-8 Crib. The 216-T-8 Crib is an inactive waste site located 15 m (50 ft) south of the 222-T Building. The crib is surrounded by a light chain barricade and posted with cave-in potential, and underground and surface radiation warning signs, as observed during a site visit in September 1991.

The 216-T-8 Crib site operated between May 1950 and September 1951. During that time it received 5×10^5 L (1.32×10^5 gal) of decontamination sink and sample slurper wastes from Building 222-T laboratory processes (Stenner et al. 1988). When laboratory operations were terminated, the pipeline from the crib to the building was blanked (WHC 1991a).

2.3.3.4 216-T-18 Crib. This crib is located 152.4 m (500 ft) south of 23rd Street, 76.2 m (250 ft) east of Camden Avenue, and north of the 216-T-26, -27 and -28 Crib series (WHC 1991a). Crib 216-T-18 operated from December 8 through December 21, 1953; during that time it received 1×10^6 L (2.64×10^5 gal) of Building 221-T first-cycle scavenged tributyl phosphate supernatant wastes. This waste stream included 194,000 kg (428,000 lb) of inorganic compounds. The aboveground piping was removed and the unit backfilled at completion of waste discharge. The crib area was stabilized in May 1990. The crib is enclosed within a light chain barricade with underground contamination placards, as observed during a site visit in September 1991.

2.3.3.5 216-T-19-TF Crib and Tile Field. One of the larger cribs at T Plant, this unit is located south of the 241-TX Tank Farm, 12.2 m (40 ft) west of Camden Avenue (WHC 1991a). The crib and tile field are enclosed within a light chain barricade; the crib is enclosed within a second, inner light chain barricade. The site is posted with a sign indicating the potential for underground radioactive material. The small cave-in potential area is posted with surface contamination warning signs, as observed during a site visit in September 1991.

The 216-T-19-TF Crib/Tile Field was used for disposal of liquid wastes from 1951 to 1980, the longest operational period of any T Plant crib. During this period, there were brief (4-5 month) periods of inactivity due to temporary shutdowns of the 242-T Waste Evaporator and/or T Plant operations. In total, this crib received 4.55 x 10^8 L (1.2 x 10^8 gal) of liquid waste. A cave-in occurred in 1956, resulting in abandonment of the crib until 1965 (WHC 1991a). After the cave-in, a bypass waste line directed to the tile field was installed. Piping to this crib was routed through Diversion Box 241-TX-153 and Catch Tanks 241-TX-302A and 241-TX-302B (WHC 1991a). The line to the tile field was blanked in 1980.

2.3.3.6 216-T-26 Crib. The 216-T-26 Crib is the northernmost crib of the 216-T-26, -27 and -28 Crib series. It is located 61 m (200 ft) north of 22nd Street, east of the 241-TY Tank Farm (WHC 1991a). Cribs 216-T-26 through 28 are currently fenced within a light chain barricade with underground contamination warning placards, as observed during a site visit in September 1991. A flush tank is located in the northeast corner of the compound. Two small concrete pads, possibly truck unloading facilities, are located east of the barricaded area. This consists of a 36 cm (14 in.) steel inlet pipe reducing to a 25.4 cm (10 in.) steel pipe, 2.7 m (9 ft) below grade. This second pipe branches to four 20.3 cm (8 in.) steel pipes, each one extending to a 1.2 x 1.2 m (4 x 4 ft) long diameter concrete open-end sewer pipe. This piping lies in a 9.1 x 9.1 m (30 x 30 ft) concrete structure. A gravel fill of approximately 2.4 m (8 ft) is covered by 2.4 m (8 ft) of earth backfill.

This crib operated between August 1955 and November 1956. During that period, it received first cycle scavenged tributyl phosphate supernatant T Plant wastes (WHC 1992b, Stenner et al. 1988). Chemical additives were apparently used to settle the ^{137}Cs. The waste was first routed through the 241-TY-101, -103 and -104 SSTs (WHC 1992b, WHC 1991a). Crib 216-T-26 received 1.2 x 10^7 L (3.17 x 10^6 gal) of liquid mixed waste, including 2.37 x 10^6 kg (5.22 x 10^6 lb) of iron cyanide and other inorganic compounds. This site was deactivated in 1956 by blanking the line leading to the 216-T-26 and -28 Cribs, between the 241-TY Tank Farm and the roadway.

Previous radiation surveys indicated localized surface contamination at this crib site, including the presence of strontium and cesium in vegetation. A survey conducted in May 1975 revealed surface contamination as high as 30,000 ct/min (WHC 1991a). A remedial action followed, which consisted of blading off the top 15.2 cm (6 in.) of soil and replacing the excavated material with clean fill to the original grade. The excavated soil was then transferred to the 200 West Area dry waste burial grounds for ultimate disposal. The 216-T-26 Crib site was surface stabilized on May 21, 1990.

2.3.3.7 216-T-27 Crib. This crib is located midway between Cribs 216-T-26 and 216-T-28 (within the same radiation zone), 76.2 m (250 ft) north of 22nd Street and 61 m (200 ft) east of Camden Avenue (Maxfield 1979). Like 216-T-26, Crib 216-T-27 was constructed of steel pipes leading to a vertical, open-ended sewer pipe, but the piping is 2.4 m (8 ft) below grade and has an earthen backfill of 2.1 m (7 ft) (WHC 1991a).

Crib 216-T-27 operated for just over one month, from September through November 1965. During this period, it received 300 Area laboratory wastes from the PNL 340 Facility, via tank truck, and wastes from the 221-T Building via the 241-T-111 and -112 SSTs (WHC 1991a). Crib 216-T-27 received 7.19 x 10.6 L (1.9 x 10^6 gal) of liquid containing 1,000 kg (2,203 lb) of nitrate. The unit was removed from operation when the radionuclide disposal limit was reached.

Diversion of wastes to this crib was initiated following breakthrough of strontium and cesium to the groundwater under Crib 216-T-28. The PNL wastes routed to this crib consisted of material generated during a period when a sudden increase (four orders of magnitude) in radionuclide activity of PNL wastes occurred. Each time waste was pumped to the 216-T-27 Crib, groundwater samples taken near the 216-T-28 Crib increased in radioactivity. Given documented surface contamination at this site (strontium and cesium), stabilization and remediation was performed in 1975 concomitant with the 216-T-26 stabilization activities. The crib is enclosed within a light chain boundary and is posted with underground contamination warning signs, as observed during a site visit in September 1991.

2.3.3.8 216-T-28 Crib. This crib, the southernmost of the 216-T-26,-27 and -28 Crib series, is located 91.4 m (300 ft) north of 22nd Street and 61 m (200 ft) east of Camden Avenue. Crib 216-T-28 is constructed identically to Crib 216-T-27.

The 216-T-28 Crib was active for six years, from February 1960 until February 1966 (WHC 1991a). [Maxfield (1979) cites February 1966.] During that time, it received 4.23 x 10^7 L (1.12 x 10^7 gal) of liquid mixed waste including 1,000 kg (2,203 lb) of nitrate. Waste constituents included: steam condensate decontamination waste, miscellaneous effluent from the 221-T Building, decontamination waste from the 2706-T Building, and 300 Area lab waste from the 340 Building.

The crib was deactivated when the prescribed radionuclide disposal limit was reached. Deactivation consisted of blanking the pipeline to the 216-T-26 through 216-T-28 (Crib) series and the riser for 300 Area laboratory wastes. Due to radionuclide contamination of nearby surface vegetation, stabilization and surface remediation were performed in 1975 along with stabilization activities at cribs 216-T-26 and 216-T-27 (WHC 1991a). The crib is enclosed within a light chain barricade and is marked with underground contamination warning signs, as observed during a site visit in September 1991.

2.3.3.9 216-T-29 Crib. The 216-T-29 Crib is an inactive waste site located approximately 58 m (190 ft) east of the 221-T Building and 29 m (95 ft) west of Beloit Avenue (Maxfield 1979). This crib is constructed of 60 vitrified soil pipes (french drains), 15.2 cm (6 in.) in diameter, in a 30.5 x 14.6 m (100 x 48 ft) area. This unit operated between 1949 and 1964 and during that time received a total of 7.4 x 10^4 L (1.96 x 10^4 gal) of condensate runoff from the 291-T Sand Filter. This waste is considered potentially acidic given the presence of nitric acid (Stenner et al. 1988; Cramer 1987).

The crib site was deactivated when the sand filter bypass water seal was removed, allowing the 221-T Building exhaust air to flow directly to the 291-T-1 Stack (WHC 1991a). The sand filter is cordoned off with a light chain barricade and posted with surface contamination warning signs, as observed during a site visit in September 1991. The seams on top of the filter have been coated with plastic and sealed.

2.3.3.10 216-T-31 French Drain. According to WIDS, this drain is a registered underground injection well located inside the 241-TX Tank Farm fence, 24.4 m (80 ft) west of Camden Avenue and 908.3 m (2,980 ft) southwest of the 221-T Building (WHC 1991a). This unit was contaminated by steam condensate from a steam line blowout during efforts to unplug a waste line in October 1959. The drain was replaced in 1959; contaminated gravel and soil were removed and buried in the 200 West Area Dry Burial Ground. The site was released from radiation zone status in February 1962. The french drain is surrounded by a chain-link fence and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.3.11 216-T-32 Crib. The 216-T-32 Crib is located 6.2 m (250 ft) north of 23rd Street and 228.6 m (750 ft) west of the 207-T Retention Basin within the confines of the 241-T Tank Farm (WHC 1991a). It consists of two wooden sumps placed 12.2 m (40 ft) apart (Maxfield 1979). The cribs were fed by a single line leading from Tank 201-T; the site was deactivated in May 1952 by blanking this line.

This crib site operated between November 1946 and May 1952. During that time, it received waste from the 224-T Building via Tank 241-T-201. Crib 216-T-32 received 2.9 x 10^7 L (7.66 x 10^6 gal) of TRU-contaminated liquid waste containing 2.62 x 10^6 kg (5.77 x 10^6 lb) of inorganic compounds (WHC 1991a). The crib is surrounded by a light chain barricade, as observed during a site visit in September 1991.

2.3.3.12 216-T-33 Crib. The 216-T-33 Crib is an inactive waste site located approximately 76.2 m (250 ft) west of the 2706-T Building and 274.3 m (900 ft) north of 23rd Street. This unit operated for approximately one month, between January and February 1963. Its use was terminated when perforations in the tile line at the discharge point to the unit became plugged. Sections of the tile line were removed and the building effluent was rerouted to the 216-T-28 Crib via the 241-T-112 Tank in the 241-T Tank Farm (WHC 1991a).

During its brief period of operation, Crib 216-T-33 apparently received 1.9 x 10^6 L (5.02 x 10^5 gal) of decontamination waste from Building 2706-T. This waste stream consisted primarily of sodium hydroxide (Cramer 1987). However, the amount of liquid that actually reached the crib has been questioned by plant personnel who suspected that the line to the unit retained all of the waste. No surface contamination has been found at this crib site (Maxfield 1979, Environmental Protection files). The crib is surrounded by a light chain barricade and posted with underground contamination warning signs, as observed during a site visit in September 1991.

2.3.3.13 216-T-34 Crib. The 216-T-34 Crib is an inactive waste site located about 457 m (1,500 ft) north of 23rd Street and 457 m (1,500 ft) west of Beloit Avenue (Stenner et al. 1988). The crib operated between May 1966 and March 1967 and during that time received 1.73×10^7 L (4.57×10^6 gal) of 300 Area laboratory waste from the 340 facility. The pipelines northwest of the unit were capped when the unit reached its prescribed radionuclide disposal guide limit and the discharge lines rerouted to the 216-T-35 Crib (WHC 1991a).

During the construction and tie-in of the 216-T-35 Companion Crib in February 1967 (see Section 2.3.3.14), low-level beta/gamma soil contamination ranging to 30,000 ct/min was measured around the 216-T-34 unloading station piping (Maxfield 1979). Forty cubic yards of contaminated soil were removed and buried in the 200 West Area Burial Ground. The site surface was stabilized in July 1990 (Huckfeldt 1990). The crib is surrounded by a light chain barricade and posted with underground contamination warning signs, as observed during a site visit in September 1991.

2.3.3.14 216-T-35 Crib. The 216-T-35 Crib is an inactive waste site located 463 m (1,520 ft) northwest of the 221-T Building and 417 m (1,368 ft) north of 23rd Street. This unit, which operated between March 1967 and January 1968, received 5.72×10^6 L (1.51×10^6 gal) of 300 Area laboratory waste from Building 340 (Stenner et al. 1988). Low-level subsurface contamination of a small area near the unloading station has been reported but surface contamination has not been documented (Fecht et al. 1977). The surface of the 216-T-35 Crib site was stabilized in July 1990 (Huckfeldt 1990). The crib is surrounded by a light chain barricade and posted with underground contamination warning signs, as observed during a site visit in September 1991.

2.3.3.15 216-T-36 Crib. This crib is located 12.2 m (40 ft) south of 23rd Street and northwest of the 241-TY Tank Farm. Crib 216-T-36 operated between May 1967 and February 1968 and during that time received 5.22×10^5 L (1.38×10^5 gal) of steam condensate, decontamination, and miscellaneous waste from buildings 221-T and 221-U (WHC 1991a). The crib is marked by a light chain barricade with surface and underground contamination placards, as observed during a site visit in September 1991. Two vent pipes are located at the west end of the crib.

2.3.3.16 216-W-LWC Crib. Located about 76.2 m (250 ft) southeast of the 2724-W Building, 216-W-LWC is the only active crib unit within the T Plant Aggregate Area. It receives only low-level liquid waste. Since the unit began operating in 1981, Crib 216-W-LWC has received 1.2×10^9 L (3.17×10^8 gal) of process wastewater from Buildings 2724-W and 2723-W (Brown et. al. 1990). The crib contains three distribution lines marked by regularly spaced polyvinyl chloride (PVC) risers. Several vertical culvert-like steel pipes with ladder extensions are located at the west end of the crib. The crib is surrounded by a light chain barricade and posted with underground contamination warning signs, as observed during a site visit in September 1991.

2.3.4 Reverse Wells

Reverse wells are buried or covered encased drilled holes with the lower end perforated or open to allow liquid to seep to the vadose zone. These units injected wastewater into the vadose soil at depths greater than the cribs and french drains described in the previous section. Reverse wells are generally constructed of steel or concrete pipe and may either be open or filled with gravel.

Reverse wells were used for the disposal of low-level liquid wastes in the early phases of Hanford Site (including T Plant) operations, but proved unsatisfactory because they plugged easily and introduced the waste into the vadose soil at or near the water table (Brown and Ruppert 1950). Therefore, by 1954, all reverse wells at the Hanford Site had been removed from service; associated wastes were re-routed to cribs and other types of ground disposal units (Fecht et al. 1977).

Two reverse wells, 216-T-2 and 216-T-3 are located in the aggregate area as shown on Figure 2-5. These units are described below.

2.3.4.1 216-T-2 Reverse Well. The 216-T-2 Reverse Well is an inactive waste site located within 4.6 m (15 ft) of the southwest corner of the 222-T Building (Maxfield 1979). The unit is a registered underground injection well that operated from 1945 to 1950. During that period, the well received 6 x 10^6 L (1.59 x 10^6 gal) of decontamination sink waste and sample slurper waste from the 222-T Building (Stenner et al. 1988; DOE 1988). The pipeline is blanked at the well, which has been sprayed with concrete. The reverse well is marked with underground contamination warning signs, as observed during a site visit in September 1991.

2.3.4.2 216-T-3 Reverse Well. The 216-T-3 Reverse Well is an inactive waste site located 45.7 m (150 ft) north of 23rd Street between the 241-T-361 Settling Tank and the 216-T-6 site (Maxfield 1979, Stenner et al. 1988). It operated for only one year (1945-1946). This well received 11.3 x 10^7 L (2.99 x 10^7 gal) of cell drainage from Building 221-T (via Tank 5-6), as well as overflow from the 241-T-361 Settling Tank containing 224-T Building wastes.

The 216-T-3 Reverse Well consists of a 2-ft high, stubbed steel pipe with a gauge at the tap. The reverse well is 62.8 m (206 ft) deep with a diameter of .25 m (10 in). In August 1975, the aboveground piping was removed, all sinkholes filled, and the ground surface decontaminated and leveled (Maxfield 1979). A light chain barricade surrounds the well, which is posted with surface and underground contamination signs, as observed during a site visit in September 1991.

2.3.5 Ponds, Ditches and Trenches

The ponds, ditches and trenches in the aggregate area were designed to percolate wastewater into the soil column. These units are shown on Figure 2-8. The 216-T-4(A/B) Pond was at the center of this disposal system and was fed by ditches that originated at the various waste generation facilities. In this report, the 216-T-4 Pond and the ditches which transferred wastewater to it are collectively called the 216-T-4 Pond System. Generally, low-level liquid waste was disposed of into the pond system, and no attempt was made to isolate the waste water from the open air. The following sections describe the 216-T-4 Pond and its associated ditches. Trenches and the 200-W-PP Powerhouse Pond are also described.

Table 2-1 lists salient features of each disposal facility. Tables 2-4 and 2-5 summarize waste quantities received by each unit for radionuclide and chemical wastes, respectively.

2.3.5.1 216-T-4 Pond System. This pond system includes one pond (216-T-4A/4B) and three ditches as shown on Figure 2-8. These units were designed to percolate wastewater or effluent into the soil column.

Ponds are bodies of water enclosed in a natural or diked surface depression used for the disposal of high-volume, low-level liquid effluent and designed to promote percolation of the liquid effluent. As the liquid infiltrated into the ground, many of the radionuclides were absorbed and concentrated by the upper soil layer. Pond bottoms were covered with clean soil and stabilized after deactivation to prevent the dispersal of radionuclides by wind erosion (Stenner et al. 1988).

Ditches are long, narrow, unlined excavations that percolate effluent into the soil column. Ditches were used for conveying large volumes of liquid to a pond. Both ponds are surrounded by a light chain barricade with surface and contamination warning signs, as observed during a site visit in September 1991.

2.3.5.1.1 Pond 216-T-4A. This L-shaped shallow pond covers 0.064 km^2 (0.025 mi^2.) and is located in the northwest corner of the aggregate area (WHC 1991a).

The pond received 4.25 x 10^{10} L (1.12 x 10^{10} gal) of liquid between November 1944 and May 1972, before it was backfilled. A number of leaks in the 221-T Building resulted in the historical release of radionuclide contamination to this pond. Radiation readings taken along the shoreline after the shutdown of 221-T ranged from 2,000 to 15,000 ct/min (WHC 1991a). The unit was stabilized in 1972 by backfilling. In 1973, 15 to 23 cm (6 to 9 in.) of soil were removed from the entire bottom surface of the unit and placed in the 218-W-2A Burial Ground. The pond was then covered with clean soil. In 1975, the bottom of the pond was seeded with grass to stabilize the soil.

2.3.5.1.2 Pond 216-T-4B. This pond was constructed in 1972, 61 m (200 ft) east of the older T-4A Pond. Though considered active, the pond has not received effluents for many years. According to WIDS, the 216-T-4B Pond is an 1.5-acre site

(536 m [1760 ft] long and 2.4 m [8 ft] wide) ranging from 0.9 to 1.8 m (3 to 6 ft) deep. The pond is fed by the 216-T-4-2 Ditch. It is separated from Pond 216-T-4A by an earthen dike 396.2 m (1,300 ft) long with an average height of 0.5 m (1.5 ft). The pond is designed to receive steam condensate and condenser cooling water from the 242-T Evaporator and nonradioactive wastewater from Building 221-T air conditioning filter units and floor drains. However, flow into the ditch is currently low, and liquid does not reach the pond. The pond has been considered dry since 1977.

The site contains 24,000 m^3 (31,000 yd^3) of contaminated soil. The radionuclide inventories for 216-T-4A and 4B are reported together as one site under the designation of 216-T-4 (WHC 1991a).

2.3.5.1.3 Ditch 216-T-1. This is an active site. The headwall is located approximately 24.4 m (80 ft) north of the 221-T Building. The ditch is 556 x .9 m (1,825 x 3 ft), with a depth of 3.3 m (10 ft). The ditch is fed by two below-grade pipes that discharge at the headwall. From November 1944 until June 1956 (Maxfield 1979 states January 1964), the ditch received miscellaneous waste from pilot plant experimental work, intermittent decontamination waste, and waste from the head end of Building 221-T. Production operations at Building 221-T were shut down in 1956 and the ditch remained inactive from June 1956 through January 1964 after which it started receiving cooling water from the blowdown vessel in Building 221-T and miscellaneous waste from PNL head end operations in Building 221-T (WHC 1991a). Since June 1970 the site has been receiving the condensate from steam-heated radiators at the head end of 221-T (WHC 1991a). This ditch currently receives 1 to 2 gal/min from the T Plant head-end and wets probably not more than 3.1 to 4.6 m (10 to 15 ft) of the ditch (judging by the amount of vegetation growing through tumbleweeds in the ditch).

Since 1977, the site had received nonradioactive sodium hydroxide wastewater solution (less than 3,800 L/month [1,000 gal/month]) from Hanford Environmental Development Laboratory (HEDL). However, laboratory activities have been suspended and there are currently no sodium hydroxide waste solutions discharged. Thick growth of surface vegetation in the ditch is considered to prevent the contaminated soil along the bottom of the ditch from becoming airborne (Maxfield 1979).

The ditch is currently barricaded by a light chain and surface contamination markings were posted (see Appendix A). The bottom of the ditch was covered with Russian thistle and the banks were heavily vegetated. The ditch is currently enclosed within a light chain boundary and is marked with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.5.1.4 Ditch 216-T-4-1D. The ditch begins 231.6 m (760 ft) north of 23rd Street, 741.3 m (2,432 ft) west of the 221-T Building at a headwall and 182.9 m (600 ft) northwest of the 207-T Retention Basin. The dimensions are about 259 x 2.4 x 1.2 m (850 x 8 x 4 ft) deep (WHC 1991a). This ditch was active from November 1944 until May 1972 when Ditch

216-T-4-2 replaced it. The ditch conveyed wastewater from 221-T and the 207-T Retention Basin to the 216-T-4 pond (Maxfield 1979).

The site received 4.19 x 10^{10} L (1.11 x 10^{10} gal) of process cooling water and steam condensate from 221-T and 242-T Waste Evaporator (Maxfield 1979). Until September 1951, it received process cooling water from Buildings 221-T and 224-T via the 207-T Retention Basin, and steam condensate from 221-T. From September 1951 until July 1955, it also received condenser cooling water and steam condensate from the 242-T Evaporator. From July 1955 until August 1956 the site received the same type of waste as before September 1951. From August 1956 until June 1957 the site received steam condensate from 221-T Building. The unit was on standby from June 1957 to July 1964. From July 1964 until December 1965 it carried decontamination waste from 2706-T and condenser cooling water from Building 242-T. From November 1970 to its closure in May 1972, it only carried cooling water from the 242-T Building (WHC 1991a).

The bottom of the ditch was contaminated to a maximum of 20,000 ct/min, and was greatly overgrown with plants and trees. The berm from the replacement 216-T-4-2 Ditch was used to cover this ditch. The total plutonium present in the ditch is estimated to be 1.41 g (3.1 x 10^{-3} lb) (WHC 1991a). At the present time the ditch extends only to the railroad tracks. It is approximately 9.1 m (30 ft) wide and has brush and cattails growing in it. The ditch is surrounded by a light chain barricade and is posted with surface contamination warning signs as observed during a site visit in September 1991.

2.3.5.1.5 Ditch 216-T-4-2. This ditch was constructed to replace the 216-T-4-1D Ditch. It begins at the outfall of the pipe from the 207-T Retention Basin, which is approximately 182.9 m (600 ft) northwest of the basin. The first 15.2 m (50 ft) of this ditch is common with the older 216-T-4-1 Ditch (WHC 1991a). The ditch was constructed in May 1972, and is still active. The ditch is about 533 x 2.4 x 1.2 m (1,750 x 8 x 4 ft) deep, and receives both steam condensate and condenser cooling water from the 242-T Evaporator and nonradioactive wastewater from the 221-T air conditioning filter units, steam condensate, compressor cooling water discharge, and floor drains. A radiation survey conducted in January 1978 showed the ditch to be free of radioactivity except for the first 15.2 m (50 ft), the portion that coincided with the old ditch. This ditch is rarely wet for more than 91.4 m (300 ft) of its length. The ditch is surrounded by a light chain barricade and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.5.2 200-W PP Powerhouse Pond. This active site is located 18.3 m (60 ft) south of Diversion Box 241-TX-155. Water treatment and steam production wastes are received by the pond. The powerhouse effluent consists mainly of cooling water, basin flush water, water softener backflush, and boiler blowdown (WHC 1991a). The pond is comprised of two 61 x 15.2 x 4.6 m (200 x 50 x 15 ft) rectangular basins separated by a narrow concrete channel. The slopes are stabilized with cobbles; little standing water is present in the basins. Four pipes open at the north headwall discharge approximately 37.9 L/min (10 gal/min) into the north basin. In September, the pond was cleaned with a crane and the spoil dumped on

the northwest side, near the 241-TX-155 and -152 Diversion Boxes. The site is currently not marked or posted.

2.3.5.3 Trenches. Trenches are long, narrow, unlined shallow excavations, usually about 3 m (10 ft) deep. Trenches were used for the disposal of limited quantities of liquid and/or solid (sludge) wastes and were backfilled after use (WHC 1991a). The T Plant Aggregate Area includes 16 trenches, described below.

2.3.5.3.1 Trench 216-T-5. This site is located 91.4 m (300 ft) north of 23rd Street and 305 m (1,000 ft) west of the 207-T Retention Basin. The trench is west of Crib 216-T-32 and north of the 216-T-7 Crib and Tile Field (WHC 1991a). The trench is 15.2 x 3 x 3.7 m (50 x 10 x 12 ft). It is enclosed within two series of light chain barricades that also enclose the 216-T-7TF Tile Field, as observed during a site visit in September 1991.

In 1955, this trench received a total of 2.6 x 10^6 L (6.87 x 10^5 gal) of second-cycle supernatant waste from the 221-T Building via the 241-T-112 Tank. The waste includes 3.45 x 10^5 kg (7.6 x 10^5 lb) of inorganic compounds (WHC 1991a). The trench is a specific retention trench, and was taken out of service shortly after operations began (less than one month) when the prescribed liquid waste volume was attained. When deactivated, the aboveground piping was removed and the trench was backfilled.

2.3.5.3.2 Trenches 216-T-9, 216-T-10 and 216-T-11. These trenches are inactive waste sites located about 186 m (610 ft) west of the 221-T Building (Maxfield 1979). These trenches are 15.2 x 3 x 1.8 m (50 x 10 x 6 ft). From 1951 to 1954, these trenches received heavy equipment and vehicle decontamination waste. In 1954, the trenches were backfilled and decontamination operations were transferred to 216-T-13. The sites were exhumed in May 1972 and released from radiation zone status. No radionuclide or chemical contamination has been documented for these trench sites. These trenches are not currently marked or posted, as observed during a site visit in September 1991.

2.3.5.3.3 Trench 216-T-12. The 216-T-12 Trench is an inactive waste site located about 91.4 m (300 ft) north of 23rd Street and 548.6 m (1,800 ft) west of Building 224-T (Maxfield 1979). This trench is 4.6 x 3 x 2.4 m (15 x 10 x 8 ft). The unit operated for less than one month in 1954. During that time, it received 5 x 10^6 L (1.32 x 10^6 gal) of contaminated sludge from the 207-T Retention Basin (Stenner et al. 1988). The site was deactivated upon completion of the retention basin sludge removal efforts, and backfilled with clean soil (Maxfield 1979). This trench is enclosed within a light chain barricade that surrounds the 207-T Retention Basin and Trenches 216-T-14 through -17; its location is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.5.3.4 Trench 216-T-13. The 216-T-13 Trench received an unknown volume of liquid mixed waste from vehicle decontamination between June 1954 and June 1964. Trench dimensions were 6.1 x 6.1 x 24.4 m (20 x 20 x 80 ft). The trench is located 853.4 m (2,800

ft) southwest of the 221-T Building and 69.5 m (228 ft) south of 23rd Street, approximately 45.7 m (150 ft) north of the 241-T Tank Farm (WHC 1991a). This trench site was excavated in April 1972; 3 m^3 (4 yd^3) of soil were then buried in the 200 West Area Dry Waste Burial Ground. This trench is not currently marked or posted, as observed during a site visit in September 1991.

2.3.5.3.5 Trenches 216-T-14, 216-T-15, 216-T-16 and 216-T-17. These trenches are inactive waste sites located approximately 610 m (2,000 ft) west of Building 224-T and 45.7 m (150 ft) north of the 207-T Retention Basin (Maxfield 1979). These trenches are 83.8 x 3 x 3 m (275 x 10 x 10 ft) and all received first cycle supernatant waste from the 221-T Building via 241-T Tank Farm tanks (-104, -105 and -106). Trenches -14, -15 and -16 each received 10^6 L (2.64 x 10^5 gal) of liquid wastes; Trench 216-T-17 received 7.85 x 10^5 L (2.07 x 10^5 gal) of the first cycle supernatant waste from Building 221-T via the 241-T-104, -105, and -106 tanks in the 241-T Tank Farm.

These trenches operated for less than one year in 1954. The sites were deactivated after they reached the prescribed liquid waste volume for the specific retention trench. The aboveground piping was removed and the units backfilled (Maxfield 1979). The trenches are enclosed within a light chain barricade and identified by labelled concrete posts. Surface contamination warning signs and plastic radiation flags are posted in an area approximately 61 m (200 ft) east of the trenches across the railroad tracks, as observed during a site visit in September 1991.

2.3.5.3.6 Trench 216-T-20. This trench is located 228.6 m (750 ft) east of Camden Avenue and 228.6 m (750 ft) south of 22nd Street. This trench is 3 x 3 x 1.2 m (10 x 10 x 4 ft). It was excavated in November 1952 to receive contaminated nitric acid from the 241-TX-155 Diversion Box catch tank. It was deactivated the same month by backfilling and removing the aboveground piping. While active, this trench received 1.89 x 10^4 L (4.99 x 10^3 gal) of contaminated nitric acid containing 1,500 kg (3,304 lb) of nitrate (WHC 1991a).

One additional alias not included in WIDS for the 216-T-20 Trench is the contaminated acid pit. The site is presently not marked or posted, although an undated aerial photo shows an area east of 241-TX-155 that may represent the trench, as observed during a site visit in September 1991.

2.3.5.3.7 Trenches 216-T-21, 216-T-22, 216-T-23 and 216-T-24. This group of trenches is located 76.2 m (250 ft) west of the 241-TX Tank Farm. These units are specific-retention trenches, and received 3,000,010 L (460,000 L, 1,530,000 L, 1,480,000 L, 1,530,000 L, respectively) of first-cycle supernatant waste from Building 221-T via the 241-TX-109, -110 and 111 tanks. Each trench is 73.2 x 3 x 3 m (240 x 10 x 10 ft).

The aboveground piping to the trenches was removed and the trenches backfilled when the specific retention capacity was reached. In September 1969, thistles growing above Trenches 216-T-21 and -24 were found to be contaminated. Herbicides were applied to trench soils in May 1970. Since the appearance of new growth, radionuclide contamination

of surface vegetation has not been detected (WHC 1991a). In addition, gamma was not detected in Well W15-81, located west of 216-T-22 (Fecht et al., 1977). This trench series is marked by concrete posts and posted with underground contamination warning signs; however, individual trenches are not identified, as observed during a site visit in September 1991.

2.3.5.3.8 Trench 216-T-25. This trench, located due north of Trenches 216-T-21 through -24, was active during September 1954 (WHC 1991a). The trench is 54.9 x 3 x 3 m (180 x 10 x 10 ft). The trench received first-cycle evaporator bottoms consisting of sludge from 242-T Building first-cycle condensed wastes (WHC 1992b). The site received 3 x 10^6 L (7.92 x 10^5 gal) of liquid mixed-waste containing radionuclides and 2,930 metric tons of inorganic compounds. Radionuclides included ^{137}Cs, ^{106} Ru, ^{90} Sr, ^{60} Co, ^{238} U and Plutonium.

The aboveground piping was removed and the trench was backfilled when the unit was deactivated (WHC 1991a). The trench is fenced within the same area as Trenches 216-T-21 through 24. This trench is marked by a concrete post, as observed during a site visit in September 1991. Portions of a concrete pad are visible northeast of the trench.

2.3.6 Septic Tanks and Associated Drain Fields

The location of the septic tanks and drain fields are shown on Figure 2-9. The T Plant Aggregate Area contains six septic tanks, described as follows.

2.3.6.1 Septic Tank 2607-W1. This active septic tank and associated drain field is located southeast of the 241-TX Tank Farm. This septic system has operated since 1944 and accepts sanitary wastewater and sewage at an estimated rate of 18,300 L/day (4,831 gal/day) (Cramer 1987). The septic tank structure is composed of a concrete pad with two manholes 1.5 m (5 ft) apart on the west side and one manhole on the east side, approximately 4.6 m (15 ft) from the other two. The drain field has dimensions of 30.5 x 22.9 x 1.8 m (100 x 75 x 6 ft) and is located approximately 15.3 m (50 ft) southeast of the septic tank, across Bridgeport Avenue. The septic tank is surrounded by a light chain barricade with no radiation warning signs, as observed during a site visit in September 1991.

2.3.6.2 Septic Tank 2607-W2. This active septic tank and drain field are located southwest of the main 200 West Area guard gate. This septic system has operated since 1980 and accepts wastewater and sewage at an estimated rate of 10,200 L/day (2,693 gal/day) (Cramer 1987). The septic tank site has a concrete pad with three square iron plates covering holes. The plates have rusted through, however, and liquid is visible below. The drain field is 18.3 x 9.2 x 2.4 m (60 x 30 x 8 ft) and is located about 9.2 m (30 ft) southwest of the septic tank. The septic tank is surrounded by a light chain barricade with no radiation warning signs, as observed during a site visit in September 1991.

2.3.6.3 2607-W3 Septic Tank. The 2607-W3 Septic Tank is an active unit that has operated since 1944. It is located southwest of the 221-T Building. This tank accepts sanitary wastewater and sewage and includes a drain field; the estimated rate of waste received is 14,200 L/day (3,749 gal/day) (Cramer 1987). The eastern most access port is posted with a radioactive material warning sign, as observed during a site visit in September 1991.

2.3.6.4 2607-W4 Septic Tank. The 2607-W4 Septic Tank is an active unit operating since 1944, and is located northwest of the 221-T Building. This tank accepts wastewater and sewage and includes a drain field with 3.1 x 9.2 x 0.9 m (10 x 30 x 3 ft) dimensions). The estimated rate of waste received is 10,600 L/day (2,799 gal/day) (Cramer 1987). This septic tank is surrounded by a light chain barricade and is marked with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.6.5 Septic Tank 2607-WT. Located east of the evaporator between the TX and TY Tank Farms, this active sanitary wastewater and sewage septic tank receives approximately 20 L/day (5 gal/day) of waste. This unit began operating in 1952 and is connected to a sanitary tile field (WHC 1991a). During a previous site visit, neither the septic tank nor the drain field could be identified from outside the chain-link fence barrier (see Appendix A, Table A.2.4). Based on available drawings, the septic tank is apparently located inside Building 241-T-601. This septic tank is surrounded by a chain-link fence and is marked with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.6.6 Septic Tank 2607-WTX. This is an active septic tank (operating since 1950) located in the southwest corner of the TX Tank Farm. This unit receives sanitary wastewater and sewage at a rate of 740 L/day (195 g/day) and is connected to a sanitary tile field (WHC 1991a). This septic tank is surrounded by a chain-link fence and is marked with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.7 Transfer Facilities, Diversion Boxes and Pipelines

Transfer Facilities (also referred to as process lines or process sewer lines) connect the major processing facilities with each other and with the various waste disposal and storage facilities. Most lines are 7.6 cm (3 in.) diameter stainless steel pipes with welded joints. Process lines are generally enclosed in steel reinforced concrete encasements and are set below grade. The major process lines in the T Plant Aggregate Area are shown on Plate 1 and Figure 2-10. The pipelines are not waste management units according to the Tri-Party Agreement and they will be addressed in detail under the Hanford Surplus Facilities Program. However, a limited study is proposed as part of T Plant Past Practice investigations (see Section 8.3.3.8) to determine if the lines are leaking and if they have contaminated the surrounding soil.

Diversion boxes house the switching facilities where waste can be routed from one process line to another. They are concrete boxes that were designed to contain any waste

that leaks from the waste transfer line connections. The diversion boxes generally drain by gravity to nearby catch tanks where any spilled waste is stored. There are 14 diversion boxes in the T Plant Aggregate Area. These units are shown on Figure 2-11 and described below.

2.3.7.1 Diversion Box 241-T-151. This diversion box, located west of Tank 241-T-110 and Diversion Box 241-T-153 and northeast of Diversion Box 241-T-152, was active from 1944 to 1980. This reinforced concrete structure interconnects the 241-T-153 Diversion Box, the 241-U-151 Diversion Box, Building 221-T, and the 241-T Tank Farm. This unit was used for the transfer of waste solutions from processing and decontamination operations. The diversion box is cordoned off by a chain-link fence, as observed during a site visit in September 1991.

2.3.7.2 Diversion Box 241-T-152. This diversion box was active from 1944 to 1983 and is located southwest of the 207-T Retention Basin, just north of 23rd Street. Diversion Box 241-T-152 is associated with the 241-T Tank Farm and the 241-T-302B Catch Tank, and interconnects Diversion Box 241-T-153, Diversion Box 241-TX-155, Diversion Box 241-TX-153, and the 221-T Building. The diversion box is cordoned off by a chain-link fence, as observed during a site visit in September 1991.

2.3.7.3 Diversion Box 241-T-153. This diversion box is currently inactive; the dates of its operation are unknown. It is located within the 241-T Tank Farm, east of Tank 241-T-110. This diversion box interconnects Diversion Boxes 241-T-153, 241-TX-153, 241-T-155 and the 221-T Building. The diversion box is cordoned off by a chain-link fence, as observed during a site visit in September 1991.

2.3.7.4 Diversion Box 241-T-252. This inactive unit operated from 1944 to September 1983. It is located within the 241-T Tank Farm, just north of 23rd Street and southwest of Tank 241-T-112. The 241-T-252 Diversion Box interconnects the 241-T-153 Diversion Box, the 221-T Building, and the 241-T Tank Farm (WHC 1991a). The diversion box is cordoned off by a chain-link fence, as observed during a site visit in September 1991.

2.3.7.5 Diversion Box 241-TR-152. This inactive unit operated from 1944 to November 1980. It is located just east of the 241-T-104 Tank. The 241-TR-152 Diversion Box interconnects Diversion Box 241-TR-153, Diversion Box 241-TXR-151, and the 241-T Tank Farm (WHC 1991a). The diversion box is cordoned off with a chain-link fence and posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.7.6 Diversion Box 241-TR-153. This inactive unit operated from 1944 until November 1983. It is located just east of Tank 241-T-107. Diversion Box 241-TR-153 is associated with the 241-T Tank Farm and Catch Tank 241-T-302-B, and interconnects Diversion Boxes 241-TR-152 and 241-TXR-151 (WHC 1991a). The diversion box is cordoned off with a chain-link fence and posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.7.7 Diversion Box 241-TX-152. This active unit has operated since 1949 and is located within the 241-TX Tank Farm. Diversion box 241-TX-152 is associated with the 241-TX Tank Farm (WHC 1991a). This diversion box is surrounded by a light chain barricade and posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.7.8 Diversion Box 241-TX-153. This inactive unit operated from 1949 to July 1982. It is located west of Camden Avenue within the 241-TX Tank Farm and southeast of Tank 241-TX-101. Diversion Box 241-TX-153 interconnects Diversion Box 241-TX-155 and the 241-TX Tank Farm, and is associated with Catch Tanks 241-TX-302-A and -B. One known release (UPR-200-W-126) has occurred from this Diversion Box. This release occurred on May 8, 1975 when a pipefitter removed old gaskets from the diversion box for replacement and placed them in a plastic bag. Spotty contamination became airborne but was limited to the transfer line from the diversion box. Readings up to 20,000 ct/min were measured on the affected employee, who was then decontaminated (WHC 1991a). The diversion box is surrounded by a chain-link fence and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.7.9 Diversion Box 241-TX-154. This active unit has operated since 1949 and is located within the 241-TX Tank Farm. Diversion Box 241-TX-154 is associated with catch tank 241-TX-302-C and the 241-TX Tank Farm (WHC 1991a). The diversion box is surrounded by a light chain barricade and is posted with surface and underground contamination warning signs, as observed during a site visit in September 1991.

2.3.7.10 Diversion Box 241-TX-155. This inactive unit operated from 1949 to December 1980. It is located east of the 241-TX Tank Farm. Diversion Box 241-TX-155 is interconnected with Catch Tank 241-TX-302-B. Two unplanned releases (UPR-200-W-5 and UPR-200-W-28) are known to have occurred from this diversion box. UPR-200-W-5 occurred in 1950 on the hillside west of Trench 216-T-20 when overflow from the diversion box contaminated the soil. The area was removed from radiation zone status in December 1970. UPR-200-W-28 occurred in the spring of 1954 and resulted from a leak in a jumper in the diversion box. The leak covered a 9.2 x 30.5 m (30 X 100 ft) area west of the diversion box; the area was covered with clean soil (WHC 1991a). The diversion box is surrounded by a light chain barricade and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.7.11 Diversion Box 241-TXR-152. This inactive diversion box operated from 1949 to August 1980. It is located within and associated with the 241-TX Tank Farm (WHC 1991a). The diversion box is surrounded by a chain-link fence and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.7.12 Diversion Box 241-TXR-153. This inactive unit operated from 1949 to December 1980. It is associated with the 241-TX Tank Farm (WHC 1991a). The diversion box is surrounded by a chain-link fence and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.7.13 Diversion Box 241-TY-153. This inactive unit operated from 1953 to May 1981. It is located within the 241-TY Tank Farm, approximately 21.4 m (70 ft) north of the 242-T Evaporator Building. Diversion Box 241-TY-153 is associated with the 241-TY Tank Farm and Catch Tank 241-TY-302-A, and interconnects Diversion Box 241-TX-153, Diversion Box 241-TX-155, and the 241-TY Tank Farm (WHC 1991a). The diversion box is surrounded by a chain-link fence and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.7.14 Diversion Box 242-T-151. The dates of operation of this inactive unit are not known. It is located southeast of tank 241-TX-116. Diversion Box 242-T-151 interconnects tanks 241-TX-113, -114, -116, and -117, Diversion Box 241-T-153, and the 242-T Evaporator (WHC 1991a). The diversion box is surrounded by a chain-link fence and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.8 Basins

For discussion purposes, basins are considered to be waste management units which provide temporary storage for either solid or liquid wastes. One site falls under this category for the T Plant Aggregate Area and is described below. The location of this basin is shown in Figure 2-12.

2.3.8.1 207-T Retention Basin. This basin is an active site approximately 458 m (1,500 ft) west of Building 221-T and 61 m (200 ft) north of 23rd Street. The site is a 75 x 37.5 x 2 m (246 x 123 x 6.5 ft) deep concrete Retention Basin with inlet and outlet structures on the east and west sides (WHC 1991a). It is divided by a concrete spillway into northern and southern halves. A 1,829 m (6,000 ft) long vitrified clay pipe approximately 0.6 m (2 ft) in diameter conveys waste to the basin.

The site was constructed in 1944 to receive potentially low-level wastes prior to discharge to the 216-T-4-2 Ditch. It receives T Plant process cooling and ventilation steam condensate. From construction completion to the 1950s, the site received process cooling water from equipment jackets in Buildings 221-T and 224-T. From the early 1950s to 1955, and again from 1965 to the late 1960s, and from 1973 to 1976, the basin received the above process cooling water and 242-T Waste Evaporator cooling water. Since 1976, the site has received intermittent flow from Buildings 221-T, 221-TA, and 224-T (WHC 1991a).

The sludge and sand at the basin bottom have low-level mixed fission products; the soil surrounding the basin is generally contaminated with low-level beta-gamma activity resulting from particulate fallout associated with unloading incidents involving wastes trucked in from the 241-T Tank Farm. The basin was periodically cleaned out in the 1950s through the early 1960s by removing the sludge and blown-in sand and burying it in scooped out holes 2.4 to 3.1 m (8 to 10 ft) deep along the east side of the basins. The buried sludge was covered

with 0.92 to 1.2 m (3 to 4 ft) of soil. There may be three or four such holes in addition to the listed 216-T-12 trench site.

On September 12, 1985, 1,893 L (500 gal) of solution containing 99.4 kg (219 lb) of sodium hydroxide was released to the basins. After six hours of continued condensate discharge, the pH lowered from 12.5 to 7.67, and no further action was taken (WHC 1991a). Currently, the basin is enclosed with a light chain barricade that extends east to the 216-T-14 through -17 Trenches, and north of the 241-T Tank Farm. This barricaded area is the UN-216-W-31 area monitored by health physics exhibiting spotty surface contamination.

2.3.9 Burial Sites

The T Plant Aggregate Area contains two types of burial grounds, the 200-W Powerhouse ash-related waste management units and the 218-W-8 Burial Ground vaults. The 200-W Powerhouse has two ash-related waste management units called the 200-W Ash Disposal Basin and the 200-W Powerhouse Ash Pit. Each of these waste management units serves a separate function. In addition, the 200-W Ash Disposal Basin is associated with two other waste management units, the 200-W Ash Pit Demolition Site and the 200-W Burning Pit . The 200-W Ash Pit Demolition Site is included in the Tri-Party Agreement as an active TSD. The 218-W-8 Burial Ground was used for the disposal of radioactive laboratory process wastes. The locations of these sites are shown in Figures 2-12 and 2-13. A graphic representation of the locations of these burial sites is as follows:

- 218-W-8 Burial Ground
- 200-W-Ash Disposal Basin
  200-W Ash Pit Demolition Site
  200-W Burning Pit
- 200-W Powerhouse Ash Pit

2.3.9.1 200-W Ash Disposal Basin. The ash disposal basin is an active waste site located northeast of the U Plant area. It is a large, irregularly-shaped excavation. The southeast corner appears to be an area where soil has been removed to be used as fill material at other sites. The other slopes are low angle and are vegetated. Present in the central part of the excavation are railroad ties and other debris. At the northern end, there are large bales of dry brush.

Two fenced sites are located within the basin. One fenced area encloses a trench, approximately 18.3 x 6.1 m (60 x 20 ft). The trench is located next to the entrance ramp on the west side of the basin and is overgrown by tumbleweeds. Contaminated laundry was surreptitiously disposed of at this location. This clothing and soil were removed upon discovery. The second fence area corresponds to the location of the ash pit demolition site and is discussed in Section 2.3.9.2.

Adjoining the basin on the northwest is the area where ash is present at the surface. There is a cut through this zone that is about 4.6 m (15 ft) deep, 45.8 m (150 ft) long, 30.5 m (100 ft) wide at the mouth, and 9.2 m (30 ft) wide at the end. The site has no barrier but is posted with a no dumping warning sign, as observed during a site visit in September 1991.

2.3.9.2 200-W Ash Pit Demolition Site. The ash pit demolition site is located in the northeastern area of the ash disposal basin. Based on an April 1992 site visit, the site is approximately 6.1 x 6.1 m (20 x 20 ft) and is roped-off and marked as the RCRA-200-W Ash Pit Demolition Site. No visible debris was observed at the site. Within this area, unstable chemicals were detonated in the past. The site has been inactive for several years. The WIDS reports the last disposal was in 1986 and that the unit received low-level waste. The ash pit demolition site is not included in the Tri-Party Agreement.

2.3.9.3 200-W Burning Pit (UN-200-W-8, UPR-200-W-37 and -70). An April 1992 site visit, the location of the burning pit could not be verified; no sign, markers, or surface disturbances were found at its suspected location, the southwest corner of the ash disposal basin, east of the U Plant. An aerial photogrpah (date unknown) shows a surface disturbance of similar size to the burning pit located 92 m (300 ft) east of its suspected location. The WIDS indicates a site area of 61 x 61 m (200 x 200 ft). This unit received nonradioactive construction and office waste, chemical solvents and paint waste to be burned. This unit has three known unplanned releases associated with it: UPR-200-W-37, -8, and -70 (Stenner et al. 1988).

The UPR-200-W-37 release consisted of the disposal of three broken boxes that contained dry high-level radioactive waste with readings of 100 mR/h and that contaminated the ground in the pit. The site was cleaned by removing the cartons to the proper burial trench and decontaminating the pit (Stenner et al. 1988).

The UPR-200-W-70 release, like UPR-200-W-37, consisted of the disposal of contaminated material into a non-radiation burning pit. Beta/gamma contamination of 5,000 to 50,000 ct/min was found along the bumper rails at the edge of the pit. Contamination at 20,000 ct/min to 30 mR/h was discovered in the pit bottom itself. A dump area on the south side of the pit was found to have 5,000 to 200,000 ct/min alpha contamination. The area was barricaded and radiation signs posted. To stabilize the contamination, fabro-film was sprayed on the affected areas (WHC 1991a).

The UN-200-W-8 release was an unplanned release of unknown source. The release is suspected to have occurred in 1950. The release resulted in spotty contamination with quantities up to 1 Ci. The area was covered with 3.1 m (10 ft) of soil and removed from radiation zone status in 1972 (WHC 1991a). The WIDS locates this site by coordinates in Operable Unit 200-TP-4, but its text describes it as being in the old burning ground, east of Building 221-U.

Currently there are no barricades nor any radiation warning signs in the area of the burning ground. The southwest part of the pit has been backfilled with a coarse gravel and its surface has a gentle slope.

2.3.9.4 200-W Powerhouse Ash Pit. The powerhouse ash pit is located just south of the coal storage yard. This pit is not part of the 200-W Ash Disposal Basin discussed above. This unit receives powerhouse ash, which has been tested for Toxicity constituents and found to be nontoxic per U.S. Environmental Protection Agency (EPA) standards. The ash is generated at the rate of about 6,800 m^3/yr (8,890 yd^3/yr). The site currently contains about 43,800 m^3/yr (57,290 yd^3) of ash (Stenner et al. 1988). Based on observations from an April 1992 site visit, the pit is approximately 213 x 61 x 7.6 m (700 x 200 x 25 ft) with steep slopes. The eastern slope has been stabilized with cobbles. Ash and a film of water covered the bottom of the pit during the previous site visit (Appendix A). A 15 cm (6 in.) steel pipe was observed discharging about (7.6 L/min (2 gal/min) of water into the pit at the northeastern corner. Ash and sediment were heaped around the ponded water, possibly indicating higher discharges in the past. Access ramps are located in the northwest and northeast corners. The site is surrounded by a light chain barricade and is posted with an open pit warning sign, as observed during a site visit in September 1991. Periodically (every 2 to 4 months), the ash pit is cleaned out and the material is taken to the Ash Disposal Basin for burial (Ebasco correspondence, 1992).

2.3.9.5 218-W-8 Burial Ground. The 218-W-8 Burial Ground is an inactive waste site which consists of three underground vaults. These vaults, located 274.3 m (900 ft) southeast of Building 222-T, received 68 m^3 of 222-T Laboratory process sample waste containing ^{137}Cs, ^{106}Ru, and ^{90}Sr (Stenner et al. 1988, Anderson et al. 1991). The two original vaults are 3 x 3 x 3.6 m (10 x 10 x 12 ft) deep, constructed of wooden planking, and have tops located 1.5 m (5 ft) below grade. The third vault is a concrete culvert pipe encasement 2.4 m (8 ft) in diameter and 7.6 (25 ft) long, placed approximately 0.9 m (3 ft) below grade. The top of the encasement is a 23 cm. (9 in.) concrete cover and the bottom is a 30 cm (12 in.) concrete floor. The disposal chutes for the wooden vault were removed and backfilled with soil. The disposal chute and three vaults are enclosed within a surface radiation contamination barrier. An additional barrier is present within this outermost barrier which surrounds the original vault. The barrier is surrounded by a light chain barricade and labelled with cave-in potential, and underground and surface radiation warning signs, as observed during a site visit in September 1991.

2.3.10 Unplanned Releases

Forty-five unplanned releases are included in the T Plant Aggregate Area. Their locations are shown on Figure 2-14. Many of the releases are not included as independent sites in the Tri-Party Agreement, however, because they are closely associated with existing waste management units. These unplanned releases and their associated waste management units will be addressed together in this study. Table 2-6 summarizes the known information for each unplanned release and, where applicable, lists the waste management unit to which

it is related. Figure 2-15 shows the breakdown of releases according to affiliated units or events. Most of the information available for the unplanned releases is derived from the WIDS sheets (WHC 1991a).

2.3.10.1 UN-200-W-2 Unplanned Release. A waste line near 241-TY-153 Diversion Box failed and discharged to the soil. Contamination was measured to a depth of 3.0 to 3.4 m (10 to 11 ft) below the surface. The release is not currently marked or posted, as observed during a site visit in September 1991.

2.3.10.2 UN-200-W-3 Unplanned Release. Transport of contaminated equipment from the T Plant Aggregate Area to the 200 West Burial Ground contaminated an area near the railroad. The contamination was covered with approximately 0.25 m (.83 ft) of clean gravel in the spring of 1950.

2.3.10.3 UN-200-W-4 Unplanned Release. Unknown beta/gamma solid contaminants from a burial box being transported in 1949 were spread from the T Plant to the heavy equipment burial ground. Radiation readings averaging 7 mrem/hr were recorded. The release is not currently marked or posted, as observed during a site visit in September 1991.

2.3.10.4 UN-200-W-7 Unplanned Release. This unplanned release occurred during work on the 241-T-151 and -152 Diversion boxes. An unknown quantity of beta/gamma liquid contamination was spread on the ground around the diversion boxes in the spring of 1950. The maximum dose rate was 20 mrad/hr at the surface. A portion of the contamination was removed and the remainder covered with 0.3 m (1ft) of clean soil. The release is surrounded by a chain-link fence and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.10.5 UN-200-W-8 Unplanned Release. During 1950, a 13.9 m^2 (150 ft^2) area in the 200-W Burning Pit was found to be contaminated with approximately 1 Ci of fission products. The maximum dose rate was 45 R/hr at the surface. The contaminated waste management unit was covered with 3 m (10 ft) of soil. This area was removed from radiation zone status in August 1972. The release is not currently marked or posted, as observed during a site visit in September 1991.

2.3.10.6 UN-200-W-12 Unplanned Release. Approximately 7.6 L (2 gal) of concentrate from the 242-T Evaporator was released from an open riser on the south side of 242-T in 1951. The maximum dose rate observed for the unknown beta/gamma material was 2 R/hr at 5.1 cm (2 in.). A portion of the contamination was removed and the remainder covered with 0.3 m (1 ft) of clean soil.

2.3.10.7 UN-200-W-14 Unplanned Release. A leak in the waste line from 242-T to the 207-T Retention Basin released an unknown quantity of waste to the soil in October of 1952. The contaminated areas were covered with 0.3 m (1 ft) of clean soil and gravel. The release is not currently marked or posted, as observed during a site visit in September 1991.

2.3.10.8 UN-200-W-17 Unplanned Release. On September 11, 1952, liquid contamination was spread in the 241-TX Tank Farm during transport of a waste pump. Cerium, cesium, nobelium, ruthenium, strontium, and zirconium were present in the waste liquid. Radiation readings of 2,000 to 35,000 ct/min were observed. Some of the highly contaminated areas were stabilized with emulsified asphalt. Wind however spread the contamination over an area 180 m (600 ft) long by 91 m (300 ft) wide. The volume involved was estimated at less than 3.8 L (1 gal). The release is enclosed within a chain-link fence and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.10.9. UN-200-W-27 Unplanned Release. On December 20, 1954, an unencased first-cycle waste line from the T Plant Aggregate Area failed and resulted in cave-in, run-off of solution, and high ground-surface dose rates. The exact location of this release is not known.

2.3.10.10 UN-200-W-29 Unplanned Release. Approximately 3,800 L (1,000 gal) of first-cycle supernatant was released in November of 1954 from a failed waste transfer line associated with the 241-TX-153 Diversion Box resulting in dose rates of 11.5 R/hr at 5 cm (2 in.) (WHC 1991a). The first-cycle supernatant contained an unknown quantity of rare earth metals plus yttrium, cesium, antimony, cerium, ruthenium, niobium, and tellurium. The contaminated waste management unit encompassed an area of 30 x 23 m (100 x 75 ft). In May, 1978 contaminated soil adjacent to the zone was removed on the south side to a depth of 1.2 m (4 ft) and on the west side to a depth of 0.9 m (3 ft). The area was backfilled and later covered with gravel. This release is currently no marked or posted, as observed during a site visit in September 1991.

2.3.10.11 UN-200-W-38 Unplanned Release. A ruptured process line released an unknown amount of beta/gamma contamination to the soil near the 241-TX-154 Diversion Box sometime prior to January 30, 1956. This release resulted in the formation of a 9.1 x 4.6 m (30 x 15 ft) pool of metal waste with a dose rate of 1.2 R/hr at a distance of 24 m (80 ft). No mention was found regarding cleanup of this release. The reported details of this unplanned release are similar to those given for UPR-200-W-160 which occurred December 30, 1955. This release is enclosed within a light chain barricade and posted with surface and underground contamination warning signs, as observed during a site visit in September 1991.

2.3.10.12 UN-200-W-58 Unplanned Release. On April 26, 1965, solid contamination was spread from the 221-T Railroad cut to the 200 West Burial Ground during transportation of canyon cell blocks. Contaminated soil with unknown beta/gamma readings of up to 100,000 ct/min was removed from the waste management unit. This release is currently no marked or posted, as observed during a site visit in September 1991.

2.3.10.13 UN-200-W-62 Unplanned Release. An unknown quantity of second-cycle bismuth phosphate waste was released to the soil in May 1966 to the same waste

management unit (i.e., 24-TX-153 Diversion Box) involved in UN-200-W-29 and UN-200-W-97. Radiation readings from 20 to 5,000 mrad/hr were recorded during the incident. This release is currently no marked or posted, as observed during a site visit in September 1991.

2.3.10.14 UN-200-W-63 Unplanned Release. On September 21, 1966 approximately 1 Ci of ^{90}Sr from a used diversion box jumper associated with 241-TX-153 Diversion Box was spread on 23rd Street during transport. The contamination on the road was removed and that on the road shoulder and borrow pit was covered with 15 cm (6 in.) of soil. This waste management unit was removed from radiation zone status in November 1972. This release is currently no marked or posted, as observed during a site visit in September 1991.

2.3.10.15 UN-200-W-64 Unplanned Release. In February 1969 ^{137}Cs readings up to 600 ct/min were observed on a 15 m (50 ft) strip of soil near Camden Avenue and 23rd Street near 241-TX-153 Diversion Box. The contamination was believed to have been spread by runoff from heavy snow in a nearby radiation zone. No mention of remedial action taken was found. This release is currently not marked or posted, as observed during a site visit in September 1991.

2.3.10.16 UN-200-W-65 Unplanned Release. Contamination on the T Plant railroad cut was found on October 27, 1969. This contamination resulted in radiation readings of 5,000 ct/min to 150 mrad/hr. An area 0.9 x 3m (3 x 10 ft) was affected as well as isolated spots out to 114 m (375 ft) from the tunnel door. This release is currently posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.10.17 UN-200-W-67 Unplanned Release. A contaminated electric lift affected an area 0.9 x 7.3 m (3 x 24 ft) on the north side of the 2706-T Building on August 5, 1970. The contamination consisted of unknown beta/gamma with readings to 20,000 ct/min. This release is enclosed within a chain-link fence and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.10.18 UN-200-W-73 Unplanned Release. A faulty railway transfer box resulted in contamination of the railroad right-of-way between the 221-T Tunnel and the 2706-T Building on October 16, 1974. The contamination consisted of unknown beta/gamma with readings to 40 mR/hr. The area was surveyed and cleaned up. This release is currently not marked or posted, as observed during a site visit in September 1991.

2.3.10.19 UN-200-W-76 Unplanned Release. In August 1977 contaminated rabbit fecal pellets were found around the 241-TX-155 Diversion Box. The pellets contained ^{137}Cs (18.6 μCi/g), ^{134}Cs (0.044 μCi/g), ^{155}Eu (0.093 μCi/g), ^{154}Eu (0.026 μCi/g), and ^{90}Sr (2.63 μCi/g). The source of the contamination was traced to an unknown volume of waste overflowing into the diversion box and subsequently into an excavation on the east side of the box (Unusual Occurrence Report #77-180). The effected area was approximately 91 x 30 m (300 x 100 ft) around the diversion box. The contaminated pellets and, to the extent possible, the contaminated soil were removed and taken to dry waste burial. The remaining

contamination was covered with clean soil. This release is enclosed within a chain-link fence and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.10.20 UN-200-W-77 Unplanned Release. On April 4, 1978, contaminated coyote feces were found in the northeast corner of the 200 West Area. All contaminated feces were collected and sent to the laboratory for evaluation and radiosotopic analysis. Readings indicated ^{239}Pu and ^{241}Am with beta/gamma readings of 40,000 ct/min and alpha readings of 55,000 dis/min.

2.3.10.21 UN-200-W-85 Unplanned Release. The pad behind the 2706-T Building was contaminated with an unknown quantity of beta/gamma contamination on April 22, 1982. The contaminant dripped from a transfer box parked on the pad resulting in radiation readings of 100,000 ct/min. The contamination was cleaned up. This release is enclosed within a chain-link fence and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.10.22 UN-200-W-88 Unplanned Release. On May 28, 1984 contaminated liquid was spilled from a uranyl nitrate trailer on the roadway in 200 West Area. All detectable contamination was chipped out of the roadway and removed.

2.3.10.23 UN-200-W-97 Unplanned Release. This unplanned release associated with the 241-TX-153 Diversion Box occurred in May 1966 and was a repeat of the UN-200-W-29 release. The same broken transfer line was used and approximately 10 Ci of fission products were released. The high salt neutral/basic waste contaminated the same area as the UN-200-W-29 release. All surface contamination to a depth of 0.9 m (3 ft) was removed. This waste management unit was stabilized in 1978 as described in UN-200-W-29 above. This release is enclosed within a light chain barricade and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.10.24 UN-200-W-98 Unplanned Release. In the spring of 1945, a high salt, neutral/basic waste containing approximately 10 Ci of fission products was released to the soil at the southeast corner of 221-T. The area was overfilled with 1.2 m (4 ft) of clean soil. No radioactivity was detected from this waste management unit in 1977 when test holes were cut to a depth of 1.2 m (4 ft). An annual survey on October 10, 1990 found contaminated tumbleweeds and rabbit feces as well as direct and smearable beta contamination of 250,000 dis/min. A blacktop road has been constructed over top of the waste management unit. This release is enclosed within a light chain barricade and is posted with surface and underground contamination warning signs, as observed during a site visit in September 1991.

2.3.10.25 UN-200-W-99 Unplanned Release. Approximately 1 Ci of ^{90}Sr was dispersed over a 230 x 91 m (750 ft x 300 ft) area by an air-borne plume from the 241-T-153 Diversion Box in September 1968. Contamination on Camden Avenue and on the road shoulders was covered with a new tar mat. A road grader was used to turn over the contaminated soil to cover the particulate contaminants. The waste management unit was

surface stabilized in July 1990. Annual surveys in September of 1988 and 1989 found general contamination levels of 4,000 ct/min for this waste management unit. This release is enclosed within a light chain barricade and is posted with underground contamination warning signs, as observed during a site visit in September 1991.

2.3.10.26 UN-200-W-100 Unplanned Release. A leak of approximately 10 Ci of fission products from first-cycle high salt, neutral/basic waste occurred in November 1954. This release occurred in the 241-TX Tank Farm during a transfer from 241-TX-105 to 241-TX-118. The contaminated area was 38.1 m (125 ft) long and 30 m (100 ft) wide. It was covered with 0.3 m (1 ft) of clean soil. This release is enclosed within a chain-link fence and is posted with surface contamination warning signs, as observed during a site visit in September 1991.

2.3.10.27 UN-200-W-102 Unplanned Release. During the remodeling of 224-T, gross alpha contamination was found in the soil on the southeast side of the building. The waste management unit is 15 m (50 ft) long, 3.7 m (12 ft) wide, and 3.7 m (12 ft) deep. One hundred thirty-nine drums of soil containing approximately 72 g (0.16 lb) of plutonium were removed. It has been estimated that the waste management unit still contains 10 g (0.45 lb) of plutonium (Maxfield 1979). No surface contamination was found during an October 1975 radiological survey. This release is currently not marked or posted, as observed during a site visit in September 1991.

2.3.10.28 UN-200-W-113 Unplanned Release. During the investigation conducted for UN-200-W-76, an additional subsurface contaminated waste management unit was identified. This 51 x 26 m (170 x 85 ft) area was located to the north of the 241-TX-155 diversion box and contained an unknown quantity of beta/gamma contaminants. It was assumed that the release source was a leak from a nearby waste transfer line, which probably occurred in the 1950's. This waste management unit was stabilized on December 18, 1990. Subsequent surveys have shown no radiation readings above background. This release is posted with underground radiation hazard signs, as observed during a site visit in September 1991.

2.3.10.29 UN-200-W-135 Unplanned Release. This unplanned release occurred in March and April 1954. An estimated 3,800 L (1,000 gal) of blended metal waste supernatant leaked from the 241-TX-302-B Catch Tank (Fosket et al. 1954). The leaking material apparently followed downhill along an encasement and then came to the surface at approximately the same elevation as the tank bottom. A 0.6 m (2 ft) diameter cave-in resulted and the waste ran along the surface for an additional 12 m (40 ft). A dose rate of 5 R/hr was observed at the cave-in and 300 R/hr at 10 cm (4 in.) above the point where the waste finally pooled. The contaminated area was sealed and covered with earth. Recent site tours indicate that the site of UN-200-W-135 is within the boundaries of the UN-200-W-113 unplanned release. This release is posted with underground radiation hazard signs, as observed during a site visit in September 1991.

2.3.10.30 UPR-200-W-5 Unplanned Release. In 1950, overflow from the 241-TX-155 diversion box contaminated soil on hillside to the west of the 216-T-20 trench.

The volume and inventory of this leak was not found. The area of this contamination was released from radiation zone status in December 1970.

2.3.10.31 UPR-200-W-21 Unplanned Release. A jumper leak in the 214-TX-154 Diversion Box in July 1953 caused the 241-TX-302-C Catch Tank to overflow releasing an unknown quantity of beta/gamma contaminants. The dose rate from this release was reported to be as high as 25 R/hr at 20 cm (8 in.). The release encompassed an area 487 x 27 m (160 x 90 ft). This area was covered with blacktop.

2.3.10.32 UPR-200-W-28 Unplanned Release. In the spring of 1950, a leak from a jumper in the 241-TX-155 diversion box contaminated a 30 x 9.1 m (100 x 30 ft) area with an unknown quantity of waste. The area was covered with soil.

2.3.10.33 UPR-200-W-37 Unplanned Release. Three boxes of radioactive dry waste were accidently dumped in the 200-W Burning Pit on June 10, 1955. One box broke open releasing some materials with a maximum reading of 100 mR/h. The materials were removed and the area decontaminated.

2.3.10.34 UPR-200-W-70 Unplanned Release. A January 1973 survey of the 200-W Burning Pit revealed several spots of 5,000 to 50,000 ct/min beta-gamma contamination and 5,000 to 20,000 dis/min alpha contamination. Fabro-film was sprayed on the contaminated areas. The radiation occurrence report stated that plans were in progress to remove all contamination to the burial grounds starting January 31, 1973. No further information was found regarding final disposition of the contaminated materials.

2.3.10.35 UPR-200-W-126 Unplanned Release. A pipefitter working in the 241-TX-153 diversion box on May 8, 1975 was contaminated to 2,000 ct/min by airborne contamination. No contamination was believed to be released to the soil.

2.3.10.36 UPR-200-W-129. There is an unplanned release, UN-200-W-129, associated with Tank 241-TX-113. It occurred on January 7, 1971. While leak testing a new jumper assembly, an employee closed a valve in a pump pit and as he did, a caustic radioactive solution sprayed up through the pit cover. The employee was decontaminated, the area was surveyed, and the pump pit was hosed down (WHC 1992a).

2.3.10.37 UPR-200-W-131 Unplanned Release. Contamination was spread to the ground around the 241-TX-302-B Catch Tank risers during an attempt to neutralize a dilute acid waste in the tank. This unplanned release occurred on March 13, 1953. Ground contamination up to 25 rem/hr at 0.6 m (2 ft) was observed. No estimates of waste volumes or concentrations were found. Portions of the contaminated soil were removed and other portions were covered (WHC 1992a)

2.3.10.38 UPR-200-W-151. In 1974, a supernatant leak (UPR-200-W-151) was noticed when the 241-TY-104 liquid level dropped more than the 0.76 cm (0.3 in.) limit.

The P-10 Salt Well was pumped as a cleanup effort for this unplanned release (Cramer 1987).

2.3.10.39 UPR-200-W-152. The UPR-200-W-152 unplanned release associated with the 241-TY-105 Tank has a 1960 occurrence date. A salt well pump system was installed to remove the pumpable interstitial liquid (Cramer 1987).

2.3.10.40 UPR-200-W-160 Unplanned Release (also known as UPR-200-W-40). This release occurred at the same site as UPR-200-W-21. The failure of an underground transfer line from the 241-T-302-C Catch Tank resulted in the release of up to 19,000 L (5,000 gal) of mixed metal waste and rainwater. Dose rates at the time were 1.5 R/hr at 24 m (80 ft) and 100 R/hr at 0.3 m (1 ft). The release contaminated an area 49 m (160 ft) long by 27 m (90 ft) wide by 4.6 m (15 ft) deep. The contaminated soil volume is estimated at 520 m^3 (680 yd^3) with an overburden soil volume of 9,300 m^3 (12,000 yd^3). The area was backfilled and sprayed with tar. In 1968, the east side of the contamination zone was cut back 3.0 m (10 ft). Thin concrete cell cover blocks were leaned at a 1.0 radian (60 degree) angle against the side of the cut for shielding.

2.4 WASTE GENERATING PROCESSES

The primary waste generating processes in the T Plant Aggregate Area are associated with the previous fuel reprocessing operations conducted in the 221-T Building (T Plant) and its ancillary support facilities. Waste generation processes associated with these and later operations are summarized in the following sections.

Figure 2-16 presents a flow diagram of the basic process steps and waste streams generated as part of this chemical separation process. A process history of the T Plant Aggregate Area is illustrated in Figure 2-17. Table 2-7 presents a summary of waste-producing processes.

2.4.1 T Plant Fuel Reprocessing Wastes (1945 - 1956)

The first step in the bismuth phosphate process was to remove the metal cladding on the fuel. This resulted in the coating-removal waste that was subsequently combined with the first-cycle decontamination waste for storage in SSTs. The coating waste contained small amounts of fission products (Waite 1991). The next step in the process was to dissolve the uranium and extract the plutonium. This step resulted in the metal waste stream, which contained the bulk of the uranium and approximately 90% of the long-lived fission products (e.g., ^{137}Cs and ^{90}Sr). This waste stream was then sent to the SSTs for storage. Cooling water and steam condensate wastes from the dissolution process were discharged to the 216-T-1 Ditch.

Once the plutonium had been extracted, two decontamination cycles were performed to purify the plutonium product. The first decontamination cycle waste stream contained almost 10% of the long-lived fission products and was sent to the SSTs for storage. The second decontamination cycle waste stream, which contained less than 0.1% of the fission products, was sent to SSTs for storage until 1948. Due to limited tank space, the second-cycle waste supernatant was discharged to cribs and trenches from 1948 to 1956, when buildings 221-T and 224-T were deactivated. The second-cycle wastes discharged to cribs were combined with two other waste streams, cell drainage waste and scavenged first-cycle wastes, described below. These combined waste streams accounted for more than 85% of the volume discharged to the ground from SSTs in support of the irradiated fuel recovery operations in T Plant, but less than 20% of the radionuclides (Waite 1991).

Cell drainage waste collected from T Plant operations was sent to in-plant tanks (or cells) for interim storage and then discharged to cribs. Between 1951 and 1956, the cell drainage waste was routed along with the second-cycle wastes and 224-T Building wastes through an SST cascade before discharging to cribs. This cell drainage waste was never intended for permanent storage in the tanks. Instead, the SSTs were used as settling tanks before discharging the waste to the ground (Waite 1991).

Beginning in 1955, the newly generated first-cycle waste in T Plant was scavenged before sending it to SSTs for settling and subsequent discharge to the ground. This scavenging involved adding chemicals to the waste to cause the normally soluble ^{137}Cs to precipitate in the settling process before discharge. The scavenging of the first-cycle waste significantly reduced the quantity of long-lived fission products discharged to the ground (Waite 1991).

While procedures were implemented to monitor and control the discharge of long-lived radionuclides to the SSTs, such controls were not always applied to the discharge of chemicals (Waite 1991). Chemicals were a significant component of the waste streams generated. For example, chemicals such as sodium hydroxide were added to neutralize the waste before it was sent to the tanks for storage (Waite 1991). Sodium ferrocyanide was added to process batches to enhance the precipitation of long-lived radionuclides before the supernatant was discharged to the ground. Such practices resulted in the discharge of substantial quantities of chemicals to the ground as part of the tank waste discharges.

Tables 2-8 and 2-9 list the chemicals used or produced in various T Plant processes. Table 2-10 lists the radionuclides and chemicals disposed of to T Plant Aggregate Area waste management units.

2.4.2 Equipment Decontamination and Laboratory Wastes (1959 - 1963)

From 1959 to 1963, steam condensate, decontamination waste, and miscellaneous effluent were sent from the 221-T Building to the tanks for cascading and subsequent discharge to the 216-T-28 Crib. Thereafter, decontamination wastes from the

2706-T Equipment Decontamination facility were combined with waste from T Plant. Also, 300- Area laboratory wastes were shipped from the 340 waste transfer facility to the 200 West Area and combined with the 221-T Building and 2706-T waste streams (Waite 1991). The 2706-T stream was rerouted directly to a separate crib in 1964. The other streams continued to be discharged to the 216-T-28 Crib via SSTs until 1966. A total of 4.23 x 10^7 L (11.2 x 10^6 gal) of waste was routed through the tanks to this crib, resulting in 594 Ci of fission products. The 340 Facility waste was rerouted directly to other cribs in 1966.

2.4.3 Containment Systems Test Facility Wastes (1956-1990)

The spent fuel dissolution process equipment was removed from the 221-T Building in 1956, and the radioactivity in the facility was partially decontaminated and stabilized. A testing program was then established for testing with iodine and radioactive cesium in a new containment vessel fabricated in place of the old dissolver cells and canyon. This modified facility was referred to as the CSTF. This work was started in 1964 and completed in 1969 by PNL. A test was conducted with radioactive cobalt during this time.

In 1972, a vacuum fractionator was built, and testing began. In 1976, testing was completed and the vacuum fractionator was removed. This work was performed by Atlantic Richfield Hanford Company.

Liquid-metal reactor safety tests were conducted by Westinghouse Hanford in the CSTF with nonradioactive sodium, lithium, and sodium iodide between 1976 and 1985. These tests consisted of sodium and lithium pool reaction, spray reaction, and aerosol behavior tests. At the conclusion of the tests, the reacted sodium, lithium, and sodium iodide were dissolved in water and discharged to the 216-T-1 Ditch or, if radioactive as a result of residual contamination from previous activity, transferred to tank farm double-shell tanks (DSTs) for storage as waste and eventual processing through waste evaporators. Unreacted metals were transferred to the 105-DR Reactor Facility for disposal. The determining conditions for routing the solutions was the solution pH; or the 221-T Building need for caustic solution to neutralize decontamination solutions; or the presence of radioactivity. If the pH was in excess of 12.5, or the caustic solution was needed for neutralization, or radioactivity was detected, the procedure allowed for the solution to be transferred to the 221-T Building head-end; otherwise, it was discharged to the 216-T-1 Ditch. No solutions accumulated that had a pH of less than 2.

Light-water reactor tests were conducted by Westinghouse Hanford using nonradioactive cesium, manganese, zinc, lithium sulfate, iodine, and hydrogen iodide between 1985 and 1990. Several related tests were conducted using nonradioactive lithium and lithium-lead alloy in support of the fusion safety program during this same period. The process wastewater discharged to the 216-T-1 Ditch during these test programs consisted of cooling water, steam condensate, and some of the 221-T Building head-end waste solutions. The used lithium-lead alloy was packaged as solid waste after completion of the tests and shipped offsite as solid waste.

2.4.4 221-T Building Head-End Wastes (October 1989 - March 1990)

The 221-T Building Head-End operations, which consisted of two sets of light-water reactor experiments, were conducted from October 1989 through March 1990. Two sets of light-water reactor experiments were conducted during this time. Cooling water, steam condensate, process solutions, and roof and floor drains associated with these tests and the building operating functions were discharged to the 221-T Building Head-End wastewater stream.

The wastewater flow to the 216-T-1 Ditch was continuous during this 6-month period. The wastewater flow consisted of two configurations: wastewater 1 - plasma torch operation and wastewater 2 - plasma torch standby. The wastewater 1 flow time period was defined as the time of cooling water flow to the plasma torch. This cooling water flow period was about one day (24 hours) for each of the two sets of experiments conducted. The plasma torch was operated to generate manganese aerosol in the aerosol mixing vessel for about one hour for each set of experiments conducted. Other cooling water and steam condensate flows contributed to the wastewater 1 stream.

The wastewater 2 flow consisted of process cooling water and steam condensate flows for the time period during which there was no cooling water flow to the plasma torch. Process wash solutions were also discharged on a batch basis as part of the wastewater 2 flow. The time of wastewater 2 flow consisted of the six-month duration designation period minus the two days for plasma torch cooling water flow (wastewater 1 flow).

2.4.5 Present Decontamination and Decommissioning Wastes

The T Plant complex presently serves as a decontamination and decommissioning facility for the Hanford site. Radioactive waste from these activities is not discharged to the chemical sewer.

The only routine "processes" that discharge to the chemical sewer are steam condensate, cooling water, and heating coil water. These process uses for each location at the T Plant complex are described below:

- Building 221-T uses steam for heating in the canyon area, decontamination activities using steam cleaning, and steam jetting to make liquid transfers within the process tanks. The steam used here for decontamination and liquid transfers within the process tanks is not discharged to the chemical sewer, but is discharged to the double-shell tanks.

- Building 221-TA uses steam for the preheater and reheat coil which heat the 221-T canyon area.

- Building 224-T uses steam for building heating. Sanitary water is also used for the building's hot water heater and for cooling water in the fan room which supplies the evaporative cooler for building cooling.

- Building 271-T uses sanitary water to cool the two air compressors which supply all of the compressed air for T Plant. Steam is used to heat the building and can be used for a steam jet transfer from the basement sump to the chemical sewer at Section 12 if the sump pump fails.

- Building 291-T uses steam in heating coils which heat the 221-T canyon air before the air is filtered through high-efficiency particulate air (HEPA) filters in the FI-2 filter unit to help prevent HEPA filters from getting wet.

2.5 INTERACTIONS WITH OTHER AGGREGATE AREAS OR OPERABLE UNITS

The T Plant Aggregate Area is bordered by the Z Plant Aggregate Area on the west and the U Plant Aggregate Area to the southeast. Wastes from these plants, as well as the Redox and B Plants, did contribute a small proportion of the wastes discharged to T Plant facilities. These interactions are summarized below.

- Crib 216-T-27 received PNL wastes from the 340 Laboratory 300 Area.

- Crib 216-T-28 received PNL wastes from the 340 Laboratory 300 Area.

- Crib 216-T-34 received PNL wastes from the 340 Laboratory 300 Area.

- Crib 216-T-35 received PNL wastes from the 340 Laboratory 300 Area.

- Crib 216-T-36 received steam condensate decontamination waste and miscellaneous waste from both the 221-T Building and the U Plant 221-U processing facility.

- Tank 241-T-101 received PNL waste, 224-U Building waste, B Plant low-level waste, and coating waste, ion-exchange waste and high-level waste from the Redox Plant.

- Tank 241-T-102 received PNL waste, Redox high-level waste, and low-level and ion-exchange waste from B Plant.

- Tank 241-T-103 received B Plant low-level waste, and high-level and ion-exchange waste from Redox. UPR-200-W-147 is an associated unplanned release involving Tank 241-T-103.

- Tank 241-T-105 received B Plant low-level waste and is associated with UPR-200-W-148.

- Tank 241-T-106 received B Plant low-level waste.
- Tank 241-T-108 received B Plant low-level waste.
- Tanks 241-T-109 and 241-T-112 received PNL waste and B Plant low-level waste.
- Tanks 241-T-110 and 241-T-111 received 224-U Building waste.
- Tanks 241-T-201, -202, -203 and -204 received 224-U Building waste.
- Tank 241-TX received waste from REDOX Plant.
- Tank 241-TY-104 received ion-exchange waste from REDOX and organic wash waste from PUREX.
- UN-200-W-88 received uranyl nitrate from a trailer spill.

One of the primary interactions of the T Plant Aggregate Area waste management unit with another Aggregate Area was the laundry (Building 2724 W) discharge. Prior to the activation of the dedicated laundry waste crib, 216-W-LWL, in 1981, radioactive and nonradioactive discharges from the laundry facility were discharged to the 216-U-14 Crib in the U Plant Aggregate Area.

2.6 INTERACTION WITH RESOURCE CONSERVATION RECOVERY ACT PROGRAM

Appendices B and C of the Tri-Party Agreement (Ecology et al. 1991) list RCRA TSD facilities on the Hanford Site which have entered interim status and, thus, will require final permitting or closure. Within the geographical extent of the T Plant Aggregate Area there are eight facilities which fall into this category:

- 241-T-101 through 241-T-112, and 241-T-201 through 241-T-204 Single-Shell Tanks (16 total)
- 241-TX-101 through 241-TX-118 Single-Shell Tanks (18 total)
- 241-TY-101 through 241-TY-106 Single-Shell Tanks (6 total)
- 244-TX Receiver Tank
- 221-T Containment Systems Test Facility (CSTF)
- T Plant Treatment Tank

- Transuranic Waste Storage and Assay Facility (TRUSAF)

- 200-W Ash Pit Demolition Site

The SSTs and their associated facilities will be closed under RCRA rather than seeking a RCRA operating permit. The preferred closure option will be resolved through the preparation and completion of a supplemental environmental impact statement (EIS). The forty single-shell tanks are grouped with other Hanford Site single-shell tanks into RCRA TSD facility group S-2-4. TPA milestone M-08-01 requires sumbission of tank farm selection criteria, closure methods, tank farm selection rational and recommended tank farm selection to Ecology for approval January 1999. Milestone M-08-03 requires sumbission of tank farm closure plans to Ecology for approval by December 2003. Closure of al 149 single-shell tanks, including the tanks in the T Plant Aggregate Area is scheduled to be completed by June 2018, according to milestone M-09-00. Facilities associated with the SST closure program are discussed in Section 9.0 and listed in Table 9-3.

The 244-TX-RT receiving tank is an inactive facility located within the boundary of the 244-TX Tank Farm and will be integrated into the SST closure program.

The 221-T CSTF is a research laboratory used to perform experiments with alkali metal compounds. In the future, this facility may be used to treat hazardous alkali metal waste by heating them in a treatment tank equipped with an off-gas system. The 221-CSTF is planned for closure under RCRA. The Part A RCRA Permit Application for the 221-CSTF may be withdrawn because the unit never handled or never will handle hazardous waste. In addition, the 221-CSTF is associated with T Plant Aggregate Area buildings and does not pose an environmental threat.

T Plant provides decontamination and repair services for the Hanford Site. The waste generated from the decontamination is collected by a drainage system which feeds to the 14,000 gallon T Plant Treatment Tank. The Part A RCRA Permit Application may be withdrawn for the T Plant Treatment Tank due to reclassification of the unit as treatment by generator. In addition, the T Plant Treatment Tank is associated with T Plant Aggregate Area buildings and does not pose an environmental threat.

The TRUSAF operation consists of a nondestructive analysis of transuranic (TRU) waste. The waste is generated nationally by various D.O.E. processing facilities, and is shipped to the Hanford Site for interim storage and handling. The waste will eventually be shipped to the Waste Isolation Pilot Plant (WIPP) in New Mexico for disposal. The TRUSAF is associated with T Plant Aggregate Area buildings and does not pose an environmental threat.

The 200-W Ash Pit Demolition Site is used to detonate explosive wastes that are generated on the Hanford Site. This site is planned for closure under RCRA. The 200-W Ash Pit Demolition site is an active facility that is scheduled to submit a RCRA Closure Plan in November 1992. In September 1991, a Management Action Plan was submitted for the

closure of the 200-W Ash Pit Demolition site. The purpose of the Management Action Plan is to 1) provide a coordinated approach for preparing the closure plan and 2) obtain the necessary environmental permits and/or regulatory approval for final closure. Implementation of this closure plan is expected to have no impact on other T Plant Area waste management units. No unplanned releases are associated with the 200-W Ash Pit Demolition Site.

2.7 INTERACTIONS WITH OTHER HANFORD PROGRAMS

In addition to RCRA, there are several other ongoing programs that affect buildings and waste management units in the T Plant Aggregate Area. These programs include: the Hanford Surplus Facilities Program, the Radiation Area Remedial Action Program, the Hanford Site SST Program, and the Defense Waste Management Program.

The Hanford Surplus Facilities Program is responsible for the safe and cost-effective surveillance, maintenance, and decommissioning of surplus facilities at the Hanford Site. All of the major inactive building within the T Plant Aggregate Area are covered under this program. The Surplus Facilities program is also responsible for managing the RCRA closure and RARA activities. The program established the cost, schedule, and technical baselines for individual projects and provides the program management for completing the work. The work activities relative to projects are completed by various functional organizations through a matrix management system. Performing organizations are assigned work by the program office using cost account authorizations and cost account plans. Project decommissioning, RCRA, and RARA field work at the Hanford Site is performed by Hanford Restoration Operations (Winship and Hughes 1991).

The Radiation Area Remedial Action (RARA) Program is conducted as part of the Surplus Facilities Program. The RARA is responsible for the surveillance, maintenance, decontamination, and/or interim stabilization of inactive burial grounds, cribs, ponds, trenches and unplanned releases at the Hanford Site. A major concern associated with these requirements is the management and control of surface soil contamination. All of the controlled access surface radiation zones and the cribs with collapse potential in the T Plant Aggregate Area are covered by this program.

The Hanford Site Single-Shell Tank Program covers near-term waste management activities to ensure safe interim storage of waste in the tanks. It also addresses the environmental restoration activities to close the SSTs operable units included in the 241-T, 241-TX and 241-TY Tank Farms. The primary regulatory drivers of this program are the Tri-Party Agreement and RCRA.

The Defense Waste Management Program is responsible for all actively operating waste management units in the T Plant Aggregate Area.

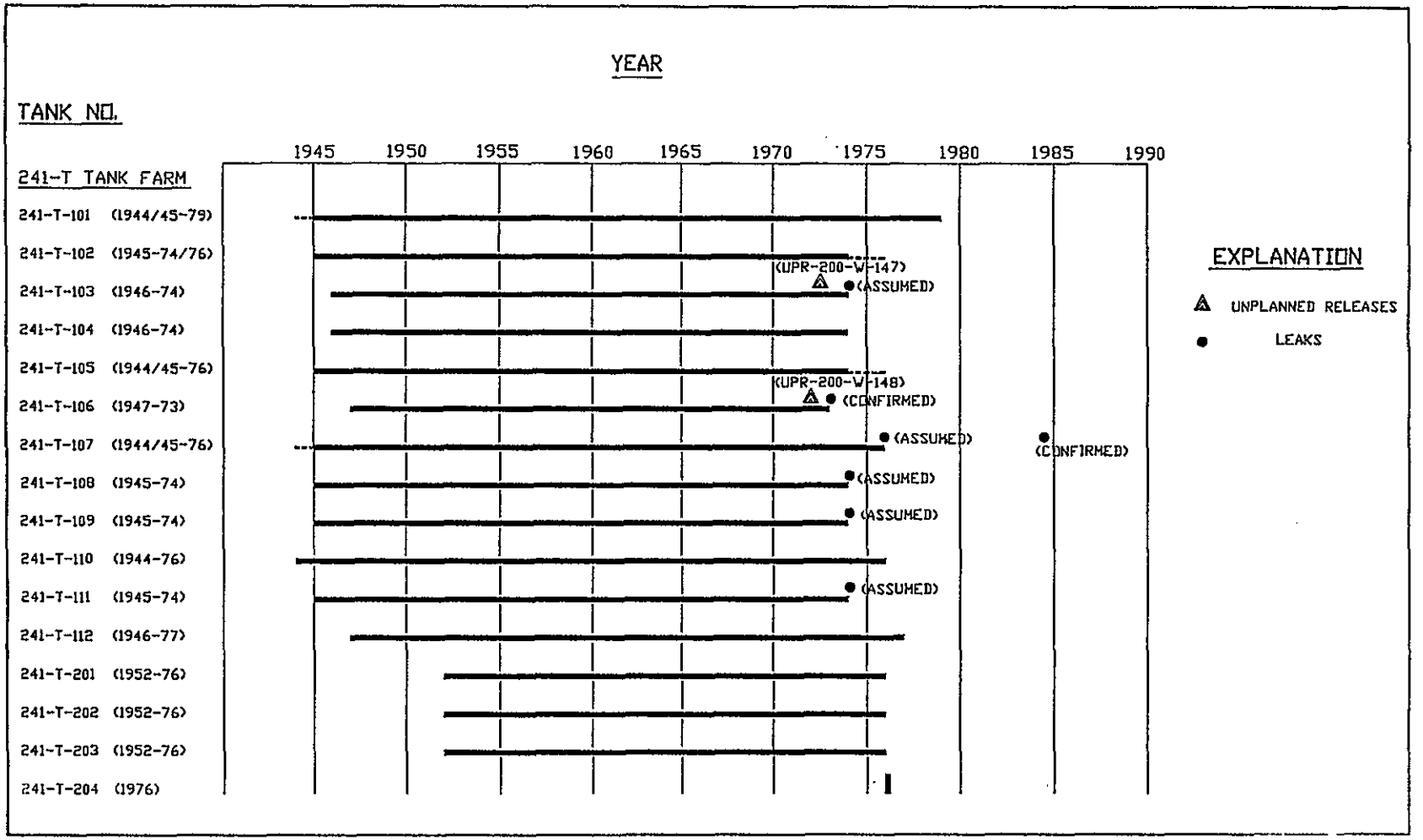


Figure 2-1. T Plant Aggregate Area Timeline. (Sheet 1 of 9)

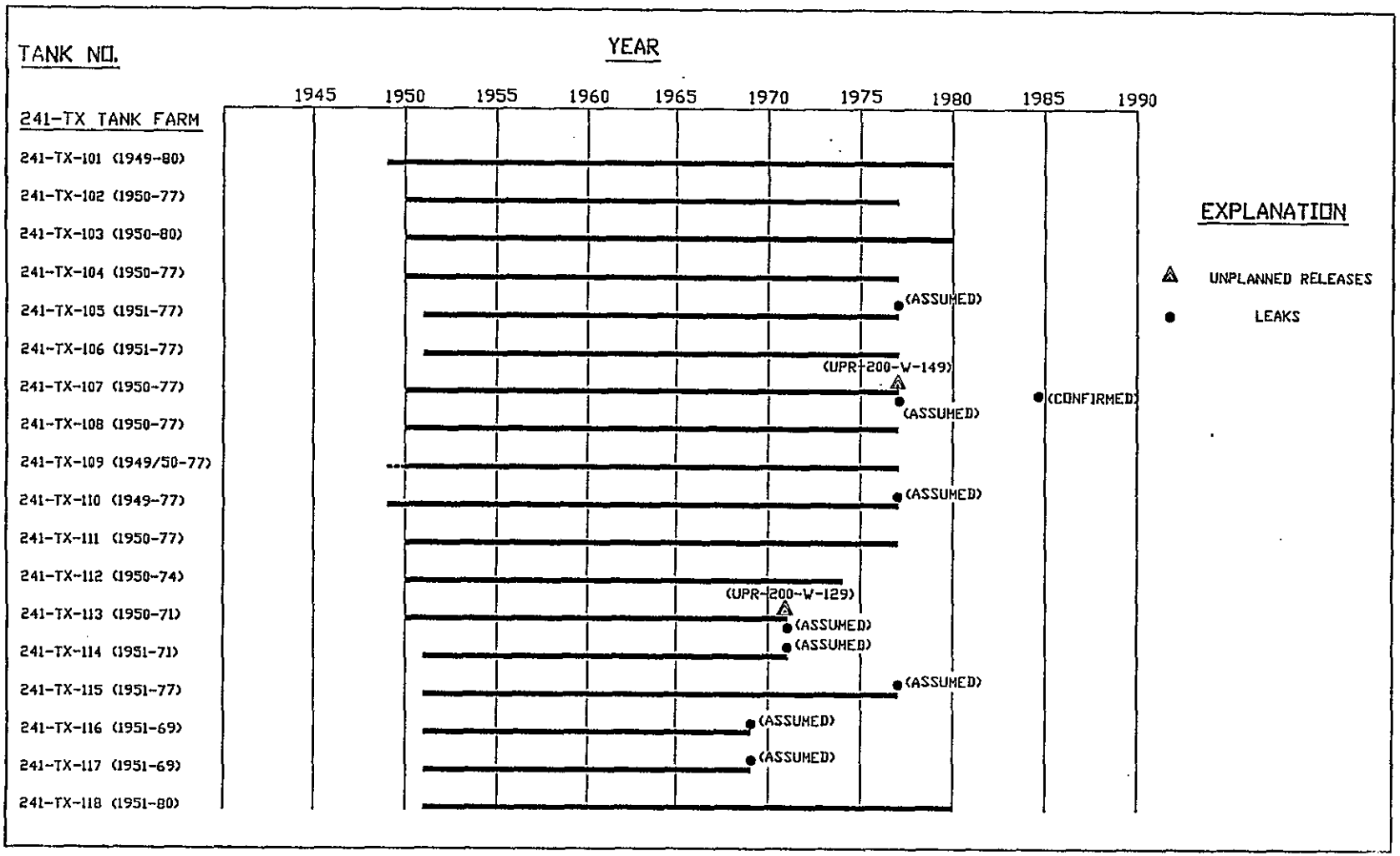


Figure 2-1. T Plant Aggregate Area Timeline. (Sheet 2 of 9)

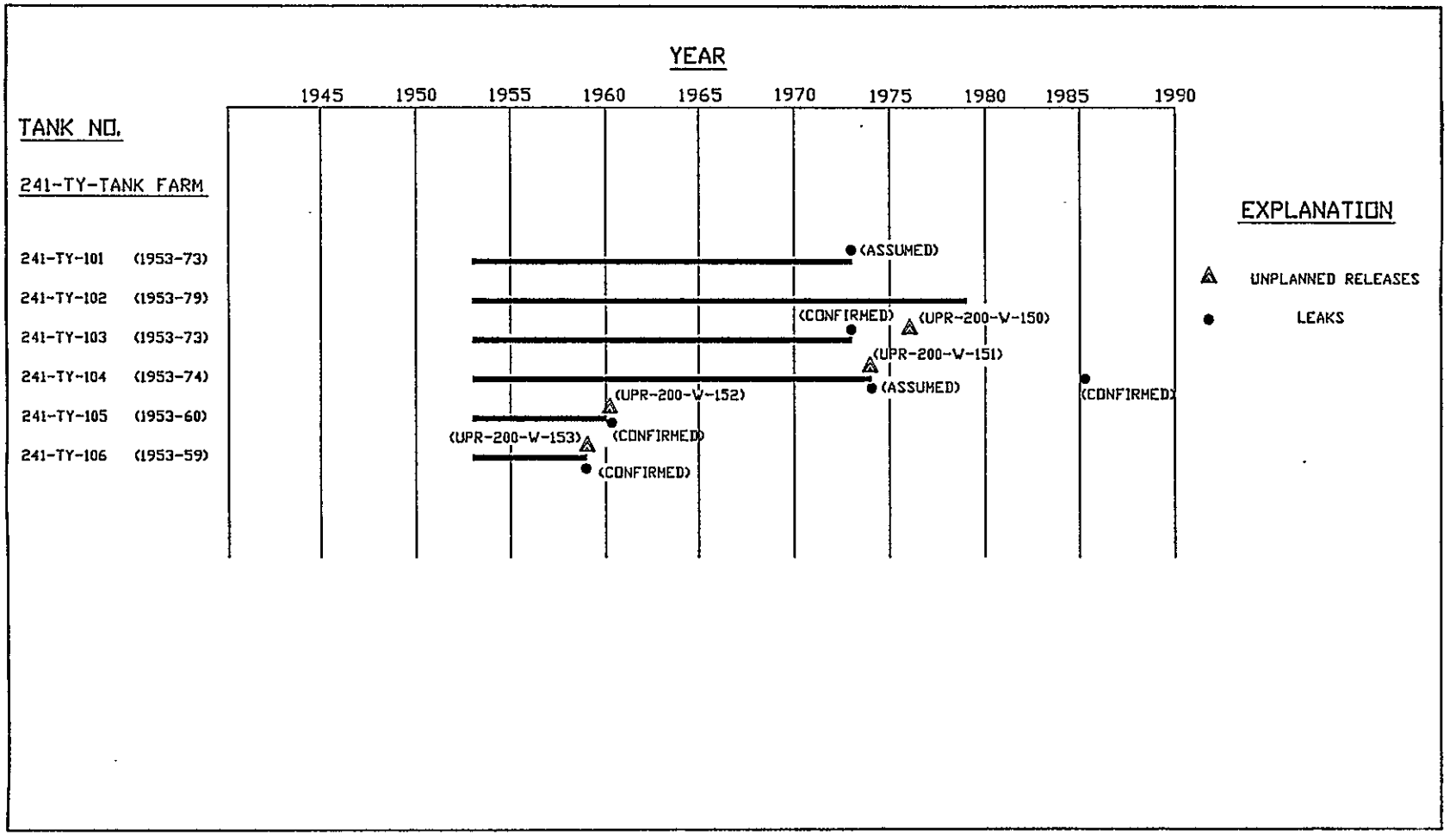


Figure 2-1. T Plant Aggregate Area Timeline. (Sheet 3 of 9)

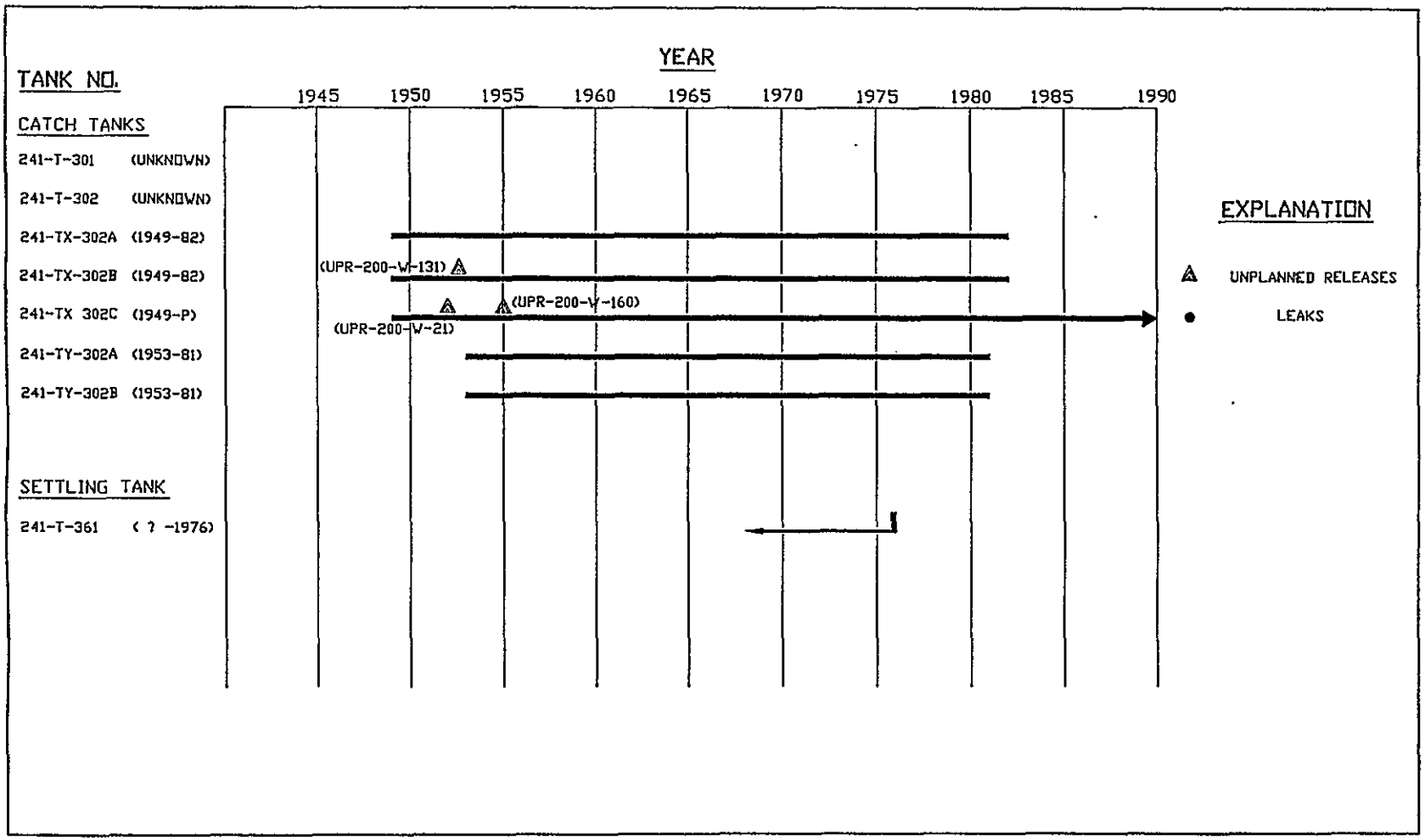


Figure 2-1. T Plant Aggregate Area Timeline. (Sheet 4 of 9)

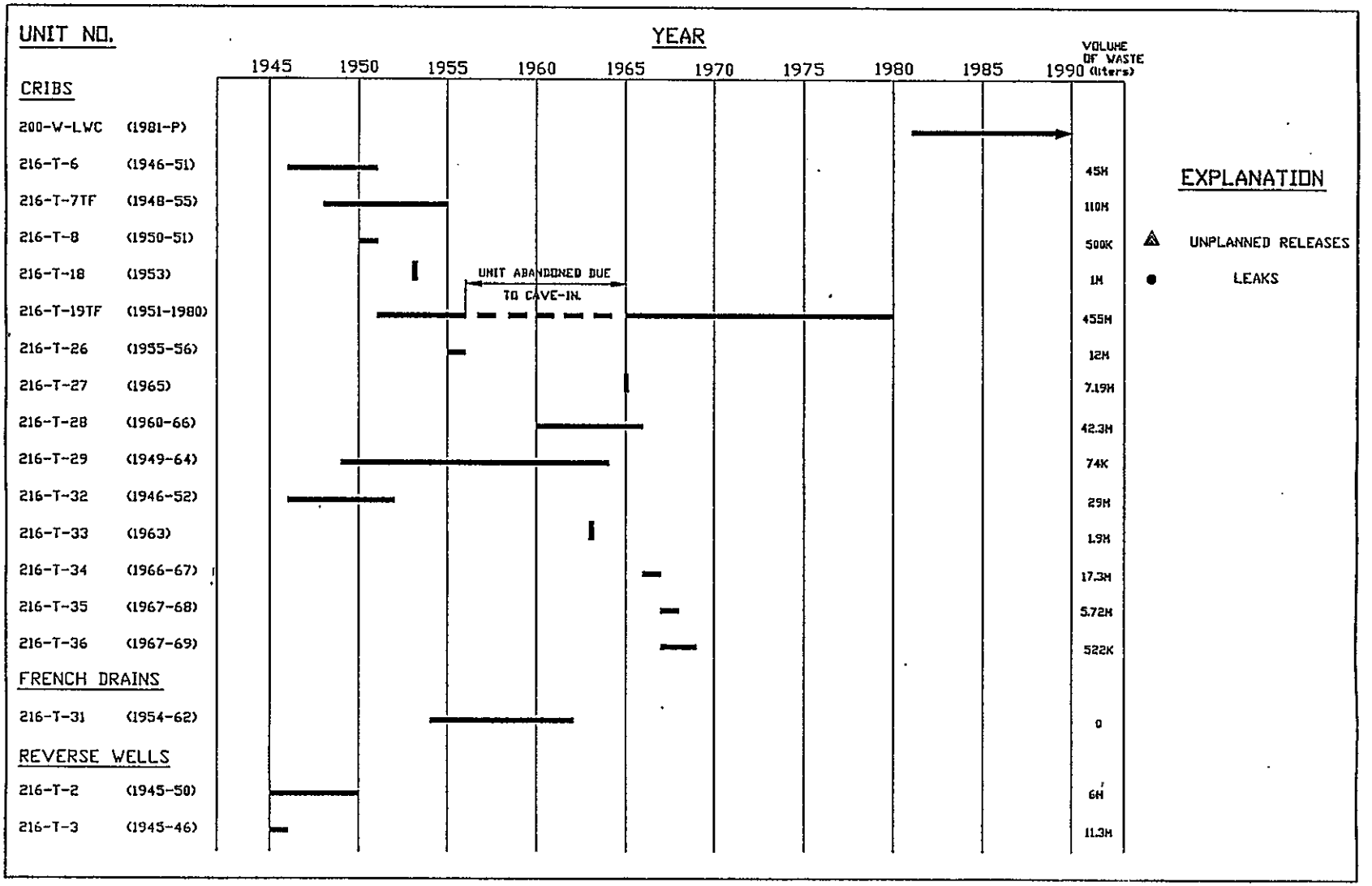


Figure 2-1. T Plant Aggregate Area Timeline. (Sheet 5 of 9)

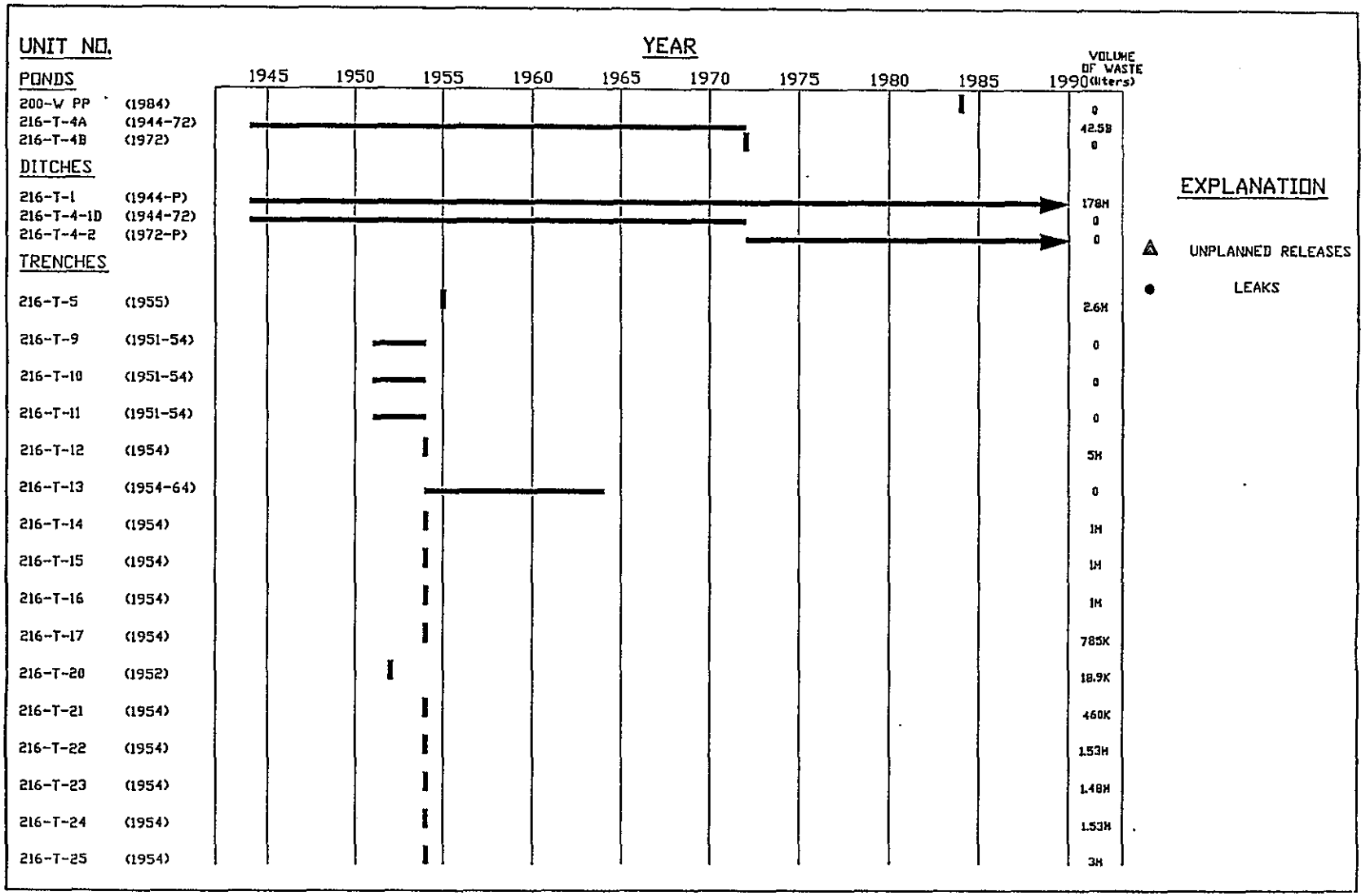


Figure 2-1. T Plant Aggregate Area Timeline. (Sheet 6 of 9)

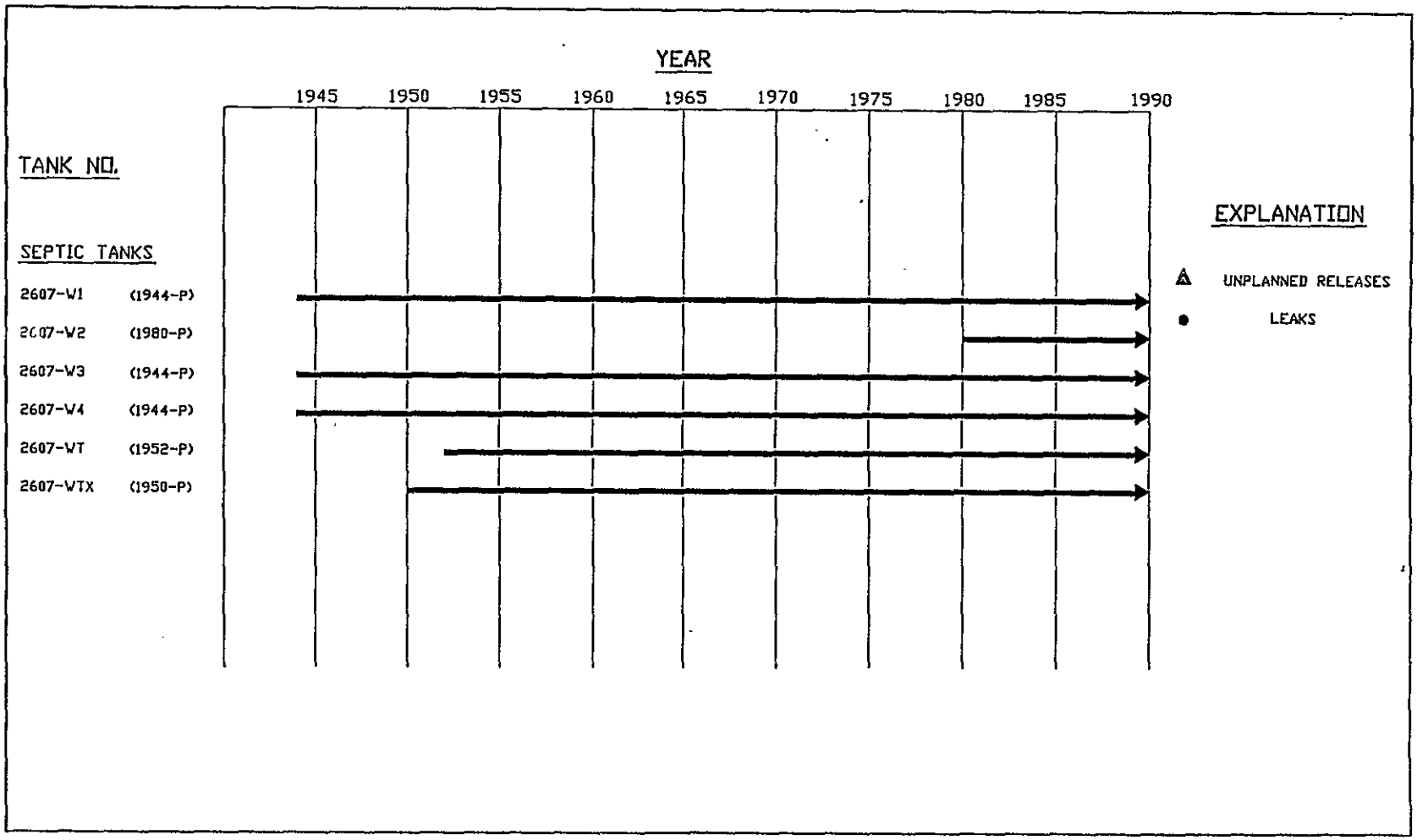


Figure 2-1. T Plant Aggregate Area Timeline. (Sheet 7 of 9)

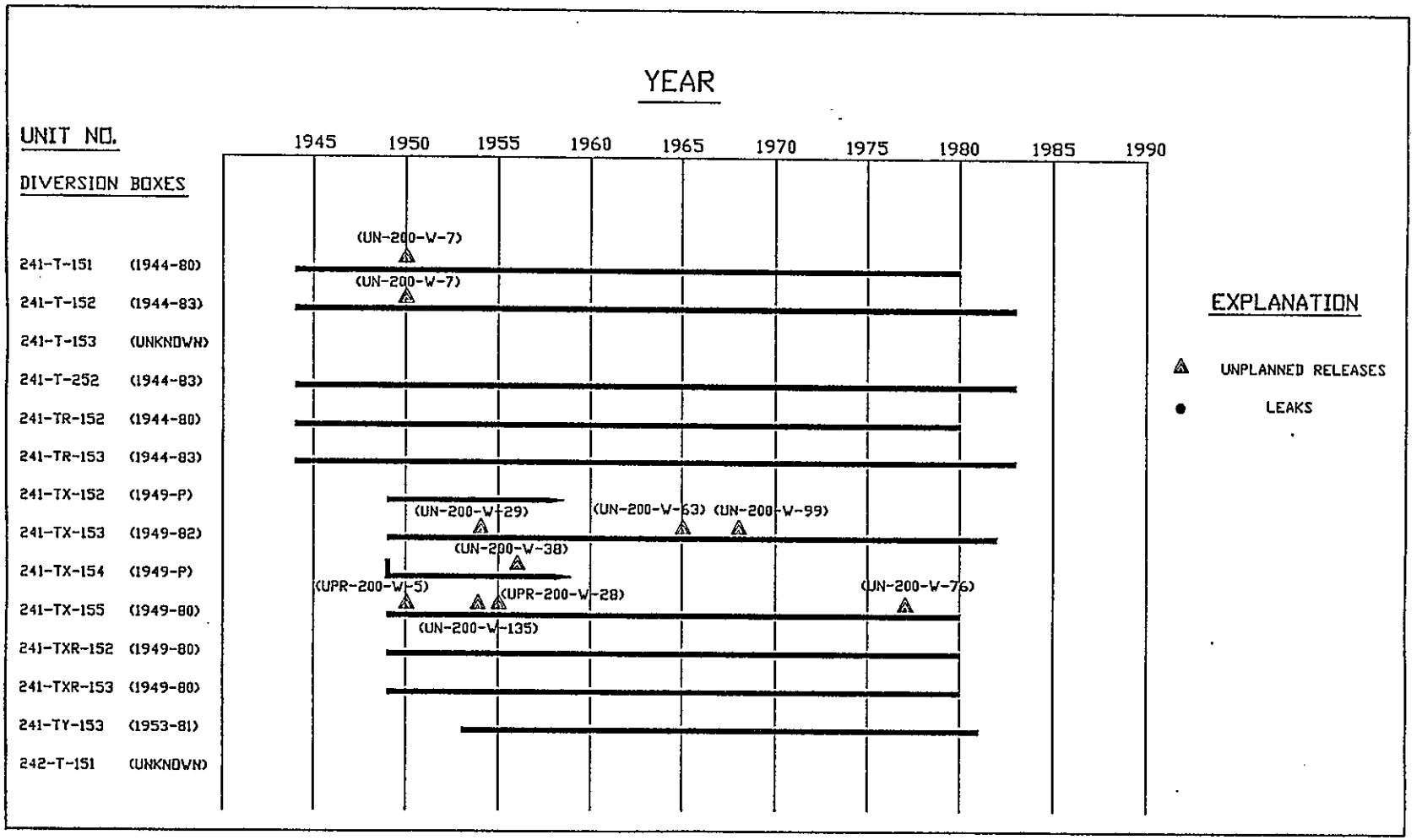


Figure 2-1. T Plant Aggregate Area Timeline. (Sheet 8 of 9)

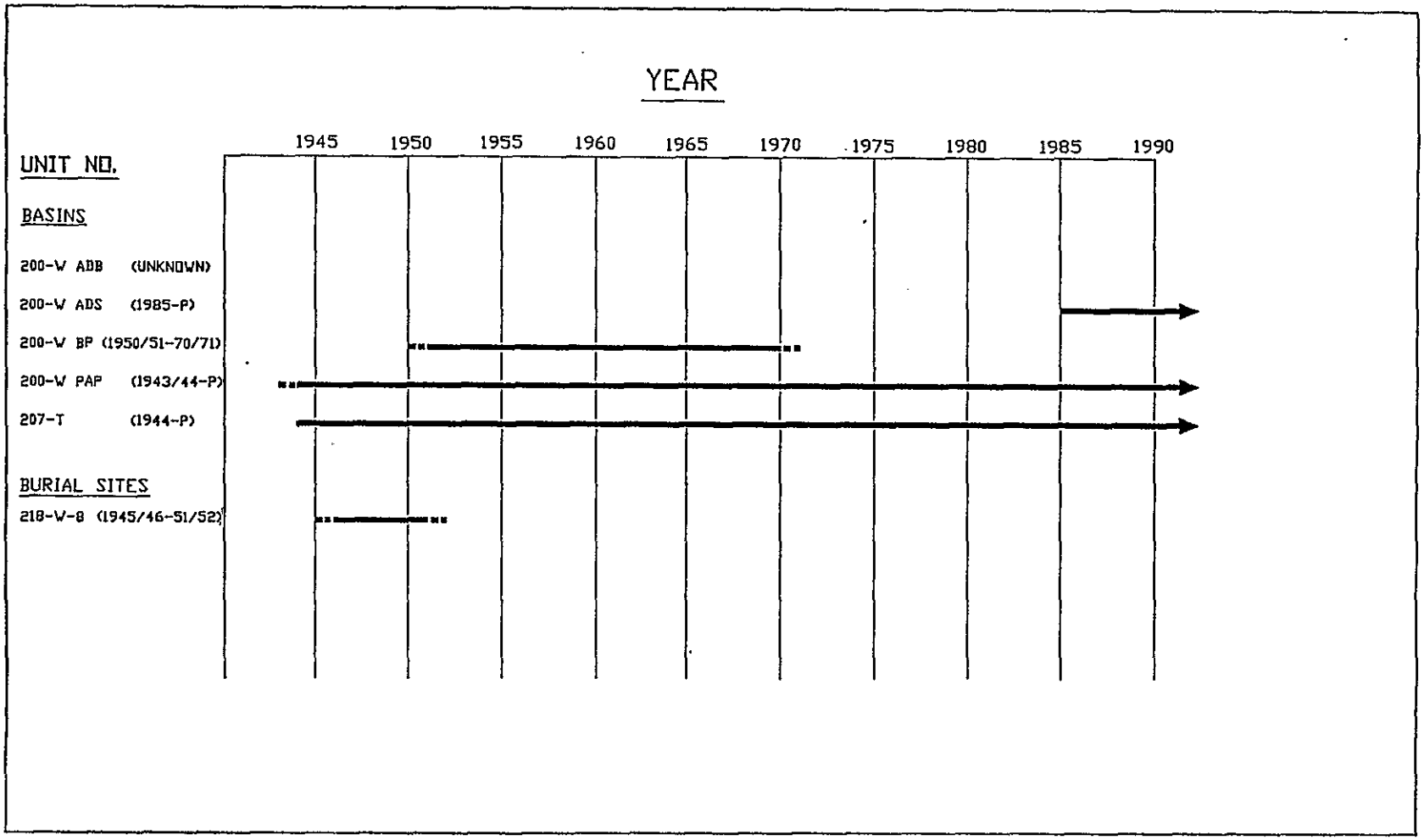


Figure 2-1. T Plant Aggregate Area Timeline. (Sheet 9 of 9)

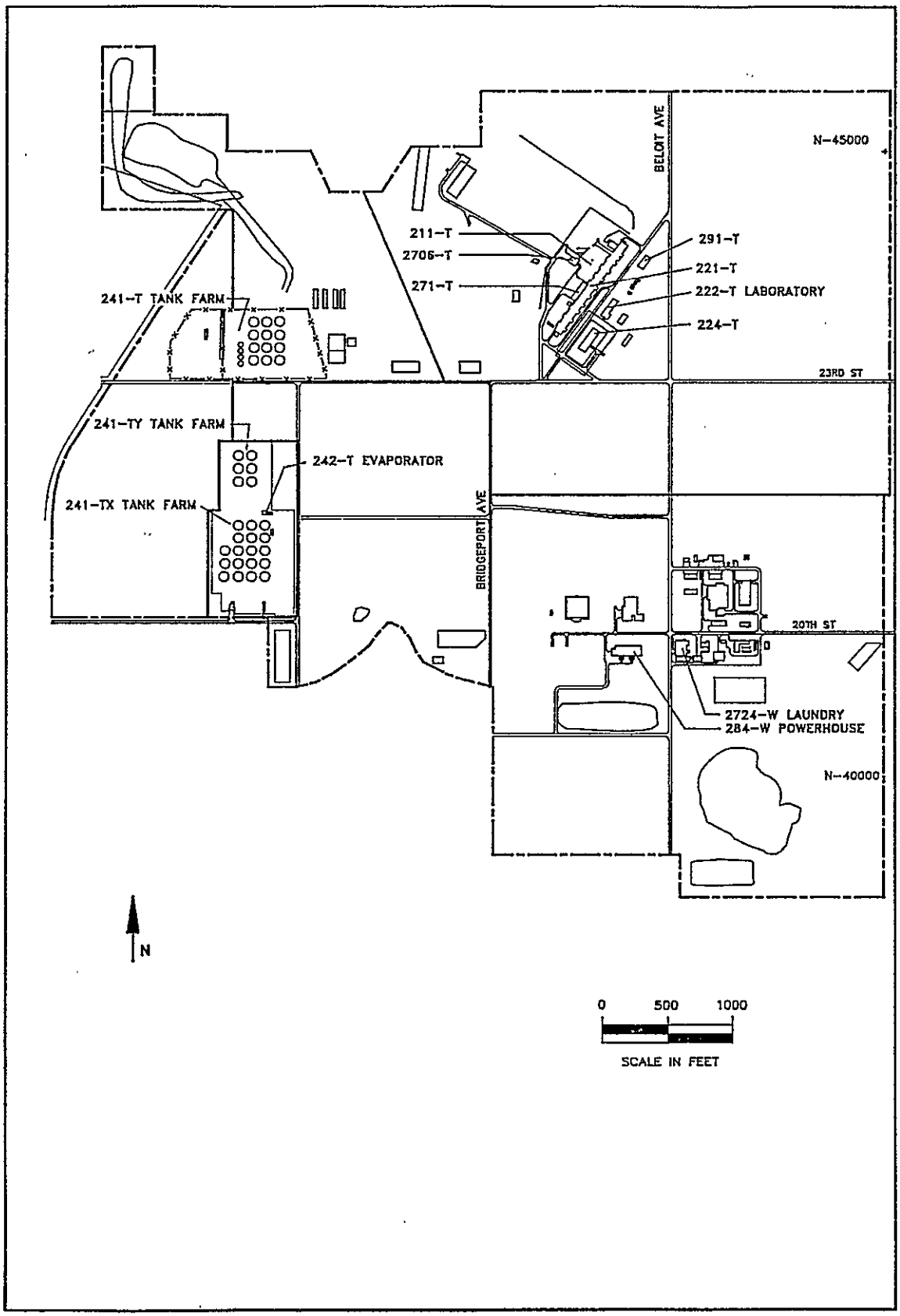


Figure 2-2. Location of Plants and Buildings.

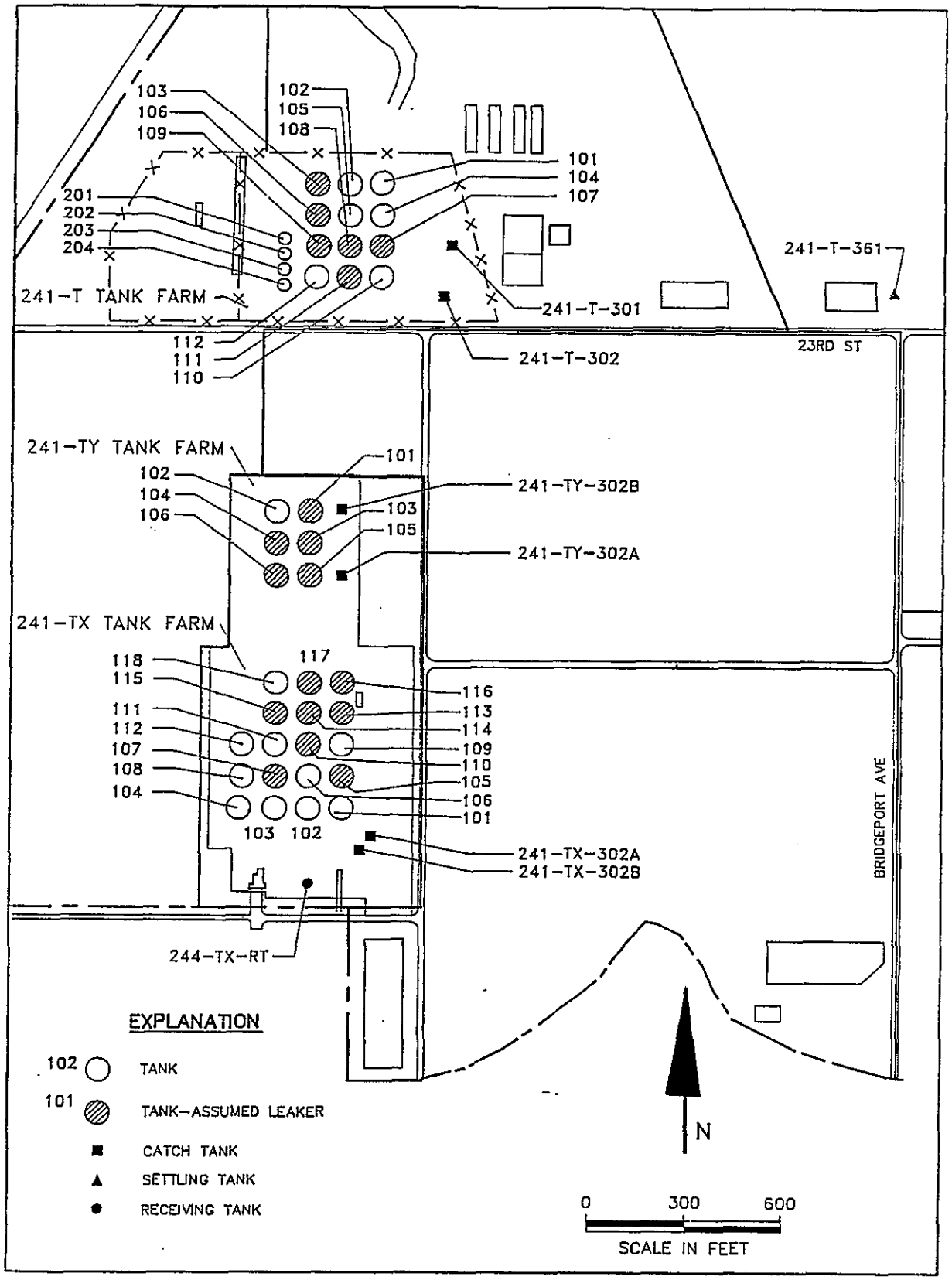


Figure 2-3. Location of Tanks and Vaults. (Sheet 1 of 2)

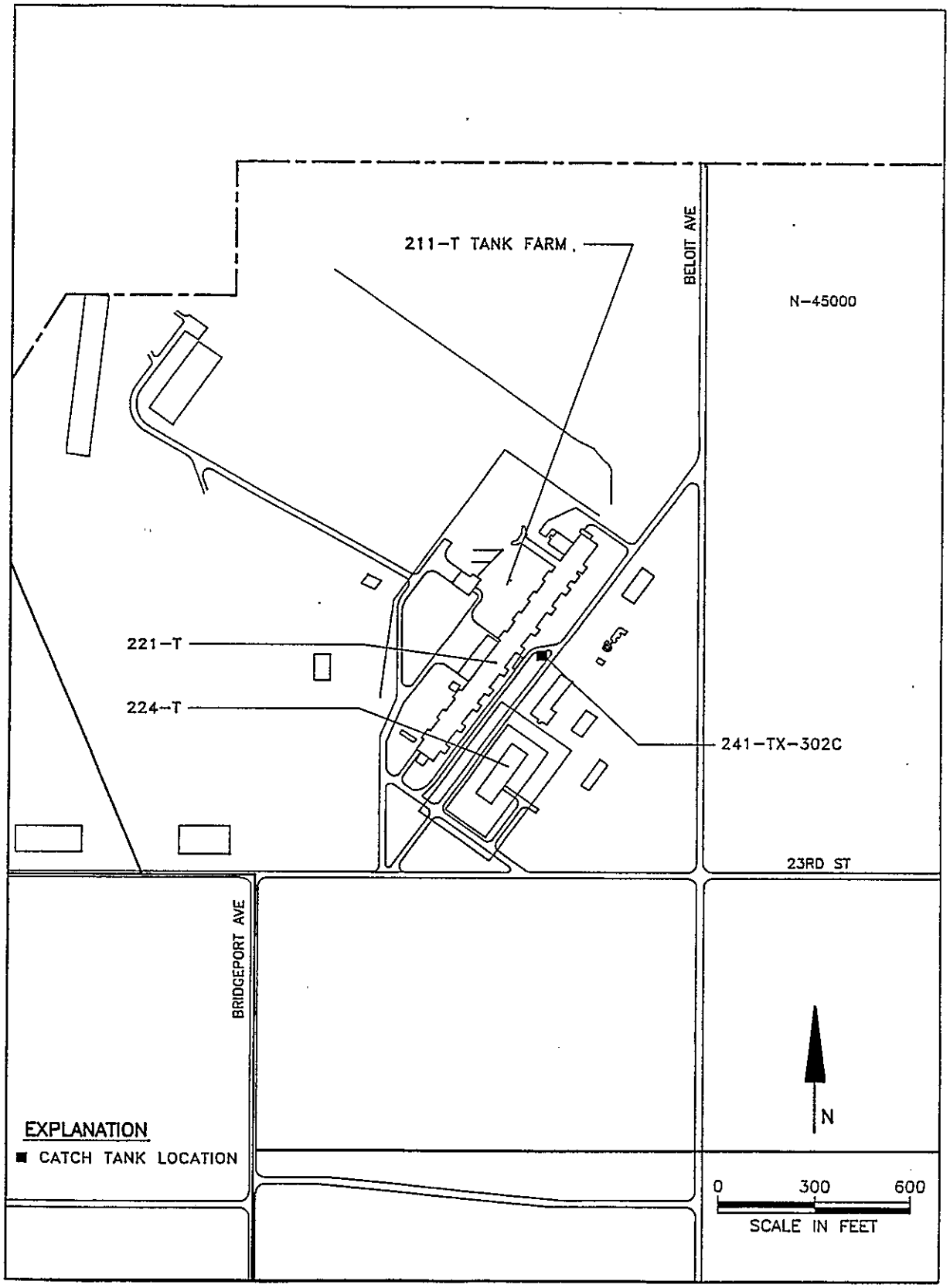


Figure 2-3. Location of Tanks and Vaults. (Sheet 2 of 2)

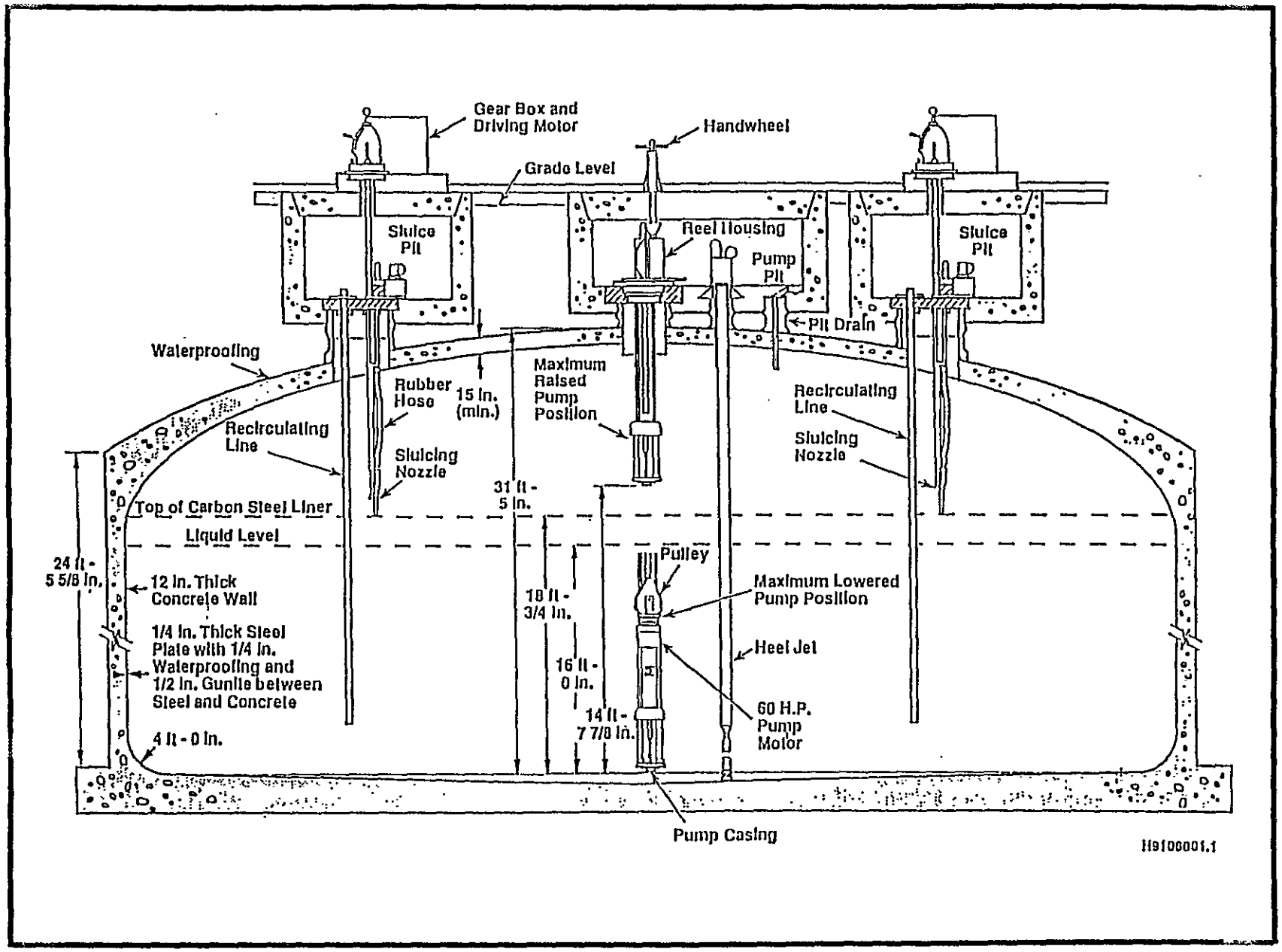


Figure 2-4. Typical Tank.

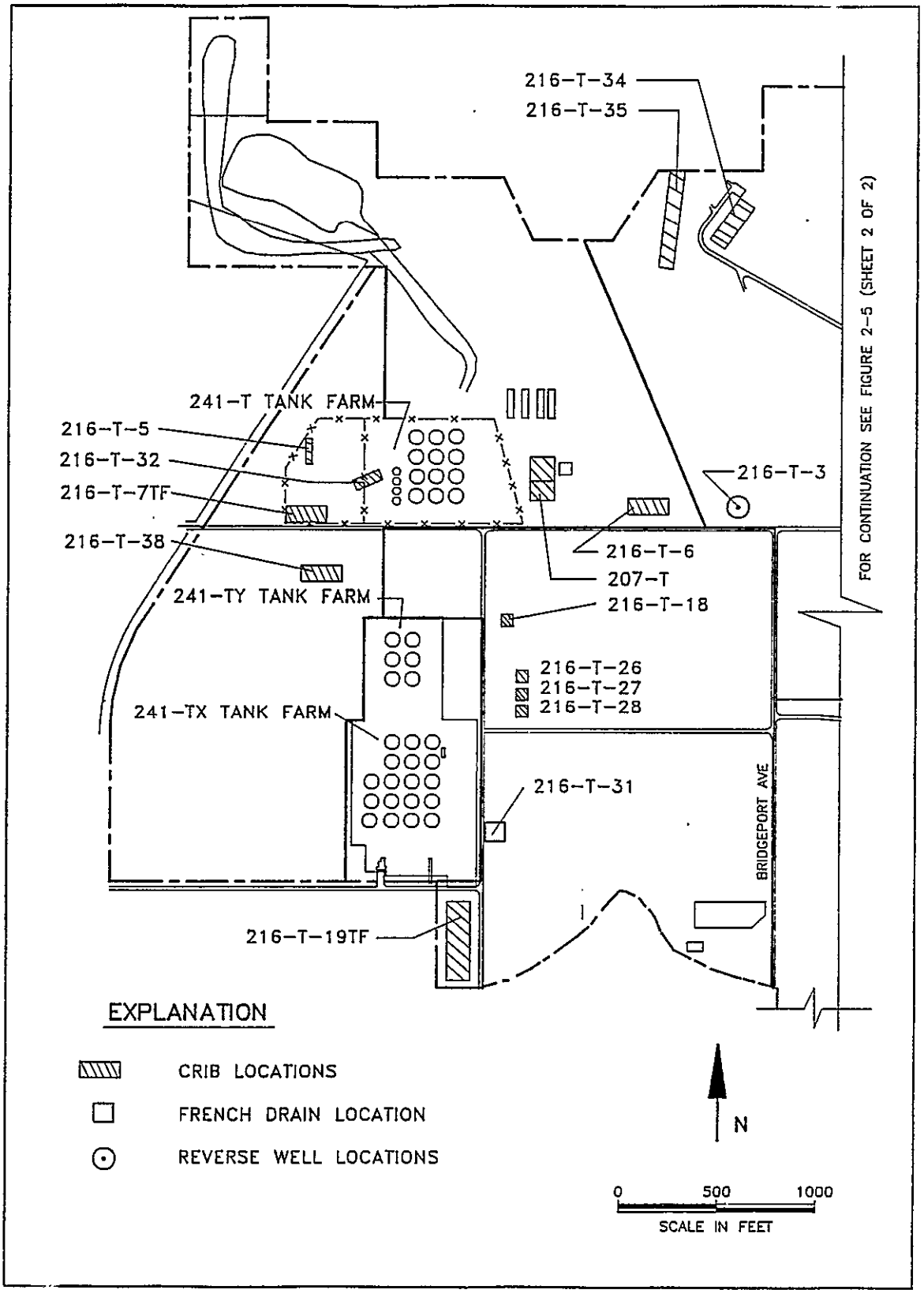


Figure 2-5. Location of Cribs, Drains and Reverse Wells. (Sheet 1 of 2)

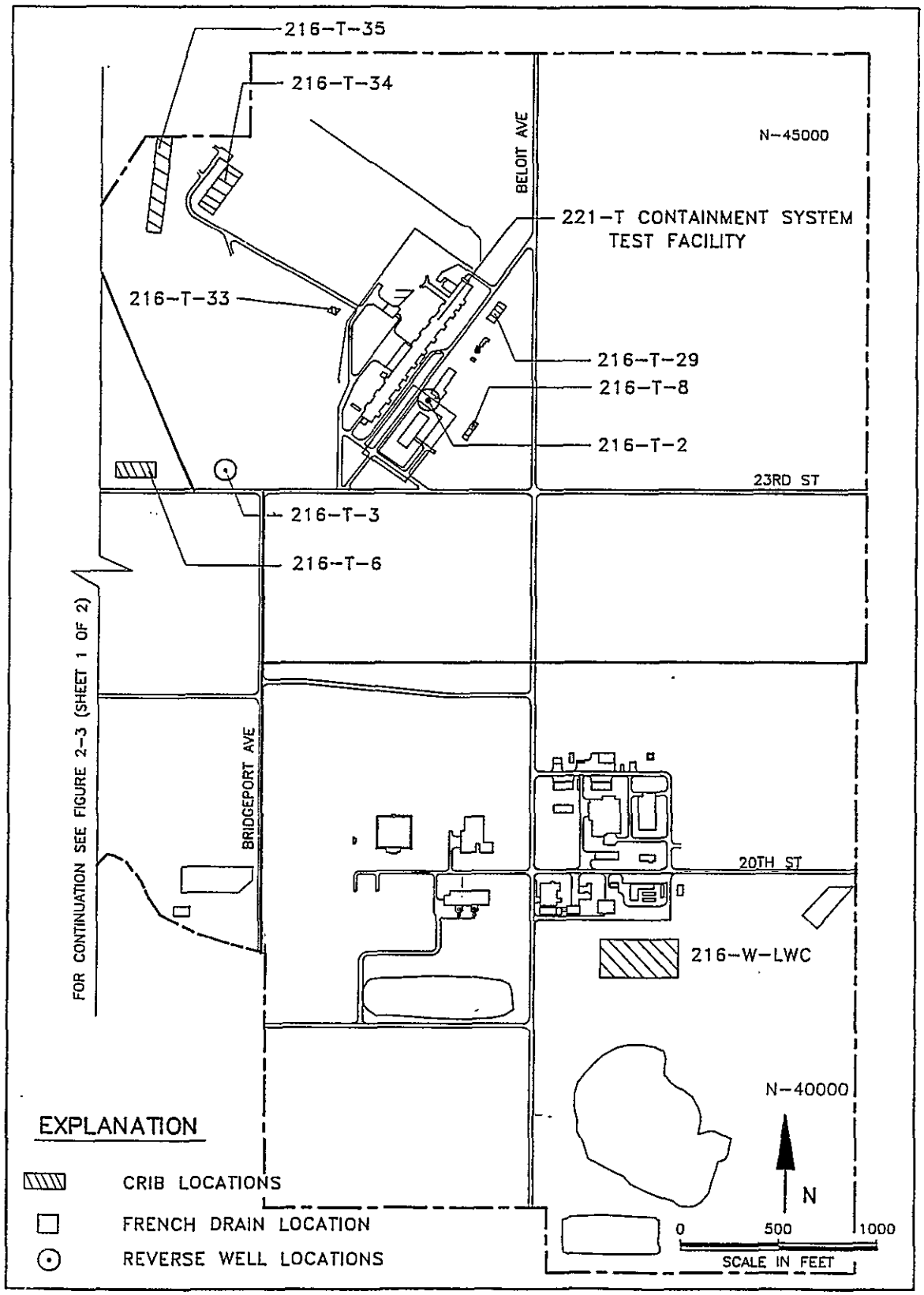


Figure 2-5. Location of Cribs, Drains and Reverse Wells. (Sheet 2 of 2)

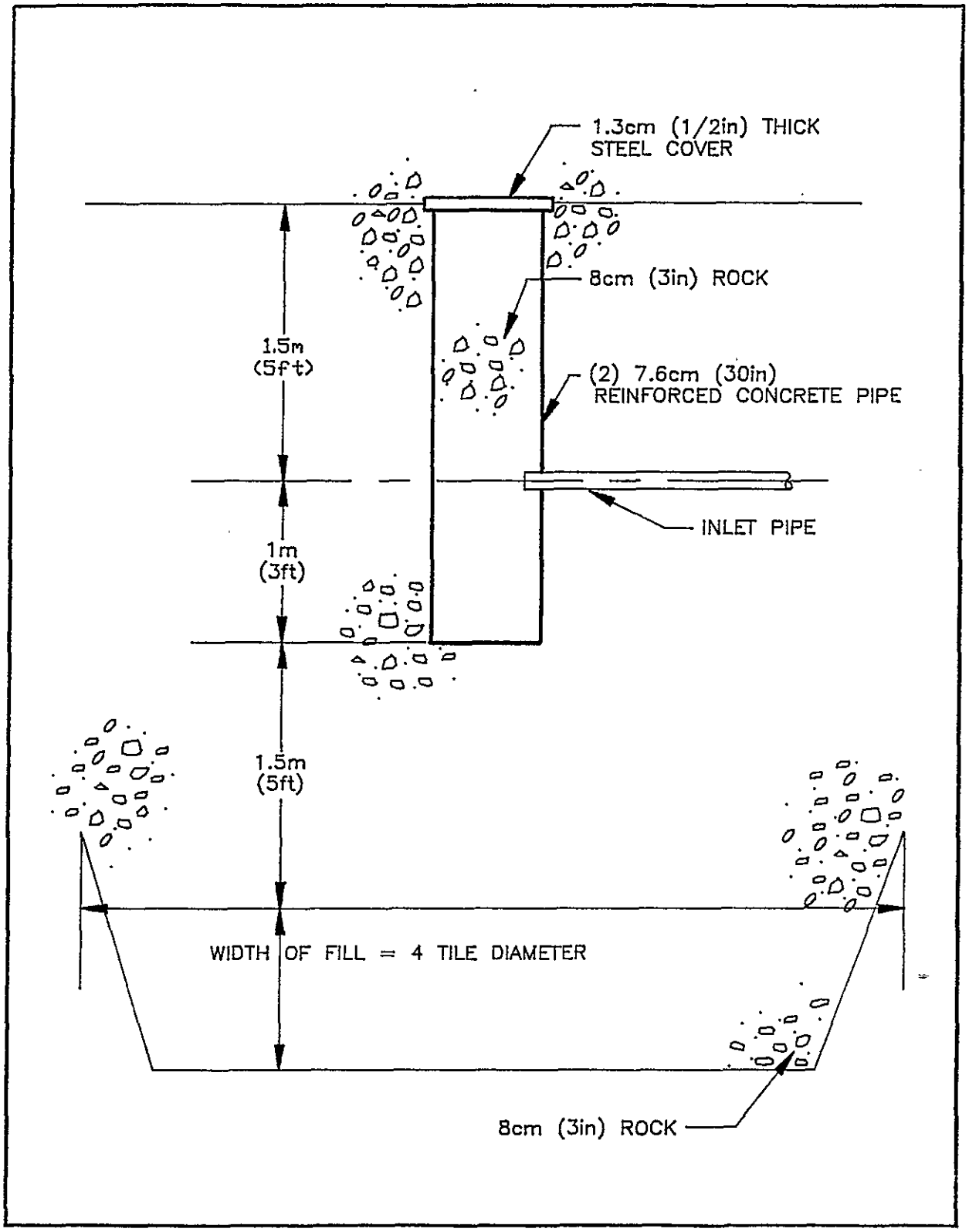


Figure 2-6. Typical French Drain.

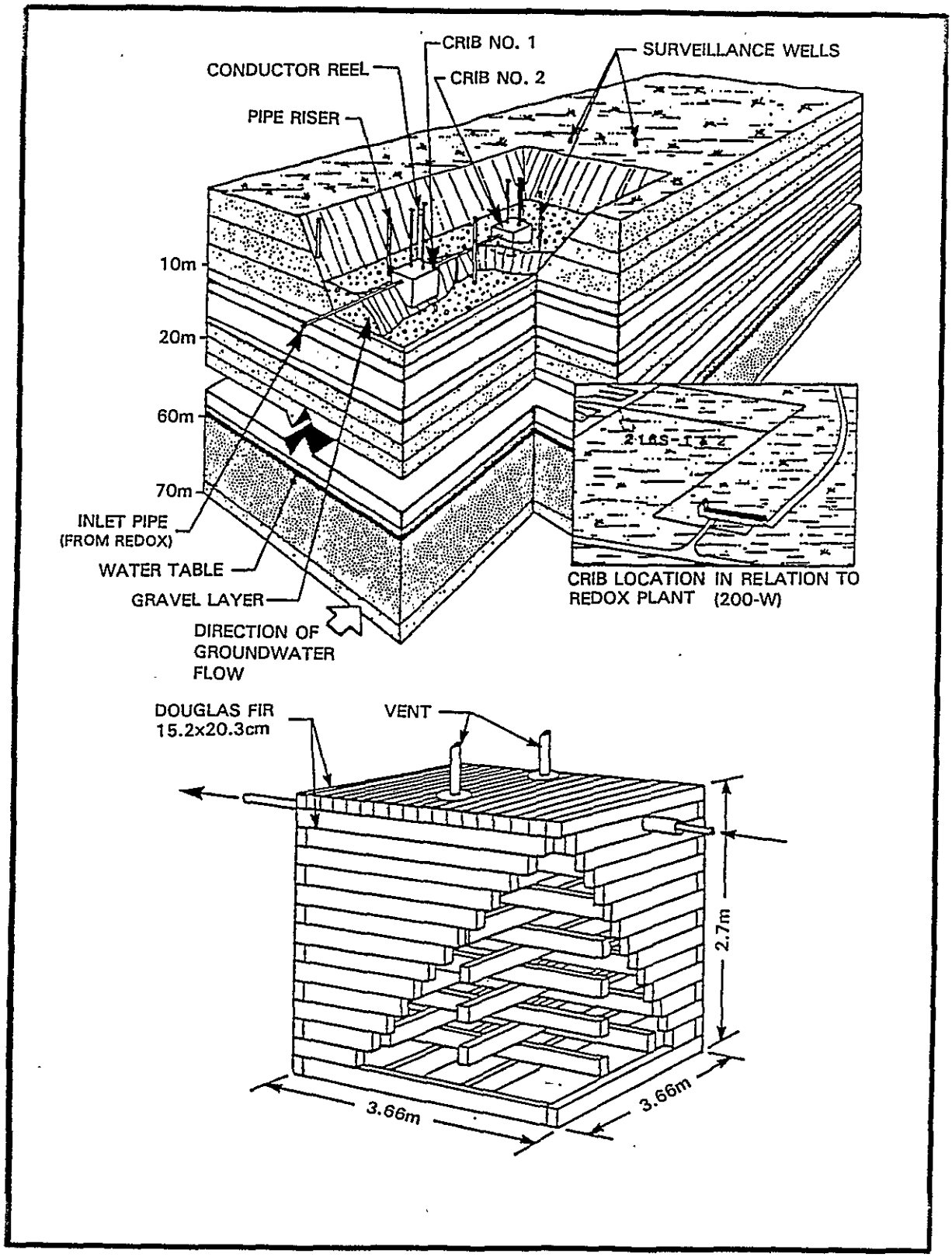


Figure 2-7. Typical Crib.

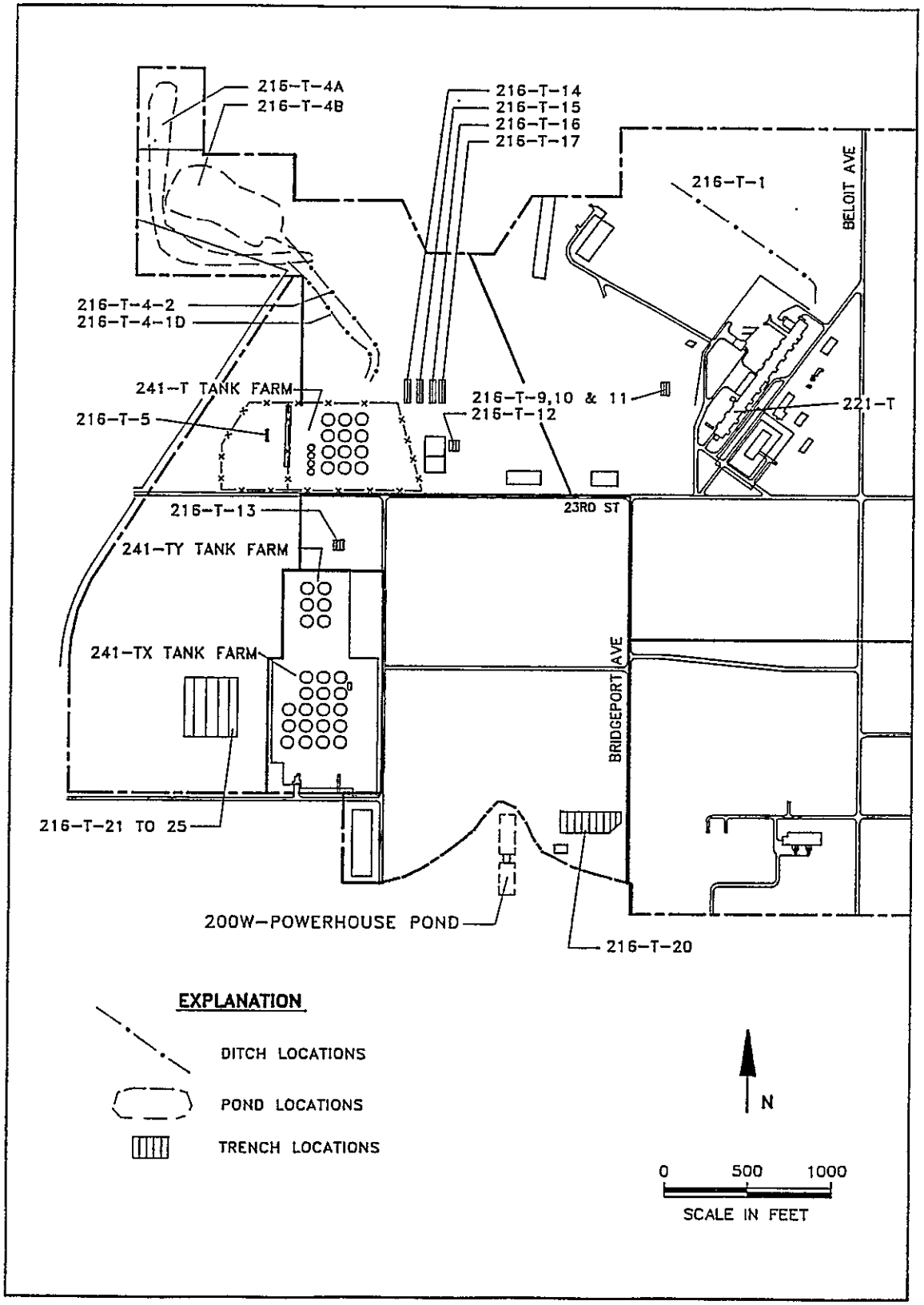


Figure 2-8. Location of Trenches, Ditches and Ponds.

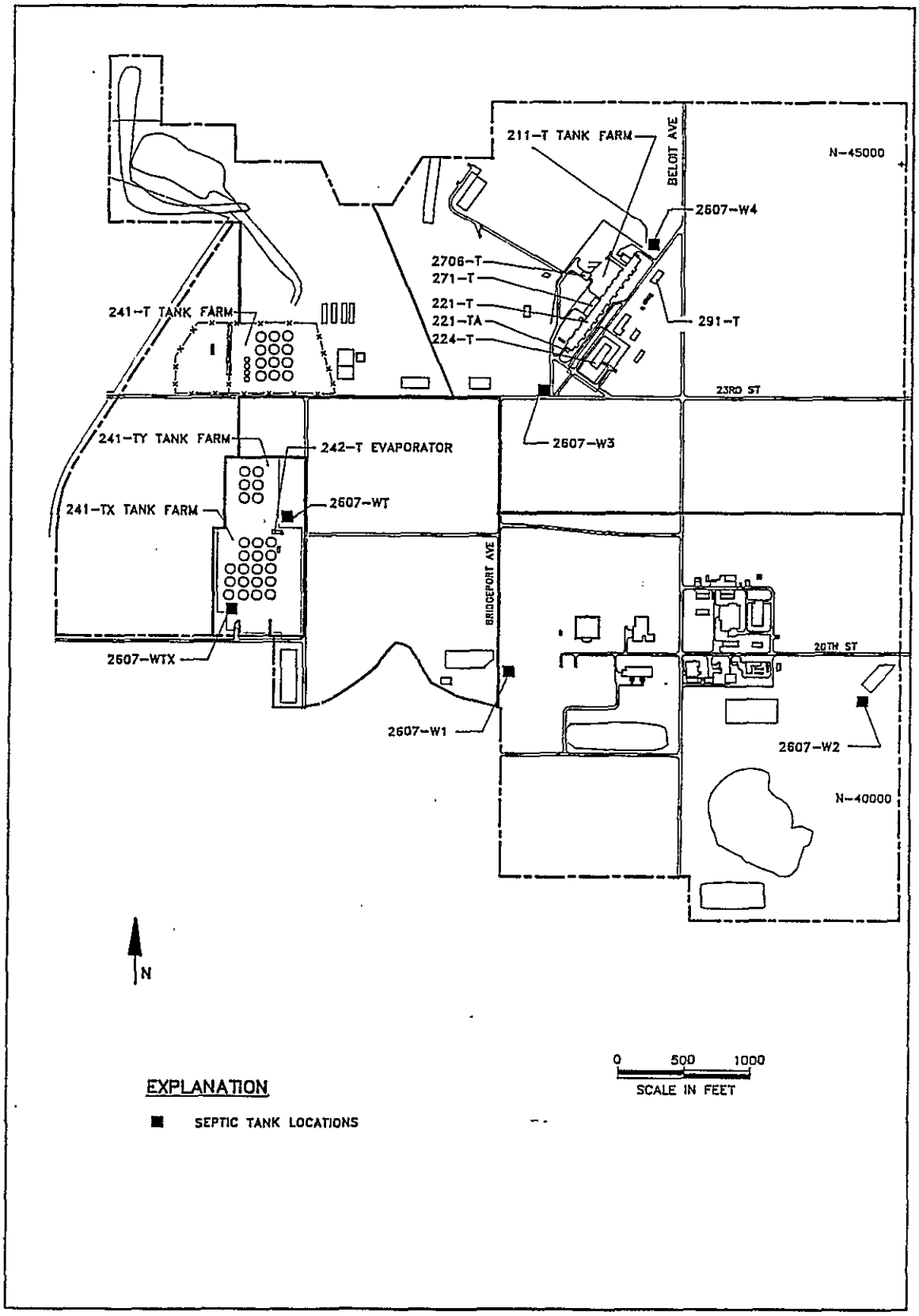


Figure 2-9. Location of Septic Tanks and Associated Drain Fields.

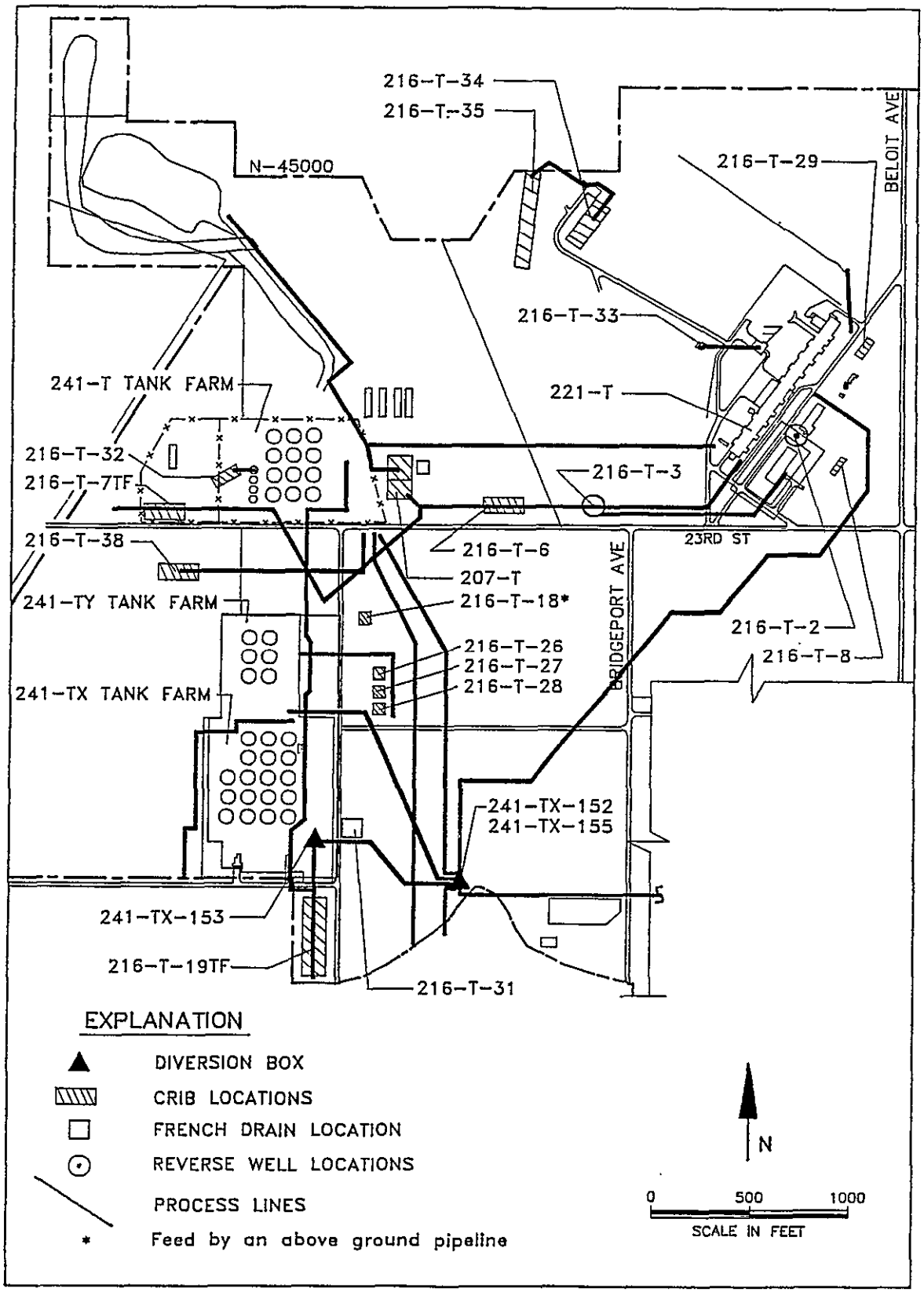


Figure 2-10. Location of Process Lines. (Sheet 1 of 2)

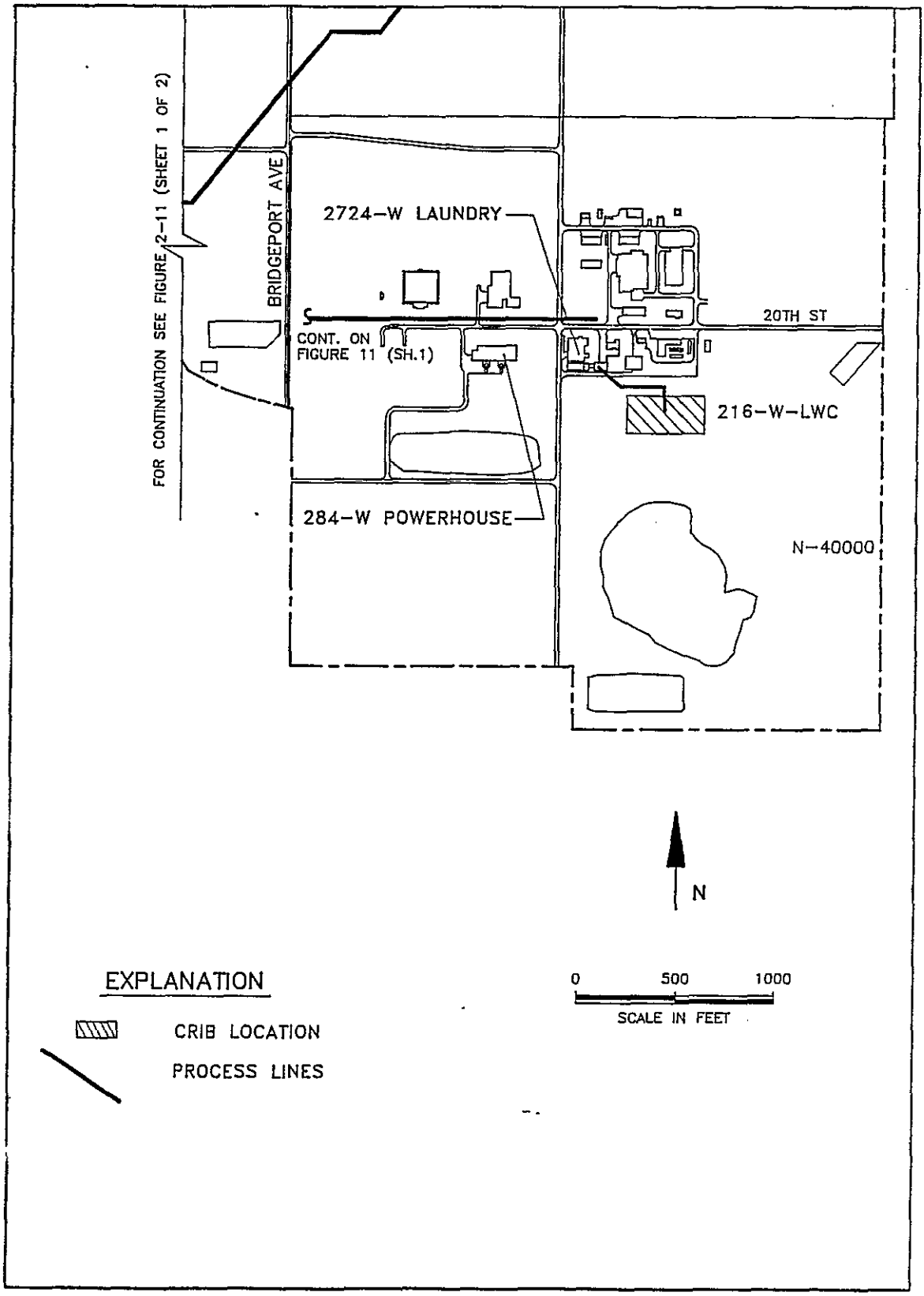


Figure 2-10. Location of Process Lines. (Sheet 2 of 2)

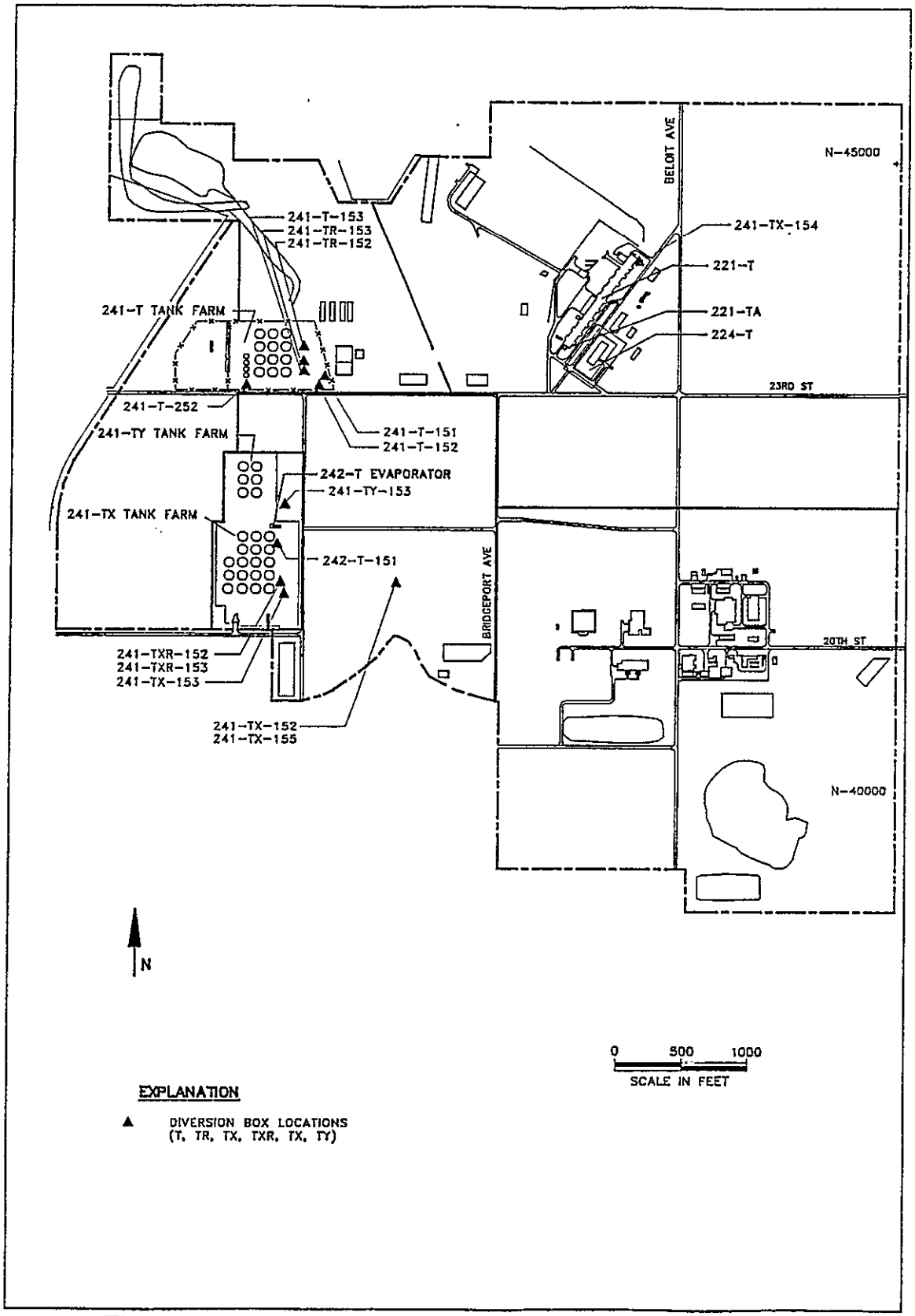


Figure 2-11. Location of Transfer Facilities and Diversion Boxes.

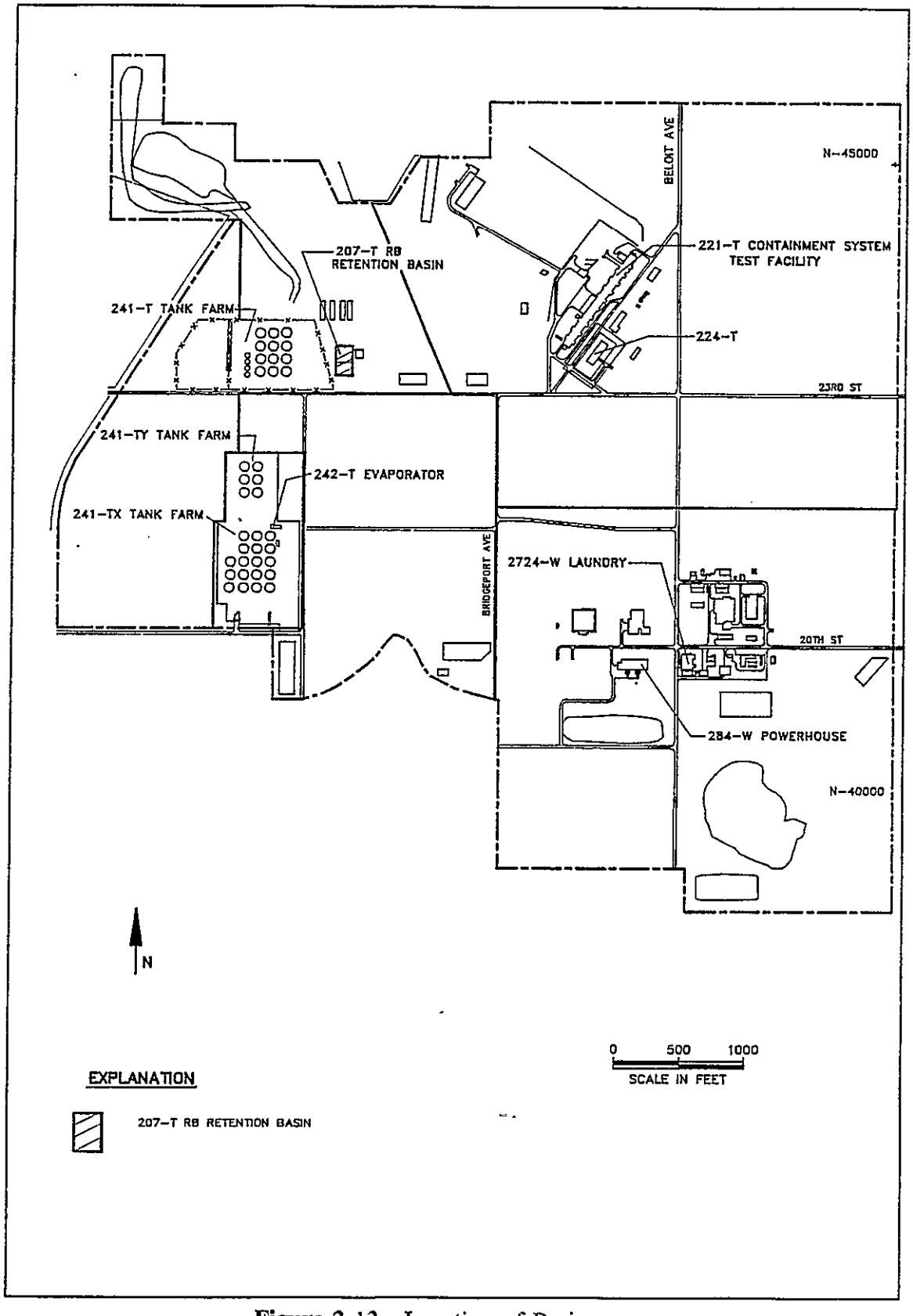


Figure 2-12. Location of Basins.

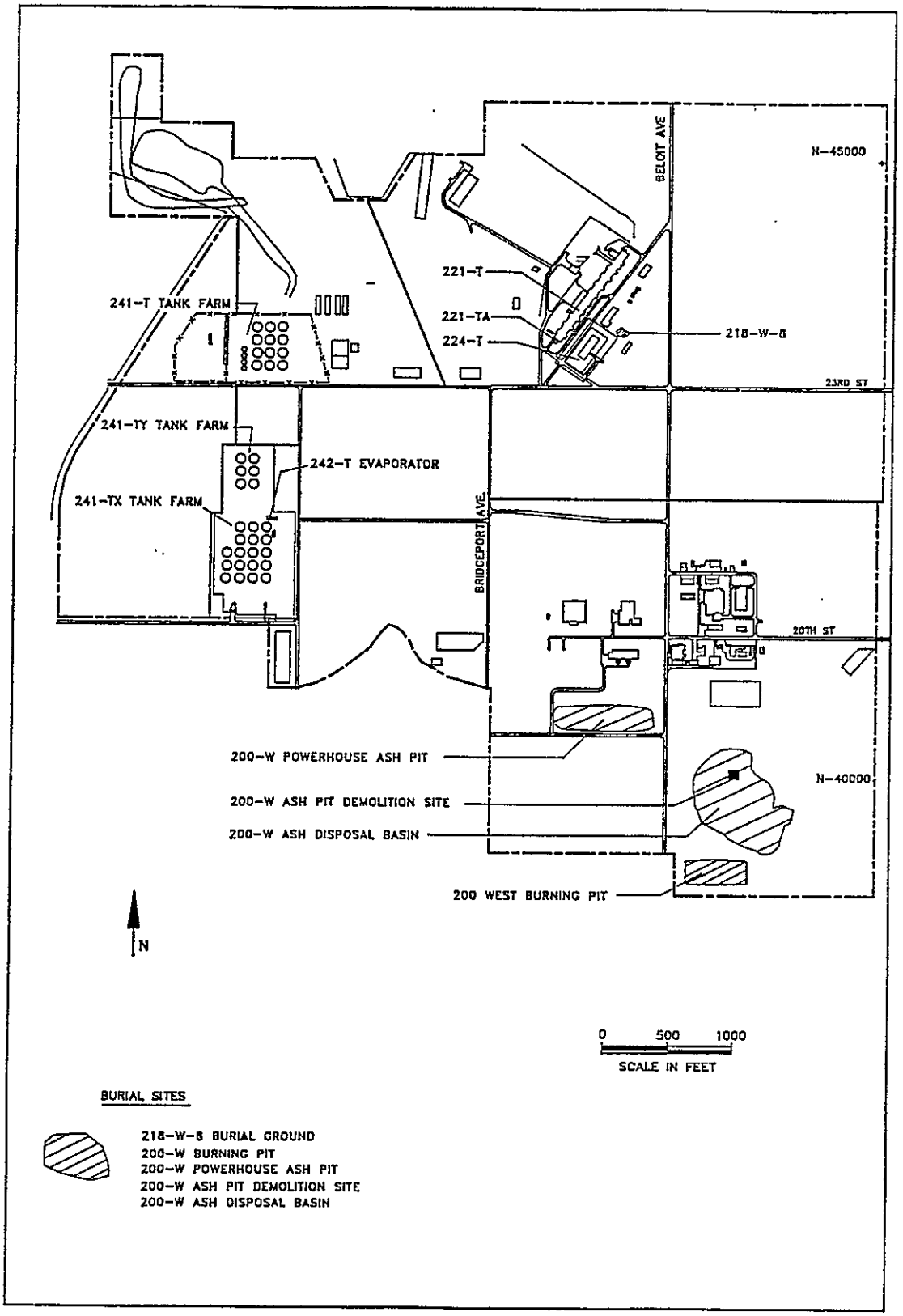


Figure 2-13. Location of Burial Sites.

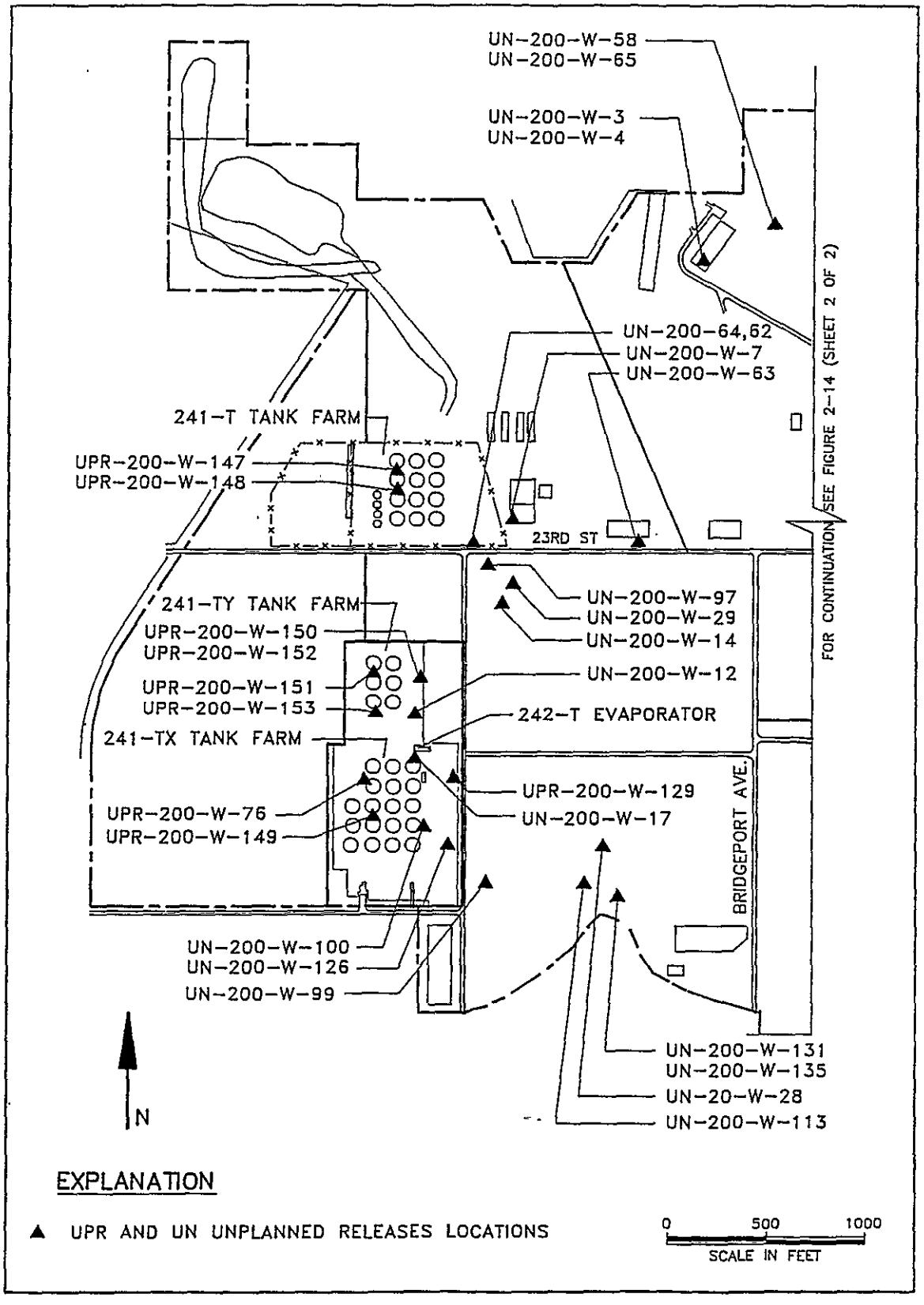


Figure 2-14. Location of Unplanned Releases. (Sheet 1 of 2)

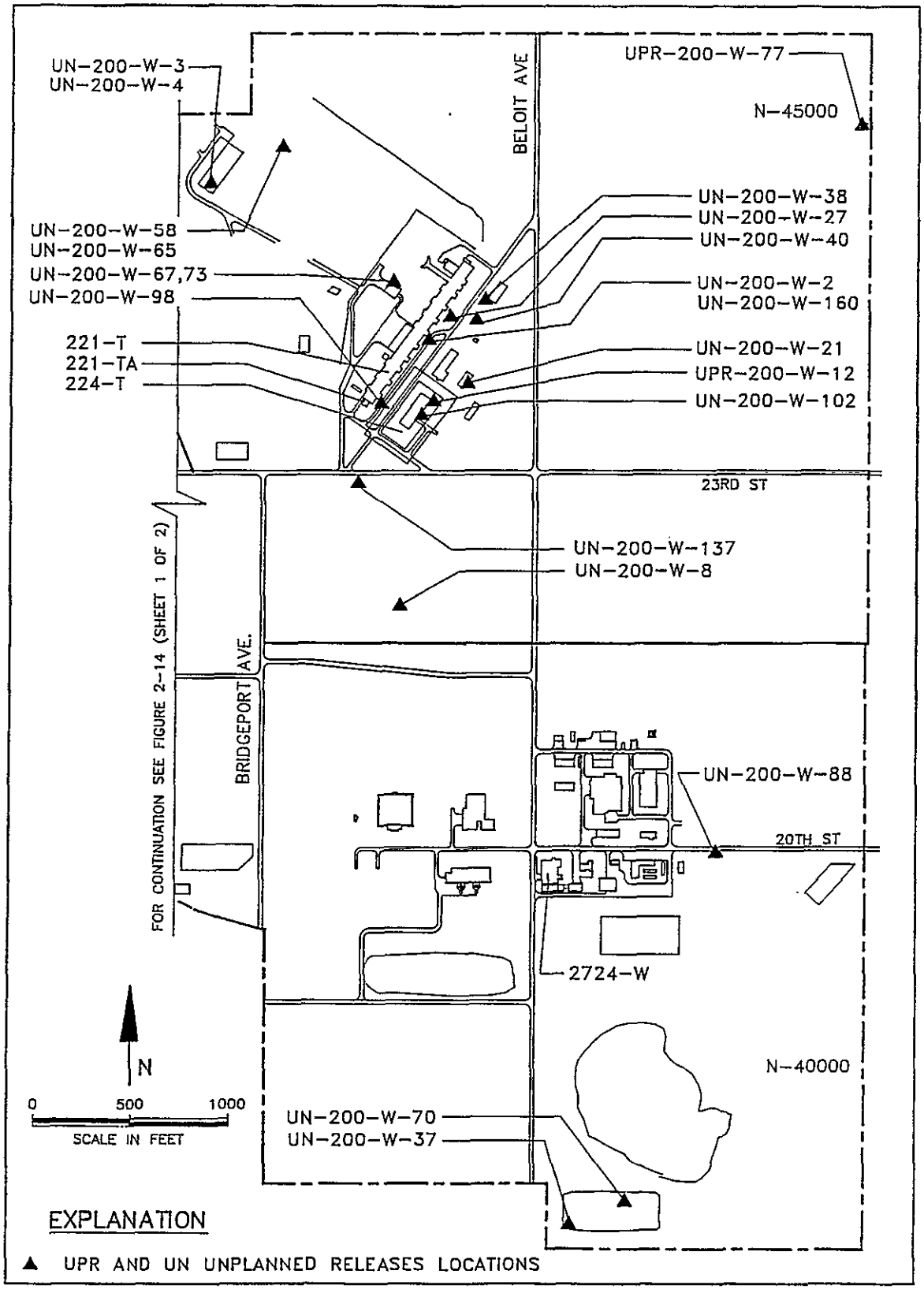


Figure 2-14. Location of Unplanned Releases. (Sheet 2 of 2)

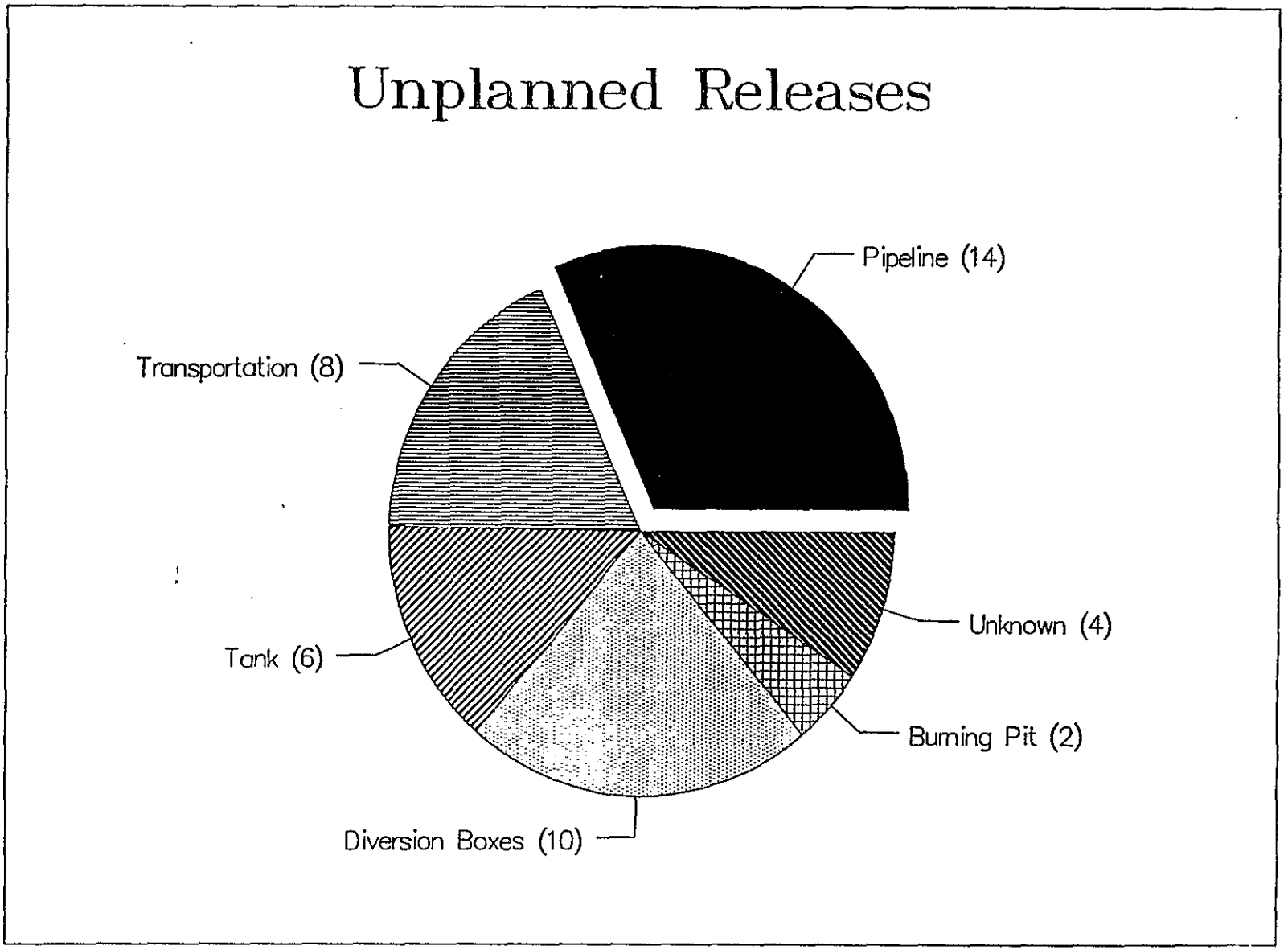


Figure 2-15. Unplanned Releases T Plant AAMS.

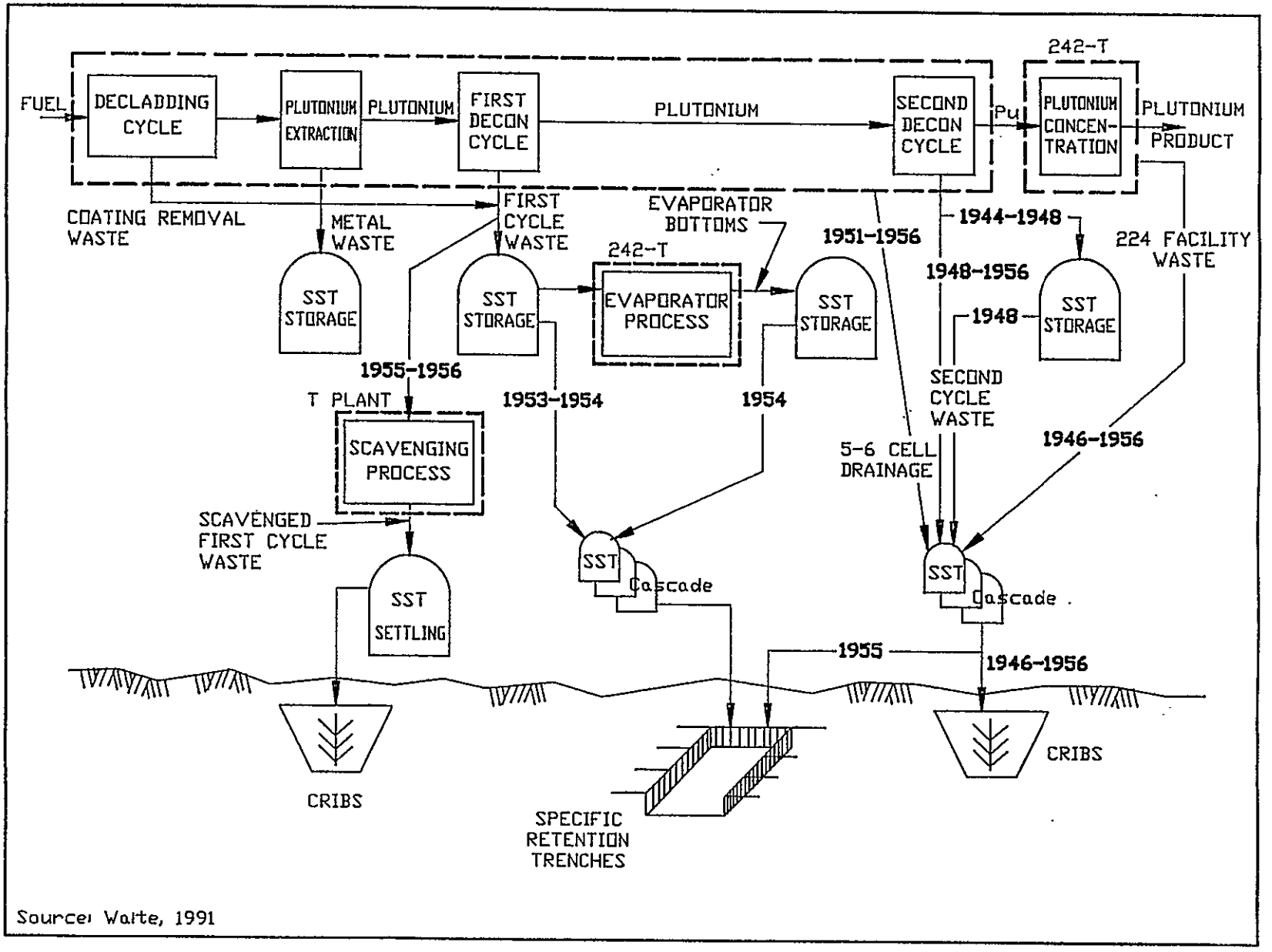


Figure 2-16. Waste Producing Diagram Fuel Reprocessing in T Plant.

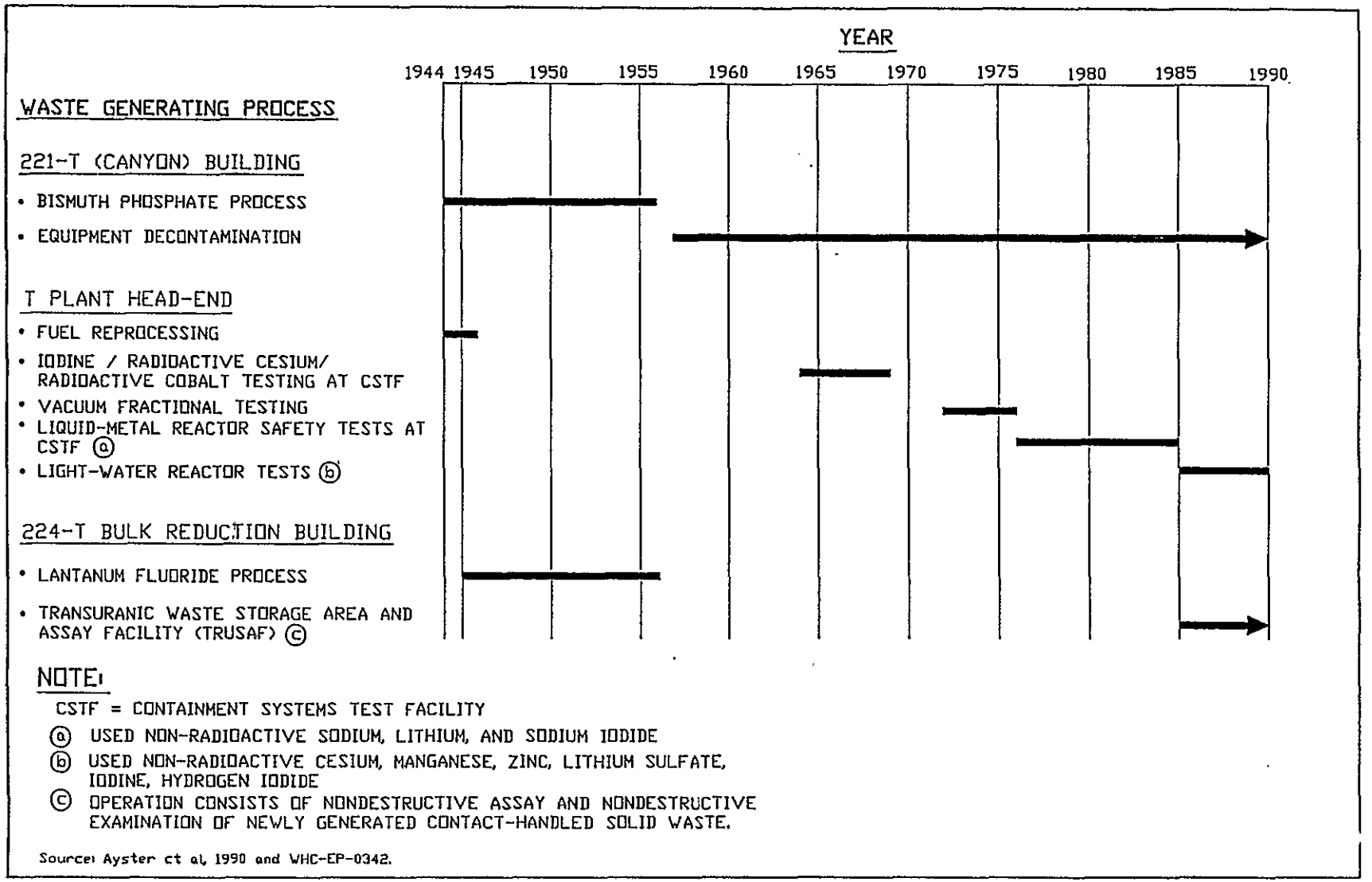


Figure 2-17. Process History of T Plant Aggregate Area.

Table 2-1. Summary of Waste Management Units at the T Plant Aggregate Area. (Page 1 of 13)

Waste Management Unit	Years in Service (active/inactive)	Source Description	Unit Capacity (L)	Waste Volume Received[1] (L)	Operable Unit
		Tanks and Vaults			
241-T-101 Single-Shell Tank	1944? - 1979 (inactive)	Bismuth phosphate metal waste, tributyl phosphate, supernatant containing coating waste, REDOX ion exchange waste, REDOX high-level waste, PNL, decontamination waste, evaporator, bottom 224-U waste.	2,017,000	-	200-TP-6
241-T-102 Single-Shell Tank	1945 - 1974? (inactive)	Bismuth phosphate metal waste, REDOX coating supernatant containing REDOX high-level waste, evaporator bottoms, B Plant ion exchange, and B Plant low-level waste from tank farms.	2,017,000	-	200-TP-6
241-T-103 Single-Shell Tank	1946 - 1974 (inactive)	Bismuth phosphate metal waste, coating waste and supernatant containing B Plant low-level waste, REDOX ion exchange, REDOX high-level waste, and evaporator bottoms.	2,017,000	-	200-TP-6
241-T-104 Single-Shell Tank	1946 - 1974 (inactive)	Bismuth phosphate first-cycle waste.	2,017,000	-	200-TP-6
241-T-105 Single-Shell Tank	1945 - 1974 (inactive)	Bismuth phosphate first-cycle and second-cycle waste, REDOX coating, decontamination waste, Hanford Laboratory operations waste, supernatant containing low-level, and ion exchange waste from tanks.	2,017,000	-	200-TP-6
241-T-106 Single-Shell Tank	1947 - 1973 (inactive)	Bismuth phosphate first-cycle and supernatant containing coating waste, B Plant low-level waste and ion exchange waste from tank farms.	2,017,000	-	200-TP-6
241-T-107 Single-Shell Tank	1944? - 1976 (inactive)	Bismuth phosphate first-cycle, tributyl phosphate, supernatant containing bismuth phosphate first-cycle, ion exchange, and coating waste from tank farms.	2,017,000	-	200-TP-6

Table 2-1. Summary of Waste Management Units at the T Plant Aggregate Area. (Page 2 of 13)

Waste Management Unit	Years in Service (active/inactive)	Source Description	Unit Capacity (L)	Waste Volume Received[1] (L)	Operable Unit
241-T-108 Single-Shell Tank	1945 - 1974 (inactive)	Tributyl phosphate, bismuth phosphate first-cycle, Hanford Laboratory operations waste, supernatant tributyl phosphate, B Plant low-level waste, ion exchange and evaporator bottoms from tank farms.	2,017,000	-	200-TP-6
241-T-109 Single-Shell Tank	1945 - 1974 (inactive)	Bismuth phosphate first-cycle, tributyl phosphate, and supernatant containing tributyl phosphate, ion exchange, evaporator bottoms, and PNL waste from tank farms.	2,017,000	-	200-TP-6
241-T-110 Single-Shell Tank	1944 - 1976 (inactive)	Bismuth phosphate second-cycle and 224-U Building waste.	2,017,000	-	200-TP-6
241-T-111 Single-Shell Tank	1945 - 1974 (inactive)	Bismuth phosphate second-cycle and 224-U Building waste.	2,017,000	-	200-TP-6
241-T-112 Single-Shell Tank	1946 - 1977 (inactive)	Bismuth phosphate second-cycle waste, PNL waste, and supernatant containing B Plant low-level waste, ion exchange from 241-T tanks, and decontamination waste.	2,017,000	-	200-TP-6
241-T-201 Single-Shell Tank	1952 - 1976 (inactive)	224-U Building waste.	208,000	-	200-TP-6
241-T-202 Single-Shell Tank	1952 - 1976 (inactive)	224-U Building waste.	208,000	-	200-TP-6
241-T-203 Single-Shell Tank	1952 - 1976 (inactive)	224-U Building waste.	208,000	-	200-TP-6
241-T-204 Single-Shell Tank	1976 (inactive)	224-U Building waste.	208,000	-	200-TP-6

Table 2-1. Summary of Waste Management Units at the T Plant Aggregate Area. (Page 3 of 13)

Waste Management Unit	Years in Service (active/inactive)	Source Description	Unit Capacity (L)	Waste Volume Received[1] (L)	Operable Unit
241-TX-101 Single-Shell Tank	1949 - 1980 (inactive)	Bismuth phosphate metal waste, supernatant containing REDOX and high level waste, coating waste, tributyl phosphate, bismuth phosphate first-cycle waste, REDOX and waste fractionization ion exchange, B Plant high-level and low-level waste, non-complexed waste, PUREX low-level waste, organic wash, partial neutralization feed, and evaporator bottoms and decontamination waste from tanks.	2,869,000	-	200-TP-5
241-TX-102 Single-Shell Tank	1950 - 1977 (inactive)	Bismuth phosphate metal waste, 242-T Evaporator waste, supernatant containing REDOX high-level waste, evaporator bottoms from 241-TX tanks.	2,869,000	-	200-TP-5
241-TX-103 Single-Shell Tank	1950 - 1980 (inactive)	Bismuth phosphate metal waste, 242-T Evaporator waste, supernatant containing bismuth phosphate metal, non-complexed waste, tributyl phosphate, and partial neutralization feed from 241-TX tanks.	2,869,000	-	200-TP-5
241-TX-104 Single-Shell Tank	1950 - 1977 (inactive)	Bismuth phosphate metal waste, 242-T Evaporator waste, supernatant containing REDOX ion exchange, and high-level waste, PUREX organic wash waste, B Plant low-level waste and tributyl phosphate from 241-TY and -TX tanks.	2,869,000	-	200-TP-5
241-TX-105 Single-Shell Tank	1951 - 1977 (inactive)	Bismuth phosphate metal waste, 242-T Evaporator waste, supernatant containing REDOX ion exchange, and high-level waste, PUREX organic wash waste from 241-BX and -SX tank farms.	2,869,000	-	200-TP-5

Table 2-1. Summary of Waste Management Units at the T Plant Aggregate Area. (Page 4 of 13)

Waste Management Unit	Years in Service (active/inactive)	Source Description	Unit Capacity (L)	Waste Volume Received[1] (L)	Operable Unit
241-TX-106 Single-Shell Tank	1951 - 1977 (inactive)	Bismuth phosphate metal waste, tributyl phosphate, 242-T Evaporator waste, supernatant containing REDOX ion high-level waste, PUREX organic wash waste, evaporator bottoms, and coating waste from 241-TX tanks.	2,869,000	-	200-TP-5
241-TX-107 Single-Shell Tank	1950 - 1977 (inactive)	Bismuth phosphate metal waste, 242-T Evaporator waste, supernatant containing bismuth phosphate metal, and REDOX high-level waste from 241-TX tanks.	2,869,000	-	200-TP-5
241-TX-108 Single-Shell Tank	1950 - 1977 (inactive)	Bismuth phosphate metal waste, REDOX high-level waste, 242-T Evaporator waste, supernatant containing decontamination waste, tributyl phosphate, and evaporator bottoms from 241-TX and -TY tanks.	2,869,000	-	200-TP-5
241-TX-109 Single-Shell Tank	1949? - 1977 (inactive)	Bismuth phosphate first-cycle waste, 242-T Evaporator waste, supernatant containing bismuth phosphate first-cycle waste, and evaporator bottoms from 241-T, -TX, -TY tanks.	2,869,000	1,453,000	200-TP-5
241-TX-110 Single-Shell Tank	1949 - 1977 (inactive)	Bismuth phosphate first-cycle waste, and 242-T Evaporator waste.	2,869,000	1,749,000	200-TP-5
241-TX-111 Single-Shell Tank	1950 - 1977 (inactive)	Bismuth phosphate first-cycle waste, and 242-T Evaporator waste, and supernatant containing tributyl phosphate waste from 241-TX tanks.	2,869,000	1,400,000	200-TP-5
241-TX-112 Single-Shell Tank	1950 - 1974 (inactive)	242-T Evaporator waste, bismuth phosphate first-cycle waste, and supernatant containing evaporator bottoms from 241-TX tanks.	2,869,000	2,457,000	200-TP-5
241-TX-113 Single-Shell Tank	1950 - 1971 (inactive)	242-T Evaporator waste and supernatant containing evaporator bottoms from 241-TX tanks.	2,869,000	2,298,000	200-TP-5

Table 2-1. Summary of Waste Management Units at the T Plant Aggregate Area. (Page 5 of 13)

Waste Management Unit	Years in Service (active/inactive)	Source Description	Unit Capacity (L)	Waste Volume Received[1] (L)	Operable Unit
241-TX-114 Single-Shell Tank	1951 - 1971 (inactive)	242-T Evaporator waste and supernatant containing bismuth phosphate first-cycle waste and evaporator bottoms from 241-TX tanks.	2,869,000	2,025,000	200-TP-5
241-TX-115 Single-Shell Tank	1951 - 1977 (inactive)	242-T Evaporator waste, tributyl phosphate waste, coating waste, decontamination waste, supernatant containing bismuth phosphate metal, evaporator bottoms from 241-U, -S, -T, -TX tanks.	2,869,000	2,422,000	200-TP-5
241-TX-116 Single-Shell Tank	1951 - 1969 (inactive)	Supernatant containing evaporator bottoms from 241-TX tanks.	2,869,000	2,388,000	200-TP-5
241-TX-117 Single-Shell Tank	1951 - 1969 (inactive)	Supernatant containing first-cycle waste and evaporator bottoms from 241-TX tanks.	2,869,000	2,369,000	200-TP-5
241-TX-118 Single-Shell Tank	1951 - 1980 (inactive)	242-T Evaporator feed tank waste, 234-Z and 235-Z buildings waste, caustic solution, tributyl phosphate, decontamination waste, supernatant containing tributyl phosphate, bismuth phosphate first-cycle waste, evaporator bottoms, partial neutralization feed, and coating waste from 241-T, -TX, -TY, -U tanks.	2,869,000	1,313,400	200-TP-5
241-TY-101 Single-Shell Tank	1953 - 1973 (inactive)	Bismuth phosphate first-cycle waste and supernatant containing bismuth phosphate, first cycle waste; tributyl phosphate waste; and evaporator bottoms from 241-TY, -TX, and -SX tank farms.	2,869,000	447,000	200-TP-5
241-TY-102 Single-Shell Tank	1953 - 1979 (inactive)	Supernatant containing B Plant low-level, REDOX high-level waste, PUREX organic wash waste, REDOX ion exchange waste, and evaporator bottoms from 241-TX and -TY tanks.	2,869,000	242,000	200-TP-5

Table 2-1. Summary of Waste Management Units at the T Plant Aggregate Area. (Page 6 of 13)

Waste Management Unit	Years in Service (active/inactive)	Source Description	Unit Capacity (L)	Waste Volume Received[1] (L)	Operable Unit
241-TY-103 Single-Shell Tank	1953 - 1973 (inactive)	Bismuth phosphate first-cycle waste and supernatant containing bismuth phosphate, first cycle waste; tributyl phosphate waste; PUREX organic wash waste, REDOX ion exchange waste, coating waste, evaporator bottoms, and decontamination waste from 241-BX, -T, -TX, -TY and -AX tanks.	2,869,000	61,300	200-TP-5
241-TY-104 Single-Shell Tank	1953 - 1974 (inactive)	Tributyl phosphate waste; supernatant containing REDOX ion exchange waste; PUREX organic wash waste, bismuth phosphate first-cycle waste, tributyl phosphate waste, and decontamination waste from 241-TX and -TY tank farms.	2,869,000	174,000	200-TP-5
241-TY-105 Single-Shell Tank	1953 - 1960 (inactive)	Tributyl phosphate waste.	2,869,000	874,000	200-TP-5
241-TY-106 Single-Shell Tank	1953 - 1959 (inactive)	Tributyl phosphate waste.	2,869,000	64,000	200-TP-5
241-T-361 Settling Tank	1976 (inactive)	Radioactively contaminated liquid with estimated 75,700 L (28,000 gal) of sludge. Drainage from T-Plant.	-	-	200-TP-4
241-T-301 Catch Tank	Unknown (inactive)	Mixed waste liquid.	-	-	200-TP-6
241-T-302 Catch Tank	Unknown (inactive)	Mixed waste liquid.	-	-	200-TP-6
241-TX-302A Catch Tank	1949 - 1982 (inactive)	Waste solutions from processing and decontamination operations.	-	-	200-TP-5
241-TX-302B Catch Tank	1949 - 1982 (inactive)	Waste solutions from processing and decontamination operations.	-	-	200-TP-2

Table 2-1. Summary of Waste Management Units at the T Plant Aggregate Area. (Page 7 of 13)

Waste Management Unit	Years in Service (active/inactive)	Source Description	Unit Capacity (L)	Waste Volume Received[1] (L)	Operable Unit
241-TX-302C Catch Tank	1949 (active)	Waste solutions from processing and decontamination operations.	-	-	200-TP-4
Cribs and Drains					
216-T-6 Crib	1946 - 1951[2] (inactive)	Cell drainage from tanks in 221-T building. The waste is low salt and neutral/basic.	-	45,000,000	200-TP-3
216-T-7TF Crib and Tile Field	1948 - 1955 (inactive)	Second-cycle supernatant waste from 221-T Building. Effluents plus waste via tank farm. The waste is high salt and neutral/basic.	-	110,000,000	200-TP-1
216-T-8 Crib	1950 - 1951 (inactive)	Decontamination sink waste and sample slurper waste. The waste is neutral/basic.	-	500,000	200-TP-4
216-T-18 Crib	1953 (inactive)	First-cycle scavenged tributyl phosphate supernatant waste.	-	1,000,000	200-TP-2
216-T-19TF Crib and Tile Field	1951 - 1980[2] (inactive)	Process condensate from waste evaporator, cell drainage, second-cycle supernatant waste, condensate and steam condensate.	-	455,000,000	200-TP-2
216-T-26 Crib	1955 - 1956 (inactive)	First-cycle scavenged tributyl phosphate supernatant waste.	-	12,000,000	200-TP-2
216-T-27 Crib	1965 (inactive)	300 Area laboratory waste from 340 facility.	-	7,190,000	200-TP-2
216-T-28 Crib	1960 - 1966 (inactive)	Steam condensate decontamination waste, laboratory waste, miscellaneous waste via tank farm.	-	42,300,000	200-TP-2
219-T-29 Crib	1949 - 1964 (inactive)	Condensate runoff from sand filter. The waste type is potentially acidic.	-	74,000	200-TP-4
216-T-31 French Drain	1954 - 1962[2] (inactive)	Contaminated steam condensate.	-	-	200-TP-2

Table 2-1. Summary of Waste Management Units at the T Plant Aggregate Area. (Page 8 of 13)

Waste Management Unit	Years in Service (active/inactive)	Source Description	Unit Capacity (L)	Waste Volume Received[1] (L)	Operable Unit
216-T-32 Crib	1946 - 1952 (inactive)	Waste from 224-T Building via tank farm.	-	29,000,000	200-TP-1
216-T-33 Crib	1963 (inactive)	Decontamination waste from 2706-T.	-	1,900,000	200-TP-4
216-T-34 Crib	1966 - 1967 (inactive)	300 area laboratory waste from the 340 facility.	-	17,300,000	200-TP-4
216-T-35 Crib	1967 - 1968 (inactive)	300 area laboratory waste from the 340 facility.	-	5,720,000	200-TP-4
216-T-36 Crib	1967 - 1969 (inactive)	Steam condensate decontamination waste, and misc. waste from 221-T and 221-U buildings.	-	522,000	200-TP-1
216-W-LWC Crib	1981 - Present (active)	All process wastewater from 2724-W and 2723-W buildings.	-	1,200,000,000	200-SS-2
Reverse Wells					
216-T-2 Reverse Well	1945 - 1950 (inactive)	Decontamination sink waste and sample slurper waste from 221-T Building.	-	6,000,000	200-TP-4
216-T-3 Reverse Well	1945 - 1946 (inactive)	Cell drainage from Tank 5-6 in the 221-T Building and overflow waste from 241-T-361 Settling Tank.	-	11,300,000	200-TP-4
Ponds, Ditches, and Trenches					
216-T-4A Pond	1944 - 1972 (inactive)	Process cooling water, steam condensate and condenser cooling water.	-	42,500,000,000	200-TP-3
216-T-4B Pond	1972 - Present (active)	Steam condensate, condenser cooling water, and nonradioactive wastewater from 221-T. This unit is considered dry from 1977 to present.	-	-	200-TP-3

Table 2-1. Summary of Waste Management Units at the T Plant Aggregate Area. (Page 9 of 13)

Waste Management Unit	Years in Service (active/inactive)	Source Description	Unit Capacity (L)	Waste Volume Received[1] (L)	Operable Unit
216-T-1 Ditch	1944 - Present (active)	Miscellaneous waste from pilot plant experimental work, intermittent decontamination waste, and waste from the head end of the 221-T building.	-	178,000,000	200-TP-4
216-T-4-1D Ditch	1944 - 1972 (inactive)	Process cooling water, steam condensate and decontamination waste from 2706-T.	-	-	200-TP-3
216-T-4-2 Ditch	1972 - Present (active)	Steam condensate, condenser cooling water and nonradioactive wastewater.	-	-	200-TP-3
200-W Powerhouse Pond	1984 - Present (active)	Wastes from steam production and water treatment activities.	-	-	200-TP-2
216-T-5 Trench	1955	Second-cycle supernatant waste, the waste is high salt and neutral/basic.	-	2,600,000	200-TP-1
216-T-9 Trench	1951 - 1954[2] (inactive)	Heavy equipment and vehicle decontamination waste.	-	-	200-TP-4
216-T-10 Trench	1951 - 1954[2] (inactive)	Heavy equipment and vehicle decontamination waste.	-	-	200-TP-4
216-T-11 Trench	1951 - 1954[2] (inactive)	Heavy equipment and vehicle decontamination waste.	-	-	200-TP-4
216-T-12 Trench	1954 (inactive)	Contaminated sludge.	-	5,000,000	200-TP-3
216-T-13 Trench	1954 - 1964 (inactive)	Vehicle decontamination sludge.	-	-	200 TP-2
216-T-14 Trench	1954 (inactive)	First cycle supernatant waste.	-	1,000,000	200-TP-3
216-T-15 Trench	1954 (inactive)	First cycle supernatant waste.	-	1,000,000	200-TP-3

Table 2-1. Summary of Waste Management Units at the T Plant Aggregate Area. (Page 10 of 13)

Waste Management Unit	Years in Service (active/inactive)	Source Description	Unit Capacity (L)	Waste Volume Received[1] (L)	Operable Unit
216-T-16 Trench	1954 (inactive)	First cycle supernatant waste.	-	1,000,000	200-TP-3
216-T-17 Trench	1954 (inactive)	First cycle supernatant waste.	-	785,000	200-TP-3
216-T-20 Trench	1952 (inactive)	Contaminated nitric acid.	-	18,900	200-TP-2
216-T-21 Trench	1954 (inactive)	First cycle supernatant waste.	-	460,000	200-TP-1
216-T-22 Trench	1954 (inactive)	First cycle supernatant waste.	-	1,530,000	200-TP-1
216-T-23 Trench	1954 (inactive)	First cycle supernatant waste.	-	1,480,000	200-TP-1
216-T-24 Trench	1954 (inactive)	First cycle supernatant waste.	-	1,530,000	200-TP-1
216-T-25 Trench	1954 (inactive)	First-cycle evaporator bottoms.	-	3,000,000	200-TP-1
Septic Tanks and Associated Drain Fields					
2607-W1 Septic Tank	1944 (active)	Sanitary wastewater and sewage.	-	18,300 [3]	200-SS-2
2607-W2 Septic Tank	1944 (active)	Sanitary wastewater and sewage.	-	10,200 [3]	200-SS-2
2607-W3 Septic Tank	1944 (active)	Sanitary wastewater and sewage.	-	14,200 [3]	200-TP-4
2607-W4 Septic Tank	1944 (active)	Sanitary wastewater and sewage.	-	10,600 [3]	200-TP-4

Table 2-1. Summary of Waste Management Units at the T Plant Aggregate Area. (Page 11 of 13)

Waste Management Unit	Years in Service (active/inactive)	Source Description	Unit Capacity (L)	Waste Volume Received[1] (L)	Operable Unit
2607-WT Septic Tank	1952 (active)	Sanitary wastewater and sewage.	-	20 [3]	200-TP-5
2607-WTX Septic Tank	1950 (active)	Sanitary wastewater and sewage.	-	740 [3]	200-TP-5
Transfer Facilities, Diversion Boxes, and Pipelines					
241-T-151 Diversion Box	1944 - 1980 (inactive)	Waste solutions from processing and decontamination operations.	-	-	200-TP-6
241-T-152 Diversion Box	1944 - 1983 (inactive)	Waste solutions from processing and decontamination operations. Volumes were variable.	-	-	200-TP-6
241-T-153 Diversion Box	Unknown (inactive)	Unknown	-	-	200-TP-6
241-T-252 Diversion Box	1944 - 1983 (inactive)	Waste solutions from processing and decontamination operations. Volumes were variable.	-	-	200-TP-6
241-TR-152 Diversion Box	1944 - 1980 (inactive)	Waste solutions from processing and decontamination operations.	-	-	200-TP-6
241-TR-153 Diversion Box	1944 - 1983 (inactive)	Waste solutions from processing and decontamination operations.	-	-	200-TP-6
241-TX-152 Diversion Box	1949 -Present (active)	Waste solutions from processing and decontamination operations.	-	-	200-TP-2
241-TX-153 Diversion Box	1949 - 1982 (inactive)	Waste solutions from processing and decontamination operations.	-	-	200-TP-5
241-TX-154 Diversion Box	1949 - Present (active)	Waste solutions from processing and decontamination operations.	-	-	200-TP-4
241-TX-155 Diversion Box	1949 - 1980 (inactive)	Waste solutions from processing and decontamination operations.	-	-	200-TP-2

Table 2-1. Summary of Waste Management Units at the T Plant Aggregate Area. (Page 12 of 13)

Waste Management Unit	Years in Service (active/inactive)	Source Description	Unit Capacity (L)	Waste Volume Received[1] (L)	Operable Unit
241-TXR-152 Diversion Box	1949 - 1980 (inactive)	Waste solutions from processing and decontamination operations.	-	-	200-TP-5
241-TXR-153 Diversion Box	1949 - 1980 (inactive)	Waste solutions from processing and decontamination operations.	-	-	200-TP-5
242-T-151 Diversion Box	Unknown (inactive)	Unknown	-	-	200-TP-5
242-TY-153 Diversion Box	1953 - 1981 (inactive)	Waste solution from processing and decontamination operations. Volumes were variable.	-	-	200-TP-5
Basins					
207-T Retention Basin	1944 - Present (active)	Process cooling water, steam condensate, evaporator cooling water, flow from 221-T, 221-TA, and 224-T buildings.	~ 264,000	-	200-TP-3
Burial Sites					
200-W Ash Disposal Basin	Unknown (active)	Various hazardous organic chemicals.	-	-	200-SS-2
200-W Ash Pit Demolition Site	1985 - Present? (active)	Various unstable chemicals, low-level waste.	-	-	200-SS-2
200-W Burning Pit	1950 - 1970 (inactive)	Construction and office waste, paint waste, and chemical solvents.	-	-	200-SS-2

Table 2-1. Summary of Waste Management Units at the T Plant Aggregate Area. (Page 13 of 13)

Waste Management Unit	Years in Service (active/inactive)	Source Description	Unit Capacity (L)	Waste Volume Received[1] (L)	Operable Unit
200-W Powerhouse Ash Pit	1943 - Present (active)	Ash from the 200 West Area Powerhouse cooling and ventilation steam condensate.	-	43,827,000	200-SS-2
218-W-8 Burial Ground	1945 - 1952 (inactive)	Laboratory process sample waste from 222-T Building.	-	68,000	200-TP-4

Sources: WHC 1991a; Maxfield 1979; Waite 1991.

(1) Tank volumes represent the current volume of the tank.
(2) Indicates a discrepancy between the sources; in such case, the data given is from WHC 1991a.
(3) Waste volume received is per day.

Table 2-2. Radionuclide Waste Inventory Summary. (Page 1 of 2)

	QUANTITY OF REPORTED RADIONUCLIDES (Ci)										
Waste Management Unit	Total Pu (grams)	^{238}U	^{137}Cs	^{106}Ru	^{90}Sr	^{60}Co	^{3}H	^{241}Am	Other Radionuclides	^{239}Pu	^{240}Pu
Cribs											
216-T-6 Crib	390.0	0.0076	110.0	6.070e-11	124.0	0.0305	-	-	-	22.30	6.01
216-T-7TF Crib and Tile Field	130.0	0.00304	21.20	2.020e-09	24.00	0.0142	-	-	-	7.42	2.00
216-T-8 Crib	5.000	0.0015	0.04010	6.630e-12	0.3760	0.00099	-	-	-	0.285	0.077
216-T-18 Crib	1800.0	0.00911	24.20	1.380e-09	2.800	0.137	0.800/a/	-	-	103.0	27.7
216-T-19TF Crib and Tile Field	14.40	-	17.50	6.030e-06	27.80	-	4.250	.009820	-	-	-
216-T-26 Crib	59.00	0.503	75.60	8.020e-08	282.0	0.0189	-	-	-	3.37	0.908
216-T-27 Crib	13.00	0.00243	55.90	4.090e-5	75.30	0.067	-	-	-	0.742	0.200
216-T-28 Crib	70.00	0.131	193.0	1.960e-5	106.0	0.319	-	-	-	4.00	1.08
216-T-32 Crib	3200.0	0.0076	9.710	4.440e-11	10.90	0.00827	-	-	-	1.83	49.3
216-T-33 Crib	5.000	0.00152	0.2670	6.860e-08	0.2560	0.0515	-	-	-	0.285	0.077
216-T-34 Crib	107.0	0.00138	157.0	5.980e-06	178.0	0.585	-	-	-	6.11	1.65
216-T-35 Crib	66.20	0.01640	11.70	1.440e-05	11.4	0.298	-	-	-	3.78	1.02
216-T-36 Crib	2.480	0.00039	3.790	5.24e-06	4.360	0.0487	-	-	-	0.142	0.0381
Reverse Wells											
216-T-3 Reverse Well	3350.0	-	21.30	5.220e-12	18.60	-	-	-	-	191.0	51.5
Trenches											
216-T-5 Trench	180.0	0.00152	31.10	8.250e-10	0.4200	0.0899	-	-	-	10.30	2.77
216-T-12 Trench	1.000	0.0152	4.340	1.380e-10	2.050	0.0341	-	-	-	0.0571	0.0154
216-T-14 Trench	0.8800	0.0102	204.0	2.070e-10	2.460	0.236	0.800 /a/	-	-	0.0502	0.135
216-T-15 Trench	0.9400	0.00911	450.0	1.660e-10	8.620	0.188	0.800 /a/	-	-	0.0537	0.0145

Table 2-2. Radionuclide Waste Inventory Summary. (Page 2 of 2)

	QUANTITY OF REPORTED RADIONUCLIDES (Ci)										
Waste Management Unit	Total Pu (grams)	^{238}U	^{137}Cs	^{106}Ru	^{90}Sr	^{60}Co	^{3}H	^{241}Am	Other Radionuclides	^{239}Pu	^{240}Pu
216-T-16 Trench	0.6500	0.00743	227.0	1.790e-10	3.280	0.204	0.800 /a/	-	-	0.0372	0.1010
216-T-17 Trench	0.5300	0.0068	162.0	1.380e-10	1.230	0.0157	0.600 /a/	-	-	0.303	0.00816
216-T-20 Trench	-	0.0167	0.4400	7.440-e12	0.3880	-	-	-	-	-	-
216-T-21 Trench	1.000	0.00033	174.0	8.560e-10	3.280	0.314	0.400 /a/	-	-	0.571	0.154
216-T-22 Trench	2.0000	0.00067	803.0	4.140e-10	20.90	0.0157	1.20 /a/	-	-	0.114	0.308
216-T-23 Trench	1.000	0.00034	577.0	3.590e-10	16.82	0.0157	1.20 /a/	-	-	0.0571	0.0154
216-T-24 Trench	2.000	0.00278	617.0	4.420e-10	16.40	0.0157	1.20 /a/	-	-	0.114	0.0308
216-T-25 Trench	1.000	0.00030	3860.0	1.380e-09	1.640	0.00157	2.40 /a/	-	-	0.571	0.154
Burial Sites											
218-W-8 Burial Ground	0.3000	0.0001	6.403	3.607e-11	5.625	-	-	-	-	0.171	0.00462
Unplanned Releases											
UPR-200-W-160 Unplanned Release	1.000	-	17.00	3.460e-10	16.00	-	-	-	-	-	-

Source: WHC 1991a.

/a/ Values are from HISS Database (Stenner et al.) and are decayed through April 1, 1986.

Table 2-3. Chemical Waste Inventory Summary. (Page 1 of 2)

Waste Management Unit	QUANTITY OF REPORTED CHEMICALS (kg)															
	NH_4NO_3	Ferrocyanide	Fluoride	Nitrate	Nitrite	HNO_3	Phosphate	Potassium	Sodium	Sodium Aluminate	Sodium Dichromate	NaOH	Sodium Oxalate	Sodium Silicate	Sulfate	H_2SO_4
Cribs																
216-T-6 Crib	2,600	-	24,000	180,000	-	-	13,000	-	160,000	-	-	-	6,000	-	1,500	-
216-T-7TF Crib and Tile Field	140,000	-	170,000	2,300,000	-	-	500,000	250,000	1,700,000	-	-	-	40,000	-	70,000	-
216-T-8 Crib	-	-	-	-	-	1,000	-	-	-	-	10	-	-	-	-	1,000
216-T-18 Crib	-	-	2,500	80,000	9,000	-	19,000	-	60,000	8,000	-	8,000	-	3,200	4,000	-
216-T-19TF Crib and Tile Field	18,000	-	-	150,000	-	-	60,000	-	90,000	-	-	-	-	-	9,000	-
216-T-26 Crib	-	6,000	30,000	1,000,000	110,000	-	230,000	-	700,000	100,000	-	100,000	-	40,000	50,000	-
216-T-27 Crib	-	-	-	1,000	-	-	-	-	-	-	-	-	-	-	-	-
216-T-28 Crib	-	-	-	10,000	-	-	-	-	-	-	-	-	-	-	-	-
216-T-32 Crib	1,600	-	160,000	1,200,000	-	-	90,000	-	1,100,000	-	-	-	40,000	-	10,000	-
216-T-33 Crib	-	-	-	-	-	-	-	-	-	-	-	10	-	-		-
216-T-34 Crib	-	-	-	1,000	-	-	-	-	-	-	-	-	-	-	-	-
216-T-35 Crib	-	-	-	1,000	-	-	-	-	-	-	-	-	-	-	-	-
216-T-36 Crib	-	-	-	-	-	-	-	-	-	-	-	1,000	-	-	-	-
Reverse Wells																
216-T-2 Reverse Well	-	-	-	-	-	6,000	-	-	-	-	200	-	-	-	-	10,000
216-T-3 Reverse Well	4,000	-	40,000	290,000	-	-	21,000	60,000	250,000	-	-	-	-	-	2,400	-
Ponds, Ditches and Trenches																
216-T-4A Pond[a]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
216-T-1 Ditch	-	-	-	-	-	-	-	-	-	-	-	1,000	-	-	-	-

Table 2-3. Chemical Waste Inventory Summary. (Page 2 of 2)

Waste Management Unit	QUANTITY OF REPORTED CHEMICALS (kg)															
	NH_4NO_3	Ferrocyanide	Fluoride	Nitrate	Nitrite	HNO_3	Phosphate	Potassium	Sodium	Sodium Aluminate	Sodium Dichromate	NaOH	Sodium Oxalate	Sodium Silicate	Sulfate	H_2SO_4
216-T-5 Trench	20,000	-	8,000	140,000	-	-	6,000	-	100,000	-	-	-	-	8,000	9,000	-
216-T-14 Trench	-	-	2,500	80,000	9,000	-	19,000	-	60,000	8,000	-	8,000	-	3,200	4,000	-
216-T-15 Trench	-	-	2,500	80,000	9,000	-	19,000	-	60,000	8,000	-	8,000	-	3,200	4,000	-
216-T-16 Trench	-	-	2,500	80,000	9,000	-	19,000	-	60,000	8,000	-	8,000	-	3,200	4,000	-
216-T-17 Trench	-	-	2,000	60,000	7,000	-	15,000	-	50,000	7,000	-	6,000	-	2,500	3,100	-
216-T-20 Trench	-	-	-	15,000	-	-	-	-	-	-	-	-	-	-	-	-
216-T-21 Trench	-	-	1,200	40,000	4,000	-	9,000	-	28,000	4,000	-	4,000	-	1,500	1,800	-
216-T-22 Trench	-	-	4,000	120,000	14,000	-	29,000	-	90,000	13,000	-	12,000	-	5,000	6,000	-
216-T-23 Trench	-	-	4,000	120,000	14,000	-	28,000	-	90,000	12,000	-	12,000	-	5,000	6,000	-
216-T-24 Trench	-	-	4,000	120,000	14,000	-	29,000	-	90,000	13,000	-	12,000	-	5,000	6,000	-
216-T-25 Trench	-	-	40,000	1,200,000	140,000	-	290,000	-	900,000	130,000	-	120,000	-	50,000	60,000	-

Source: WHC 1991a.

[a] Inventory of 216-T-4-2 Trench and 216-T-4B Pond are included in the 216-T-4A inventory.

Table 2-4. Description of 241-T, -TX and -TY Tank Farms. (Page 1 of 3)

Name	Type	Integrity	Interim Stabilized	Isolation	Total Waste Volume (L)	Drainable Waste Volume (L)	Flammable Gas Generation?
241-T Tank Farm							
241-T-101	single-shell	sound	no	part. interim isolated	504,000	132,500	no
241-T-102	single-shell	sound	yes	interim isolated	121,200	49,200	no
241-T-103	single-shell	assumed leaker	yes	interim isolated	102,200	15,100	no
241-T-104	single-shell	sound	no	part. interim isolated	1,684,400	189,300	no
241-T-105	single-shell	sound	yes	interim isolated	370,900	87,100	no
241-T-106	single-shell	assumed leaker	yes	interim isolated	79,500	7,600	no
241-T-107	single-shell	assumed leaker	no	part. interim isolated	681,300	83,300	no
241-T-108	single-shell	assumed leaker	yes	interim isolated	166,500	0	no
241-T-109	single-shell	assumed leaker	yes	interim isolated	219,500	0	no
241-T-110	single-shell	sound	no	part. interim isolated	1,434,500	159,000	yes
241-T-111	single-shell	assumed leaker	no	part. interim isolated	1,733,500	193,000	no
241-T-112	single-shell	sound	yes	interim isolated	253,600	26,500	no
241-T-201	single-shell	sound	yes	interim isolated	109,800	15,100	no
241-T-202	single-shell	sound	yes	interim isolated	79,500	7,600	no
241-T-203	single-shell	sound	yes	interim isolated	132,500	15,100	no
241-T-204	single-shell	sound	yes	interim isolated	143,800	15,100	no

Table 2-4. Description of 241-T, -TX and -TY Tank Farms. (Page 2 of 3)

Name	Type	Integrity	Interim Stabilized	Isolation	Total Waste Volume (L)	Drainable Waste Volume (L)	Flammable Gas Generation?
241-TX Tank Farm							
241-TX-101	single-shell	sound	yes	interim isolated	329,300	18,900	no
241-TX-102	single-shell	sound	yes	interim isolated	427,700	83,300	no
241-TX-103	single-shell	sound	yes	interim isolated	594,200	56,800	no
241-TX-104	single-shell	sound	yes	interim isolated	246,000	56,800	no
241-TX-105	single-shell	assumed leaker	yes	interim isolated	2,305,100	75,700	no
241-TX-106	single-shell	sound	yes	interim isolated	1,714,600	37,900	no
241-TX-107	single-shell	assumed leaker	yes	interim isolated	136,300	7,600	no
241-TX-108	single-shell	sound	yes	interim isolated	507,200	0	no
241-TX-109	single-shell	sound	yes	interim isolated	1,453,400	37,900	no
241-TX-110	single-shell	assumed leaker	yes	interim isolated	1,748,700	56,800	no
241-TX-111	single-shell	sound	yes	interim isolated	1,400,500	34,100	no
241-TX-112	single-shell	sound	yes	interim isolated	2,456,500	90,800	no
241-TX-113	single-shell	assumed leaker	yes	interim isolated	2,297,500	60,600	no
241-TX-114	single-shell	assumed leaker	yes	interim isolated	2,025,000	56,800	no
241-TX-115	single-shell	assumed leaker	yes	interim isolated	2,422,400	71,900	no
241-TX-116	single-shell	assumed leaker	yes	interim isolated	2,388,300	87,100	no
241-TX-117	single-shell	assumed leaker	yes	interim isolated	2,369,400	30,300	no
241-TX-118	single-shell	sound	yes	interim isolated	1,313,400	102,200	no

Table 2-4. Description of 241-T, -TX and -TY Tank Farms. (Page 3 of 3)

Name	Type	Integrity	Interim Stabilized	Isolation	Total Waste Volume (L)	Drainable Waste Volume (L)	Flammable Gas Generation?
241-TY Tank Farm							
241-TY-101	single-shell	assumed leaker	yes	interim isolated	446,600	0	no
241-TY-102	single-shell	sound	yes	interim isolated	242,200	53,000	no
241-TY-103	single-shell	assumed leaker	yes	interim isolated	613,200	18,900	no
241-TY-104	single-shell	assumed leaker	yes	interim isolated	174,100	56,800	no
241-TY-105	single-shell	assumed leaker	yes	interim isolated	874,300	0	no
241-TY-106	single-shell	assumed leaker	yes	interim isolated	64,300	0	no

Source: Hanlon 1992.

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 1 of 25)

Total (1/1/90)	T-101 Curies	T-102 Curies	T-103 Curies	T-104 Curies	T-105 Curies	T-106 Curies	T-107 Curies	T-108 Curies	T-109 Curies
1. Ac225	9E-09	1E-10	4E-09	3E-09	4E-09	2E-08	5E-09	9E-09	9E-09
2. Ac227	3E-05	5E-07	2E-06	1E-05	3E-05	7E-06	5E-06	2E-06	9E-06
3. Am241	9E+01	2E+00	9E+00	2E+01	2E+01	3E+00	2E+00	2E-01	2E-02
4. Am242	2E-01	3E-03	2E-02	5E-04	8E-03	9E-04	2E-05	2E-06	3E-07
5. Am242m	2E-01	3E-03	2E-02	5E-04	8E-03	9E-04	2E-05	2E-06	3E-07
6. Am243	9E-02	1E-03	8E-03	2E-03	2E-03	2E-04	5E-05	5E-06	6E-07
7. At217	8E-09	1E-10	4E-09	3E-09	4E-09	2E-08	4E-09	9E-09	9E-09
8. Ba135m	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba137m	2E+04	4E+02	2E+03	1E+04	7E-13	6E+02	7E-13	1E+03	5E+03
10. Bi210	7E-12	1E-13	2E-12	7E-11	5E-10	7E-11	4E-11	8E-12	3E-12
11. Bi211	3E-05	5E-07	2E-06	1E-05	3E-05	7E-06	5E-06	2E-06	9E-06
12. Bi213	9E-09	2E-10	5E-09	4E-09	4E-09	2E-08	5E-09	9E-09	9E-09
13. Bi214	2E-11	4E-13	8E-12	3E-10	2E-09	3E-10	1E-10	3E-11	1E-11
14. C14	7E+01	1E+00	7E+00	2E-01	2E-16	1E-01	3E-03	1E-01	1E-01
15. Cm242	1E-01	2E-03	1E-02	4E-04	7E-03	7E-04	2E-05	2E-06	2E-07
16. Cm244	4E-01	8E-03	4E-02	1E-03	1E-19	6E-05	6E-20	1E-04	2E-05
17. Cm245	3E-05	5E-07	3E-06	6E-08	2E-24	2E-09	1E-24	2E-09	3E-10
18. Cs135	1E-01	2E-03	7E-03	9E-02	7E-18	4E-03	4E-18	7E-03	1E-01
19. Cs137	3E+04	4E+02	2E+03	1E+04	8E-13	6E+02	8E-13	1E+03	5E+03
20. Fr221	9E-09	1E-10	4E-09	3E-09	4E-09	2E-08	5E-09	9E-09	9E-09
21. Fr223	4E-07	7E-09	3E-08	2E-07	4E-07	1E-07	7E-08	3E-08	1E-07
22. I129	1E-01	2E-03	1E-02	5E-03	5E-19	3E-04	3E-19	5E-04	3E-03
23. Nb93m	1E+00	2E-02	1E-01	2E+00	1E+00	9E-02	2E+00	2E-01	3E-02
24. Ni59	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni63	8E+02	2E+01	5E+02	3E+00	3E-15	2E+00	1E-15	3E+00	2E+01
26. Np237	8E-02	1E-03	6E-03	1E-02	2E-04	6E-04	2E-05	2E-03	7E-03

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 2 of 25)

Total (1/1/90)	T-101 Curies	T-102 Curies	T-103 Curies	T-104 Curies	T-105 Curies	T-106 Curies	T-107 Curies	T-108 Curies	T-109 Curies
27. Np239	8E-02	1E-03	8E-03	2E-03	2E-03	2E-04	5E-05	5E-06	6E-07
28. Pa231	5E-05	9E-07	4E-06	4E-05	8E-05	2E-05	1E-05	5E-06	1E-05
29. Pa233	8E-02	1E-03	6E-03	1E-02	2E-04	7E-04	2E-05	2E-03	7E-03
30. Pa234m	5E-02	5E-03	2E-02	9E-01	2E+00	1E+00	3E-01	1E-01	4E-02
31. Pb209	9E-09	1E-10	4E-09	3E-09	4E-09	2E-08	5E-09	9E-09	9E-09
32. Pb210	6E-12	1E-13	2E-12	7E-11	5E-10	6E-11	3E-11	8E-12	3E-12
33. Pb211	3E-05	5E-07	2E-06	1E-05	3E-05	7E-06	5E-06	2E-06	9E-06
34. Pb214	2E-11	4E-13	8E-12	3E-10	2E-09	3E-10	1E-10	3E-11	1E-11
35. Pd107	2E-01	4E-03	2E-02	8E-03	7E-19	4E-04	3E-19	7E-04	3E-03
36. Po210	6E-12	1E-13	2E-12	7E-11	5E-10	6E-11	3E-11	8E-12	3E-12
37. Po213	8E-09	1E-10	4E-09	3E-09	4E-09	2E-08	4E-09	9E-09	9E-09
38. Po214	2E-11	4E-13	1E-11	3E-10	3E-09	4E-10	1E-10	3E-11	1E-11
39. Po215	3E-05	5E-07	2E-06	1E-05	3E-05	7E-06	5E-06	2E-06	9E-06
40. Po218	2E-11	4E-13	8E-12	3E-10	2E-09	3E-10	1E-10	3E-11	1E-11
41. Pu238	3E-02	5E-04	8E-02	2E+00	2E+01	3E+00	9E-02	8E-03	2E-03
42. Pu239	7E-05	1E-06	1E-01	1E+02	2E+02	2E+01	5E+01	5E+00	5E-01
43. Pu240	1E-03	3E-05	2E-02	2E+01	3E+01	3E+00	4E+00	4E-01	4E-02
44. Pu241	2E-04	2E-06	8E-02	1E+02	2E+02	2E+01	5E+00	5E-01	6E-02
45. Ra223	3E-05	5E-07	2E-06	1E-05	3E-05	7E-06	5E-06	2E-06	9E-06
46. Ra225	9E-09	1E-10	4E-09	3E-09	4E-09	2E-08	5E-09	9E-09	9E-09
47. Ra226	2E-11	4E-13	8E-12	3E-10	2E-09	3E-10	1E-10	3E-11	1E-11
48. Ru106	3E-05	5E-07	3E-06	3E-06	4E-06	3E-08	1E-08	4E-07	4E-08
49. Sb126	4E-08	3E-09	2E-03	4E-01	2E-01	2E-02	3E-01	3E-02	3E-03
50. Sb126m	4E-08	3E-09	2E-03	4E-01	2E-01	2E-02	3E-01	3E-02	3E-03
51. Se79	2E+00	4E-02	2E-01	9E-02	8E-18	5E-03	4E-18	9E-03	5E-02
52. Sm151	2E-04	2E-06	4E+00	6E+02	3E+02	4E+01	9E+02	9E+01	1E+01

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 3 of 25)

Total (1/1/90)	T-101 Curies	T-102 Curies	T-103 Curies	T-104 Curies	T-105 Curies	T-106 Curies	T-107 Curies	T-108 Curies	T-109 Curies
53. Sn126	4E-08	3E-09	2E-03	4E-01	2E-01	2E-02	3E-01	3E-02	3E-03
54. Sr90	2E+03	4E+01	2E+04	4E+04	5E+03	2E+02	3E+04	3E+03	7E+01
55. Tc99	8E+01	1E+00	7E+00	3E+00	3E-16	2E-01	2E-16	3E-01	2E+00
56. Th227	3E-05	5E-07	2E-06	1E-05	3E-05	7E-06	5E-06	2E-06	9E-06
57. Th229	9E-09	1E-10	4E-09	3E-09	4E-09	2E-08	4E-09	9E-09	9E-09
58. Th230	5E-10	5E-11	2E-09	6E-08	5E-07	7E-08	1E-08	4E-09	1E-09
59. Th231	2E-03	2E-04	8E-04	4E-02	1E-01	5E-02	1E-02	5E-03	2E-03
60. Th233	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th234	5E-02	5E-03	2E-02	9E-01	2E+00	1E+00	3E-01	1E-01	4E-02
62. Tl207	3E-05	5E-07	2E-06	1E-05	3E-05	7E-06	5E-06	2E-06	9E-06
63. U233	8E-06	2E-07	3E-06	2E-06	1E-06	6E-06	1E-06	4E-06	4E-06
64. U234	5E-06	5E-07	1E-05	3E-04	3E-03	4E-04	5E-05	2E-05	5E-06
65. U235	2E-03	2E-04	8E-04	4E-02	1E-01	5E-02	1E-02	5E-03	2E-03
66. U238	5E-02	5E-03	2E-02	9E-01	2E+00	1E+00	3E-01	1E-01	4E-02
67. Y90	3E+03	4E+01	2E+04	4E+04	5E+03	3E+02	4E+04	4E+03	7E+01
68. Zr93	3E-07	1E-08	1E-02	2E+00	1E+00	1E-01	2E+00	2E-01	2E-02
TOTAL CURI	6E+04	9E+02	5E+04	1E+05	1E+04	2E+03	7E+04	9E+03	1E+04

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 4 of 25)

Total (1/1/90)	T-110 Curies	T-111 Curies	T-112 Curies	T-201 Curies	T-202 Curies	T-203 Curies	T-204 Curies	Total T Curies
1. Ac225	2E-11	6E-11	8E-11	0E+00	2E-14	2E-13	0E+00	6E-08
2. Ac227	4E-06	1E-05	3E-05	0E+00	1E-12	1E-11	0E+00	1E-04
3. Am241	8E+00	2E+01	3E+01	0E+00	5E-02	5E-01	0E+00	2E+02
4. Am242	8E-06	2E-03	3E-04	0E+00	0E+00	0E+00	0E+00	2E-01
5. Am242m	8E-06	2E-03	3E-04	0E+00	0E+00	0E+00	0E+00	2E-01
6. Am243	2E-05	1E-04	5E-04	0E+00	0E+00	0E+00	0E+00	1E-01
7. At217	2E-11	6E-11	8E-11	0E+00	2E-14	2E-13	0E+00	6E-08
8. Ba135m	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba137m	2E-07	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	4E+04
10. Bi210	2E-11	4E-11	3E-10	0E+00	6E-14	6E-13	0E+00	1E-09
11. Bi211	4E-06	1E-05	3E-05	0E+00	1E-12	1E-11	0E+00	1E-04
12. Bi213	2E-11	6E-11	8E-11	0E+00	2E-14	2E-13	0E+00	7E-08
13. Bi214	9E-11	2E-10	1E-09	0E+00	2E-13	2E-12	0E+00	4E-09
14. C14	2E-12	0E+00	4E-37	0E+00	0E+00	0E+00	0E+00	8E+01
15. Cm242	7E-06	2E-03	3E-04	0E+00	0E+00	0E+00	0E+00	1E-01
16. Cm244	6E-16	0E+00	1E-33	0E+00	0E+00	0E+00	0E+00	4E-01
17. Cm245	4E-20	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	3E-05
18. Cs135	2E-12	0E+00	1E-37	0E+00	0E+00	0E+00	0E+00	3E-01
19. Cs137	2E-07	0E+00	1E-31	0E+00	0E+00	0E+00	0E+00	5E+04
20. Fr221	2E-11	6E-11	8E-11	0E+00	2E-14	2E-13	0E+00	6E-08
21. Fr223	6E-08	1E-07	4E-07	0E+00	2E-14	2E-13	0E+00	2E-06
22. I129	8E-14	0E+00	9E-39	0E+00	0E+00	0E+00	0E+00	1E-01
23. Nb93m	3E-01	2E-01	3E-01	0E+00	0E+00	0E+00	0E+00	7E+00
24. Ni59	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni63	5E-11	7E-01	8E+00	0E+00	0E+00	0E+00	0E+00	1E+03
26. Np237	7E-05	1E-04	3E-04	0E+00	4E-07	4E-06	0E+00	1E-01

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 5 of 25)

Total (1/1/90)	T-110 Curies	T-111 Curies	T-112 Curies	T-201 Curies	T-202 Curies	T-203 Curies	T-204 Curies	Total T Curies
27. Np239	2E-05	1E-04	5E-04	0E+00	0E+00	0E+00	0E+00	9E-02
28. Pa231	9E-06	2E-05	7E-05	0E+00	4E-12	4E-11	0E+00	3E-04
29. Pa233	7E-05	1E-04	3E-04	0E+00	4E-07	4E-06	0E+00	1E-01
30. Pa234m	2E-01	6E-01	2E+00	0E+00	0E+00	0E+00	0E+00	7E+00
31. Pb209	2E-11	6E-11	8E-11	0E+00	2E-14	2E-13	0E+00	6E-08
32. Pb210	2E-11	4E-11	3E-10	0E+00	5E-14	5E-13	0E+00	1E-09
33. Pb211	4E-06	1E-05	3E-05	0E+00	1E-12	1E-11	0E+00	1E-04
34. Pb214	9E-11	2E-10	1E-09	0E+00	2E-13	2E-12	0E+00	4E-09
35. Pd107	1E-13	0E+00	1E-38	0E+00	0E+00	0E+00	0E+00	2E-01
36. Po210	2E-11	4E-11	2E-10	0E+00	5E-14	5E-13	0E+00	9E-10
37. Po213	2E-11	6E-11	8E-11	0E+00	2E-14	2E-13	0E+00	6E-08
38. Po214	1E-10	2E-10	1E-09	0E+00	3E-13	3E-12	0E+00	5E-09
39. Po215	4E-06	1E-05	3E-05	0E+00	1E-12	1E-11	0E+00	1E-04
40. Po218	9E-11	2E-10	1E-09	0E+00	2E-13	2E-12	0E+00	4E-09
41. Pu238	4E-01	7E-01	1E+01	0E+00	2E-03	2E-02	0E+00	4E+01
42. Pu239	2E+02	1E+02	2E+02	0E+00	3E-01	3E+00	0E+00	9E+02
43. Pu240	2E+01	2E+01	4E+01	0E+00	6E-02	6E-01	0E+00	1E+02
44. Pu241	4E+01	1E+02	2E+02	0E+00	3E-01	3E+00	0E+00	7E+02
45. Ra223	4E-06	1E-05	3E-05	0E+00	1E-12	1E-11	0E+00	1E-04
46. Ra225	2E-11	6E-11	8E-11	0E+00	2E-14	2E-13	0E+00	6E-08
47. Ra226	9E-11	2E-10	1E-09	0E+00	2E-13	2E-12	0E+00	4E-09
48. Ru106	2E-08	9E-08	7E-07	0E+00	0E+00	0E+00	0E+00	4E-05
49. Sb126	4E-02	4E-02	6E-02	0E+00	0E+00	0E+00	0E+00	1E+00
50. Sb126m	4E-02	4E-02	6E-02	0E+00	0E+00	0E+00	0E+00	1E+00
51. Se79	3E-12	0E+00	3E-37	0E+00	0E+00	0E+00	0E+00	2E+00
52. Sm151	1E+02	6E+01	7E+01	0E+00	0E+00	0E+00	0E+00	2E+03

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 6 of 25)

Total (1/1/90)	T-110 Curies	T-111 Curies	T-112 Curies	T-201 Curies	T-202 Curies	T-203 Curies	T-204 Curies	Total T Curies
53. Sn126	4E-02	4E-02	6E-02	0E+00	0E+00	0E+00	0E+00	1E+00
54. Sr90	4E+03	3E+03	4E+03	0E+00	0E+00	0E+00	0E+00	1E+05
55. Tc99	1E-10	0E+00	5E-36	0E+00	0E+00	0E+00	0E+00	9E+01
56. Th227	4E-06	9E-06	3E-05	0E+00	1E-12	1E-11	0E+00	1E-04
57. Th229	2E-11	6E-11	8E-11	0E+00	2E-14	2E-13	0E+00	6E-08
58. Th230	2E-08	3E-08	2E-07	0E+00	4E-11	4E-10	0E+00	9E-07
59. Th231	1E-02	3E-02	9E-02	0E+00	1E-08	1E-07	0E+00	3E-01
60. Th233	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th234	2E-01	6E-01	2E+00	0E+00	0E+00	0E+00	0E+00	7E+00
62. Tl207	4E-06	1E-05	3E-05	0E+00	1E-12	1E-11	0E+00	1E-04
63. U233	1E-08	2E-08	3E-08	0E+00	3E-11	3E-10	0E+00	3E-05
64. U234	8E-05	2E-04	1E-03	0E+00	2E-07	2E-06	0E+00	5E-03
65. U235	1E-02	3E-02	9E-02	0E+00	1E-08	1E-07	0E+00	3E-01
66. U238	2E-01	6E-01	2E+00	0E+00	0E+00	0E+00	0E+00	7E+00
67. Y90	4E+03	3E+03	5E+03	0E+00	0E+00	0E+00	0E+00	1E+05
68. Zr93	3E-01	3E-01	3E-01	0E+00	0E+00	0E+00	0E+00	6E+00
TOTAL CURI	8E+03	6E+03	1E+04	0E+00	7E-01	7E+00	0E+00	3E+05

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 7 of 25)

Total (1/1/90)	TX-101 Curies	TX-102 Curies	TX-103 Curies	TX-104 Curies	TX-105 Curies	TX-106 Curies	TX-107 Curies	TX-108 Curies	TX-109 Curies	TX-110 Curies	TX-111 Curies
1. Ac225	3E-08	5E-08	1E-08	3E-08	1E-07	4E-09	1E-15	2E-08	1E-07	5E-08	2E-08
2. Ac227	4E-13	3E-06	5E-06	9E-10	2E-05	3E-06	2E-12	3E-05	5E-04	2E-04	7E-05
3. Am241	1E-03	5E-04	1E-01	9E-06	3E-03	6E-05	7E-07	1E+00	1E+02	4E+01	5E+00
4. Am242	1E-06	1E-07	2E-04	8E-15	5E-07	2E-07	1E-11	3E-05	2E-01	8E-02	8E-03
5. Am242m	1E-06	1E-07	2E-04	8E-15	5E-07	2E-07	1E-11	3E-05	2E-01	8E-02	8E-03
6. Am243	4E-07	4E-08	1E-04	1E-15	2E-07	3E-08	3E-10	6E-04	1E-01	5E-02	5E-03
7. At217	3E-08	5E-08	1E-08	3E-08	1E-07	4E-09	1E-15	2E-08	1E-07	5E-08	2E-08
8. Ba135m	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba137m	7E-05	2E+03	3E+03	5E-04	2E+04	3E+04	9E-04	1E+05	8E+05	4E+05	8E+04
10. Bi210	2E-13	8E-14	1E-13	2E-14	7E-13	3E-14	5E-18	5E-12	1E-10	4E-11	9E-12
11. Bi211	4E-13	3E-06	6E-06	9E-10	2E-05	3E-06	2E-12	3E-05	5E-04	2E-04	7E-05
12. Bi213	3E-08	5E-08	1E-08	3E-08	1E-07	4E-09	1E-15	2E-08	1E-07	5E-08	2E-08
13. Bi214	8E-15	2E-13	2E-13	9E-14	2E-12	5E-14	2E-17	2E-11	7E-10	1E-10	3E-11
14. C14	2E+01	3E+00	8E-01	5E-07	3E+01	5E+00	1E-08	1E+01	3E+02	1E+02	1E+01
15. Cm242	9E-07	1E-07	2E-04	6E-15	4E-07	1E-07	9E-12	2E-05	2E-01	7E-02	7E-03
16. Cm244	2E-10	5E-03	1E-03	1E-09	5E-02	2E-03	2E-10	5E-02	1E+00	4E-01	5E-02
17. Cm245	2E-14	1E-07	6E-08	2E-14	1E-06	4E-08	1E-14	3E-06	6E-05	2E-05	2E-06
18. Cs135	6E-10	7E-03	4E-02	2E-09	7E-02	2E-01	1E-08	8E-01	5E+00	3E+00	1E+00
19. Cs137	7E-05	2E+03	3E+03	5E-04	2E+04	3E+04	1E-03	1E+05	9E+05	4E+05	9E+04
20. Fr221	3E-08	5E-08	1E-08	3E-08	1E-07	4E-09	1E-15	2E-08	1E-07	5E-08	2E-08
21. Fr223	5E-15	4E-08	8E-08	1E-11	3E-07	4E-08	3E-14	5E-07	7E-06	3E-06	1E-06
22. I129	9E-11	2E-02	2E-03	3E-09	1E-01	1E-02	5E-10	6E-02	1E+00	5E-01	7E-02
23. Nb93m	4E-08	1E-01	1E-02	6E-05	1E+00	6E-02	1E-07	3E-01	1E+01	3E+00	4E-01
24. Ni59	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni63	1E+02	6E-03	1E+02	4E-07	3E+00	1E+01	2E-07	3E+02	1E+03	5E+02	2E+02
26. Np237	8E-09	2E-02	4E-03	5E-09	2E-01	4E-02	2E-09	8E-02	2E+00	8E-01	1E-01

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 8 of 25)

Total (1/1/90)	TX-101 Curies	TX-102 Curies	TX-103 Curies	TX-104 Curies	TX-105 Curies	TX-106 Curies	TX-107 Curies	TX-108 Curies	TX-109 Curies	TX-110 Curies	TX-111 Curies
27. Np239	4E-07	4E-08	1E-04	1E-15	2E-07	3E-08	3E-10	6E-04	1E-01	5E-02	5E-03
28. Pa231	1E-12	4E-06	8E-06	3E-09	4E-05	4E-06	8E-12	5E-05	7E-04	3E-04	1E-04
29. Pa233	8E-09	2E-02	4E-03	5E-09	2E-01	4E-02	2E-09	8E-02	2E+00	8E-01	1E-01
30. Pa234m	8E-08	1E-08	2E-07	1E-04	1E-12	3E-07	2E-07	2E-01	1E+00	4E-01	2E-01
31. Pb209	3E-08	5E-08	1E-08	3E-08	1E-07	4E-09	1E-15	2E-08	1E-07	5E-08	2E-08
32. Pb210	2E-13	7E-14	1E-13	2E-14	7E-13	3E-14	5E-18	5E-12	1E-10	2E-11	8E-12
33. Pb211	4E-13	3E-06	5E-06	9E-10	2E-05	3E-06	2E-12	3E-05	5E-04	2E-04	7E-05
34. Pb214	8E-15	2E-13	2E-13	9E-14	2E-12	5E-14	2E-17	2E-11	7E-10	1E-10	3E-11
35. Pd107	2E-10	3E-02	3E-03	7E-09	3E-01	2E-02	1E-09	9E-02	2E+00	9E-01	1E-01
36. Po210	2E-13	8E-14	1E-13	1E-14	7E-13	3E-14	5E-18	5E-12	1E-10	3E-11	8E-12
37. Po213	3E-08	5E-08	1E-08	3E-08	1E-07	4E-09	1E-15	2E-08	1E-07	5E-08	2E-08
38. Po214	9E-15	2E-13	4E-13	1E-13	2E-12	6E-14	3E-17	3E-11	8E-10	1E-10	4E-11
39. Po215	4E-13	3E-06	6E-06	9E-10	2E-05	3E-06	2E-12	3E-05	5E-04	2E-04	7E-05
40. Po218	8E-15	2E-13	2E-13	9E-14	2E-12	5E-14	2E-17	2E-11	7E-10	1E-10	3E-11
41. Pu238	3E-04	1E-04	5E-04	3E-03	8E-04	1E-05	2E-07	1E-01	5E+00	2E-01	2E-02
42. Pu239	3E-05	9E-08	9E-07	3E-04	4E-04	3E-08	9E-07	6E-01	2E+02	1E+01	1E+00
43. Pu240	5E-04	1E-04	5E-06	1E-04	4E-04	7E-06	2E-07	1E-01	3E+01	2E+00	2E-01
44. Pu241	1E-04	5E-07	3E-06	1E-04	3E-03	5E-08	2E-06	1E+00	1E+02	9E+00	9E-01
45. Ra223	4E-13	3E-06	5E-06	9E-10	2E-05	3E-06	2E-12	3E-05	5E-04	2E-04	7E-05
46. Ra225	3E-08	5E-08	1E-08	3E-08	1E-07	4E-09	1E-15	2E-08	1E-07	5E-08	2E-08
47. Ra226	8E-15	2E-13	2E-13	9E-14	2E-12	5E-14	2E-17	2E-11	7E-10	1E-10	3E-11
48. Ru106	3E-06	1E-07	1E-07	4E-14	7E-05	2E-08	5E-13	3E-07	2E-04	6E-05	6E-06
49. Sb126	7E-09	8E-10	3E-09	1E-05	2E-10	9E-10	5E-08	2E-02	5E-01	4E-02	5E-03
50. Sb126m	7E-09	8E-10	3E-09	1E-05	2E-10	9E-10	5E-08	2E-02	5E-01	4E-02	5E-03
51. Se79	3E-09	3E-01	4E-02	4E-08	3E+00	3E-01	8E-09	1E+00	3E+01	9E+00	1E+00
52. Sm151	3E-04	8E-07	2E-05	2E-02	1E-04	2E-05	3E-05	3E+01	8E+02	7E+01	7E+00

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 9 of 25)

Total (1/1/90)	TX-101 Curies	TX-102 Curies	TX-103 Curies	TX-104 Curies	TX-105 Curies	TX-106 Curies	TX-107 Curies	TX-108 Curies	TX-109 Curies	TX-110 Curies	TX-111 Curies
53. Sn126	7E-09	8E-10	3E-09	1E-05	2E-10	8E-10	5E-08	2E-02	5E-01	4E-02	5E-03
54. Sr90	8E+03	3E+02	7E+02	6E-05	3E+03	5E-06	1E-03	5E+03	1E+05	1E+05	5E+04
55. Tc99	1E-07	1E+01	2E+00	2E-06	1E+02	9E+00	5E-07	4E+01	9E+02	3E+02	5E+01
56. Th227	4E-13	2E-06	5E-06	9E-10	2E-05	3E-06	2E-12	3E-05	4E-04	2E-04	7E-05
57. Th229	3E-08	5E-08	1E-08	3E-08	1E-07	4E-09	1E-15	2E-08	1E-07	5E-08	2E-08
58. Th230	2E-12	1E-12	9E-12	3E-11	6E-12	2E-13	6E-15	4E-09	1E-07	1E-08	4E-09
59. Th231	2E-09	5E-10	8E-09	6E-06	1E-10	2E-08	2E-08	7E-03	5E-02	2E-02	8E-03
60. Th233	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th234	8E-08	1E-08	2E-07	1E-04	1E-12	3E-07	2E-07	2E-01	1E+00	4E-01	2E-01
62. Tl207	4E-13	3E-06	5E-06	9E-10	2E-05	3E-06	2E-12	3E-05	5E-04	2E-04	7E-05
63. U233	1E-05	2E-05	6E-06	2E-05	6E-05	4E-06	6E-13	1E-05	2E-04	6E-05	2E-05
64. U234	2E-08	1E-08	5E-08	2E-07	6E-08	1E-09	4E-11	3E-05	7E-04	7E-05	2E-05
65. U235	2E-09	5E-10	8E-09	6E-06	1E-10	2E-08	2E-08	7E-03	5E-02	2E-02	8E-03
66. U238	8E-08	1E-08	2E-07	1E-04	1E-12	3E-07	2E-07	2E-01	1E+00	4E-01	2E-01
67. Y90	9E+03	3E+02	7E+02	7E-05	3E+03	5E-06	1E-03	5E+03	1E+05	1E+05	5E+04
68. Zr93	6E-08	7E-09	1E-08	8E-05	8E-10	7E-09	2E-07	1E-01	3E+00	3E-01	3E-02
TOTAL CURI	2E+04	5E+03	8E+03	3E-02	5E+04	6E+04	4E-03	2E+05	2E+06	1E+06	3E+05

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 10 of 25)

Total (1/1/90)	TX-112 Curies	TX-113 Curies	TX-114 Curies	TX-115 Curies	TX-116 Curies	TX-117 Curies	TX-118 Curies	Total TX Curies
1. Ac225	2E-08	1E-08	2E-08	2E-09	1E-08	1E-08	4E-07	9E-07
2. Ac227	9E-05	1E-03	1E-04	3E-04	7E-05	3E-04	5E-04	3E-03
3. Am241	3E-01	6E+00	6E-01	7E-02	1E-02	2E-02	2E+03	2E+03
4. Am242	5E-04	2E-02	2E-03	2E-04	2E-06	2E-05	2E+00	2E+00
5. Am242m	5E-04	2E-02	2E-03	2E-04	2E-06	2E-05	2E+00	2E+00
6. Am243	3E-04	4E-04	3E-05	4E-06	7E-07	4E-06	7E-01	9E-01
7. At217	2E-08	1E-08	2E-08	2E-09	1E-08	1E-08	4E-07	9E-07
8. Ba135m	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba137m	6E+04	2E+04	6E+04	3E+04	1E+04	6E+03	1E+06	3E+06
10. Bi210	4E-12	2E-09	3E-10	4E-10	1E-10	5E-10	5E-10	4E-09
11. Bi211	9E-05	1E-03	1E-04	3E-04	7E-05	3E-04	5E-04	3E-03
12. Bi213	2E-08	1E-08	2E-08	2E-09	1E-08	1E-08	4E-07	9E-07
13. Bi214	9E-12	1E-08	1E-09	2E-09	4E-10	2E-09	2E-09	2E-08
14. C14	2E+00	1E+01	3E+00	7E+00	1E+00	1E+01	1E+03	2E+03
15. Cm242	4E-04	2E-02	2E-03	2E-04	1E-06	2E-05	2E+00	2E+00
16. Cm244	3E-03	4E-05	2E-04	3E-03	4E-05	2E-05	1E+00	3E+00
17. Cm245	1E-07	8E-10	5E-09	8E-08	8E-10	3E-10	7E-05	2E-04
18. Cs135	1E+00	4E-01	1E+00	4E-01	3E-01	1E-01	5E+00	2E+01
19. Cs137	7E+04	2E+04	7E+04	4E+04	2E+04	6E+03	1E+06	3E+06
20. Fr221	2E-08	1E-08	2E-08	2E-09	1E-08	1E-08	4E-07	9E-07
21. Fr223	1E-06	2E-05	2E-06	5E-06	1E-06	4E-06	7E-06	5E-05
22. I129	4E-02	1E-02	3E-02	2E-02	8E-03	3E-03	1E+00	3E+00
23. Nb93m	1E-01	1E+00	2E-01	5E-02	3E-02	1E-02	5E+01	7E+01
24. Ni59	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni63	2E+02	9E+01	2E+02	1E+02	4E+01	2E+01	3E+03	6E+03
26. Np237	8E-02	3E-02	8E-02	3E-02	2E-02	8E-03	2E+00	5E+00

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 11 of 25)

Total (1/1/90)	TX-112 Curies	TX-113 Curies	TX-114 Curies	TX-115 Curies	TX-116 Curies	TX-117 Curies	TX-118 Curies	Total TX Curies
27. Np239	3E-04	3E-04	3E-05	4E-06	6E-07	3E-06	7E-01	9E-01
28. Pa231	1E-04	3E-03	3E-04	7E-04	1E-04	7E-04	9E-04	7E-03
29. Pa233	9E-02	3E-02	8E-02	3E-02	2E-02	8E-03	2E+00	6E+00
30. Pa234m	4E-02	1E+02	3E+00	2E+01	3E+00	2E+01	8E+00	2E+02
31. Pb209	2E-08	1E-08	2E-08	2E-09	1E-08	1E-08	4E-07	9E-07
32. Pb210	4E-12	2E-09	3E-10	4E-10	9E-11	5E-10	5E-10	4E-09
33. Pb211	9E-05	1E-03	1E-04	3E-04	7E-05	3E-04	5E-04	3E-03
34. Pb214	9E-12	1E-08	1E-09	2E-09	4E-10	2E-09	2E-09	2E-08
35. Pd107	4E-02	1E-02	4E-02	2E-02	9E-03	4E-03	2E+00	6E+00
36. Po210	4E-12	2E-09	3E-10	4E-10	9E-11	5E-10	5E-10	4E-09
37. Po213	2E-08	1E-08	2E-08	2E-09	1E-08	1E-08	4E-07	9E-07
38. Po214	1E-11	1E-08	1E-09	2E-09	5E-10	3E-09	2E-09	2E-08
39. Po215	9E-05	1E-03	1E-04	3E-04	7E-05	3E-04	5E-04	3E-03
40. Po218	9E-12	1E-08	1E-09	2E-09	4E-10	2E-09	2E-09	2E-08
41. Pu238	8E-04	3E-01	1E-01	6E-02	3E-03	2E-02	2E+01	3E+01
42. Pu239	6E-02	5E+01	5E+00	5E-01	8E-10	4E-09	9E+02	1E+03
43. Pu240	8E-03	8E+00	8E-01	9E-02	8E-07	1E-05	2E+02	2E+02
44. Pu241	2E-02	3E+01	3E+00	3E-01	1E-09	2E-08	4E+03	4E+03
45. Ra223	9E-05	1E-03	1E-04	3E-04	7E-05	3E-04	5E-04	3E-03
46. Ra225	2E-08	1E-08	2E-08	2E-09	1E-08	1E-08	4E-07	9E-07
47. Ra226	9E-12	1E-08	1E-09	2E-09	4E-10	2E-09	2E-09	2E-08
48. Ru106	4E-07	3E-07	3E-08	2E-06	6E-10	3E-09	3E-03	4E-03
49. Sb126	2E-04	2E-01	2E-02	2E-03	9E-13	2E-12	5E+01	5E+01
50. Sb126m	2E-04	2E-01	2E-02	2E-03	9E-13	2E-12	5E+01	5E+01
51. Se79	7E-01	2E-01	6E-01	3E-01	2E-01	6E-02	2E+01	7E+01
52. Sm151	4E-01	3E+02	3E+01	3E+00	2E-03	4E-03	5E+04	5E+04

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 12 of 25)

Total (1/1/90)	TX-112 Curies	TX-113 Curies	TX-114 Curies	TX-115 Curies	TX-116 Curies	TX-117 Curies	TX-118 Curies	Total TX Curies
53. Sn126	2E-04	2E-01	2E-02	2E-03	8E-13	2E-12	5E+01	5E+01
54. Sr90	8E+03	8E+03	8E+02	3E+04	4E+04	7E+04	7E+05	1E+06
55. Tc99	2E+01	8E+00	2E+01	1E+01	6E+00	2E+00	9E+02	2E+03
56. Th227	8E-05	1E-03	1E-04	2E-04	6E-05	3E-04	5E-04	3E-03
57. Th229	2E-08	1E-08	2E-08	2E-09	1E-08	1E-08	4E-07	9E-07
58. Th230	9E-10	2E-06	2E-07	3E-07	7E-08	4E-07	3E-07	3E-06
59. Th231	2E-03	4E+00	1E-01	7E-01	1E-01	9E-01	3E-01	6E+00
60. Th233	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th234	4E-02	1E+02	3E+00	2E+01	3E+00	2E+01	8E+00	2E+02
62. Tl207	9E-05	1E-03	1E-04	3E-04	7E-05	3E-04	5E-04	3E-03
63. U233	1E-05	5E-06	1E-05	2E-06	6E-06	5E-06	3E-04	7E-04
64. U234	4E-06	1E-02	7E-04	2E-03	4E-04	2E-03	2E-03	2E-02
65. U235	2E-03	4E+00	1E-01	7E-01	1E-01	9E-01	3E-01	6E+00
66. U238	4E-02	1E+02	3E+00	2E+01	3E+00	2E+01	8E+00	2E+02
67. Y90	8E+03	8E+03	8E+02	3E+04	4E+04	8E+04	8E+05	1E+06
68. Zr93	2E-03	1E+00	1E-01	1E-02	0E+00	0E+00	0E+00	5E+00
TOTAL CURI	1E+05	6E+04	1E+05	1E+05	1E+05	2E+05	4E+06	8E+06

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 13 of 25)

Total (1/1/90)	TY-101 Curies	TY-102 Curies	TY-103 Curies	TY-104 Curies	TY-105 Curies	TY-106 Curies	Total TY Curies
1. Ac225	8E-09	6E-08	2E-07	4E-09	1E-08	6E-09	3E-07
2. Ac227	2E-05	1E-04	2E-04	3E-06	2E-04	7E-06	5E-04
3. Am241	5E+01	3E-01	4E+01	2E+00	2E+01	3E+00	1E+02
4. Am242	4E-04	5E-06	9E-04	4E-05	6E-02	6E-03	7E-02
5. Am242m	4E-04	5E-06	9E-04	4E-05	6E-02	6E-03	7E-02
6. Am243	6E-03	3E-05	4E-03	3E-04	2E-03	2E-04	1E-02
7. At217	8E-09	6E-08	2E-07	4E-09	1E-08	6E-09	3E-07
8. Ba135m	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba137m	6E+03	7E+04	1E+05	1E+03	3E+04	2E-04	2E+05
10. Bi210	7E-10	1E-11	3E-09	2E-11	5E-10	6E-11	4E-09
11. Bi211	2E-05	1E-04	2E-04	3E-06	2E-04	7E-06	5E-04
12. Bi213	8E-09	6E-08	2E-07	4E-09	2E-08	6E-09	3E-07
13. Bi214	3E-09	5E-11	1E-08	8E-11	2E-09	2E-10	2E-08
14. C14	3E+00	6E+01	2E+02	3E-01	1E+01	1E-01	3E+02
15. Cm242	3E-04	4E-06	7E-04	3E-05	5E-02	5E-03	6E-02
16. Cm244	1E-04	1E-01	3E-01	2E-04	2E-04	1E-12	4E-01
17. Cm245	5E-09	3E-06	9E-06	9E-09	5E-09	4E-17	1E-05
18. Cs135	9E-02	5E-01	5E-01	1E-02	4E-01	2E-09	2E+00
19. Cs137	6E+03	7E+04	1E+05	2E+03	3E+04	2E-04	2E+05
20. Fr221	8E-09	6E-08	2E-07	4E-09	1E-08	6E-09	3E-07
21. Fr223	3E-07	1E-06	2E-06	4E-08	3E-06	1E-07	7E-06
22. I129	3E-03	4E-01	1E+00	7E-04	1E-02	9E-11	1E+00
23. Nb93m	2E+00	3E+00	2E+01	6E-01	2E+01	2E+00	4E+01
24. Ni59	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni63	6E+01	1E+02	4E-01	3E+00	3E+02	1E-06	5E+02
26. Np237	7E-03	6E-01	2E+00	2E-03	3E-02	3E-05	3E+00

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 14 of 25)

Total (1/1/90)	TY-101 Curies	TY-102 Curies	TY-103 Curies	TY-104 Curies	TY-105 Curies	TY-106 Curies	Total TY Curies
27. Np239	6E-03	3E-05	4E-03	3E-04	2E-03	2E-04	1E-02
28. Pa231	4E-05	2E-04	4E-04	6E-06	4E-04	2E-05	1E-03
29. Pa233	7E-03	6E-01	2E+00	2E-03	3E-02	3E-05	3E+00
30. Pa234m	2E-01	7E-03	2E+00	2E-01	5E+00	5E-01	8E+00
31. Pb209	8E-09	6E-08	2E-07	4E-09	1E-08	6E-09	3E-07
32. Pb210	6E-10	9E-12	2E-09	2E-11	5E-10	6E-11	3E-09
33. Pb211	2E-05	1E-04	2E-04	3E-06	2E-04	7E-06	5E-04
34. Pb214	3E-09	5E-11	1E-08	8E-11	2E-09	2E-10	2E-08
35. Pd107	4E-03	7E-01	2E+00	1E-03	2E-02	1E-10	3E+00
36. Po210	6E-10	9E-12	2E-09	2E-11	5E-10	6E-11	3E-09
37. Po213	8E-09	6E-08	2E-07	4E-09	1E-08	6E-09	3E-07
38. Po214	4E-09	6E-11	1E-08	1E-10	2E-09	2E-10	2E-08
39. Po215	2E-05	1E-04	2E-04	3E-06	2E-04	7E-06	5E-04
40. Po218	3E-09	5E-11	1E-08	8E-11	2E-09	2E-10	2E-08
41. Pu238	3E+01	5E-01	1E+02	6E-01	5E-01	6E-02	1E+02
42. Pu239	2E+02	3E+00	3E+02	8E+00	7E+01	8E+00	6E+02
43. Pu240	4E+01	6E-01	4E+01	2E+00	8E+00	9E-01	9E+01
44. Pu241	3E+02	4E+00	2E+02	1E+01	2E+01	2E+00	5E+02
45. Ra223	2E-05	1E-04	2E-04	3E-06	2E-04	7E-06	5E-04
46. Ra225	8E-09	6E-08	2E-07	4E-09	1E-08	6E-09	3E-07
47. Ra226	3E-09	5E-11	1E-08	8E-11	2E-09	2E-10	2E-08
48. Ru106	9E-06	3E-06	2E-05	2E-07	2E-06	2E-07	3E-05
49. Sb126	4E-01	5E-03	1E+00	1E-01	3E+00	3E-01	5E+00
50. Sb126m	4E-01	5E-03	1E+00	1E-01	3E+00	3E-01	5E+00
51. Se79	6E-02	7E+00	2E+01	1E-02	3E-01	1E-09	3E+01
52. Sm151	5E+02	8E+00	3E+03	3E+02	6E+03	7E+02	1E+04

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 15 of 25)

Total (1/1/90)	TY-101 Curies	TY-102 Curies	TY-103 Curies	TY-104 Curies	TY-105 Curies	TY-106 Curies	Total TY Curies
53. Sn126	4E-01	5E-03	1E+00	1E-01	3E+00	3E-01	5E+00
54. Sr90	2E+04	1E+04	1E+05	6E+03	3E+05	9E+03	5E+05
55. Tc99	2E+00	2E+02	7E+02	4E-01	1E+01	5E-08	9E+02
56. Th227	2E-05	1E-04	2E-04	3E-06	2E-04	7E-06	5E-04
57. Th229	8E-09	6E-08	2E-07	4E-09	1E-08	6E-09	3E-07
58. Th230	6E-07	9E-09	2E-06	2E-08	2E-07	2E-08	3E-06
59. Th231	1E-02	3E-04	8E-02	1E-02	2E-01	2E-02	3E-01
60. Th233	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th234	2E-01	7E-03	2E+00	2E-01	5E+00	5E-01	8E+00
62. Tl207	2E-05	1E-04	2E-04	3E-06	2E-04	7E-06	5E-04
63. U233	4E-06	5E-05	2E-04	2E-06	6E-06	2E-06	2E-04
64. U234	4E-03	6E-05	1E-02	9E-05	7E-04	8E-05	1E-02
65. U235	1E-02	3E-04	8E-02	1E-02	2E-01	2E-02	3E-01
66. U238	2E-01	7E-03	2E+00	2E-01	5E+00	5E-01	8E+00
67. Y90	2E+04	1E+04	1E+05	6E+03	3E+05	1E+04	5E+05
68. Zr93	2E+00	3E-02	8E+00	7E-01	2E+01	2E+00	3E+01
TOTAL CURI	5E+04	2E+05	4E+05	2E+04	7E+05	2E+04	1E+06

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 16 of 25)

Total (1/1/90)	T-101 Grams	T-102 Grams	T-103 Grams	T-104 Grams	T-105 Grams	T-106 Grams	T-107 Grams	T-108 Grams	T-109 Grams
69. Ag	0.000970812	0.000021573	0.000097081	0.000053934	3.23604E-21	0.000002157	2.15736E-21	0.000004314	0.000021573
70. Al	5935938.8	134907.7	27790986.2	10819597.54	5396308	1349077	21585.232	26981.54	547725.262
71. Ba	480.655	3.98257	101.6242	164.796	137.33	554.8132	411.99	416.1099	288.393
72. Bi	2.92573E-11	6.06043E-13	1.69274E-11	41796080	417960800	62694120	14628628	1462862.8	167184.32
73. C2H3O3	0	0	0	0	0	0	0	0	0
74. C6H5O7	7564052	132370.91	756405.2	0	0	0	0	0	0
75. CO3	12001840.24	240036.8	240036.8	0	0.000000000	0.000000000	360055.2	600092	18005160.36
76. C2O4	0	0	0	0	0	0	0	0	0
77. Ca	0.2004	0.0008016	0.004008	0	0	0	0	2.40480E-31	2.40480E-32
78. Cd	0	0	0	0	0	0	0	0	0
79. Ce	4203.6	70.06	1.4012	56048	5.60480E-14	280.24	2.80240E-14	70.06	2802.4
80. Cl	0.00248171	0.000035453	0.000010635	0	1.06359E-19	0	1.06359E-19	0.000141812	0.0035453
81. Cr	1.55988E-11	4.15968E-12	5.19960E-13	1039920	363972	36397.2	519960	51996	5199.6
82. EDTA	0	0	0	0	0	0	0	0	0
83. F	3039744.48	56995.209	11399.0418	7599361.2	1.89984E-10	17117561.10	1.89984E-10	569952.09	189984.03
84. Fe	335082	5584.7	33508.20335	16754100	5584700	558470	11169400	1116940	111694
85. Fe(CN)6	19075.83039	2119.616781	21.19743953	0	2.11953E-12	0	2.11953E-12	6358.596	635.8596
86. HEDTA	1948.1	27.83	194.81	0	0	0	0	0	0
87. Hg	0	0	0	0	0	0	0	0	0
88. K	1172949	19549.15	3127.864	0	7.81966E-12	0	7.81966E-12	11729.49	1172.949
89. La	9.72339E-11	1.38906E-12	0	0	0	0	0	0	0
90. Mn	10987.6	219.752	1098.76	0	0	0	0	0	0
91. NO2	4600550	92011	460055	13801650	1.38017E-10	1840220	9.20110E-12	13801.65	920110
92. NO3	124009800	2480196	12400980	248019600	0.000000000	136410780	0.000012401	1240098	18601470
93. Na	73567264	1149488.5	4597954	114948850	6.896931	140237597	185527.4439	8966010.3	22990919.48
94. Ni	93920	2935	17610	0	1.76100E-16	0	1.76100E-16	0.3522	0.03522

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 17 of 25)

Total (1/1/90)	T-101 Grams	T-102 Grams	T-103 Grams	T-104 Grams	T-105 Grams	T-106 Grams	T-107 Grams	T-108 Grams	T-109 Grams
95. OH	851215.365	102145.8438	51022053.06	17010701.46	15306575.10	1704131.46	10205570.51	1020778.146	137078.838
96. PO4	5698281.6	94971.36	18994.272	66479952	189942720	95161302.72	6647995.2	9782050.08	4805550.816
97. Pb	1.8648	0.014504	0.082880001	0.000000080	0.000000145	0.000000021	0.000000020	0.000000014	0.000000089
98. SeO4	0	0	0	0	0	0	0	0	0
99. SiO3	760837	15216.74	68475.33	4565022	3.80419E-12	60866.96	2.28251E-12	5325.859	304334.8
100. Sn	0	0	0	0	0	0	0	0	0
101. SO4	6724320.172	96059.52115	96124.84032	9605856.057	96.0576	38807.2704	288.1728	288460.9728	7684800.115
102. Sr	0.8762	0.026286	0.08762	0	0	0	0	0	0
103. WO4	0	0	0	0	0	0	0	0	0
104. ZrO	58.97067	0.30021432	214.974897	5360978.577	536097	64332.71219	2144388	214438.8107	32165.92721
105. Volume	1E+02								
Total Grams	246392653.3	4624910.017	97519342.76	557857881.6	635091412.3	457274498.4	45883809.75	25378362.85	74508277.20

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 18 of 25)

Total (1/1/90)	T-110 Grams	T-111 Grams	T-112 Grams	T-201 Grams	T-202 Grams	T-203 Grams	T-204 Grams	Total T Grams
69. Ag	2.15736E-15	0	0	0	0	0	0	0.001171446
70. Al	0	0	0	0	0	0	0	52023107.27
71. Ba	0.274660001	0	0.82398	0	0	0	0	2560.79251
72. Bi	2089804000	2089804000	2089804000	0	62694.12	626941.2	0	6808811310.
73. C2H3O3	0	0	0	0	0	0	0	0
74. C6H5O7	0	0	0	0	0	0	0	8452828.11
75. CO3	0	0	0	0	0	0	0	31447221.40
76. C2O4	0	0	0	0	0	0	0	0
77. Ca	0	0	0	0	0	0	0	0.2052096
78. Cd	0	0	0	0	0	0	0	0
79. Ce	0	0	0	0	0	0	0	63475.7612
80. Cl	0	0	0	0	0	0	0	0.006214910
81. Cr	1039920	1559880	1559880	0	10399.2	103992	0	6291516
82. EDTA	0	0	0	0	0	0	0	0
83. F	151987.2240	56995.209	56995.209	0	379968.0601	949920.1509	0	30180863.00
84. Fe	22338800	22338800	27923500	0	0	0	0	108270578.9
85. Fe(CN)6	0	0	0	0	0	0	0	28211.10021
86. HEDTA	0	0	0	0	0	0	0	2170.74
87. Hg	0	0	0	0	0	0	0	0
88. K	0	0	0	0	781966	1563932	0	3554426.453
89. La	0	1111244	111124.4	0	13890.55	138905.5	0	1375164.45
90. Mn	0	1098760	109876	0	16701.152	165198.566	0	1402841.83
91. NO2	0	0	0	0	0	0	0	21728397.65
92. NO3	1860147.012	0	2.48020E-26	0	6200490	12400980	0	563624541.0
93. Na	1839181.611	0	0.000011494	229.8977	4597954	6896931	459.7954	379978373.9
94. Ni	0	0	0	0	0	0	0	114465.3874

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 19 of 25)

Total (1/1/90)	T-110 Grams	T-111 Grams	T-112 Grams	T-201 Grams	T-202 Grams	T-203 Grams	T-204 Grams	Total T Grams
95. OH	17007300	34014600	34014600	170.073	714306.6	1870803	340.146	184982369.6
96. PO4	949713600	949713600	949713600	0	284914.0800	569828.1628	0	3228627360.
97. Pb	0.000000020	0.000000062	0.000000165	0	6.21600E-15	6.21600E-14	0	1.962184622
98. SeO4	0	0	0	0	0	0	0	0
99. SiO3	0.001521674	0	4.56502E-28	0	0	0	0	5780078.690
100. Sn	0	0	0	0	0	0	0	0
101. SO4	0.194996928	0	0.5763456	0	28817.28	67240.32	0	24630871.55
102. Sr	0	0	0	0	0	0	0	0.990106
103. WO4	0	0	0	0	0	0	0	0
104. ZrO	53.6097	42.88776	53.6097	0	0	0	0	8352825.380
105. Volume						0	0	101
Total Grams	3083754989.	3099697922.	3103293630.	399.9707	13092101.04	25354671.9	799.9414	11469725663

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 20 of 25)

Total (1/1/90)	TX-101 Grams	TX-102 Grams	TX-103 Grams	TX-104 Grams	TX-105 Grams	TX-106 Grams	TX-107 Grams	TX-108 Grams	TX-109 Grams	TX-110 Grams	TX-111 Grams
69. Ag	7.551E-13	0.0001078	0.0000215	3.236E-11	0.0010786	0.0001078	8.629E-12	0.0005393	0.0107868	0.0043147	0.0006472
70. Al	26981540.	5396.3619	277909.86	24283.399	43170464	5396308	0	26986936.	269923326	134961663	16210509.
71. Ba	2746.6000	2756.2131	557.5598	1098.6400	4174.832	219.728	0.0000137	1510.63	5493.2	2197.28	961.31
72. Bi	1.254E-10	2.096E-10	6.332E-11	1.463E-10	0.0000000	1.254E-11	4.598E-18	6.478E-11	41796080	4179608	417960.8
73. C2H3O	0.0000045	0	0	0	0	0	0	0	0	0	0
74. C6H5O	0.0056730	170191.17	170191.17	0.0189101	113460780	0	0	0	189101300	75640520	7564052
75. CO3	3.6023522	360055.2	4800736	0.1200184	18002760	0.0120018	0.600092	12361895.	301846276	180267636	120138418
76. C2O4	0	0	0	0	0	0	0	0	0	0	0
77. Ca	12.024	0.0001603	0.0000080	3.607E-11	0.16032	0	0	32064.160	0.012024	0.0036072	0.0003607
78. Cd	0	0	0	0	0	0	0	0	0	0	0
79. Ce	0.0000014	28.024	280.24	0.0000280	280.24	0	0	126108	112096	84072	28024
80. Cl	2.482E-13	0.0000106	0.0010635	1.773E-11	0.0002127	0	0	0.0031907	0.035453	0.0283624	0.0248171
81. Cr	0.0000156	3.687E-12	1.560E-13	2.080E-20	2.600E-11	2.080E-12	0	2.600E-11	1559880	155988	15598.8
82. EDTA	0.0000175	0	0	0	0	0	0	0	0	0	0
83. F	0.0000759	3799.6806	18998.403	0.0094992	56995.209	0	0	2089824.3	9499201.5	7789345.2	1899840.3
84. Fe	55.847446	5584.7	11169.4	0.0016754	5584700	0	0	2.234E-19	39092900	6143170	670164
85. Fe(CN)	4239.064	19.075788	0.0012717	0.0000021	0.0084781	0	0	0	211.97439	21.619226	4.239064
86. HEDTA	0.0000278	278.3	13.915	0.0000556	2783	0	0	0	19481	5566	556.6
87. Hg	0	0	0	0	0	0	0	0	0	0	0
88. K	0.0003127	1954.915	390.983	0.0003127	39098.3	0	0	0	390983	234589.8	23458.98
89. La	0	0	1.389E-22	0	0	0	0	0	8.334E-19	8.334E-20	1.389E-21
90. Mn	0.0000054	164.814	164.814	0.0000274	109876	0	0	0	164814	54938	5493.8
91. NO2	0.0046005	230027.5	322038.5	0.0460055	9201100	0.0003220	0	27603300	322038500	138016500	18402200
92. NO3	1.24E+09	63244998	5580441	0.4960392	434034300	55804410	0.1860147	620049000	1.28E+09	620049000	186014700
93. Na	459795400	24139258.	4597954	689.6931	183918160	11494885	2298.977	206907930	252887470	229897700	183918160
94. Ni	46960	0.0000003	2359.74	5.283E-14	358070	0	0	0	387420	146750	17023

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 21 of 25)

Total (1/1/90)	TX-101 Grams	TX-102 Grams	TX-103 Grams	TX-104 Grams	TX-105 Grams	TX-106 Grams	TX-107 Grams	TX-108 Grams	TX-109 Grams	TX-110 Grams	TX-111 Grams
95. OH	68029200	10204.38	18367.884	51532.119	68032601.	6806321.4	1700.7980	14456.205	34018001.	3404861.4	343547.46
96. PO4	0.0003798	759.77088	949713.6	0.0189942	189942.72	0.0047485	0.3798854	19089243.	102569068	66479952	47485680
97. Pb	2072000	0.0000000	0.0062160	0.0000000	4.1440000	0.0000000	1.036E-14	0.0000002	7.252	2.0720000	0.2072000
98. SeO4	0	0	0	0	0	0	0	0	0	0	0
99. SiO3	0.0003043	7608.37	38041.85	0.0022825	760837	0.0000076	0	7608370	30433480	15216740	3043348
100. Sn	0	0	0	0	0	0	0	0	0	0	0
101. SO4	960576.00	386151.55	1921536.2	768.55685	3845185.7	384316.85	0.5763456	28818144.	96059521.	76846944.	57635040.
102. Sr	0.0000001	0.0000087	0.061334	2.629E-12	0.0000876	0	0	0	70.096	26.286	2.6286
103. WO4	0	0	0	0	0	0	0	0	0	0	0
104. ZrO	85.775520	1.072194	108.29159	21.443880	16.08291	0.0000007	0.0000235	64.867737	8577873.6	750643.01	75160.799
105. Volume	0	0	0	0	0	0	0	0	0	0	0
Total Grams	1.80E+09	88569237.	18710973.	78394.566	880772128	79886461.	4001.5174	951688847	2.98E+09	1.56E+09	643909904

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 22 of 25)

Total (1/1/90)	TX-112 Grams	TX-113 Grams	TX-114 Grams	TX-115 Grams	TX-116 Grams	TX-117 Grams	TX-118 Grams	Total TX Grams
69. Ag	0.0003236	0.0000970	0.0003236	0.0001078	0.0000755	0.0000323	0.0161802	0.0347442
70. Al	21587930.	13517751.	2719739.2	13509657.	2725135.5	1376058.5	189410410	768785019
71. Ba	961.31	466.922	1098.64	233.461	453.189	425.723	10986.4	36341.637
72. Bi	20898.04	20898040	2089804	208980.4	0.0000000	0.0000835	0.0835921	69611371.
73. C2H3O3	0	0	0	0	0	0	5253073	5253073
74. C6H5O7	378202.6	0	0	0	0	0	132370910	518856146
75. CO3	180027600	66010120	126019320	84012880	37205704	66010120	600692092	1.80E+09
76. C2O4	0	0	0	0	0	0	0	0
77. Ca	0.0000200	0	0	0	0	0	1.68336	32078.044
78. Cd	0	0	0	0	0	0	0	0
79. Ce	112096	70060	14012	28024	14012	7006	70060	666158.50
80. Cl	0.0319077	0.0106359	0.0283624	0.0106359	0.0070906	0.0028362	0.035453	0.2200319
81. Cr	1039.92	519960	51996	10399.2	0.0000000	0.0000025	5199.6031	2320061.5
82. EDTA	0	0	0	0	0	0	29224500	29224500
83. F	1709856.2	22798083.	189984.03	7599361.2	38186790.	57071202.	41796486.	190709769
84. Fe	39092.9	11169400	1116940	111694	1.162E-17	5.601E-17	11225247	75170117.
85. Fe(CN)6	0	0	0	0	0	0	635859.60	640355.58
86. HEDTA	27.83	0	0	0	0	0	55660000	55688706.
87. Hg	0	0	0	0	0	0	0	0
88. K	1172.949	0	0	0	0	0	390983	1082631.9
89. La	0	0	0	0	0	0	2.778E-23	9.183E-19
90. Mn	384.566	0	0	0	0	0	1099858.7	1435694.7
91. NO2	27603300	18402200	4600550	9201100	3680440	1380165	230027500	810708921
92. NO3	372029400	310024500	124009800	248019600	675853410	458836260	7.44E+09	1.414E+10
93. Na	243691562	344846550	211505884	135639643	827631720	735672640	4.60E+09	8.66E+09
94. Ni	1291.4	0	0	0	0	0	645700	1605574.1

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 23 of 25)

Total (1/1/90)	TX-112 Grams	TX-113 Grams	TX-114 Grams	TX-115 Grams	TX-116 Grams	TX-117 Grams	TX-118 Grams	Total TX Grams
95. OH	56124.09	13609241.	1363985.4	173474.46	86737.23	103744.53	1531507.3	197655609
96. PO4	47485680	313405488	48340422.	19070249.	388432862	478655654	190227634	1.72E+09
97. Pb	0.0165760	0.0000087	0.0000008	0.0000018	0.0000003	0.0000015	6216.1864	2078229.8
98. SeO4	0	0	0	0	0	0	0	0
99. SiO3	7608370	38041850	1521674	15216740	152167400	45650220	45680653.	362995332
100. Sn	0	0	0	0	0	0	0	0
101. SO4	86452416.	38423328.	67240992.	19211616.	19211808.	7684896.1	384614630	889697873
102. Sr	0.17524	0	0	0	0	0	262.86	362.10727
103. WO4	0	0	0	0	0	0	0	0
104. ZrO	5382.4138	3216582.5	321658.95	42888.403	536.31143	965.03893	4288.776	12996277.
105. Volume	0	0	0	0	0	0	0	0
Total Grams	988812789	1.21E+09	591107860	552056540	2.15E+09	1.85E+09	1.396E+10	3.031E+10

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 24 of 25)

Total (1/1/90)	TY-101 Grams	TY-102 Grams	TY-103 Grams	TY-104 Grams	TY-105 Grams	TY-106 Grams	Total TY Grams
69. Ag	0.0000323604	0.00323604	0.00970812	0.0000064721	0.000107868	7.550760E-13	0.0130908605
70. Al	558517.878	277909.862	26981541.889	822936.97	4317.0464	809.44622698	28646033.091
71. Ba	425.723	1098.64	1785.29	278.7799	1441.965	274.66000275	5305.0579027
72. Bi	16718432	417960.8	20898040	417960.8	1.128494E-10	4.179608E-11	38452393.6
73. C2H3O3	0	0	0	0	0	0	0
74. C6H5O7	0	3782026	11346078	0	0	0	15128104
75. CO3	12481913.6	55808556	27004140	780119.6	66010120	600092.24004	162684941.44
76. C2O4	0	0	0	0	0	0	0
77. Ca	0	0.0032064	0.036072	0.000012024	0	0	0.039290424
78. Cd	0	0	0	0	0	0	0
79. Ce	2802.4	2802.4	1401.2	1120.96	14.012	0.0000000701	8140.9720001
80. Cl	0.00212718	0.0106359	0.00070906	0.000106359	0.0106359	7.090600E-11	0.0242143991
81. Cr	519960	15598.8	519960	15598.8	1.559880E-14	1.039920E-22	1071117.6
82. EDTA	0	0	0	0	0	0	0
83. F	569952.09	197583.3912	379968.06	170985.627	1709.85627	0.0000094992	1320199.0245
84. Fe	11169400	446776	11727870	279235	27.9235	2.79235	23623311.716
85. Fe(CN)6	0	423.9064	1271.7192	635.8596	0	0	2331.4852
86. HEDTA	0	5566	19481	0	0	0	25047
87. Hg	0	0	0	0	0	0	0
88. K	0	39098.3	117294.9	1172.949	0	0	157566.149
89. La	0	0	0	0	0	0	0
90. Mn	0	3845.66	10987.6	5.4938	0	0	14838.7538
91. NO2	460055	4600550	13801650	920110	3220.385	0.0000230028	19785585.385
92. NO3	341026950	86806860	62004900	12400980.000	62004900.006	0.4965352392	564244590.5
93. Na	133340666	91959080	70578593.9	4712902.85	73567264	27587724	401746230.75
94. Ni	0	0.001174	0.00002348	0.03522	0	0	0.03641748

Table 2-5. TRAC Inventory of Chemical and Radionuclide Contents in the 241-TX, -TX and -TY Tank Farms. (Sheet 25 of 25)

Total (1/1/90)	TY-101 Grams	TY-102 Grams	TY-103 Grams	TY-104 Grams	TY-105 Grams	TY-106 Grams	Total TY Grams
95. OH	10205060.292	340486.146	68046207.3	340486.146	341846.73	68165.2584	79342251.872
96. PO4	13295990.4	19089243.36	9544621.68	474856.8	18994272	0.09497136	61398984.335
97. Pb	0.0000002196	0.0000008702	0.0000012018	0.0000000145	0.0000014504	0.0000000414	0.000003798
98. SeO4	0	0	0	0	0	0	0
99. SiO3	228251.1	380418.5	684753.3	76083.7	1521.674	45650220	47021248.274
100. Sn	0	0	0	0	0	0	0
101. SO4	4803168.1728	28817952.403	28818240.576	384422.5152	19212480.576	192.3073152	82036456.551
102. Sr	0	0.00026286	0.02698696	0.0017559048	0	0	0.0290057248
103. WO4	0	0	0	0	0	0	0
104. ZrO	3216582.1072	85796.96388	3216624.8878	85775.530722	4289.0976582	321.6582	6609390.2454
105. Volume	0	0	0	0	0	0	0
Total Grams	548598126.77	293079633.15	355705411.38	21885668.418	240147425.28	73907802.954	1533324067.9

Table 2-6. Summary of Unplanned Releases[a] at the T Plant Aggregate Area. (Sheet 1 of 12)

Unplanned Release No.	Location (Operable Unit)	Date	Associated Waste Management Unit[b]	Reported Waste-Related History
UN-200-W-2	North of 224-T Building (200-TP-4)	1947	N/A	· Waste line failure resulted in discharge to ground. · Radionuclide contamination measure to a depth of 10-11 ft bgs. · Waste line replaced. · PNL Hazard Ranking: 0.00
UN-200-W-3	T Plant railroad cut, northwest of 221-T Building (200-TP-4)	1949	N/A	· Spillage of radioactive cask cars and equipment in transit from T Plant to the 200 West Burial Ground. · Contaminated area was covered with ≈ 10 inches of clean gravel in the Spring of 1950. · PNL Hazard Ranking: 0.00
UN-200-W-4	Northwest of 221-T Canyon Building (200-TP-4)	1949	N/A	· Contamination spread from a burial box in transit from T Plant to the heavy equipment burial ground. · Readings averaged 7 mR/hr of unknown beta/gamma. · PNL Hazard Ranking: 0.00
UN-200-W-7	241-T-151 and -152 Diversion Boxes (200-TP-3)	Spring 1950	N/A	· Resulted from work at the diversion boxes. · Contaminated soil partially removed; remainder covered with about one foot of clean soil. · PNL Hazard Ranking: 0.00
UN-200-W-8	≈ 1500 feet east of 221-U Building {old burning ground} (200-TP-4)	1950	N/A	· Release of unknown source. · Fission products with ≈ 1 Ci and a maximum dose rate of 45 R/h were measured at the surface. · Area removed from radiation zone status in 1972. · PNL Hazard Ranking: 1.04
UN-200-W-14	Along the waste line connecting the 242-T Building and the 207-T Retention Basin (200-TP-2)	10/52	N/A	· Detected when contaminated water rose to the ground surface above the waste line. · Waste line leakage repaired and contaminated area covered with ≈ 1 foot of soil. · PNL Hazard Ranking: 0.00

Table 2-6. Summary of Unplanned Releases[a] at the T Plant Aggregate Area. (Sheet 2 of 12)

Unplanned Release No.	Location (Operable Unit)	Date	Associated Waste Management Unit[b]	Reported Waste-Related History
UN-200-W-17	Central portion of TX Tank Farm and adjacent major construction area (200-TP-5)	9/11/52	N/A	· Spill during transfer of a temporary process waste pump from tank 241-TX-106 to tank 241-TX-114 resulted in surface contamination distributed over a 300 x 600 foot area. · Radionuclides released included cerium, cesium, nobelium, ruthenium, strontium and zirconium; surface readings ranged from 2,000 - 5,000 ct/m. · Some highly contaminated areas were stabilized with emulsified asphalt. · PNL Hazard Ranking: 0.00
UN-200-W-27	Near 221-T Building; exact location unknown (200-TP-4)	12/20/54	N/A	· Failure of an unencased process waste line from T Plant resulted in a cave-in and run-off of first-cycle process wastes. Readings indicated high ground-surface dose rates. · PNL Hazard Ranking: 0.00
UN-200-W-29	A cave-in ≈ 75 ft east of Camden and ≈75 ft south of 23rd Street, between 241-T-152 and 241-TX-153 Diversion Boxes (200-TP-2)	11/15/54	N/A	· Failure of an enencased line connecting diversion boxes. · First-cycle supernatant wastes from the 241-T-105 tank release, with dose rates of 11.5 R/hr at 2 inches. · Area hosed down with water and backfilled shortly after the leak was discovered. · A spill occurred in May 1966 at the same location due to re-use of same unencased line. · In 1978, the entire area was excavated to a depth of one foot and treated with fiber-film to prevent moisture penetration; surface was stabilized to prevent wind dispersal; and area was backfilled and later filled with gravel. · PNL Hazard Ranking: 1.04
UN-200-W-38	Near 241-TX-154 Diversion Box (200-TP-4)	1956	N/A	· Rupture of underground process line released a 15 x 30 foot pool of metal waste on the ground surface. · Radiation field of 1.2 R/h at 80 ft. · Area around diversion box stabilized with sprayed concrete. · PNL Hazard Ranking: 1.09

Table 2-6. Summary of Unplanned Releases[a] at the T Plant Aggregate Area. (Sheet 3 of 12)

Unplanned Release No.	Location (Operable Unit)	Date	Associated Waste Management Unit[b]	Reported Waste-Related History
UN-200-W-58	Area between the 221-T railroad cut and the 200 West Burial Ground (200-TP-4)	4/26/65	N/A	· Release occurred during transit of cell blocks from 221-T Canyon Building to burial ground. · Unknown beta/gamma with readings to a maximum of 5 R/h, including 100,000 ct/min. · Contaminated soil removed from the railroad bed. · PNL Hazard Ranking: 0.00
UN-200-W-62	Corner of 23rd Street and Camden Avenue (200-TP-6)	5/4/66	N/A	· Second-cycle wastes released to the ground from a ruptured transfer line during transfer of bismuth phosphate waste from the 241-T-107 Tank to the 242-T Evaporator Feed. · Readings ranged from 20 to 5,000 mR/h. · Liquid dispersed over an approximate 72 x 1440 foot area which was isolated and covered with sand and gravel. · PNL Hazard Ranking: 1.31
UN-200-W-63	Along 23rd Street and shoulder from 241-TX-153 Diversion Box (200-TP-3)	9/21/66	N/A	· Released from a used diversion box jumper in transit via truck from 200 West dry waste Burial Ground to the 221-T Canyon. · Waste material contained strontium-90 with readings of approximately 1 Ci. · Contamination on road removed and area covered with 6 inches of soil. · Currently no signs of stabilization in the area. · PNL Hazard Ranking: 1.04
UN-200-W-64	Along Camden Avenue and 23rd Street (200-TP-6)	2/13/69	N/A	· Contamination of cesium-137 to 600 ct/m discovered in mud samples in an area cordoned off as a radiation zone. · Cause may be snow melt run-off of nearby radiation zones (possibly UN-200-W-29 and -987 releases). · PNL Hazard Ranking: 0.86
UN-200-W-65	Spur line (200-TP-4)	10/27/69	N/A	· Release of contamination from a rail car. · Unknown beta/gamma readings from 5,000 ct/m to 150 mR/h. · Spur line not labelled, stabilized or barricaded. · PNL Hazard Ranking: 0.63

Table 2-6. Summary of Unplanned Releases[a] at the T Plant Aggregate Area. (Sheet 4 of 12)

Unplanned Release No.	Location (Operable Unit)	Date	Associated Waste Management Unit[b]	Reported Waste-Related History
UN-200-W-67	Area of 3 x 24 foot on the north side of the 2706-T Building (200-TP-4)	8/5/70	N/A	· Contamination of 20,000 ct/m found following removal of a lift that was reading 500 mR/hr. · Fence surrounds building on north, west and south sides, and extends 100 feet from building. · North side of building paved with gravel and used for equipment storage. · Area not marked for radiation hazard. · PNL Hazard Ranking: 0.86
UN-200-W-73	Area of railway between 221-T Building to 2706-T Building (200-TP-4)	10/6/74	N/A	· Released from a hole in a multi-purpose box in transit from 221-T Building tunnel to the 2706-T Building. · Unknown beta/gamma with readings up to 40 mR/hr. · Area not barricaded. · PNL Hazard Ranking: 0.70
UN-200-W-76	241-TX Diversion Box (200-TP-5)	8/24/77	N/A	· Discovery of contaminated rabbit fecal pellets containing cesium-137, cesium-134, europium-155, and strontium-90. · Pellets and soil removed to dry waste burial. · Remaining contamination covered with clean soil. · PNL Hazard Ranking: 0.00
UN-200-W-77	Northwest portion of 200 West Area (200-TP-4)	4/4/78	N/A	· Discovery of highly radioactive coyote feces. · Readings of 40,000 ct/m beta/gamma and 55,000 ct/m alpha activity of plutonium-239 and americium-241 respectively. · Feces collected and sent to laboratory for radioisotopic analysis. · Area not marked or barricaded. · PNL Hazard Ranking: 0.00

Table 2-6. Summary of Unplanned Releases[a] at the T Plant Aggregate Area. (Sheet 5 of 12)

Unplanned Release No.	Location (Operable Unit)	Date	Associated Waste Management Unit[b]	Reported Waste-Related History
UN-200-W-85	Rear of 2706-T Building (200-TP-4)	4/22/82	N/A	· Leakage from multi-purpose transfer box while parked on a concrete pad. · Liquid contamination had unknown beta/gamma readings of 100,000 ct/m. · Area contaminated to background radiation levels. · Area not labelled or barricaded; no indication of a radiation hazard or stabilization. · PNL Hazard Ranking: 0.00
UN-200-W-88	Inside main gate of 200-W Area (200-SS-2)	5/28/84	N/A	· Spill from uranyl nitrate liquid trailer. · Readings from 300 to 650 ct/m unknown beta/gamma readings. · Detectable contamination removed by chipping asphalt and repaving it. · Some discrepancy in WIDS about location of spill. Coordinates do match the written description of location; location does correspond to location given by Health Physics personnel. · PNL Hazard Ranking: 0.00
UN-200-W-97	Southeast corner of 23rd Street and Camden Avenue, south to near 22nd Street (200-TP-6)	5/66	N/A	· Release of liquid waste solution from broken underground line of southeast corner of Camden Avenue, surfaced, and crossed the street, but did not run down the side of the road. · Surface contamination removed to a depth of 3 feet and buried in 200 West Burial Ground. · In 1978, contaminated soil adjacent to the zone removed on south side to a depth of 4 feet and on west side to a depth of 3 feet. Area backfilled with earth and later covered with clean soil. · Subsurface contamination of 600 ct/m detected. · PNL Hazard Ranking: 1.04

Table 2-6. Summary of Unplanned Releases[a] at the T Plant Aggregate Area. (Sheet 6 of 12)

Unplanned Release No.	Location (Operable Unit)	Date	Associated Waste Management Unit[b]	Reported Waste-Related History
UN-200-W-98	Section R-19, 221-T Building (200-TP-4)	Spring 1945	N/A	· Leak in an underground metal waste transfer line surfaced, resulting in contamination of small surface area with mixed fission products. · Maximum dose of 20 R/hr. · Affected area overfilled with approximately 4 feet of clean soil; a blacktop road has since been constructed over the area. · No radioactivity has been detected. · Area around site to east is barricaded and surface contamination is marked. · PNL Hazard Ranking: 1.14
UN-200-W-99	241-TX-153 Diversion Box (200-TP-2)	9/22/66	N/A	· Airborne contamination of strontium-90 resulting from diversion box. · Readings ranged from 20,000 to 100,000 ct/m. · Road contamination covered with new tar mat; area between Camden and TX tank farm covered with gravel; area east of Camden is barricaded, labelled, and marked with underground contamination signs. · Test plots in 1978 showed strontium-90 particulate matter still present. · PNL Hazard Ranking: 0.69
UN-200-W-100	Process line extending from 241-TX-105 to 241-TX-118 in the TX Tank Farm (200-TP-5)	11/54	N/A	· Spill of first-cycle high-salt neutral/basic waste. · Waste contained fission products with approximately 10 Ci, which generated a maximum dose rate of 4.5 R/h at 4 feet. · Contaminated area covered with 1 foot of clean soil. · Area is entirely within chain-link fence surrounding TX Tank Farm. · PNL Hazard Ranking: 0.00

Table 2-6. Summary of Unplanned Releases[a] at the T Plant Aggregate Area. (Sheet 7 of 12)

Unplanned Release No.	Location (Operable Unit)	Date	Associated Waste Management Unit[b]	Reported Waste-Related History
UN-200-W-102	Back of 224-T Building (200-TP-4)	2/72	N/A	· Contamination resulted from moisture seeping through pipe joints from underground process tank vent lines during years of operation. · Excavation revealed subsurface contamination 50 feet long by 12 feet wide by 12 feet deep. · Total of 139 drums of soil, containing approximately 10 grams of plutonium, were removed; northwest side of building covered with asphalt; southwest side of building has extensive gravel. · No barricades or other signs of release. · PNL Hazard Ranking: 1.04
UN-200-W-113	700 feet east of the 241-TX Tank Farm, just north of the 241-TX-155 Diversion Box (200-TP-2)	Mid 1950's	N/A	· Discovered in 1977, when radioactive rabbit feces were found near diversion box. · After soil removal, radioactivity increased and source believed to be a leak in a waste transfer line. · Acid spill from diversion box catch tank is a possible influence. · Stabilized with clean gravel. · Area is stabilized with soil, sown with grass and posted with underground radiation hazard signs. · PNL Hazard Ranking: 0.00
UN-200-W-135	150 feet northwest of 241-TX-155 Diversion Box (200-TP-2)	3/17/54	N/A	· Failure of the jumper in the diversion box allowed liquid to flow along the encasement and exit on a hillside. · Approximately 1,000 gallons of supernatant leaked. WIDS document estimates 60,000 cubic feet. · Dose rate of 5 r/hr including 2.5 r/hr at 3 feet. · Access roads barricaded until contamination was covered; area sealed and covered with earth. · PNL Hazard Ranking: 1.20
UN-200-W-137	N/A	N/A	N/A	*This unplanned release is part of S Plant Operable Unit 200-RO-3 and therefore is not discussed.*

Table 2-6. Summary of Unplanned Releases[a] at the T Plant Aggregate Area. (Sheet 8 of 12)

Unplanned Release No.	Location (Operable Unit)	Date	Associated Waste Management Unit[b]	Reported Waste-Related History
UPR-200-W-5	Hillside to the west of 216-T-20 Trench (200-TP-2)	During 1950	241-TX-155 Diversion Box	· Resulted from leaky jumpers or overflow and contaminated soil around the diversion box. · Area around the diversion box was covered with clean soil. · Presently, the diversion box is coated with weatherproofing foam. · Light chain barricade with surface contamination placards surrounds the diversion box. · PNL Hazard Ranking: 0.00
UPR-200-W-12	Southside of 242-T Building (200-TP-5)	Spring 1951	242-T Building	· While jetting concrete from the waste evaporator, the waste was forced up and out of an open riser. · Portion of contamination removed, remainder covered with a foot of clean soil.
UPR-200-W-21	241-TX-302C Catch Tank (200-TP-4)	7/53	241-TX-302C Catch Tank	· Cave-in over a process line caused contamination of an extended area between the 221-T and 222-T Buildings. · Dose rates or 25 R//hr at 8 inches. · Jumper leak in the 241-TX-154 Diversion Box caused the 241-TX-302C Catch Tank to overflow. · Area covered with blacktop and posted with underground contamination warning signs.
UPR-200-W-28	West of 241-TX-155 Diversion Box (200-TP-2)	4/43	241-TX-155 Diversion Box	· Leaky jumpers or overflow contaminated soil around the diversion box. · Area around the diversion box was covered with clean soil; diversion box is coated with weatherproofing foam. · Light chain barricade with surface contamination placards surround the diversion box.
UPR-200-W-37	200 West Area Burning Ground (200-SS-2)	6/10/55	UN-200-W-8 Burning Ground	· Disposal of three broken boxes containing dry high-level radioactive waste into a non-radiation burning pit. · Reading of 100 mR/h. · No barricades or radiation signs in the area. · PNL Hazard Ranking: 0.00

Table 2-6. Summary of Unplanned Releases[a] at the T Plant Aggregate Area. (Sheet 9 of 12)

Unplanned Release No.	Location (Operable Unit)	Date	Associated Waste Management Unit[b]	Reported Waste-Related History
UPR-200-W-40	Southeast of 221-T Building between 241-TX-154 Diversion Box and 241-TX-302C Catch Tank (200-TP-4)	3/3/86	241-TX-154 Diversion Box	*This is a duplicate of UPR-200-W-160.*
UPR-200-W-70	200 West Burning Ground (200-SS-2)	1/22/73	UN-200-W-8 Burning Pit	· Disposal of contaminated material into a non-radiation burning pit. · Beta/gamma contamination of 5,000 to 50,000 ct/m along bumper rails at edge of pit. · Beta/gamma contamination of 20,000 to 30,000 ct/m in pit bottom itself. · Dump area on south side of pit found to have 5,000 to 200,000 dis/m alpha contamination. · Area barricaded; radiation signs posted. · To stabilize, fiber-film was sprayed on affected areas. · PNL Hazard Ranking: 0.00
UPR-200-W-126	Next to 241-TX-153 Diversion Box (200-TP-5)	5/8/75	241-TX-153 Diversion Box	· A pipe-fitter removed old gaskets from the 241-TX-153 Diversion Box (for replacement) and placed them in a plastic bag; spotty contamination became airborne. · Contamination was limited to the transfer line from the 241-TX-153 Diversion Box. · Affected employees were decontaminated. · PNL Hazard Ranking: 0.00
UPR-200-W-129	Pump pit at 241-TX-113 Tank (200-TP-5)	1/7/71	241-TX-113 Tank	· While leak testing a new jumper assembly, an employee closed a valve in a pump pit causing a caustic radioactive solution to spray up through the pit cover. · Employee was decontaminated. · Area was surveyed and the pump pit hosed down. · PNL Hazard Ranking: 0.00

Table 2-6. Summary of Unplanned Releases[a] at the T Plant Aggregate Area. (Sheet 10 of 12)

Unplanned Release No.	Location (Operable Unit)	Date	Associated Waste Management Unit[b]	Reported Waste-Related History
UPR-200-W-131	5 ft. diameter around the 241-TX-155 Diversion Box (200-TP-2)	4/43	241-TX-155 Diversion Box	· Resulted from leaky jumpers or overflow and contaminated soil around the diversion box. · Area around the diversion box was covered with clean soil; diversion box is coated with weatherproofing foam. · Light chain barricade with surface contamination placards surround the diversion box. · PNL Hazard Ranking: 0.00
UPR-200-W-147	Southeast side of the 241-T-103 Tank (200-TP-6)	During 1973	241-TX-103 Tank	· Contamination encountered while monitoring wells were being drilled to track tank leak. · Leak possibly resulted from a failed grout seal in a spare entry line. · Spill approximately 5 cubic meters. · PNL Hazard Ranking: 0.00
UPR-200-W-148	23 ft. from 241-T-105 Tank (200-TP-6)	4/20/73	241-T-105 Tank	· Leak suspected to have started during a routine filling operation, but not detected until June 8, 1973. · 115,000 gallons of fluid released to ground. · Fluid contained approximately 40,000 curies of cesium-137, 14,000 curies of strontium-90, 4 curies of plutonium, and various fission products. · Leak contaminated over 25,000 cubic meters of soil. · Leak possibly resulted from corrosion of aging (29-30 year old) carbon steel tank by the caustic waste solution. · PNL Hazard Ranking: 0.00
UPR-200-W-149	Surrounding 241-TX-107 Tank (200-TP-5)	During 1977	241-TX-107 Tank	· High levels of radioactivity detected in well 51-07-118. · Tank leak suspected source of contamination. · Tank pumped to a minimum level to remove as much of the supernatant material as possible. · PNL Hazard Ranking: 0.00

Table 2-6. Summary of Unplanned Releases[a] at the T Plant Aggregate Area. (Sheet 11 of 12)

Unplanned Release No.	Location (Operable Unit)	Date	Associated Waste Management Unit[b]	Reported Waste-Related History
UPR-200-W-150	Surrounding 241-TY-103 Tank (200-TP-5)	During 1976	241-TY-103 Tank	· Overflow of the 241-TX-155 diversion box catch tank flowed back into the tank, depositing 1.3 inches of sludge waste. · Dry wells show no significant increase attributable to this flooding event. · PNL Hazard Ranking: 0.00
UPR-200-W-151	Surrounding 241-TY-104 Tank (200-TP-5)	During 1974	241-TY-104 Tank	· Approximately 1,400 gallons of supernatant leaked from this tank. · Leak consisted of REDOX ion exchange waste, PUREX organic waste, bismuth phosphate first-cycle waste, tributyl phosphate waste, and decontamination waste from the 241-TX and -TY tank farms. · P-10 saltwell was pumped as a cleanup effort for this unplanned release. · PNL Hazard Ranking: 0.00
UPR-200-W-152	Surrounding 241-TY-105 Tank (200-TP-5)	During 1960	241-TY-105 Tank	· Tank identified as a "confirmed" leaker. · Waste was listed as tributyl phosphate of unknown quantity. · A saltwell pump system was installed to remove the pumpable interstitial liquid. · PNL Hazard Ranking: 0.00
UPR-200-W-153	Surrounding 241-TY-106 Tank (200-TP-5)	During 1959	241-TY-106 Tank	· Tank identified as a "confirmed" leaker. · Routine surveillance of radiation dry wells indicated a change of profile in dry well 52-06-05, which now appears stabilized. · Waste identified as tributyl phosphate; quantity unknown. · Tank stabilized with diatomaceous earth. · PNL Hazard Ranking: 0.00

Table 2-6. Summary of Unplanned Releases[a] at the T Plant Aggregate Area. (Sheet 12 of 12)

Unplanned Release No.	Location (Operable Unit)	Date	Associated Waste Management Unit[b]	Reported Waste-Related History
UPR-200-W-160	Around 241-TX-302C Catch Tank between 221-T and 222-T Buildings (200-TP-4)	12/30/55	241-TX-302C Catch Tank	· Failure of an underground transfer line from 241-TX-302C Catch Tank to 241-U-101 metal waste storage tank. · Spill of several thousand gallons of metal waste and rainwater. · Liquid forced through several feet of soil onto the surface surrounding the 241-TX-302C Catch Tank. · Area backfilled and sprayed with tar and posted as a radiation zone. · In 1968, a 10-foot cut placed in the eastern side of the zone was covered with cement blocks to provide an adequate shielding measure. · Tank and surrounding area sprayed with concrete. · PNL Hazard Ranking: 0.65

Source: WIDS 1991a

[a] All unplanned releases reported are liquid mixed waste (except UN-200-W-3, UN-200-W-4, UN-200-W-8, UN-200-W-58, UN-200-W-67, UN-200-W-73, UN-200-W-76, UN-200-W-77, UN-200-W-99, UN-200-W-37, and UN-200-W-70).

[b] If a waste management unit is listed in this column, the unplanned release is not included as a separate site in the Tri-Party Agreement Action Plan.

Table 2-7. Summary of Waste-Producing Processes in the T Plant Aggregate Area.

Process	Waste Generated	Major Chemical Constituents	Ionic Strength	pH	Organic Concentration	Radioactivity
Bismuth Phosphate	Process waste Aqueous process waste	nitric acid phosphoric acid nitrate solution uranium, plutonium	high	acidic	low	high
Lanthanum Fluoride	Process waste Aqueous process waste	plutonium sodium bismuthate phosphoric acid nitric acid hydrogen fluoride lanthanum salts	N/A	N/A	N/A	high
"Hot" Semi-Works	Aqueous process waste	ammonium silico-fluoride	N/A	N/A	N/A	high
Decontamination and Equipment Refurbishment	Wastewater	bismuth phosphate	low	neutral	low	low-high
Containment Systems Test Facility (CSTF)	N/A	N/A	N/A	N/A	N/A	N/A
T Plant Laboratory						
Liquid Metal Reactor Safety Tests	Aqueous process waste	sodium, lithium, sodium iodine	N/A	N/A	N/A	low
Light Water Reactor Tests	Aqueous process waste	cesium, manganese, zinc, lithium, sulfate, iodine and hydrogen iodine	N/A	N/A	N/A	low

N/A - Not Available

Table 2-8. Chemicals Used or Produced in Separation/Recovery Processes.

Inorganic Constituents	Organic Constituents
Aluminum nitrate	Acetone
Barium	Caffeine
Calcium	Carbon tetrachloride (CC/4)
Chloride	Chloroform
Chromium	Decane
Copper	Dibutyl phosphate
Fluoride	Dibutyl butyl phosphate (DBBP)
Hydrofluoric acid	Monobutyl phosphate
Iron	Trichloromethane
Magnesium	Tributyl phosphate (TBP)
Mercury	**Radionuclides**
Nickel	^{241}Am
Nitrate salts	^{137}Cs
Plutonium fluoride	^{238}Pu
Plutonium nitrate	^{239}Pu
Plutonium oxide	^{240}Pu
Potassium	Ra
Silicon	^{90}Sr
Sodium	^{234}U
Sulfate	^{238}U
Uranium	Total Alpha
Zinc	

Table 2-9. Chemicals Used in Various T Plant Processing Areas.

Compound Name	Formula
Aluminum	Al
Ammonium Nitrate	NH_4NO_3
Ammonium Fluosilicate	$(NH_4)_2SiF_6$
Ammonium Sulfate	NH_4SO_4
Ammonium Sulfite	$(NH_4)_2SO_3$
Boric Acid	H_3BO_3
Ceric Nitrate	$Ce(NO_3)_4$
Ferrous Sulfate	$FeSO_4$
Hydrogen Fluoride	HF
Hydrogen Peroxide	H_2O_2
Hyflo-Super-Cel	Contains Silica
Lanthanum Nitrate	$La(NO_3)_3$
Nickel Sulfate	$NiSO_4$
Nitric Acid	HNO_3
Oxalic Acid	$HO_2CCO_2H \cdot 2H_2O$
Phosphoric Acid	H_3PO_4
Potassium Hydroxide	KOH
Potassium Ferrocyanide	$K_4Fe(CN)_6$
Potassium Permanganate	$KMnO_4$
Silicon	Si
Sodium Bismuthate	$NaBiO_3$
Sodium Carbonate	Na_2CO_3
Sodium Dichromate	$Na_2Cr_2O_7 \cdot 2H_2O$
Sodium Hydroxide	NaOH
Sodium Nitrate	$NaNO_3$
Sodium Nitrite	$NaNO_2$
Sodium Thiosulfate	$Na_2S_2O_3$
Sulfuric Acid	H_2SO_4
Trichloroethane	CH_3CHCl_3
Zirconyl Nitrate	$ZrO(NO_3)_2$

Source: Klem 1990.

3.0 SITE CONDITIONS

The following sections describe the physical nature and setting of the Hanford Site, the 200 West Area, and the T Plant Aggregate Area. The site conditions are presented in the following sections:

- Physiography and Topography (Section 3.1)
- Meteorology (Section 3.2)
- Surface Hydrology (Section 3.3)
- Geology (Section 3.4)
- Hydrogeology (Section 3.5)
- Environmental Resources (Section 3.6)
- Human Resources (Section 3.7)

Sections describing topography, geology, and hydrogeology have been taken from standardized texts provided by the Westinghouse Hanford Company (Westinghouse Hanford) (Delaney et al. 1991 and Lindsey et al. 1991) for that purpose.

3.1 PHYSIOGRAPHY AND TOPOGRAPHY

The Hanford Site (Figure 3-1) is situated within the Pasco Basin of southcentral Washington. The Pasco Basin is one of a number of topographic depressions located within the Columbia Basin Subprovince of the Columbia Intermontane Province (Figure 3-2), a broad basin located between the Cascade Range and the Rocky Mountains. The Pasco Basin is bounded on the north by the Saddle Mountains, on the west by Umtanum Ridge, Yakima Ridge, and the Rattlesnake Hills, on the south by Rattlesnake Mountain and the Rattlesnake Hills, and on the east by the Palouse slope (Figure 3-1).

The physiography of the Hanford Site is dominated by the low-relief plains of the Central Plains physiographic region and anticlinal ridges of the Yakima Folds physiographic region (Figure 3-3). Surface topography seen at the Hanford Site is the result of (1) uplift of anticlinal ridges, (2) Pleistocene cataclysmic flooding, (3) Holocene eolian activity, and (4) landsliding. Uplift of the ridges began in the Miocene epoch and continues to the present. Cataclysmic flooding occurred when ice dams in western Montana and northern Idaho were breached, allowing large volumes of water to spill across eastern and central Washington. The last major flood occurred about 13,000 years ago, during the late Pleistocene epoch. Anastomosing flood channels, giant current ripples, bergmounds, and giant flood bars are

among the landform created by the floods. Since the end of the Pleistocene epoch, winds have locally reworked the flood sediments, depositing dune sands in the lower elevations and loess (windblown silt) around the margins of the Pasco Basin. Generally, sand dunes have been stabilized by anchoring vegetation except where they have been reactivated where vegetation is disturbed (Figure 3-4).

A series of numbered areas have been delineated at the Hanford Site. The 100 Areas are situated in the northern part of the Hanford Site adjacent to the Columbia River in an area commonly called the "Horn." The elevation of the Horn is between 119 and 143 m (390 and 470 ft) above mean sea level (msl) with a slight increase in elevation away from the river. The 200 Areas are situated on a broad flat area called the 200 Areas plateau. The 200 Areas plateau is near the center of the Hanford Site at an elevation of approximately 198 to 229 m (650 to 750 ft) above msl. The plateau decreases in elevation to the north, northwest, and east toward the Columbia River, and plateau escarpments have elevation changes of between 15 to 30 m (50 to 100 ft).

The 200 West Area is situated on the 200 Areas Plateau on a relatively flat prominent terrace (Cold Creek Bar) formed during the late Pleistocene flooding (Figure 3-5). Cold Creek Bar trends generally east to west and is bisected by a flood channel that trends north to south. This terrace drops off rather steeply to the north and northwest with elevation changes between 15 and 30 m (50 to 100 ft).

Within the T Plant Aggregate Area, the elevation ranges from about 221 m (725 ft) along the eastern part of the unit to about 197 m (695 ft) above msl in the western part. A detailed topographic map of the area is provided as Plate 2. There are no natural surface drainage channels within the area.

3.2 METEOROLOGY

The following subsections provide information on Hanford Site meteorology including precipitation (Section 3.2.1), wind conditions (Section 3.2.2), and temperature variability (Section 3.2.3).

The Hanford Site lies east of the Cascade Mountains and has a semiarid climate because of the rainshadow effect of the mountains. The weather is monitored at the Hanford Meteorology Station and at other points situated through the reservation. The following sections summarize the Hanford Site meteorology.

3.2.1 Precipitation

The Hanford Site receives an annual average of 16 cm (6.3 in.) of precipitation. Precipitation falls mainly in the winter, with about half of the annual precipitation occurring between November and February. The maximum 25 yr/24 hr storm event has been calculated at 3.0 cm (1.5 in.) (Stone et al 1988). The maximum 100 yr/24 hr storm event is

approximately 5 cm (2 in.). Average winter snowfall ranges from 13 cm (5.3 in.) in January to 0.8 cm (0.31 in.) in March. The record snowfall of 62 cm (24.4 in.) occurred in February 1916 (Stone et al. 1987). During December through February, snowfall accounts for about 38% of all precipitation in those months.

The average yearly relative humidity at the Hanford Site for 1946 to 1980 was 54.4%. Humidity is higher in winter than in summer. The monthly averages for the same period range from 32.2% for July to 80% in December. Atmospheric pressure averages are higher in the winter months and record absolute highs and lows also occur in the winter.

3.2.2 Winds

The Cascade Mountains have considerable effect on the wind regime at the Hanford Site by serving as a source of cold air drainage. This gravity drainage results in a northwest to west-northwest prevailing wind direction (WPPSS 1977). The average mean monthly speed for 1945 to 1980 is 3.4 m/s (7.7 mph). Peak gust speeds range from 28 to 36 m/s (63 to 80 mph) and are generally southwest or west-southwest winds (Stone et al. 1983).

Figure 3-6 shows wind roses for the Hanford Telemetry Network (Stone et al. 1987). The gravity drainage from the Cascades produces a prevailing west-northwest wind in the 200 West Area. In July, hourly average wind speeds range from a low of 2.3 m/s (5.2 mph) from 9 to 10 a.m. to a high of 6 m/s (13.0 mph) from 9 to 10 p.m.

3.2.3 Temperature

Based on data from 1914 to 1980, minimum winter temperatures vary from -33 °C (-27 °F) to -6 °C (22 °F), and maximum summer temperatures vary from 38 °C (100 °F) to 46 °C (115 °F). Between 1914 and 1980, a total of 16 days with temperatures -29 °C (-20 °F) or below were recorded. There are 10 days of record when the maximum temperature failed to go above -18 °C (0 °F). Prior to 1980, there were three summers on record when the temperatures were 38 °C (100 °F) or above for 11 consecutive days (Stone et al. 1983).

3.3 SURFACE HYDROLOGY

3.3.1 Regional Surface Hydrology

Surface drainage enters the Pasco Basin from several other basins, which include the Yakima River Basin, Horse Heaven Basin, Walla Walla River Basin, Palouse/Snake Basin, and Big Bend Basin (Figure 3-7). Within the Pasco Basin, the Columbia River is joined by major tributaries including the Yakima, Snake, and Walla Walla Rivers. No perennial streams originate within the Pasco Basin. Columbia River inflow to the Pasco Basin is

recorded at the United States Geological Survey (USGS) gage below Priest Rapids Dam, and outflow is recorded below McNary Dam. Average annual flow at these recording stations is approximately 1.1 x 10^{11} m^3 (8.7 x 10^7 acre-ft) at the USGS gage and 1.6 x 10^{11} m^3 (1.3 x 10^8 acre-ft) at the McNary Dam gage (DOE 1988).

Total estimated precipitation over the basin averages less than 15.8 cm/yr (6.2 in./yr). Mean annual runoff from the basin is estimated to be less than 3.1 x 10^7 m^3/yr (2.5 x 10^4 acre-ft/yr), or approximately 3% of the total precipitation. The remaining precipitation is assumed to be lost through evapotranspiration with a small component (perhaps less than 1%) recharging the groundwater system (DOE 1988).

3.3.2 Surface Hydrology of the Hanford Site

Primary surface water features associated with the Hanford Site, located near the center of the Pasco Basin (Figure 3-7), are the Columbia and Yakima Rivers and their major tributaries, the Snake and Walla Walla Rivers. West Lake, about 4 hectares (10 acres) in area and less than 0.9 m (3 ft) deep, is the only natural lake within the Hanford Site (DOE 1988). Wastewater ponds, cribs, and ditches associated with nuclear fuel reprocessing and waste disposal activities are also present on the Hanford Site.

The Columbia River flows through the northern part and along the eastern border of the Hanford Site. This section of the river, the Hanford Reach, extends from Priest Rapids Dam to the headwaters of Lake Wallula (the reservoir behind McNary Dam). Flow along the Hanford Reach is controlled by Priest Rapids Dam. Several drains and intakes are also present along this reach, including irrigation outfalls from the Columbia Basin Irrigation Project, the Washington Public Power Supply System (WPPSS) Nuclear Project 2, and Hanford Site intakes for onsite water use. Much of the northern and eastern parts of the Hanford Site are drained by the Columbia River.

Routine water-quality monitoring of the Columbia River is conducted by the U.S. Department of Energy (DOE) for both radiological and nonradiological parameters and has been reported by Pacific Northwest Laboratory (PNL) since 1973. The Washington State Department of Ecology (Ecology) has issued a Class A (excellent) quality designation for Columbia River water along the Hanford Reach from Grand Coulee Dam, through the Pasco Basin, to McNary Dam. This designation requires that all industrial uses of this water be compatible with other uses, including drinking, wildlife habitat, and recreation. In general, the Columbia River water is characterized by a very low suspended load, a low nutrient content, and an absence of microbial contaminants (DOE 1988).

Approximately one-third of the Hanford Site is drained by the Yakima River system. Cold Creek and its tributary, Dry Creek, are ephemeral streams within the Yakima River drainage system. Both streams drain areas along the western part of the Hanford Site and cross the southwestern part of the Hanford Site toward the Yakima River. Surface flow, which may occur during spring runoff or after heavier-than-normal precipitation, infiltrates and disappears into the surface sediments. Rattlesnake Springs, located on the western part

of the Hanford Site, forms a small surface stream that flows for about 2.9 km (1.8 mi) before infiltrating into the ground.

3.3.3 T Plant Aggregate Area Surface Hydrology

No natural surface water bodies exist in the T Plant Aggregate Area. The only existing man-made surface water bodies are the 207-T Retention Basins, open stretches of the 216-T-4 Ditch. The 216-T-4 Ditch runs from northwest to southeast across about 460 m (1500 ft) of 200 West Area. It originates about 30 m (100 ft) north of the T Tank Farm, and terminates at the old 216-T-4A Pond, which has been backfilled and stabilized. The open portion of the doesn't present any flooding potential due to the nature of the soil which allows for rapid infiltration of surface water into the ground. The 200 West Area in not in a designated floodplain. The 207-T Retention Basins present no threat of flooding because they discharge into the 216-T-4 Ditch. However, the low precipitation potential (0.16 m [6.3 in.] annual average) at the site plus the limited basin discharge, suggests little likelihood of flooding of the basin could occur.

The 200 West Area, and specifically the T Plant Aggregate Area, is not in a designated floodplain. Calculations of probable maximum floods for the Columbia River and the Cold Creek Watershed indicate that the 200 West Area in not expected to be inundated under maximum flood conditions (DOE-RL 1991c).

3.4 GEOLOGY

The following subsections provide information pertaining to geologic characteristics of southcentral Washington, the Hanford Site, the 200 West Area, and the T Plant Aggregate Area. Topics included are the regional tectonic framework (Section 3.4.1), regional stratigraphy (Section 3.4.2), and 200 West Area and T Plant Aggregate Area geology (Section 3.4.3).

The geologic characterization of the Hanford Site, including the 200 West Area and T Plant Aggregate Area is the result of many previous site investigation activities at Hanford. These activities include the siting of nuclear reactors, characterization activities for the Basalt Waste Isolation Project (BWIP), waste management activities, and related geologic studies supporting these efforts. Geologic investigations have included regional and Hanford Site surface mapping, borehole/well sediment logging, field and laboratory sediment classification, borehole geophysical studies (including gamma radiation logging), and in situ and laboratory hydrogeologic properties testing.

3.4.1 Regional Tectonic Framework

The following subsections provide information of regional (southcentral Washington) geologic structure, structural geology of the Pasco Basin and Hanford Site, and regional and Hanford Site seismology.

3.4.1.1 Regional Geologic Structure. The Columbia Plateau is a part of the North American continental plate and lies in a back-arc setting east of the Cascade Range. It is bounded on the north by the Okanogan Highlands, on the east by the Northern Rocky Mountains and Idaho Batholith, and on the south by the High Lava Plains and Snake River Plain (Figure 3-8).

The Columbia Plateau is divided into three informal structural subprovinces: (Figure 3-9) Blue Mountains, Palouse, and Yakima Fold Belt (Tolan and Reidel 1989). These structural subprovinces are delineated on the basis of their structural fabric, unlike the physiographic provinces that are defined on the basis of landform. The Hanford Site is located near the junction of the Yakima Fold Belt Subprovince with the Palouse Subprovince.

The principal characteristics of the Yakima Fold Belt (Figure 3-10) are characterized by a series of segmented, narrow, asymmetric, east-west trending anticlines that have wavelengths between 5 and 31 km (3 and 19 mi) and amplitudes commonly less than 1 km (0.6 mi) (Reidel et al. 1989a). The northern limbs of the anticlines generally dip steeply to the north, are vertical, or even overturned. The southern limbs generally dip at relatively shallow angles to the south. Thrust or high-angle reverse faults with fault planes that generally parallel fold axial trends commonly are found on the north sides of these anticlines. The amount of vertical stratigraphic offset associated with these faults varies but commonly exceeds hundreds of meters. The anticlinal ridges are separated by broad synclines or basins that, in many cases, contain thick accumulations of Neogene to Quaternary age sediments. The Pasco Basin is one of the larger structural basins in the Yakima Fold Belt Subprovince.

Deformation of the Yakima folds occurred under north-south compression and was contemporaneous with the eruption of the basalt flows (Reidel 1984, Reidel et al. 1989a). Deformation occurred during the eruption of the Columbia River Basalt Group and continued to enlarge through the Pliocene epoch, into the Pleistocene epoch, and perhaps to the present.

3.4.1.2 Pasco Basin and Hanford Site Structural Geology. The Pasco Basin, in which the Hanford Site is located, is bounded on the north by the Saddle Mountains anticline, on the west by the Umtanum Ridge, Yakima Ridge, and Rattlesnake Hills anticlines, and on the south by the Rattlesnake Mountain anticline (Figure 3-11). The Pasco Basin is divided into the Wahluke syncline on the north, and Cold Creek syncline on the south, by the Gable Mountain anticline, the easternmost extension of the Umtanum Ridge anticline. The Cold Creek syncline is bounded on the south by the Yakima Ridge anticline. Both the Cold Creek and Wahluke synclines are asymmetric and relatively flat-bottomed structures. The north limbs of both synclines dip gently (approximately 5°) to the south and the south limbs dip steeply to the north. The deepest parts of the Cold Creek syncline, the Wye Barricade depression, and the Cold Creek depression are approximately 12 km (7.5 mi) southeast of the

Hanford Site 200 Areas, and just to the west-southwest of the 200 West Area, respectively. The deepest part of the Wahluke syncline lies just north of Gable Gap.

The 200 West Area is situated on the generally southward dipping north limb of the Cold Creek syncline 1 to 5 km (0.6 to 3 mi) north of the syncline axis. The Gable Mountain-Gable Butte segment of the Umtanum Ridge anticline lies approximately 4 km (2.5 mi) north of the 200 West Area. The axes of the anticline and syncline are separated by a distance of 9 to 10 km (5.6 to 6.2 mi) and the crest of the anticline (as now exposed) is over 200 m (656 ft) higher than the uppermost basalt layer in the syncline axis. As a result, the basalts and overlying sediments dip to the south and southwest beneath the 200 West Area.

3.4.1.3 Regional and Hanford Site Seismology. Eastern Washington, especially the Columbia Plateau region, is a seismically inactive area when compared to the rest of the western United States (DOE 1988). The historic seismic record for eastern Washington began in approximately 1850, and no earthquakes large enough to be felt had epicenters on the Hanford Site. The closest regions of historic moderate-to-large earthquake generation are in western Washington and Oregon and western Montana and eastern Idaho. The most significant event relative to the Hanford Site is the 1936 Milton-Freewater, Oregon, earthquake that had a magnitude of 5.75 and that occurred more than 90 km (54 mi) away. The largest Modified Mercalli Intensity for this event was felt about 105 km (63 mi) from the Hanford Site at Walla Walla, Washington, and was VII.

Geologic evidence of past moderate or possibly large earthquake activity is shown by the anticlinal folds and faulting associated with Rattlesnake Mountain, Saddle Mountain, and Gable Mountain. The currently recorded seismic activity related to these structures consists of micro-size earthquakes. The suggested recurrence rates of moderate and larger-size earthquakes on and near the Hanford Site are measured in geologic time (tens of thousands of years).

3.4.2 Regional Stratigraphy

The following subsections summarize regional stratigraphic characteristics of the Columbia River Basalt and Suprabasalt sediments. Specific references to the Hanford Site and 200 West Area are made as applicable to describe the general occurrence of these units within the Pasco Basin.

The principal geologic units within the Pasco Basin include the Miocene age basalt of the Columbia River Basalt Group, and overlying late Miocene to Pleistocene suprabasalt sediments (Figure 3-12). Older Cenozoic sedimentary and volcaniclastic rocks underlying the basalts are not exposed at the surface near the Hanford Site. The basalts and sediments thicken into the Pasco Basin and generally reach maximum thicknesses in the Cold Creek syncline. The sedimentary sequence at the Hanford Site is up to approximately 230 m

(750 ft) thick in the west-central Cold Creek syncline, but pinches out against the anticlinal structures of Saddle Mountains, Gable Mountain/ Umtanum Ridge, Yakima Ridge, and Rattlesnake Hills.

The suprabasalt sediments are dominated by laterally extensive deposits assigned to the late Miocene to Pliocene age Ringold formation and the Pleistocene age Hanford formation (Figure 3-13). Locally occurring strata described as pre-Missoula gravels, a discontinuous Plio-Pleistocene unit, and early Palouse soil comprise the remainder of the sedimentary sequence. The pre-Missoula gravels underlie the Hanford formation in the east-central Cold Creek syncline and at the east end of Gable Mountain anticline east and south of 200 East Area. The pre-Missoula gravels have not been identified in the 200 West Area. The nature of the contact between the pre-Missoula gravels and the overlying Hanford formation has not been completely delineated, based on available subsurface data. In addition, it is unclear whether the pre-Missoula gravels overlie or interfinger with the early Palouse soil and Plio-Pleistocene unit. Magnetic polarity data indicate the unit is no younger than early Pleistocene in age (> 1 Ma) as reported in Lindsey et al (1991).

Relatively thin surficial deposits of eolian sand, loess, alluvium, and colluvium discontinuously overlie the Hanford formation.

3.4.2.1 Columbia River Basalt Group. The Columbia River Basalt Group (Figure 3-12) comprises an assemblage of tholeiitic, continental flood basalts of Miocene age. These flows cover an area of more than 163,000 km^2 (63,000 mi^2) in Washington, Oregon, and Idaho, and have an estimated volume of about 174,000 km^3 (40,800 mi^3) (Tolan et al. 1989). Isotopic age determinations indicate that basalt flows were erupted approximately 17 to 6 Ma (million years before present), with more than 98% by volume being erupted in a 2.5 million year period (17 to 14.5 Ma) (Reidel et al. 1989b).

Columbia River basalt flows were erupted from north-northwest-trending fissures of linear vent systems in north-central and northeastern Oregon, eastern Washington, and western Idaho (Swanson et al. 1979). The Columbia River Basalt Group is formally divided into five formations (from oldest to youngest): Imnaha Basalt, Picture Gorge Basalt, Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountains Basalt. Of these, only the Picture Gorge Basalt is not known to be present in the Pasco Basin. The Saddle Mountains Basalt, divided into the Ice Harbor, Elephant Mountain, Pomona, Esquatzel, Asotin, Wilbur Creek, and Umatilla Members (Figure 3-12) forms the uppermost basalt unit throughout most of the Pasco Basin. The Elephant Mountain Member is the uppermost unit beneath most of the Hanford Site except near the 300 Area where the Ice Harbor member is found and north of the 200 Areas where the Saddle Mountains Basalt has been eroded down to the Umatilla member locally. On anticlinal ridges bounding the Pasco Basin, erosion has removed the Saddle Mountains Basalt, exposing the Wanapum and Grande Ronde Basalts.

3.4.2.2 Ellensburg Formation. The Ellensburg formation consists of all sedimentary units that occur between the basalt flows of the Columbia River Basalt Group in the central Columbia Basin. The Ellensburg formation generally displays two main lithologies,

volcaniclastics and siliciclastics. The volcaniclastics consist mainly of primary pyroclastic air fall deposits and reworked epiclastics derived from volcanic terrains west of the Columbia Plateau. Siliciclastic strata consist of clastic, plutonic, and metamorphic detritus derived from the Rocky Mountain terrain. These two lithologies occur as both distinct and mixed in the Pasco Basin. A detailed discussion of the Ellensburg formation on the Hanford Site area is given by Reidel and Fecht (1981). Smith et al. (1989) provide a discussion of age equivalent units adjacent to the Columbia Plateau.

The stratigraphic names for individual units of the Ellensburg formation are given in Figure 3-12. The nomenclature for these units is based on the upper- and lower- bounding basalt flows and thus the names are valid only for those areas where the bounding basalt flows occur. Because the Pasco Basin is an area where most bounding flows occur, the names given in Figure 3-12 are applicable to the Hanford Site. At the Hanford Site the three uppermost units of the Ellensburg formation are the Selah interbed, the Rattlesnake Ridge interbed, and the Levey interbed.

3.4.2.2.1 Selah Interbed. The Selah Interbed is bounded on the top by the Pomona Member and on the bottom by the Esquatzel Member. The interbed is a variable mixture of silty to sandy vitric tuff, arkosic sands, tuffaceous clays, and locally thin stringers of predominantly basaltic gravels. The Selah interbed is found beneath most of the Hanford Site.

3.4.2.2.2 Rattlesnake Ridge Interbed. The Rattlesnake Ridge interbed is bounded on the top of the Elephant Mountain member and on the bottom by the Pomona member. The interbed is up to 33 m (108 ft) thick and dominated by three facies at the Hanford Site: (1) a lower clay of tuffaceous sandstone, (2) a middle, micaceous-arkosic and /or tuffaceous sandstone, and (3) an upper, tuffaceous siltstone to sandstone. The unit is found beneath most of the Hanford Site.

3.4.2.2.3 Levey Interbed. The Levey interbed is the uppermost unit of the Ellensburg formation and occurs between the Ice Harbor member and the Elephant Mountain member. It is confined to the vicinity of the 300 Area. The Levey interbed ia a tuffaceous sandstone along its northern edge and fine-grained tuffaceous siltstone to sandstone along its western and southern margins.

3.4.2.3 Ringold Formation. The Ringold formation at the Hanford Site is up to 185m (605 ft) thick in the deepest part of the Cold Creek syncline south of the 200 West Area and 170 m (560 ft) thick in the western Wahluke syncline near the 100-B Area. The Ringold formation pinches out against the Gable Mountain, Yakima Ridge, Saddle Mountains, and Rattlesnake Mountain anticlines. It is largely absent in the northern and northeastern parts of the 200 East Area and adjacent areas to the north in the vicinity of West Pond. The Ringold formation is assigned a late Miocene to Pliocene age (Fecht et al. 1987, DOE 1988).

Recent studies of the Ringold formation (Lindsey 1991) indicate that it is best described and divided on the basis of sediment facies associations and their distribution. Facies associations in the Ringold formation (defined on the basis of lithology, petrology,

stratification, and pedogenic alteration) include fluvial gravel, fluvial sand, overbank deposits, lacustrine deposits, and basaltic alluvial deposits. The facies associations are summarized as follows:

- **Fluvial gravel** - Clast-supported granule to cobble gravel with a sandy matrix dominates the association. Intercalated sands and muds also are found. Clast composition is variable, with common types being basalt, quartzite, porphyritic volcanics, and greenstones. Silicic plutonic rocks, gneisses, and volcanic breccias also are found. Sands in this association are generally quartzo-feldspathic, with basalt contents generally in the range of 5 to 15%. However, basalt contents as high as 25% (or locally more) are encountered. Low angle to planar stratification, massive channels, and large-scale cross-bedding are found in outcrops. The association was deposited in a gravelly fluvial system characterized by wide, shallow shifting channels.

- **Fluvial sand** - Quartzo-feldspathic sands displaying cross-bedding and cross-lamination in outcrop dominate this association. These sands usually contain less than 15% basalt. Intercalated strata consist of lenticular silty sands and clays up to 3 m (10 ft) thick and thin (<0.5 m [1.6 ft]) gravels. Fining upwards sequences less than 1 m (3.3 ft) to several meters thick are common in the association. Strata comprising the association were deposited in wide, shallow channels incised into a muddy floodplain.

- **Overbank** - This association dominantly consists of laminated to massive silt, silty fine-gained sand, and paleosols containing variable amounts of calcium carbonate. These sediments record deposition in a floodplain under proximal levee to more distal floodplain conditions.

- **Lacustrine** - Plane laminated to massive clay with thin silt and silty sand interbeds displaying some soft-sediment deformation characterize this association. Coarsening upwards packages less than 1 m (3.3 ft) to 10 m (33 ft) thick are common in the association. Strata comprising the association were deposited in a lake under standing water to deltaic conditions.

- **Alluvial fan** - Massive to crudely stratified, weathered to unweathered basaltic detritus dominates this association. This association was deposited largely by debris flows in alluvial fan settings.

The lower half of the Ringold formation contains five separate stratigraphic intervals dominated by fluvial gravels. These gravels, designated units, A, B, C, D, and E (Figure 3-13), are separated by intervals containing deposits typical of the overbank and lacustrine facies associations. The lowermost of the fine-grained sequences, overlying unit A, is designated the lower mud sequence. The uppermost gravel unit, unit E, grades upwards into interbedded fluvial sand and overbank deposits. These sands and overbank deposits are overlain by lacustrine-dominated strata.

Fluvial gravel units A and E correspond to the lower basal and middle Ringold units respectively as defined by DOE (1988). Gravel units B, C, and D do not correlate to any previously defined units. The lower mud sequence corresponds to the upper basal and lower units as defined by DOE (1988). The upper basal and lower units are not differentiated. The sequence of fluvial sands, overbank deposits, and lacustrine sediments overlying unit E corresponds to the upper unit as seen along the White Bluffs in the eastern Pasco Basin. This essentially is the same usage as originally proposed by Newcomb (1958) and Myers et al. (1979).

3.4.2.4 Plio-Pleistocene Unit. Unconformably overlying the Ringold formation in the western Cold Creek syncline in the vicinity of 200 West Area (Figures 3-11, 3-12, and 3-13) is the laterally discontinuous Plio-Pleistocene unit (DOE 1988). The unit is up to 25 m (82 ft) thick and divided into two facies: (1) basaltic detritus and (2) calcic paleosol (Stage III and Stage IV) (DOE 1988). The calcrete facies generally consists of interfingering calcium carbonate-cemented silt, sand, gravel, and carbonate-poor silt and sand. The basaltic detritus facies consists of weathered and unweathered basaltic gravels deposited as locally derived slope wash, colluvium, and sidestream alluvium. The Plio-Pleistocene unit appears to be correlative to other sidestream alluvial and pedogenic deposits found near the base of the ridges bounding the Pasco Basin on the north, west, and south. These sidestream alluvial and pedogenic deposits are inferred to have a late Pliocene to early Pleistocene age on the basis of stratigraphic position and magnetic polarity of interfingering loess units.

3.4.2.5 Pre-Missoula Gravels. Quartzose to gneissic clast-supported pebble to cobble gravel with a quartzo-feldspathic sand matrix underlies the Hanford formation in the east-central Cold Creek syncline and at the east end of Gable Mountain anticline east and south of the 200 East Area (Figures 3-11, 3-12, and 3-13). These gravels, called the pre-Missoula gravels (PSPL 1982), are up to 25 m (82 ft) thick, contain less basalt than underlying Ringold gravels and overlying Hanford deposits, have a distinctive white or bleached color, and sharply truncate underlying strata. The nature of the contact between the pre-Missoula gravels and the overlying Hanford formation is not clear. In addition, it is unclear whether the pre-Missoula gravels overlie or interfinger with the early Palouse soil and Plio-Pleistocene unit. Magnetic polarity data indicates the unit is no younger than early Pleistocene in age (>1 Ma) (Bjornstad, et al. (1987).

3.4.2.6 Early Palouse Soil. The early Palouse soil consists of up to 20 m (66 ft) of massive, brown yellow, and compact, loess-like silt and minor fine-grained sand (Tallman et al. 1981; Bjornstad 1984; DOE 1988). These deposits overlie the Plio-Pleistocene unit in the western Cold Creek syncline around the 200 West Area (Figures 3-11, 3-12, and 3-13). The unit is differentiated from overlying graded rhythmites (Hanford formation) by greater calcium carbonate content, massive structure in core, and high natural gamma response in geophysical logs (Bjornstad 1984, DOE 1988). The upper contact of the unit is poorly defined, and it may grade up-section into the lower part of the Hanford formation. Based on a predominantly reversed polarity the unit is inferred to be early Pleistocene in age.

3.4.2.7 Hanford Formation. The Hanford formation consists of pebble to boulder gravel, fine- to coarse-grained sand, and silt. These deposits are divided into three facies: (1)

gravel-dominated, (2) sand-dominated, and (3) slackwater or normally graded rhythmite. The slackwater deposits also are referred to as the "Touchet Beds," while the gravelly facies are generally referred to as the Pasco Gravels. The Hanford formation is thickest in the Cold Creek bar in the vicinity of 200 West and 200 East Areas where it is up to 65 m (213 ft) thick (Figures 3-11, 3-12, and 3-13). Hanford deposits are absent on ridges above approximately 385 m (1,263 ft) above sea level. The following subsections describe the three Hanford formation facies.

3.4.2.7.1 Gravel Dominated Facies. The gravel-dominated facies is dominated by coarse-grained sand and granule to boulder gravel. These deposits display massive bedding, plane to low-angle bedding, and large-scale cross-bedding in outcrop, while the gravels generally are matrix-poor and display an open-framework texture. Lenticular sand and silt beds are intercalated throughout the facies. Gravel clasts generally are dominated by basalt (50 to 80%). Other clast types include Ringold and Plio-Pleistocene rip-ups, granite, quartzite, and gneiss clasts. The relative proportion of gneissic and granitic clasts in Hanford gravels versus Ringold gravels generally is higher (up to 20% as compared to less than 5%). Sands in this facies usually are very basaltic (up to 90%), especially in the granule size range. Locally Ringold and Plio-Pleistocene rip-up clasts dominate the facies, comprising up to about 75% of the deposit. The gravel facies dominates the Hanford formation in the 100 Areas north of Gable Mountain, the northern part of 200 East Area, and the eastern part of the Hanford Site including the 300 Area. The gravel-dominated facies was deposited by high-energy flood waters in or immediately adjacent to the main cataclysmic flood channelways.

3.4.2.7.2 Sand-Dominated Facies. The sand-dominated facies consists of fine-grained to granular sand displaying plane lamination and bedding and less commonly plane and trough cross-bedding in outcrop. These sands may contain small pebbles or pebble-gravel interbeds and silty interbeds less than 1 m (3.3 ft) thick. The silt content of these sands is variable, but where it is low an open framework texture is common. These sands are typically very basaltic, commonly being referred to as black, gray, or salt-and-pepper sands. This facies is most common in the central Cold Creek syncline, in the central to southern parts of the 200 East and 200 West Areas, and in the vicinity of the WPPSS facilities. The laminated sand facies was deposited adjacent to main flood channelways as water in the channelways spilled out of them, loosing competence. The facies is transitional between the gravel-dominated facies to the north and the rhythmite facies.

3.4.2.7.3 Slackwater Facies. The slackwater facies consists of thinly bedded, plane laminated and ripple cross-laminated silt and fine- to coarse-grained sand that commonly display normally graded rhythmites a few centimeters to several tens of centimeters thick in outcrop (Myers et al. 1979, DOE 1988). This facies is found throughout the central, southern, and western Cold Creek syncline within and south of 200 East and 200 West Areas. The sediments were deposited under slackwater conditions and in backflooded areas (DOE 1988).

3.4.2.8 Holocene Surficial Deposits. Holocene surficial deposits consist of silt, sand, and gravel that form a thin (<10 m, [33 ft]) veneer across much of the Hanford Site. These sediments were deposited by a mix of eolian and alluvial processes.

3.4.3 200 West Area and T Plant Aggregate Area Geology

The following subsections describe the occurrence and variation of suprabasalt sediments in the 200 West Area. The subsections discuss notable stratigraphic characteristics, sediment thickness variations, dip trends, and other features such as areas where sediments are known or suspected to be absent. Also, stratigraphic variations pertinent to the T Plant Aggregate Area are identified where applicable, and are presented in the overall context of stratigraphic trends throughout the 200 West Area.

Geologic cross sections depicting the distribution of basalt and sedimentary units within and near the T Plant Aggregate Area are presented on Figures 3-14 through 3-18. Figure 3-14 illustrates the cross sections locations. A legend for symbols used on the cross sections is provided on Figure 3-15. The cross sections are based on geologic information from wells shown on the figures, as interpreted in Lindsey et al. (1991) and from Chamness, et al. (1991). Chamness et al. (1991) provide a compilation of geologic logs from the T Plant Aggregate Area, and a listing of additional geological, geochemical, and geophysical data available from the boreholes. This information was compiled in support of the T Plant Aggregate Area Management Study (AAMS). The cross sections depict subsurface geology near solid waste burial ground areas in the western and northern part of the T Plant Aggregate Area (Figures 3-16 through 3-19: Sections A-A′, B-B′, and C-C′); and burial ground areas and liquid waste disposal sites in the southern portion of the site (Figure 3-19, Section D-D′). For each cross section, locations of T Plant Aggregate Area waste sites are identified for reference. Figures 3-20 through 3-37 present structural maps of the top of the sedimentary units, and isopach maps illustrating the thickness of each unit in the 200 West Area and T Plant Aggregate Area. The structural and isopach maps are included from Lindsey et al. (1991). Plate 2 should be consulted to identify locations of T Plant Aggregate Area buildings and waste sites referenced in the text.

3.4.3.1 Elephant Mountain Basalt. The Elephant Mountain member of the Saddle Mountains Basalt is continuous beneath the entire 200 West Area. The top of the Elephant Mountain member dips to the southwest and south into the Cold Creek syncline, reflecting the structure of the area (Figure 3-20). There is little evidence of significant erosion into the top of the Elephant Mountain member and no indication of erosional "windows" through the basalt into the underlying Rattlesnake Mountain interbed.

3.4.3.2 Ringold Formation. Within the 200 West Area, the Ringold formation includes the fluvial gravels of unit A, the paleosol and lacustrine muds of the lower mud sequence, the fluvial gravels of unit E, and the sands and minor muds of the upper unit. Ringold units B, C, and D are not found in the immediate vicinity of the 200 West Area.

Several observations can be made regarding the variation of sediment types within the Ringold units in the 200 West Area. In the Ringold unit A gravels, intercalated lenticular sand and silt are most common in the western portion of the 200 West Area (including a portion of the T Plant Aggregate Area), and in the southern part of the 200 West Area. In the overlying lower mud sequence, stratigraphic trends seen elsewhere in the Pasco Basin suggest that paleosols in the unit become more common progressing structurally up-dip (Lindsey 1991). In the Ringold unit E gravels, intercalated lenticular beds of sand and silt occur throughout the 200 West Area, although predicting where they will occur is difficult. The upper unit of the Ringold in the 200 West Area tends to be dominated by sand, unlike the upper unit elsewhere in the Pasco Basin where paleosols tend to dominate the upper unit.

Beneath the 200 West Area, the fluvial gravels of Ringold unit A, and the Ringold lower mud sequence tend to thicken and dip to the south-southwest, toward the axis of the Cold Creek Syncline (Figures 3-16 and 3-22 through 3-24). The top of unit A is relatively flat in the 200 Areas, dipping gently to the west and southwest. Like the unit A gravels, the Ringold lower mud sequence thickens and dips to the south and southeast over the 200 West Area. The top of the lower mud unit is less regular, however, and the unit pinches out in the northeastern corner of the 200 West Area. Within the T Plant Aggregate Area, unit A reaches a thickness of more than 26 m (80 ft) in the southern part of the Aggregate Area, and apparently pinches out just north of the T Plant Aggregate Area boundary. The lower mud sequence ranges in thickness from a not present in the northeast corner of the T Plant Aggregate Area to about 13 m (40 ft) at the southwest corner of the Aggregate Area.

Isopach and structural contour maps of fluvial gravel unit E (Figures 3-25 and 3-26) and the upper Ringold unit (Figures 3-27 and 3-28) show trends not seen in the underlying unit A and the lower mud sequence in the 200 West Area. The top of unit E is irregular, and displays several highs near the north and northeastern parts of the 200 West Area. These highs include the northern part of the Aggregate Area. Unit E gravels generally thin from north-northeast to southwest, and generally dip to the southeast across the 200 Areas. Unit E thickness varies from about 66 m (200 ft) at the southwestern boundary of the T Plant Aggregate Area to about 100 m (300 ft) at the Northeastern boundary of the T Plant Aggregate Area.

The upper unit of the Ringold formation is present only in the western, northern, and central portion of the 200 West Area (Figures 3-27 and 3-28). Where the upper unit is present, the top generally dips to the south-southwest. The upper unit is absent on the west central and southern parts of the T Plant Aggregate Area (Figures 3-16, and 3-17 through 3-19). The upper unit reaches a thickness of about 6 m (25 ft) at the southwest corners of the T Plant Aggregate Area.

3.4.3.3 Plio-Pleistocene Unit. As discussed in the Regional Stratigraphy section (Section 3.4.2), the Plio-Pleistocene unit is largely restricted to the vicinity of the 200 West Area, pinching out to the east and south of the area (Figure 3-29 and 3-30). The thickness of the unit is very irregular and is thickest in the northwest part of the 200 West Areas. Relatively thick portions of the unit [approximately 12 m (40 ft)] also occur northwest of the T Plant Aggregate Area, and near the northern boundary of the aggregate area [8 m (25 ft)]. Several

prominent thin areas [1.5 m (5 ft) or less] occur near the central portion of the main T Plant Aggregate Area building complex. Although undocumented, potential eroded zones through the unit may exist, especially where the unit thins. The top of the unit generally dips to the southwest, although irregularities occur, especially in the southeastern part of the T Plant Aggregate Area.

3.4.3.4 Early Palouse Soil. As for the Plio-Pleistocene unit, the early Palouse soil is largely restricted to the vicinity of the 200 West Area (Figures 3-31 and 3-32). The unit pinches out near the southern, eastern, and northern portions of the 200 Area. Data from boreholes located west of the 200 West Area indicate that the unit extends to the west. The early Palouse Soil is also absent at several locations within the 200 West Area, including locations north and southwest of the T Plant Aggregate Area. Like the Plio-Pleistocene unit, the thickness of the Early Palouse Soil in the 200 Area varies considerably. The unit is thickest in the southeast and southwest parts of the 200 West Area. Within the T Plant Aggregate Area, the unit reaches a thickness of about 6.5 m (20 ft) in the southern part of the aggregate area. Across the 200 Areas, the top of the unit dips to the south.

Although carbonate is present in the unit in the 200 Area, no obvious caliches like those seen in the underlying Plio-Pleistocene unit are documented. The loess-like sediments of the early Palouse soil are uncemented.

3.4.3.5 Hanford Formation. In the 200 West Area, the Hanford formation is divided into a lower fine-grained unit, and an upper coarse-grained unit based on the distribution of facies types and similarities in lithologic succession from borehole to borehole. The units are essentially the same as those defined by Last et al. (1989). The upper and lower units are very heterogeneous, and display marked changes in thickness and continuity across the 200 West Area. Typical lithologic successions consist of fining upward packages, major fine-grained intervals, and laterally persistent coarse-grained sequences. Mineralogic and geochemical data were not used in differentiating units because of the lack of a comprehensive mineralogic and geochemical data set.

The lower fine-grained unit of the Hanford formation in the 200 West Area is thick but locally discontinuous. The lower unit consists of silts, silty sand, and sand typical of the slackwater facies interbedded with coarser sands like those comprising the sand-dominated facies. Thin (<3 m [10 ft]) intervals dominated by the gravel facies are found locally. The distribution of the gravel facies within the lower unit is quite variable, although the unit generally fines to the south where deposits associated with the slackwater facies become more common. The lower unit is not present over much of the northern part of the 200 West Area, and an area which includes the western portion of the T Plant Aggregate Area (Figures 3-16 through 3-19, and 3-33 and 3-34). Erosional windows through the lower fine unit are present to the south of the T Plant Aggregate Area. The lower unit dips irregularly across the 200 West Area. The lower unit is up to about 33 m (100 ft) thick toward the southeastern edge of the T Plant Aggregate Area, and generally dips to the north, toward the area where the unit is not present.

The upper coarse unit of the Hanford formation consists of interstratified gravel, sand, and minor silt. Gravelly deposits typical of the gravel facies generally dominate. However, at some localities the upper unit, sand with minor silt and gravel typical of the sand-dominated facies is prevalent. Also, minor silty deposits associated with the slackwater facies are found locally. The distribution of each of the facies types within the upper coarse unit is quite variable. Fining upward sequences from coarser to finer gravel, or to sand and silt are present at some locations. The thickness of the upper coarse unit varies across the 200 West Area (Figures 3-35 and 3-36), and is thickest at the northwest corner of the area. The unit is laterally discontinuous and pinches out south and southwest of the 200 West Area. Several local areas occur where thickness of the upper coarse unit exceeds 30 m (100 ft), including areas in the southern and northern parts of the T Plant Aggregate Area. The base of the upper coarse unit is incised into the underlying lower fine unit, and fills erosional windows where the lower unit is absent. The contact between the upper coarse unit and underlying strata is generally sharp, and consists of gravel facies deposits overlying the fines of the lower unit, early Palouse soil, or the Plio-Pleistocene unit.

3.4.3.6 Holocene Surficial Deposits. Holocene surficial deposits consist of silt, sand, and gravel that form a thin veneer of less than about 10 m (33 ft) across much of the Hanford Site. The sediments are a mix of eolian-deposited sands and alluvial materials. In the vicinity of the 200 West Area, eolian sands dominate. Holocene deposits have been removed from much of the area by construction activities. Dune structures are not generally well developed within the 200 West Area.

3.5 HYDROGEOLOGY

The following subsections present discussions of regional hydrogeology (Section 3.5.1), Hanford Site hydrogeology (Section 3.5.2), and T Plant Aggregate Area hydrogeology (Section 3.5.3). Sections 3.5.2 and 3.5.3 also discuss Hanford Site and T Plant Aggregate Area vadose zone characteristics.

3.5.1 Regional Hydrogeology

The hydrogeology of the Pasco Basin is characterized by a multiaquifer system that consists of four hydrogeological units that correspond to the upper three formations of the Columbia River Basalt Group (Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountains Basalt) and the suprabasalt sediments. The basalt aquifers consist of the tholeiitic flood basalts of the Columbia River Basalt Group and relatively minor amounts of intercalated fluvial and volcaniclastic sediments of the Ellensburg formation. Confined zones in the basalt aquifers are present in the sedimentary interbeds and/or interflow zones that occur between dense basalt flows. The main water-bearing portions of the interflow zones are networks of interconnecting vesicles and fractures of the flow tops and flow bottoms (DOE 1988). The suprabasalt sediment or uppermost aquifer system consists of fluvial, lacustrine, and glaciofluvial sediments. This aquifer is regionally unconfined and is

contained largely within the Ringold formation and Hanford formation. The position of the water table in the southwestern Pasco Basin is generally within Ringold fluvial gravels of unit E. In the northern and eastern Pasco Basin the water table is generally within the Hanford formation. Table 3-1 presents hydraulic parameters for various water-bearing geologic units at the Hanford Site.

Local recharge to the shallow basalt aquifers results from infiltration of precipitation and runoff along the margins of the Pasco Basin, and in areas of artificial recharge where a downward gradient from the unconfined aquifer systems to the uppermost confined basalt aquifer may occur. Regional recharge of the deep basalt aquifers is inferred to result from interbasin groundwater movement originating northeast and northwest of the Pasco Basin in areas where the Wanapum and Grande Ronde Basalts crop out extensively (DOE 1988). Groundwater discharge from shallow basalt aquifers is probably to the overlying aquifers and to the Columbia River. The discharge area(s) for the deeper groundwater system is uncertain, but flow is inferred to be generally southeastward with discharge thought to be south of the Hanford Site (DOE 1988).

Erosional "windows" through dense basalt flow interiors allow direct interconnection between the uppermost aquifer systems and underlying confined basalt aquifers. Graham et al. (1984) reported that some contamination was present in the uppermost confined aquifer (Rattlesnake Ridge interbed) south and east of Gable Mountain Pond. Graham et al. (1984) evaluated the hydrologic relationships between the Rattlesnake Ridge interbed aquifer and the unconfined aquifer in this area and delineated a potential area of intercommunication beneath the northeast portion of the 200 East Area.

The base of the uppermost aquifer system is defined as the top of the uppermost basalt flow. However, fine-grained overbank and lacustrine deposits in the Ringold formation locally form confining layers for Ringold fluvial gravels underlying unit E. The uppermost aquifer system is bounded laterally by anticlinal basalt ridges and is approximately 152 m (500 ft) thick near the center of the Pasco Basin.

Sources of natural recharge to the uppermost aquifer system are rainfall and runoff from the higher bordering elevations, water infiltrating from small ephemeral streams, and river water along influent reaches of the Yakima and Columbia Rivers. The movement of precipitation through the unsaturated (vadose) zone has been studied at several locations on the Hanford Site (Gee 1987, Routson and Johnson 1990, Rockhold et al. 1990). Conclusions from these studies vary. Gee (1987) and Routson and Johnson (1990) conclude that no downward percolation of precipitation occurs on the 200 Areas Plateau where the sediments are layered and vary in texture, and that all moisture penetrating the soil is removed by evapotranspiration. These two studies analyzed data collected over a period of 12 and 14 years, respectively, and do not specifically address short-term seasonal fluctuations. Rockhold et al. (1990) suggest that downward water movement below the root zone is common in the 300 Area, where soils are coarse-textured and precipitation was above normal.

3.5.2 Hanford Site Hydrogeology

This section describes the hydrogeology of the Hanford Site with specific reference to the 200 Areas.

3.5.2.1 Hydrostratigraphy. The hydrostratigraphic units of concern in the 200 Areas are (1) the Elephant Mountain Basalt Member (confining horizon), (2) the Ringold formation (unconfined and confined water-bearing zones and lower part of the vadose zone), (3) the Plio-Pleistocene unit and early Palouse soil (primary vadose zone perching horizons and/or perched groundwater zones), and (4) the Hanford formation (vadose zone)(Figure 3-37). The Plio-Pleistocene unit and early Palouse soil are only encountered in the vicinity of the 200 West Area. Strata below the Elephant Mountain Basalt Member are not discussed because the more significant water-bearing intervals, relating to environmental issues, are closer to the ground surface. The hydrogeologic designations for the 200 Areas were determined by examination of borehole logs and integration of these data with stratigraphic correlations from existing reports.

3.5.2.1.1 Vadose Zone. The vadose zone beneath the 200 Areas ranges from approximately 55 m (180 ft) beneath the former U Pond to approximately 100 m (340 ft) west of the 200 East Area (Last et al. 1989). Sediments in the vadose zone primarily consist of the (1) fluvial gravel of the Ringold unit E, (2) the upper unit of the Ringold Formation, (3) Plio-Pleistocene unit, (4) early Palouse soils, and (5) Hanford formation. Only the Hanford formation is continuous throughout the vadose zone in the 200 Areas. The upper unit of the Ringold formation, the Plio-Pleistocene unit, and the early Palouse soil only occur in the 200 West Area. The unconfined aquifer water table (discussed in Subsection 3.5.2.1.3) lies within the Ringold unit E.

The transport of water through the vadose zone depends in complex ways on several factors, including most significantly the moisture content of the soils and their hydraulic properties. Darcy's law, although originally conceived for saturated flow only, was extended by Richards to unsaturated flow, with the provision that the soil hydraulic conductivity becomes a function of the water content of the soil and the driving force is predominently differences in moisture level. The moisture flux, q, in centimeters per second (cm/s) in one direction is then described by a modified form of Darcy's law commonly referred to as Richards' Equation (Hillel, 1971) as follows:

$$q = K(\Theta) \times \delta\Phi/\delta\Theta \times \delta\Theta/\delta x \quad \text{(Richards' Equation)}$$

where

- $K(\Theta)$ is the water content dependent unsaturated hydraulic conductivity in cm/s

- $\delta\Phi/\delta\Theta$ is the slope of the soil-moisture retention curve $[\Phi(\Theta)]$ at a particular volumetric moisture content Θ (a soil-moisture retention curve plots volumetric

moisture content observed in the field or laboratory against suction values for a particular soil, see Figure 3-38 from Gee and Heller 1985 for an example)

- $\delta\Theta/\delta x$ is the water content gradient in the x direction.

More complicated forms of this equation are also available to account for the effects of more than one dimensional flow and the effects of other driving forces such as gravity.

The usefulness of Richards' Equation is that knowing the moisture content distribution in soil, having measured or estimated values for the unsaturated hydraulic conductivity corresponding to these moisture contents, and having developed a moisture retention curve for this soil, one can calculate a steady state moisture flux. With appropriate algebraic manipulation or numerical methods, one could also calculate the moisture flux under transient conditions.

In practice, applying Richards' Equation is quite difficult because the various parameters involved are difficult to measure and because soil properties vary depending on whether the soil is wetting or drying. As a result, soil heterogeneities affect unsaturated flow even more than saturated flow. Several investigators at the Hanford Site have measured the vadose zone moisture flux directly using lysimeters (e.g., Rockhold et al. 1990, Routson and Johnson 1990). These direct measurements are discussed in Section 3.5.2.2 under the heading of natural groundwater recharge.

An alternative to direct measurement of unsaturated hydraulic conductivity is to use theoretical methods which predict the conductivity from measured soil moisture retention data.

Thirty-five soil samples from the 200 West Area have had moisture retention data measured. These samples were collected from Wells 299-W18-21, 299-W15-16, 299-W15-2, 299-W10-13, 299-W7-9, and 299-W7-2. Eleven of these samples were reported by Bjornstad (1990). The remaining 24 were analyzed as part of an ongoing performance assessment of the low-level burial grounds. For each of these samples saturated hydraulic conductivity was measured in the laboratory. Van Genuchten's computer program RETC was then used to develop wetting and drying curves for the Hanford, early "Palouse," Plio-Pleistocene, upper Ringold, and Ringold Gravel lithologic units. An example of the wetting and drying curves, and corresponding grain size distributions, is provided on Figure 3-39.

The unsaturated hydraulic conductivities may vary by orders of magnitude with varying moisture contents and among differing lithologies with significantly different soil textures and hydraulic conductivities. Therefore, choosing a moisture retention curve should be made according to the particle size analyses of the samples and the relative density of the material.

Once the relationship between unsaturated hydraulic conductivity and moisture content is known for a particular lithologic unit, travel time can also be estimated for a steady-state flux passing through each layer by assuming a unit hydraulic gradient. Under the unit gradient condition, only the force of gravity is acting on water and all other forces are considered negligible. These assumptions may be met for flows due to natural recharge since moisture differences become smoothed out after sufficient time. Travel time for each lithologic unit of a set thickness and calculated for any given recharge rate and the total travel time is equivalent to the sum of the travel times for each individual lithologic unit. To calculate the travel time for any particular site the detailed layering of the lithologic units should be considered. For sites with artificial recharge (e.g., cribs and trenches) more complicated analyses would be required to account for the effects of saturation.

Several other investigators have measured vadose zone soil hydraulic conductivities and moisture retention characteristics at the Hanford Site both in situ (i.e., in lysimeters) and in specially prepared laboratory test columns. Table 3-1 summarizes data identified for this study by stratigraphic unit. Rockhold et al. (1988) presents a number of moisture retention characteristic curves and plots of hydraulic conductivity versus moisture content for various Hanford Site soils. For the Hanford formation, vadose zone hydraulic conductivity values at saturation range from 1×10^{-4} to 1×10^{-2} cm/s (4×10^{-5} to 4×10^{-3} in./s). These saturated hydraulic conductivity values were measured at volumetric water contents of 40 to 50%. Hydraulic conductivity values corresponding to volumetric water contents ranging from 2 to 10% ranged from 2×10^{-11} to 7×10^{-7} cm/s (8×10^{-12} to 3×10^{-7} in./s).

An example of the potential use of this vadose zone hydraulic parameter information is presented by Smoot et al. (1989) in which precipitation infiltration and subsequent contaminant plume movement near a prototype single-shell tank was evaluated using a numerical computer code. Smoot el al. (1989) used the UNSAT-H one-dimensional finite-difference unsaturated zone water flow computer code to predict the precipitation infiltration for several different soil horizon combinations and characteristics. The researchers used statistically generated precipitation values which were based on actual daily precipitation values recorded at the Hanford Site between 1947 and 1989 to simulate precipitation infiltration from January 1947 to December 2020. In a coupled analysis, the same authors used the PORFLO-3 computer code to simulate ^{106}Ru and ^{137}Cs movement in the unsaturated zone for the period 1960 to 1990.

Smoot et al. (1989) concluded that 68 to 86% of the annual precipitation infiltrated into a gravel-capped soil column while less than 1% of the annual precipitation infiltrated into a silt loam-capped soil column. For the gravel-capped soil column, the simulations showed the ^{106}Ru plume approaching the water table after 10 years of simulated precipitation infiltration. The simulated ^{137}Cs plume migrated a substantially shorter distance due to greater adsorption on soil particles. In both cases, the simulated plume migration scenarios are considered to be conservative due to the relatively high soil absorption coefficients used.

Graham et al. (1981) estimated that historical artificial recharge from liquid waste disposal in the 200 (Separations) Areas exceeded all natural recharge by a factor of 10. In the absence of ongoing artificial recharge, i.e., liquid waste disposal to the soil column,

natural recharge could potentially be a driving force for mobilizing contaminants in the subsurface. Natural sources of recharge to the vadose zone and the underlying water table aquifer are discussed in Section 3.5.2.2. Additional discussion of the potential for natural and artificial recharge to mobilize subsurface contaminants is presented in Section 4.2.

Another facet of moisture migration in the vadose zone is moisture retention above the water table. Largely due to capillary forces, some portion of the moisture percolating down from the ground surface to the unconfined aquifer will be held against gravity in soil pore space. Finer-grained soils retain more water (against the force of gravity) on a volumetric basis than coarse-grained soils (Hillel 1971). Because unsaturated hydraulic conductivity increases with increasing moisture content, finer-grained soils may be more permeable than coarse-grained soils at the same water content. Also, because the moisture retention curve for coarse-grained soils is generally quite steep (Smoot et al. 1989), the permeability contrast between fine-grained and coarse-grained soils at the same water content can be substantial. The occurrence of interbedded fine-grained and coarse-grained soils may result in the formation of "capillary barriers" and can in turn lead to the formation of perched water zones. General conditions leading to the formation of perched water zones at the Hanford Site are discussed in Subsection 3.5.2.1.2. Potential perched water zones in the T Plant Aggregate Area are discussed in Subsection 3.5.3.1.2.

3.5.2.1.2 Perched Water Zones. Moisture moving downward through the vadose zone may accumulate on top of highly cemented horizons and may accumulate above the contact between a fine-grained horizon and an underlying coarse-grained horizon as a result of the "capillary barrier" effect. If sufficient moisture accumulates, the soil pore space in these perching zones may become saturated. In this case, the capillary pressure within the horizon may locally exceed atmospheric pressure, i.e., a water table condition may develop. Additional input of downward percolating moisture to this horizon may lead to a hydraulic head buildup above the top of the horizon. Consequently, a monitoring well screened within or above this horizon would be observed to contain free water.

The lateral extent and composition of the Plio-Pleistocene and early Palouse soil units may provide conditions amenable to the formation of perched water zones in the vadose zone above the unconfined aquifer. The calcrete facies of the Plio-Pleistocene unit, consisting of calcium-carbonate-cemented silt, sand, and gravel, is a potential perching horizon due to its likely low hydraulic conductivity. However, the Plio-Pleistocene unit is typically fractured and may have erosional scours in some areas, potentially allowing deeper infiltration of groundwater, a factor which may limit the lateral extent of accumulated perched groundwater. The early Palouse soil horizon, consisting of compact, loess-like silt and minor fine-grained sand, is also a likely candidate for accumulating moisture percolating downward through the sand and gravel-dominated Hanford formation.

3.5.2.1.3 Unconfined Aquifer. The uppermost aquifer system in the 200 Areas occurs primarily within the sediments of the Ringold formation and Hanford formation. In the 200 West Area, the uppermost aquifer is contained within the Ringold formation and displays unconfined to locally confined or semiconfined conditions. In the 200 East Area the upper aquifer occurs in the Ringold formation and the Hanford formation. The depth to

groundwater in the upper aquifer underlying the 200 Areas ranges from about 60 m (197 ft) beneath the former U Pond 200 West Area to approximately 105 m (340 ft) west of the 200 East Area. The saturated thickness of the unconfined aquifer ranges from approximately 67 to 112 m (220 to 368 ft) in the 200 West Area and approximately 61 m (200 ft) in the southern 200 East Area to nearly absent in the northeastern 200 East Area where the aquifer thins out and terminates against the basalt cropping above the water table in that area.

The upper part of the uppermost aquifer in the 200 West Area is generally contained within the Ringold unit E under unconfined conditions. The lower part of the uppermost aquifer consists of confined to semi-confined groundwater within the gravelly sediments of Ringold unit A. The Ringold unit A is generally confined by fine-grained sediments of the lower mud sequence. The thickness of this confined zone ranges from greater than 38 m (125 ft) in the southeastern portion of the 200 West Area to nearly absent where it pinches out just north of the northern 200 West Area boundary. The lower mud sequence confining zone overlying unit A is up to 30 m (100 ft) thick below the south-central section of the 200 West Area before pinching out in the northeastern corner of the 200 West Area. Where it is absent, the Ringold units A and E combine to form a single thick unconfined aquifer.

Due to its importance with respect to contaminant transport, the unconfined aquifer is generally the most characterized hydrologic unit beneath the Hanford Site. A number of observation wells have been installed and monitored in the unconfined aquifer. Additionally, in situ aquifer tests have been conducted in a number of the unconfined aquifer monitoring wells. Results of these in situ tests vary greatly depending on the following:

- Horizontal position/location between areas across the Hanford Site and even smaller areas (such as across portions of the 200 Areas)
- Depth, even within a single hydrologic unit
- Analytical methods for estimating hydraulic conductivity

Details regarding this aquifer system can be found in the 200 West Groundwater Aggregate Area Management Study Report (AAMSR).

3.5.2.2 Natural Groundwater Recharge. Sources of natural recharge to groundwater at the Hanford Site include precipitation infiltration, runoff from higher bordering elevations and subsequent infiltration within the Hanford Site boundaries, water infiltrating from small ephemeral streams, and river water infiltrating along influent reaches of the Yakima and Columbia Rivers (Graham et al. 1981). The principal source of natural recharge is believed to be precipitation and runoff infiltration along the periphery of the Pasco Basin. Small streams such as Cold Creek and Dry Creek, west of the 200 West Area, also lose water to the ground as they spread out on the valley plain. Conflicting data as to whether any recharge to groundwater occurs from precipitation falling on broad areas of the 200 Areas Plateau.

Natural precipitation infiltration at or near waste management units or unplanned releases may provide a driving force for the mobilization of contaminants previously introduced to surface or subsurface soils. For this reason, determination of precipitation recharge rates at the Hanford Site has been the focus of many previous investigations. Previous field programs have been designed to assess precipitation, infiltration, water storage changes, and evaporation to evaluate the natural water balance during the recharge process. Precipitation recharge values ranging from 0 to 10 cm/yr (0 to 3.9 in./yr) have been estimated from various studies.

The primary factors affecting precipitation recharge appear to be surface soil type, vegetation type, topography, and year-to-year variations in seasonal precipitation. A modeling analysis (Smoot et al. 1989) indicated that 68 to 86% of the precipitation falling on a gravel-covered site might infiltrate to a depth greater than 2 m (6 ft). As discussed below, various field studies suggest that less than 25% of the precipitation falling on typical Hanford Site soils actually infiltrates to any depth.

Examples of precipitation recharge studies include:

- A study by Gee and Heller (1985) described various models used to estimate natural recharge rates. Many of the models use a water retention relationship for the soil. This relates the suction required to remove (or move) water to its dryness (saturation or volumetric moisture content). Two of these have been developed by Gee and Heller (1985) for soils in lysimeters on the Hanford Site. As an example of available data, the particle size distribution and the water retention curves of these two soils are shown in Figure 3-40. Additional data and information about possible models for unsaturated flow may be found in Brownell et al. (1975), and Rockhold et al. (1990).

- Field moisture contents have been obtained from a number of core-barrel samples in the 200 Areas (East and West) and varied from 1 to 18%, with most in the range of 2 to 6% (Last et al. 1989). The data appear to indicate zones of increased moisture content that could be interpreted as signs of moisture transport. None of the boreholes that this study used (for moisture content or other parameters) were located in the vicinity of the T Plant Aggregate Area.

- A lysimeter study reported by Routson and Johnson (1990) was conducted at a location 1.6 km (1 mi) south of the 200 East Area. During much of the lysimeters' 13-year study period between 1972 and 1985, the surface of the lysimeters were maintained unvegetated with herbicides. No information regarding the soil types in the lysimeters was found. To a precision of ±0.2 cm (±0.08 in.), no downward moisture movement was observed in the instruments during periodic neutron-moisture measurements or as a conclusion of a final soil sample collection and moisture content analysis episode.

- An assessment of precipitation recharge involving the redistribution of ^{137}Cs in vadose zone soil also reported by Routson and Johnson (1990). In this study, split-spoon soil samples were collected beneath a solid waste burial trench in the T Plant Aggregate Area. The trench, apparently located just south and west of the 218-W-3AE Burial Ground, received soil containing ^{137}Cs from an unspecified spill. Cesium-137 was not detected below the bottom of the burial trench. However, increased ^{137}Cs activity was observed above the top of the waste fill which Routson and Johnson concluded indicated that net negative recharge (loss of soil moisture to evapotranspiration) had occurred during the 10-year burial period.

  Sparse Russian thistle was observed at the burial trench area in 1980. Rockhold et al. (1990) noted that ^{137}Cs appears to strongly absorb to Hanford Site soils indicating that the absence of the radionuclide at depth below the burial trench may not support the conclusion that no downward moisture movement occurred.

- A weighing lysimeter study reported by Rockhold et al. (1990) which was conducted at a grassy plot approximately 5 km (3.1 mi) northwest of the 300 Areas. The grass test site was located in a broad, shallow topographic depression approximately 900 m (2900 ft) wide, several hundred meters long, trending southwest. The area is covered with annual grasses (cheatgrass and bluegrass). The upper 3.5 m (11.5 ft) of the soil profile consists of slightly silty to silty sand (sandy loam) with an estimated saturated hydraulic conductivity of 9×10^{-3} cm/s (3.5×10^{-3} in./s). Rockhold et al. (1990) estimated that approximately 0.8 cm (0.3 in.) of downward moisture movement occurred between July 1987 and June 1988. This represents approximately 7% of the total precipitation recorded in that area during that time period.

- A gravel-covered lysimeter study discussed by Rockhold et al. (1990) which was conducted at the 622 Area Lysimeter Site, approximately 0.5 km (0.3 mi) east of the 200 West Area. Approximately 4 cm (1.6 in.) of downward moisture movement was observed in two gravel-covered lysimeters during 1988 and 1989. This represented approximately 25% of the total precipitation recorded in the area during the study period. The authors concluded that gravel placed on the soil surface reduces evaporation and facilitates precipitation infiltration.

The drainage (downward moisture movement) observed in these studies may represent potential recharge to deeper vadose zone soils and/or the underlying water table.

3.5.2.3 Groundwater Flow. Groundwater flow in the unconfined aquifer beneath the 200 West Area is generally toward the north and east, away from the groundwater mound observed in the southern part of the Z Plant Aggregate Area. Groundwater elevations in June 1990 for the unconfined aquifer in the 200 Areas are shown on Figure 3-40 (Kasza et

al. 1990). Graham et al. (1981) calculated horizontal hydraulic gradients for the 200 West Area of 0.004 to 0.015 for data collected in December 1979. Graham et al. (1981) estimated that vertical hydraulic gradients in the unconfined aquifer exceed 10% in some areas of the unconfined aquifer.

Natural groundwater inflow to the unconfined aquifer primarily occurs along the western boundary of the Hanford Site. Currently, man-made recharge occurs in several waste management units (e.g., the 216-T-1 Ditch, 216-T-4 Ditch, 216-T-4B Pond) located within the T Plant Aggregate Area in the 200 West Area. Historically, greater recharge probably occurred from a number of waste management units in the 200 Areas. Man-made recharge probably substantially exceeds natural precipitation recharge in these areas. The unconfined aquifer ultimately discharges to the Columbia River, either near the 100 Areas, north of the 200 Areas through Gable Gap, or between the 100 Areas and the 300 Area, east of the 200 Areas. The precise path is strongly dependent on the hydrologic conditions in the 200 East Area (Delaney et al. 1991). If recharge in the 200 East Area is large, more of the recharge from the 200 West Area is diverted north through Gable Gap toward the 100 Areas. Generally, however, the easterly route appears to be more likely for recharge from the 200 West Area.

3.5.2.5 Historical Effects of Operations. Historical effluent disposal at the Hanford Site altered previously prevailing groundwater hydraulic gradients and flow directions. Before operations at the Hanford Site began in 1944, groundwater flow was generally toward the east, and the groundwater hydraulic gradient in the 200 West Area was on the order of 0.001 (Delaney et al. 1991). Prior to disposing liquid waste to the soil column in the Separations Areas, groundwater elevations in the 200 West Area may have been as much as 20 m (65 ft) lower in 1944 than at present. As seen in Figure 3-41, a distinct groundwater mound is still apparent beneath the 200 West Area. The horizontal hydraulic gradient is expected to increase and shift to the east as the mound continues to dissipate.

3.5.3 T Plant Aggregate Area Hydrogeology

This section presents additional hydrogeologic information identified with specific application to the T Plant Aggregate Area.

3.5.3.1 Hydrostratigraphy. As shown on Figure 3-41, the hydrostratigraphic units of concern beneath the T Plant Aggregate Area are (1) the Rattlesnake Ridge Interbed, (2) the Elephant Mountain Basalt Member, (3) the Ringold formation units A and E, (4) the Plio-Pleistocene unit and early Palouse soil, and (5) the Hanford formation. The hydrogeologic designations for the T Plant Aggregate Area were determined by examination of borehole logs from Lindsey et al. (1991) and Chamness et al. (1991) and integration of these data with stratigraphic correlations from existing reports. For the purposes of the T Plant AAMS Report, this discussion will be limited to the vadose zone and possible perching horizons within the vadose zone underlying the Aggregate Area.

3.5.3.1.1 Vadose Zone. The vadose zone beneath the T Plant Aggregate Area ranges in thickness from about 90 m (272 ft) along the northern part of the aggregate area boundary to 65 m (195 ft) in the vicinity of the 216-T-19 Crib based on December 1990 groundwater elevation data (WHC 1991a). The observed variation in vadose zone thickness is the result of variable surface topography and the variable elevation of the water table in the underlying unconfined aquifer.

Published vadose zone hydraulic data specific to soil samples or subsurface explorations advanced in the T Plant Aggregate Area were not found. However, ongoing work by the Westinghouse Hanford Company Environmental Technology, Risk and Performance Assessment group to evaluate potential contaminant transport from a proposed facility in the low-level solid waste burial grounds utilizes soil samples from Well 299-W7-9 on the north side of the 218-W-5 Burial Ground in the T Plant Aggregate Area. In this study, laboratory-measured soil moisture retention curves were used to determine vadose zone soil hydraulic conductivity values for use in a numerical modeling analysis. The soil samples used to prepare the moisture retention curves were collected from the referenced well. A summary of the moisture content and hydraulic conductivity values is presented below.

Soil Horizon	Sample Depth m	Moisture Content Wt %	Measured Saturated Hydraulic Conductivity (cm/s)
Hanford Formation (Upper Coarse Grained Unit)	3.05	0.20	1.2×10^{-02}
Early Palouse Soil	19.8	0.38	7.0×10^{-06}
	21.1	0.38	1.4×10^{-04}
Plio-Pleistocene Unit	26.9	0.23	1.3×10^{-04}
Upper Ringold	30.0	0.26	1.6×10^{-04}
	31.8	0.20	2.1×10^{-05}
	34.2	0.21	1.1×10^{-03}
	40.4	0.23	3.0×10^{-04}
	43.2	0.24	1.9×10^{-04}

3.5.3.1.2 Perched Water Zones. Downward-moving moisture in the vadose zone, whether from precipitation recharge or artificial recharge, may accumulate on or within the Plio-Pleistocene and early Palouse soil units beneath the T Plant Aggregate Area. The top of the Plio-Pleistocene Unit occurs at elevations ranging from 180 m to 206 m (540 to 620 ft). The early Palouse soil horizon is typically occurs at elevations between 210 m to 183 m (630 to 183 ft). Additional characteristics information on the extent and stratigraphic position of the Plio-Pleistocene and early Palouse soil are provided in Figures 3-16, 3-17, 3-

18, 3-19, 3-30, 3-31, and 3-32. The high concentration, laterally continuous nature, and relatively gentle (1.5°) dip to the southwest of the Plio-Pliestocene unit indicate the possibility of perched water zones. Further examination of the existing drilling logs failed to provide additional data on the existence of perched water zones.

3.5.3.2 Natural Groundwater Recharge. As discussed in Section 3.3.3, no natural surface water bodies were identified within the T Plant Aggregate Area. Therefore, the potential for natural groundwater recharge within the T Plant Aggregate Area is limited to precipitation infiltration. No precipitation infiltration data were identified with specific reference to the T Plant Aggregate Area. However, the amount of precipitation infiltration is likely comparable to the range of values identified for various Hanford test sites, i.e., 0 to 10 cm/yr (0 to 3.9 in./yr).

As suggested in Section 3.5.2.2, precipitation infiltration rates probably vary with respect to location within the T Plant Aggregate Area. Higher infiltration rates are expected in unvegetated areas or areas with shallow rooting plants. Higher infiltration rates are also expected in areas with gravelly soils exposed at the surface.

3.5.3.3 Groundwater Flow beneath the T Plant Aggregate Area. Within the T Plant Aggregate Area, groundwater flow is generally toward the east, with some flow to the north based on December 1990 Hanford wells groundwater elevation data (WHC 1991a) (Figure 3-41). Flow is generally away from a groundwater mound located in the southern part of the 200 West Area. This observed groundwater mound is attributed to the residual from a mound which formed during past liquid waste discharges to the U Pond. A review of groundwater maps of the unconfined aquifer (Kasza et al. 1990) indicates generally decreasing groundwater elevations in the northeastern part of the T Plant Aggregate Area.

3.5.3.4 Historical Effects of Operations. Data identified for this study were not sufficient to quantitatively evaluate the effect of wastewater discharges to the soil column from T Plant Aggregate Area waste management units on groundwater flow in the unconfined aquifer. Evaluations discussed in Section 4.1.8 suggest that wastewater discharged to the 216-T-6, 216-T-7, 216-T-18, 216-T-19TF, 216-T-26, 216-T-27, 216-T-28, 216-T-32, 216-T-33, 216-T-34, 216-W-LWC Cribs, 216-T-1, 216-T-4A, 216-T-4-2 Ponds and Ditches, and 216-T-2, 216-T-3 Reverse Wells may have infiltrated to the underlying unconfined aquifer. Although an estimate of the total volume of fluid discharged to each of these facilities was found (Table 2-2), discharge rates were not identified. Therefore, estimating the potential water level rise associated with individual waste management units by means of a point source algorithm (e.g., the Theis equation) could not be done.

3.6 ENVIRONMENTAL RESOURCES

The Hanford Site is characterized as a cool desert or a shrub-steppe and supports a biological community typical of this environment.

3.6.1 Flora and Fauna

The 200 Area Plateau is represented by a number of plant, mammal, bird, reptile, amphibian, and insect species as discussed below.

3.6.1.1 Vegetation of the 200 Area Plateau. The vegetation of the 200 Area Plateau is characterized by native shrub steppe interspersed with large areas of disturbed ground with a dominant annual grass component. The native stands are classified as an *Artemisia tridentata/Poa sandbergii - Bromus tectorum* community (Rogers and Rickard 1977) meaning that the dominant shrub is Big Sagebrush (*Artemisia tridentata*) and the understory is dominated by the native Sandberg's Bluegrass (*Poa sandbergii*) and the introduced annual Cheatgrass (*Bromus tectorum*). Other shrubs that are typically present include Gray Rabbitbrush (*Chrysothamnus nauseosus*), Green Rabbitbrush (*C. viscidiflorus*), Spiny Hopsage (*Grayia spinosa*), and occasionally Antelope Bitterbrush (*Pursia tridentata*). Other native bunchgrasses that are typically present include Bottlebrush Squirreltail (*Sitanion hystrix*), Indian Ricegrass (*Oryzopsis hymenoides*), Needle-and-Thread (*Stipa comata*), and Prairie Junegrass (*Koleria cristata*). Common and important herbaceous species include Turpentine cymopteris (*Cymopteris terebinthinus*), Globemallow (*Spheracea munroana*), balsamroot (*Basamorhiza careyana*), several Milkvetch species (*Astragalus caricinus*, *A. sclerocarpus*, *A. succumbens*), Long-leaf Phlox (*Phlox longifolia*), the common Yarrow (*Achillea millifolium*), Pale Evening-primrose (*Oenothera pallida*), Thread-leaf phacelia (*Phacelia linearis*), and several Daisy/Fleabane Species (*Erigeron poliospermus*, *E. Filifolius*, and *E. pumilus*). In all, well over 100 plant species have been documented to occur in native stands on the 200 Area Plateau.

Disturbed communities on the 200 Area Plateau are primarily the result of either mechanical disturbance or range fires. Mechanical disturbance, including construction activities, soil borrow areas, road clearings, and fire breaks, results in drastic changes to the plant community. This type of disturbance usually entails a complete loss of soil structure and total disruption of nutrient cycling. The principle colonizers of mechanically disturbed areas are the annual weeds Russian Thistle (*Salsola kali*), Jim Hill Mustard (*Sisymbrium altissimum*), and Bur-ragweed (*Ambrosia acanthicarpa*). If no further disturbance occurs, the areas will eventually become dominated by cheatgrass. All of these annual weeds are occasionally found in native stands, but only at relatively low frequencies.

Range fires also have dramatic effects on the overall ecosystem, the most obvious being the complete removal of Sagebrush from the community, and the rapid increase in cheatgrass coverage. Unlike the native grasses, the other important shrubs, and many of the perennial herbaceous species, Sagebrush is unable to resprout from rootstocks after being burned. Therefore, there is no dominant shrub component in burned areas until Sagebrush is able to become re-established from seed. Burning also opens the community to the invasion by cheatgrass which is capable of quickly utilizing the nutrients that are released through burning. The extensive cover of cheatgrass may then prevent the re-establishment of many of the native species, including Sagebrush. The species richness in formerly burned areas is usually much lower than in native stands, often consisting of only cheatgrass, Sandberg's Bluegrass, Russian thistle, and Jim Hill Mustard, with very few other species.

The vegetation in and around the ponds and ditches on the 200 Area Plateau is significantly different from that of the surrounding dryland areas. Several tree species are present, especially Cottonwood (*Populus trichocarpa*) and Willows (*Salix* spp.). A number of wetland species area also present including several sedges (*Carex* spp.), bulrushes (*Scirpus* spp.), Cattails (*Typha latifolia* and *T. angustifolia*), and pond-weeds (*Potamogeton* spp.).

3.6.1.2 Plant Species of Concern. The Washington State Department of Natural Resources, Natural Heritage Program classifies rare plants in the State of Washington in three different categories, depending on the overall distribution of the taxon and the state of its natural habitat. These categories are: *Endangered*, which is a "vascular plant taxon in danger of becoming extinct or extirpated in Washington within the near future if factors contributing to its decline continue. Populations of these taxa are at critically low levels or their habitats have been degraded or depleted to a significant degree"; *Threatened*, which is a "vascular plant taxon likely to become endangered within the near future in Washington if factors contributing to its population decline or habitat degradation or loss continue"; and *Sensitive*, which is a taxon that is "vulnerable or declining, and could become endangered or threatened in the state without active management or removal of threats" (definitions taken from Washington Department of Natural Resources 1990). Of concern to the Hanford Site, there are two Endangered taxa, two Threatened taxa, and at least eleven Sensitive taxa; these are listed in Table 3-3. All four of the Threatened and Endangered taxa are presently candidates for the Federal Endangered Species List.

Of the two Endangered taxa, Persistantsepal Yellowcress is well documented along the banks of the Columbia River throughout the 100 Areas, it is unlikely to occur in the 200 Areas. The Northern Wormwood is known in the State of Washington by only two populations, one across from The Dalles, Oregon, and the other near Beverly, Washington, just north of the Hanford Site. This taxon has not been found on the Hanford Site, but would probably occur only on rocky areas immediately adjacent to the Columbia River if it were present. Neither of the Threatened taxa listed in Table 3-2 have been observed on the Hanford Site. The Columbia Milkvetch is known to be relatively common on the Yakima Firing Range, and has been documented to occur within 1.6 to 3.2 km (1 to 2 mi) to the west of the Hanford site on both sides of Umptanum Ridge. This species could occur on the 200 Area Plateau. Hoover's Desert Parsley inhabits the steep talus slopes near Priest Rapids Dam. Potentially, it could be found on similar slopes on Gable Mountain and Gable Butte, but has yet to be documented in these areas.

Of the Sensitive species, five are inhabitants of aquatic or moist habitats and the other six are inhabitants of dry upland habitats. Dense Sedge, Shining Flatsedge, Southern Mudwort, and False Pimpernel are all known to occur in the 100 Areas, especially near the B-C Area, in or near the Columbia River. Some of these species could be present in or near ponds and ditches in the 200 Areas. The few-flowered collinsia may also occur in these habitats. The Gray Cryptantha occurs on open dunes throughout the Hanford Site. Piper's Daisy is fairly common on Umptanum Ridge and Rattlesnake Ridge, but has also been documented in the vicinity of B Pond, the A-24 Crib, and 100-H Area. Bristly Cryptantha, Dwarf Evening-primrose have been found at the south end of the White Bluffs, approximately 3.2 km (2 mi) upstream from the 300 Area. The Palouse Milk-vetch and

Coyote tobacco are not as well documented but are known to inhabit dry sandy areas such as the 200 Area Plateau.

In addition to the three classifications for species of concern listed above, the Natural Heritage Program also maintains a "Monitor" list, which is divided into three groups. Group 1 consists of taxa in need of further field work before a formal status can be assigned. The Tooth-sepal Dodder (*Cuscuta denticulata*), which has been found in the State of Washington only on the Hanford Site is the only taxon in this group that is of concern to Hanford Site operations. This parasitic species has been found in the area west of McGee Ranch. Group 2 of the Monitor list includes species with unresolved taxonomic questions. Thompson's sandwort (*Arenaria franklinii* var. *thompsonii*) is of concern to Hanford operations. However, the representatives of this species in the State of Washington are now believed to all be variety *franklinii* which is not considered particularly rare. Group 3 of the Monitor list includes taxa that are either more abundant or less threatened than previously believed. There are approximately 15 taxa on the Hanford Site that are included on this list

3.6.1.3 Fauna of the 200 Area Plateau. The mammals, birds, reptiles, amphibians inhabiting the 200 Area Plateau are discussed below.

3.6.1.3.1 Mammals. The largest mammal occurring on the 200 Area Plateau is the mule deer (*Odocoileus hemionus*). Although mule deer are much more common to riparian sites along the Columbia River they are frequently observed foraging throughout the 200 Areas. Elk (*Cervus elaphus*) also occur at Hanford but they have only been observed at the Arid Lands Ecology Reserve. Other mammal species common to the 200 Areas include badgers (*Taxidea taxus*), coyotes (*Canis latrans*), blacktail jackrabbits (*Lepus californicus*), Townsend ground squirrels (*Spermophilus townsendii*), Great Basin pocket mice (*Perognathus parvus*), pocket gophers (*Thomomys talpoides*), and deer mice (*Peromyscus maniculatus*). Badgers are known for their digging capability and have been implicated several times for encroaching into inactive burial grounds throughout the 200 Areas. The majority of the badger excavations in the 200 Areas are a result of badgers searching for prey (mice and ground squirrels). Coyotes are the principal predators, consuming such prey as rodents, insects, rabbits, birds, snakes and lizards. The Great Basin pocket mouse is the most abundant small mammal, which thrives in sandy soils and lives entirely on seeds from native and revegetated plant species. Townsend ground squirrels are not abundant in the 200 Areas but they have been seen at several different sites. Other small mammals that occur in low numbers include the Western harvest mouse (*Reithrodontomys megalotis*) and the Grasshopper mouse (*Onychomys leucogaster*). Mammals associated more closely with buildings and facilities include Nuttall's cottontails (*Sylvilagus nuttallii*), house mice (*Mus musculus*), Norway rats (*Rattus norvegicus*), and some bat species. Bats probably play a minor role in the 200 Area's ecosystem but no documentation is available on bat populations at Hanford. Mammals such as skunks (*Mephitis mephitis*), raccoons (*Procyon lotor*), weasels (*Mustela* spp.), porcupines (*Erethizon dorsatum*), and bobcats (*Lynx rufus*) have only been observed on very few occasions.

3.6.1.3.2 Birds. Over 235 species of birds have been documented to occur at the Hanford Site (Landeen et al. 1991). At least 100 of these species have been observed in the

200 Areas. The most common passerine birds include starlings (*Sturnus vulgaris*), horned larks (*Ermophila alpestris*), meadowlarks (*Sturnella neglecta*), Western kingbirds (*Tyranus virticalis*), rock doves (*Columba livia*), barn swallows (*Hirundo rustica*), cliff swallows (*Hirundo pyrrhonota*), black-billed magpies (*Pica*) and ravens (*Corvus corax*). Common raptors include the Northern harrier (*Circus cyaneus*), American kestrel (*Falco sparvarius*), and Red tailed hawk (*Buteo jamaicensis*). Swainson's hawks (*Buteo swainsoni*) sometimes nest in the trees located at some of the army bunker sites that were used in the 1940's. Golden eagles (*Aquila chrysaetos*) are observed infrequently. Burrowing owls (*Athene cunicularia*) nest at several locations throughout the 200 Areas. The most common upland game birds found in the 200 Areas are California Quail (*Callipepla californica*) and Chukar partridge (*Alectoris chukar*), however, Ring-necked pheasants (*Phasianus colchicus*) and Gray partridge (*Pertx perdix*) may be found in limited numbers. The only native game bird common to the 200 Area Plateau is the Mourning dove (*Zenaida macrora*) which migrates south each fall. Other species of note which nest in undisturbed sagebrush habitats in the 200 Areas include Sage sparrows (*Amphispiza belli*), and Loggerhead shrikes (*Lanius ludovicianus*). Long-billed Curlews (*Numenius americanus*) also use the sagebrush areas and revegetated burial grounds for nesting and foraging.

Waterfowl and aquatic birds inhabit B Pond and other areas where there is running or standing water. However many of these areas such as A-29 Ditch are becoming more scarce due to stabilization and remedial action cleanup activities. Aquatic birds and waterfowl common to B-Pond on a seasonal basis include Canada Geese (*Branta canadensis*), American coot (*Fulica americana*), Mallard (*Anas platyrhynchos*), Ruddy duck (*Oxyura jamaicensis*), Redhead (*Aythya americana*), Bufflehead (*Bucephala albeola*) and Great blue heron (*Ardea herodius*).

3.6.1.3.3 Reptiles and Amphibians. Common reptiles include gopher snakes (*Pituophis melanoleucus*) and sideblotched lizards (*Uta stansburiana*). Other reptiles and amphibians which are infrequently observed include sagebrush lizards (*Sceloporus graciosus*), horned toads (*Phryosoma douglassi*), western spadefoot toads (*Scaphiopus intermontana*) , yellow-bellied racer (*Coluber constrictor*), Pacific rattlesnake (*Crotalus viridis*), and striped whipsnake (*Masticophis taeniatus*). Both lizards and snakes are prey items of mammalian and avian predators.

3.6.1.3.4 Insects. There are hundreds of insect species which inhabit the 200 Areas. Two of the most common groups of insects include several species of darkling beetles and grasshoppers. Harvester ants are also common and have been implicated in the uptake of radionuclides from some of the burial grounds in 200 East Area. Harvester ants have the ability to excavate and bring up material from as far down as 4.6 to 6.1 m (15 to 20 ft). Other major groups of insects include bees, butterflies and scarab beetles. Insects impact the surrounding plant community as well as serving as the prey base for many species of birds, reptiles and mammals.

3.6.1.4 Wildlife Species of Concern. Some animals which inhabit the Hanford Site have been given special status designations by the state and federal government. Some of these designations include state and federal threatened and endangered species, federal

candidate, state monitor, state sensitive, and state candidate species. Species listed in Table 1 as state and\or federal threatened and endangered such as the bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), American white pelican (*Pelecanus erythroryhnchos*), ferruginous hawk (*Buteo regalis*), and sandhill crane (*Grus canadensis*) do not inhabit the 200 Areas. The bald eagle and American white pelican utilize the Columbia River and associated habitats for roosting and feeding. Peregrine falcons and sandhill cranes fly over the Hanford Site during migration. Ferruginous hawks nest on the Hanford Site but nesting has not been documented for this species on the 200 Area Plateau. Other species listed in Table 3-4 as state and\or federal candidates and state monitor species such as burrowing owls, Great Blue Herons, Prairie falcons (*Falco mexicanus*), Sage sparrows, and Loggerhead shrikes are not uncommon to the 200 Area Plateau.

3.6.2 Land Use

The T Plant Aggregate Area is the location of the T Plant and its attendant facilities (e.g., 234-5T Building, 231-T Building, 242-T Building and other structures) and the 218-W Solid Waste Burial Grounds.

Past activities at the T Plant included plutonium separation from waste streams generated in other 200 Areas facilities and plutonium and americium recovery from in-plant waste streams. Historically, liquid waste generated in T Plant was disposed of to various land disposal units. Low-level and mixed waste from T Plant, other Hanford facilities, and off-site facilities was deposited in the 218-W Burial Grounds. Various storage facilities, offices, and laboratories are also located in T Plant. Waste management units that remain active are noted in Table 2-1.

3.6.3 Water Use

There are no consumptive use of groundwater within the 200 West Area. Water for drinking and emergency use, and facilities process water is drawn from the Columbia River, treated, and imported to the 200 West Area. The nearest wells used to supply drinking water are located at the Yakima barricade, about 5 km (3.1 mi) west of the 200 West Area; at the Hanford Safety Patrol Training Academy (Well 699-528-EO) about 40 km (25 mi) to the southeast; at the PNL observatory (Well 6652-C); and near the Fast Flux Test Facility (Well 699-49-100-C) in the 400 Area (Well 699-51-8J), about 32 km (20 mi) to the southeast. The nearest water supply wells are located offsite about 15 km (9.4 mi) to the northwest. These wells obtain their water from the basalt and the basalt interbeds (The Berkshire well and Chateau Ste. Michelle No. 1 and No. 2). The latter wells are reportedly used for irrigation although they may also be used to supply drinking water.

3.7 HUMAN RESOURCES

The environmental conditions at the T Plant Aggregate Area must be evaluated in relationship to the surrounding population centers and other human resources. A very brief summary of demography, archeology, historic resources, and community involvement is given below.

3.7.1 Demography

There are no residences on the Hanford Site. The nearest inhabited residences are farm homes on land located 21 km (13 mi) north of the T Plant Aggregate Area. There are approximately 258,000 people living within a 80 km (50 mi) radius of the 200 Area plateau. The primary population centers are the cities of Richland, Kennewick, and Pasco, located southeast of the Hanford Site, Prosser to the south, Sunnyside to the southwest, and Benton City to the southeast.

3.7.2 Archeology

An archaeologic survey has been conducted of undeveloped portions of the 200 West Area by the Hanford Cultural Resources Laboratory. Isolated artifacts and sites of interest were identified in the 200 West Area but not within the T Plant Aggregate Area. The closest site of interest is the remains of the White Bluffs Road, located approximately 1.6 km (1 mi) northwest of the T Plant Aggregate Area, which was previously an Indian trail.

3.7.3 Historic Resources

The only historic site in 200 West Area is the old Whites Bluffs freight road that crosses diagonally through the vicinity. This site is not considered to be eligible for the National Register.

3.7.4 Community Involvement

A community relations plan (CRP)(Ecology et al. 1989) has been developed for the Hanford Site Environmental Restoration Program which includes any potentially affected community with respect to the T Plant AAMSR. The CRP includes a discussion on analysis of key community concerns and perceptions regarding the project, along with a list of all interested parties.

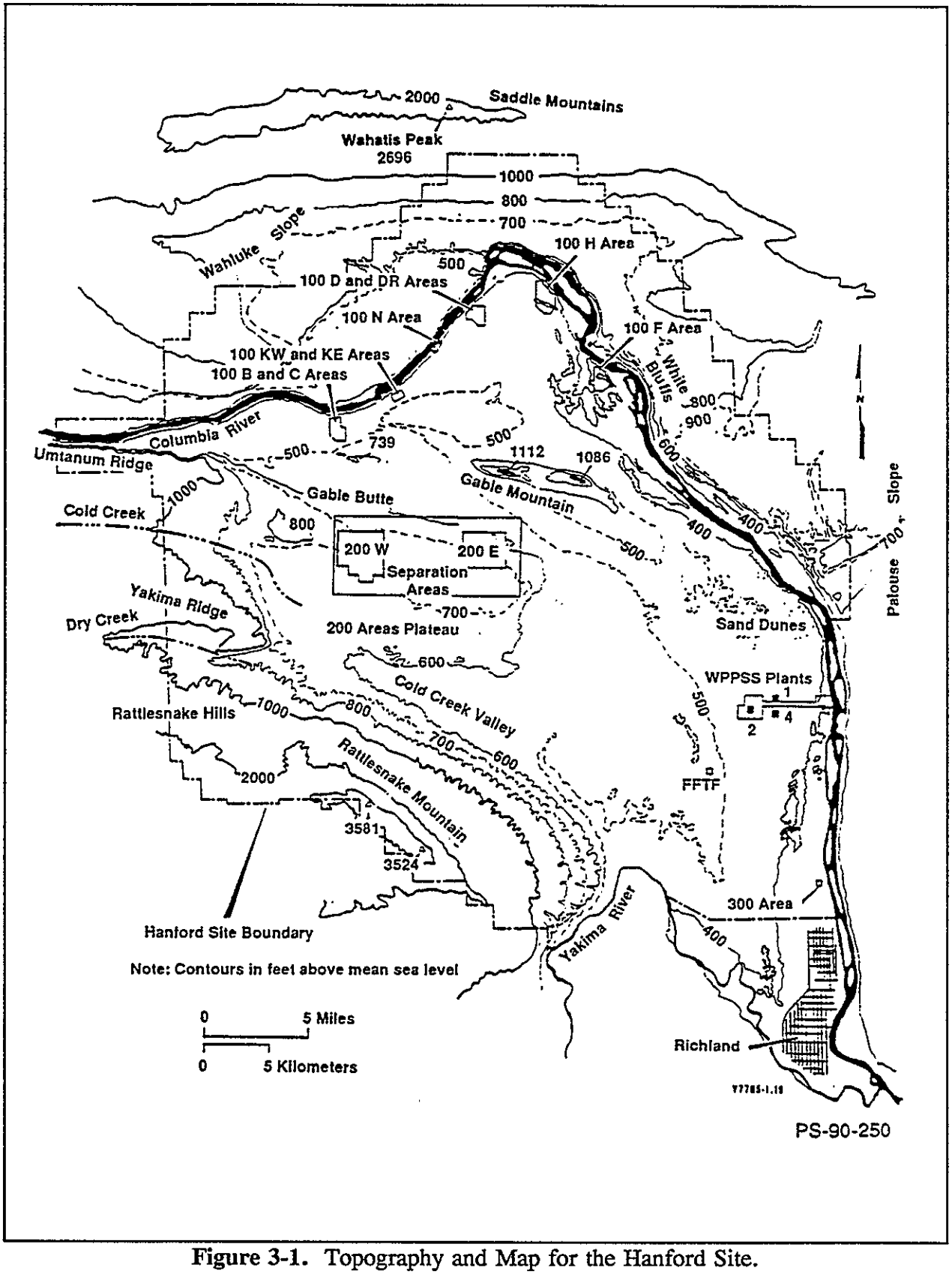


Figure 3-1. Topography and Map for the Hanford Site.

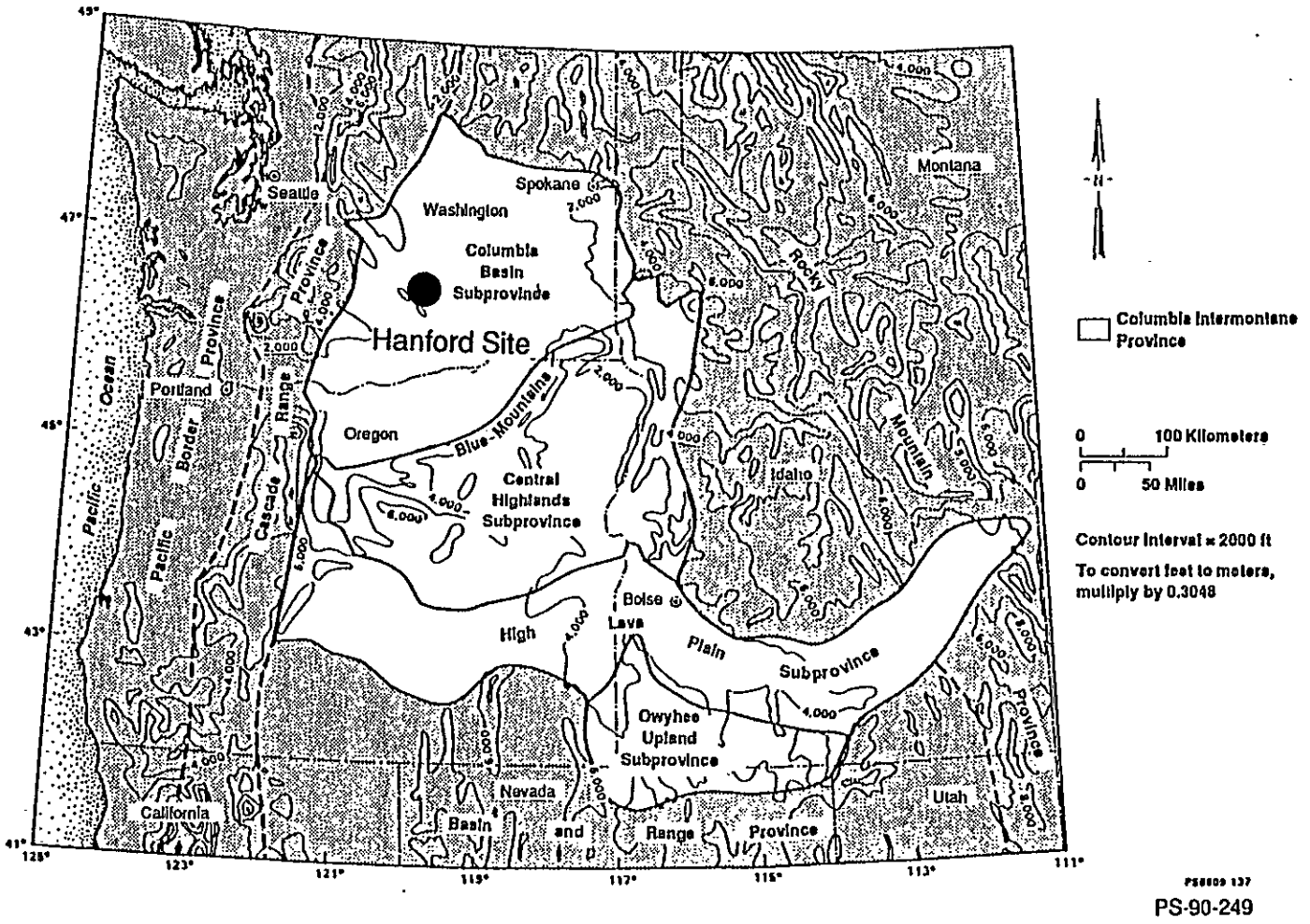


Figure 3-2. Divisions of the Columbia Intermontane Province and Adjacent Snake River Plains Province.

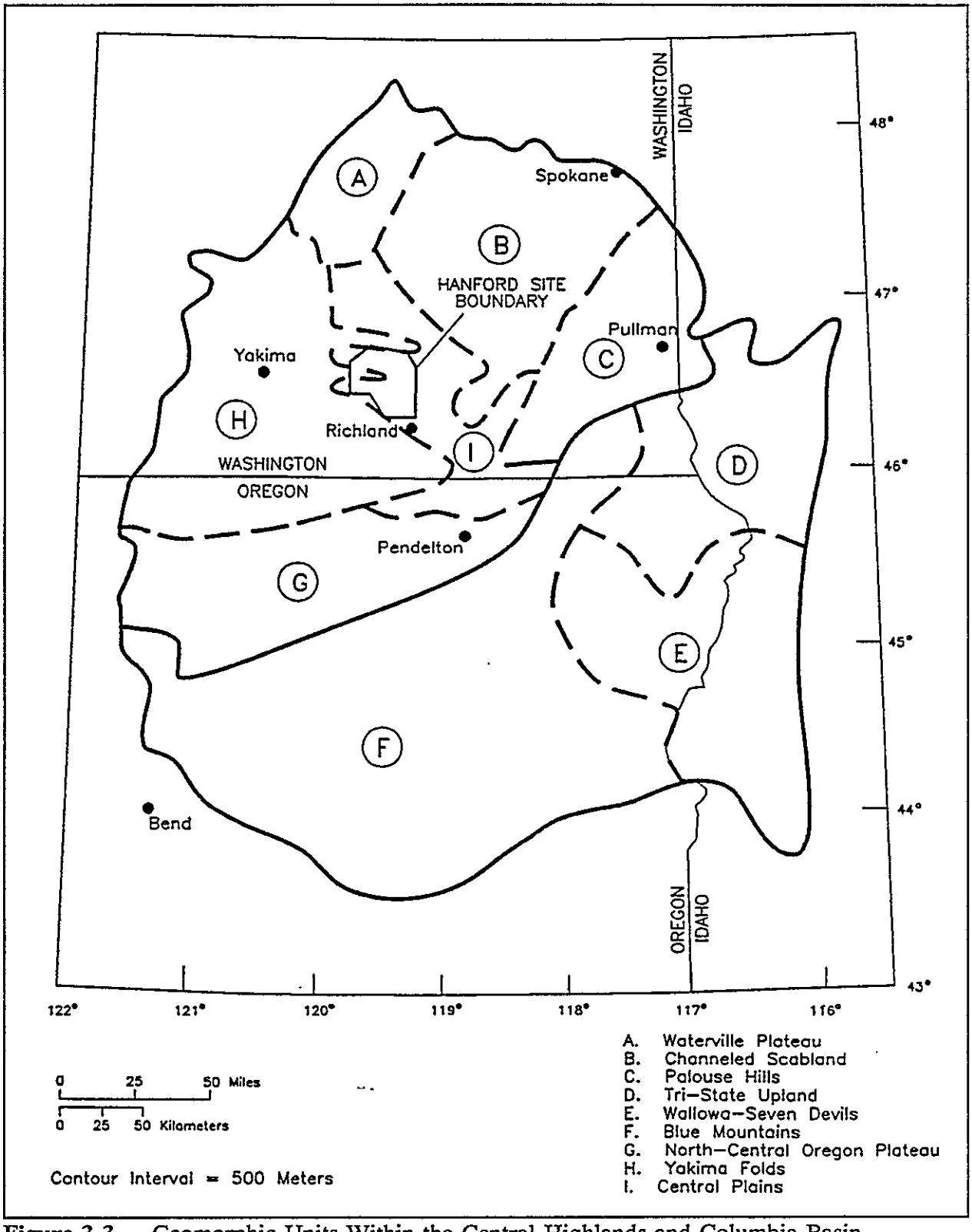


Figure 3-3. Geomorphic Units Within the Central Highlands and Columbia Basin Subprovinces that Contain the Columbia River Basalt Group (after Thornbury 1965) (Last et al. 1989).

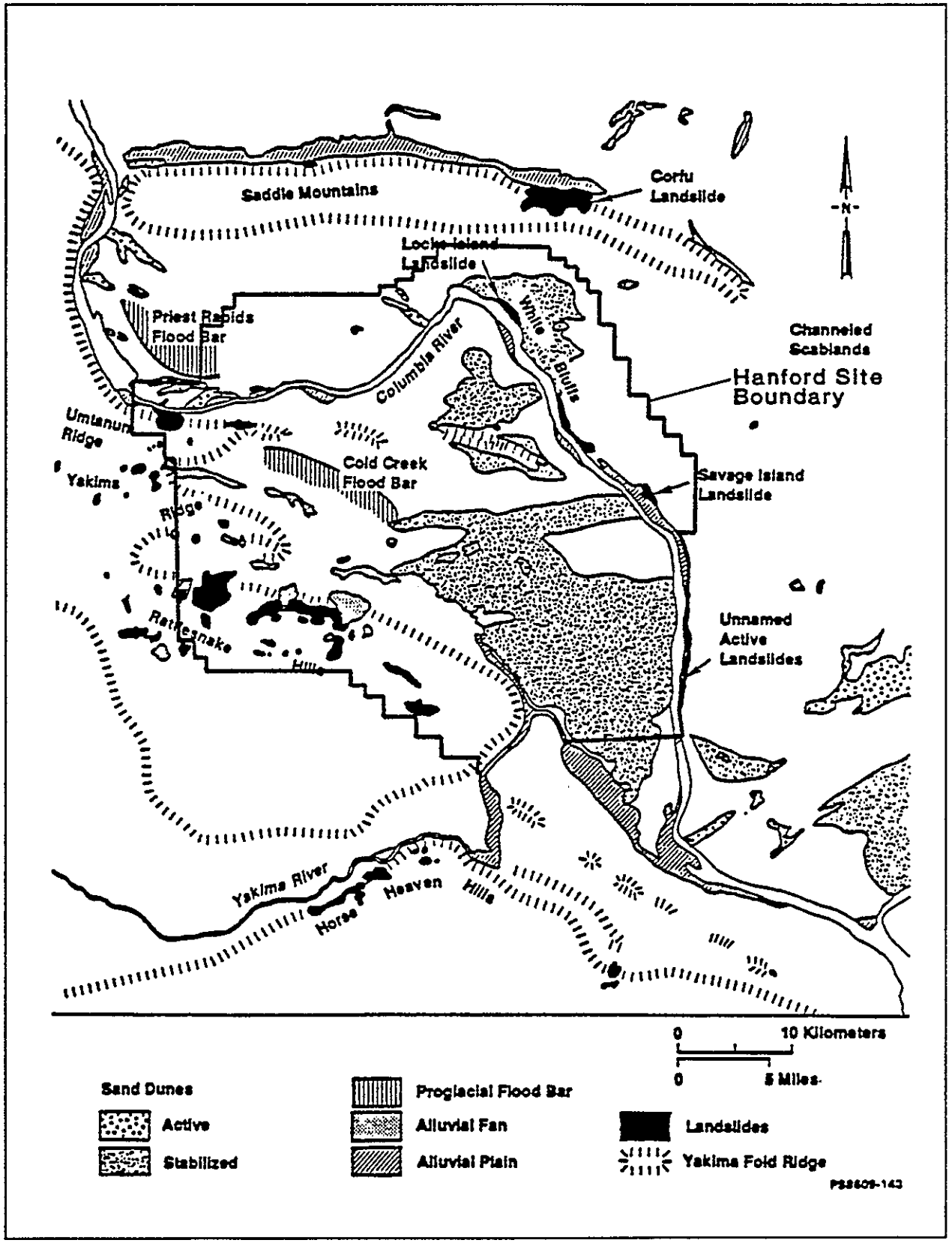


Figure 3-4. Landforms of the Pasco Basin and the Hanford Site.

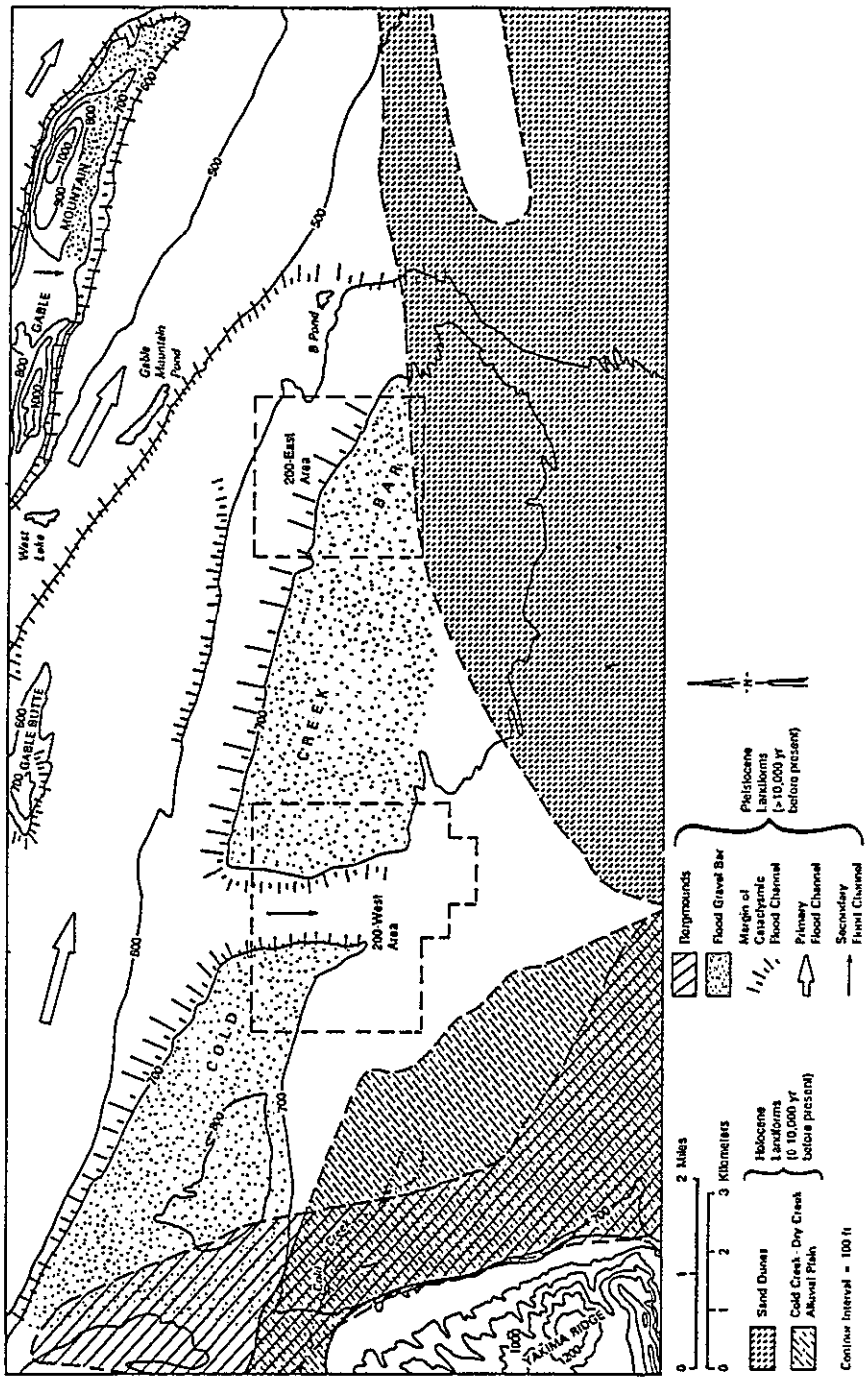


Figure 3-5. Geomorphic Features Surrounding the 200 Areas (Last et al. 1989).

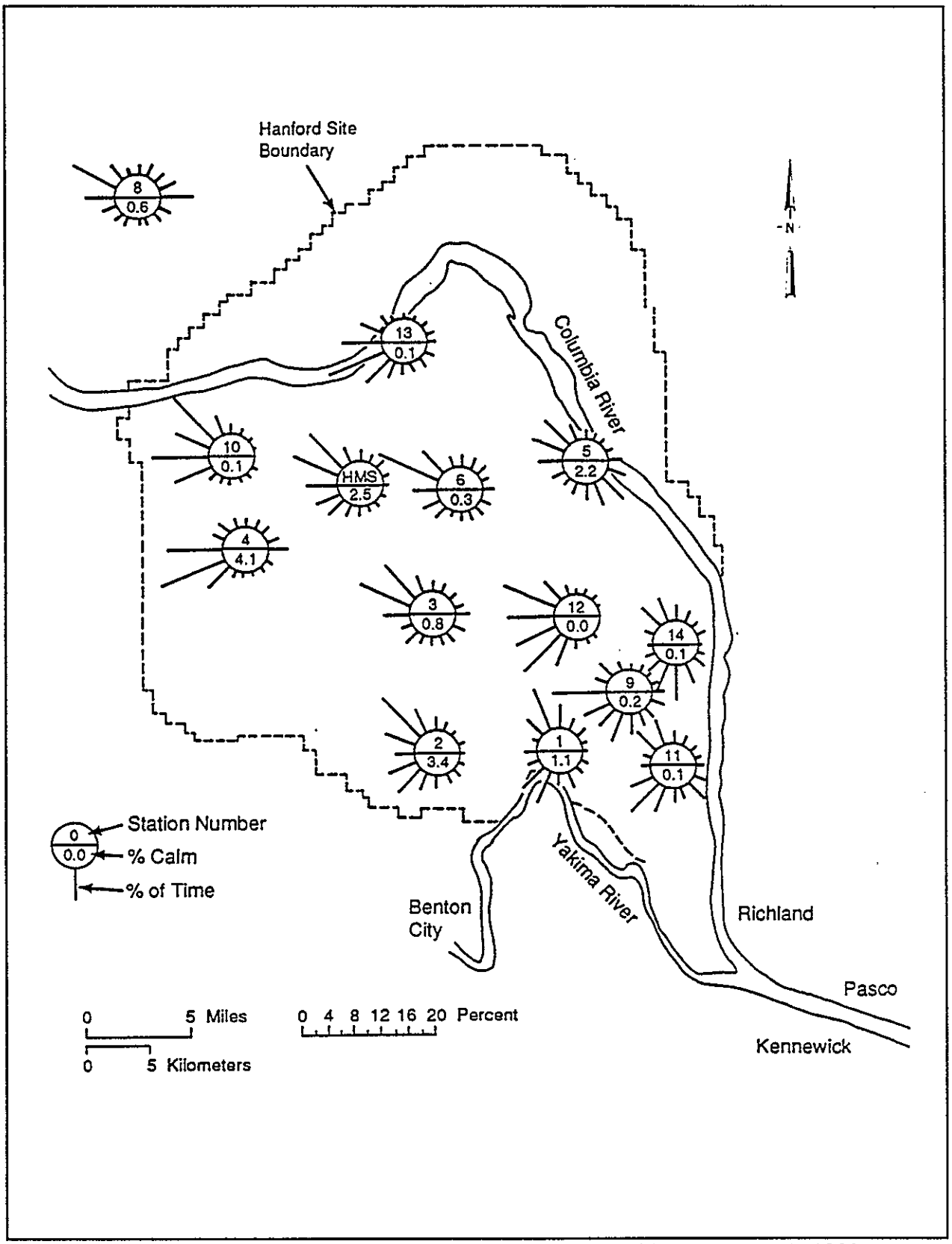


Figure 3-6. Hanford Site Wind Roses, 1979 through 1982 (Stone et al. 1983).

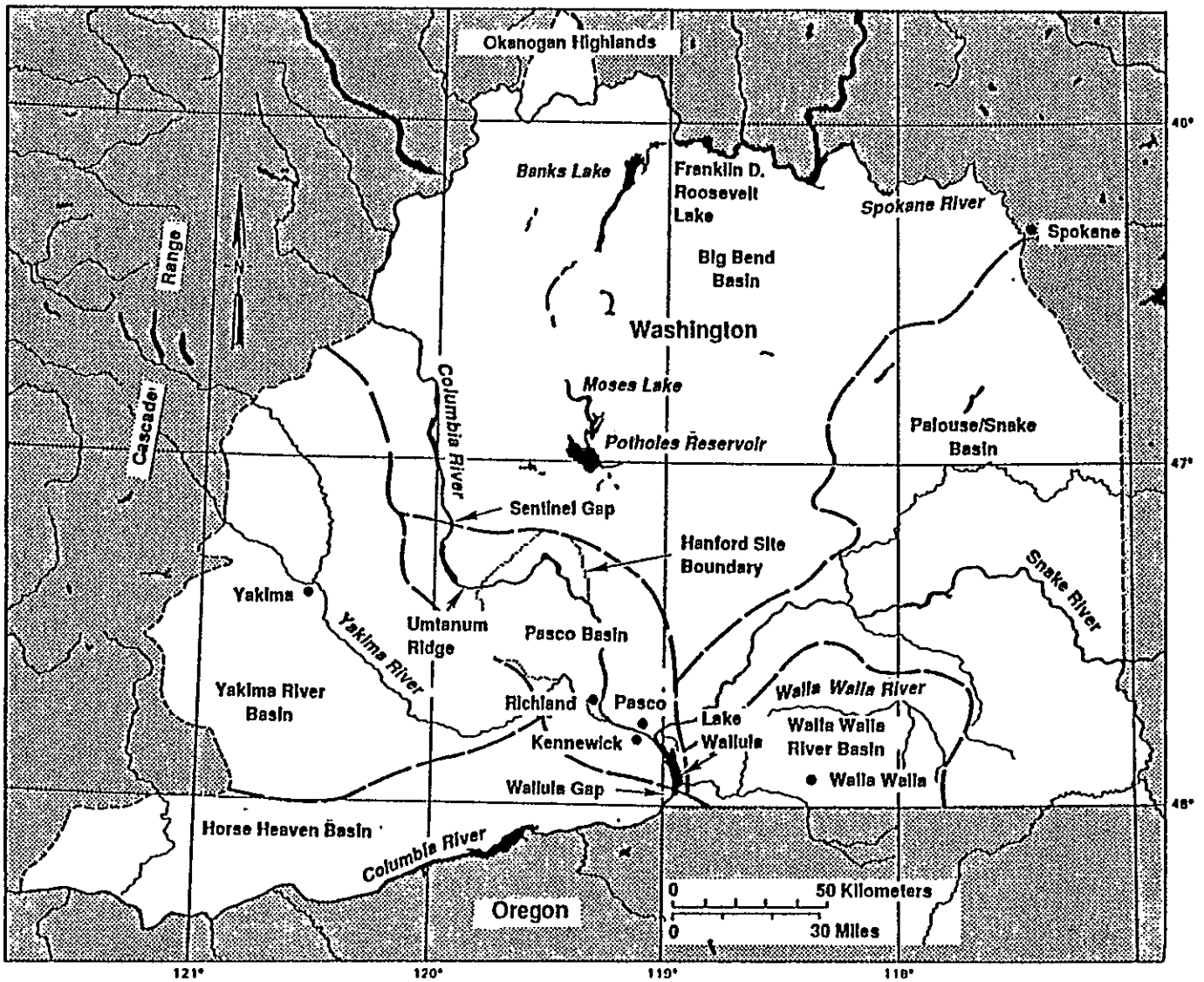


Figure 3-7. Hydrologic Basins Designated for the Washington State Portion of the Columbia Plateau (DOE 1988).

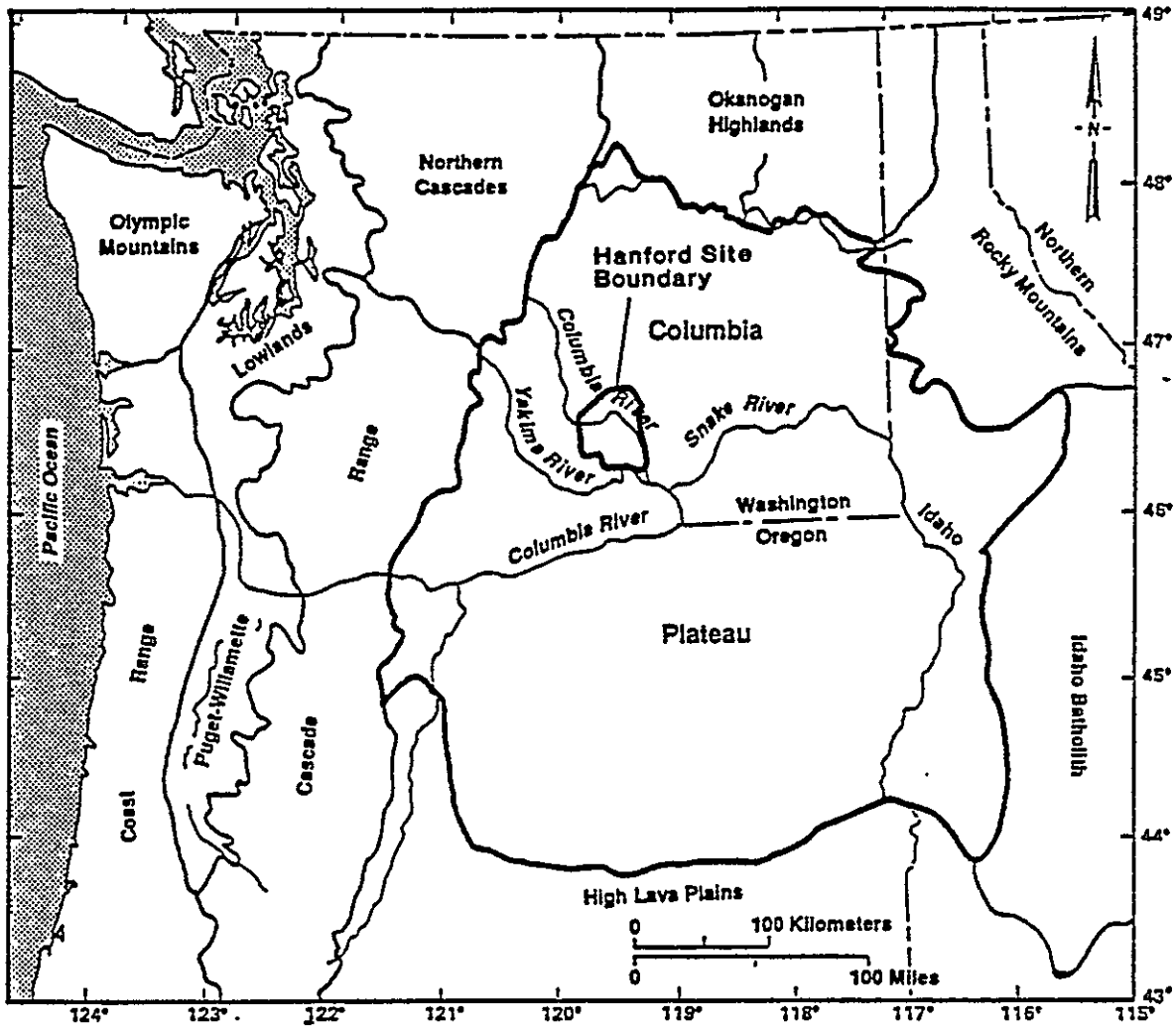


Figure 3-8. Structural Provinces of the Columbia Plateau.

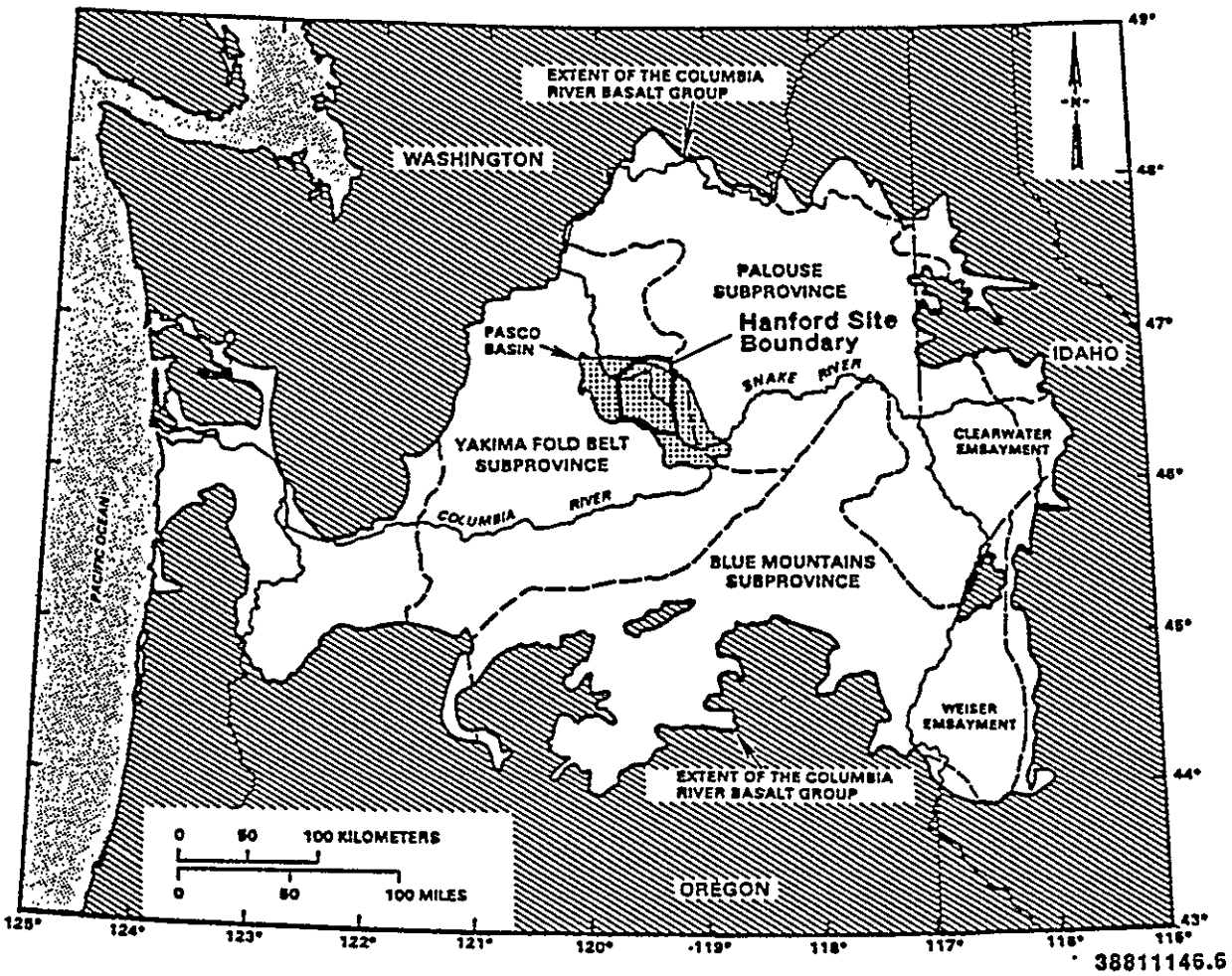


Figure 3-9. Structural Subprovinces of the Columbia Plateau (Last et al. 1989).

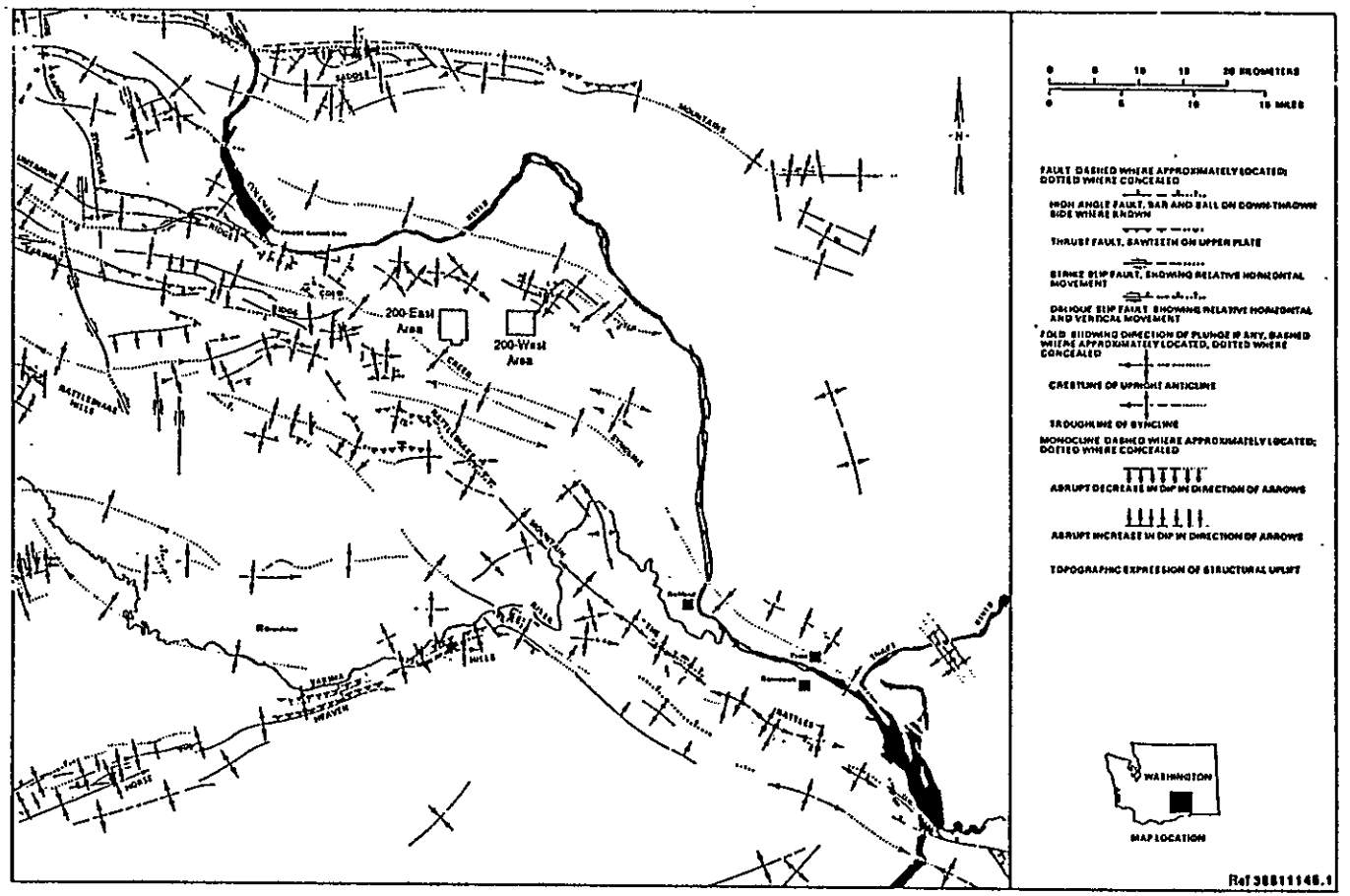


Figure 3-10. Structural Elements of the Yakima Fold Belt Subprovince (Last et al. 1989).

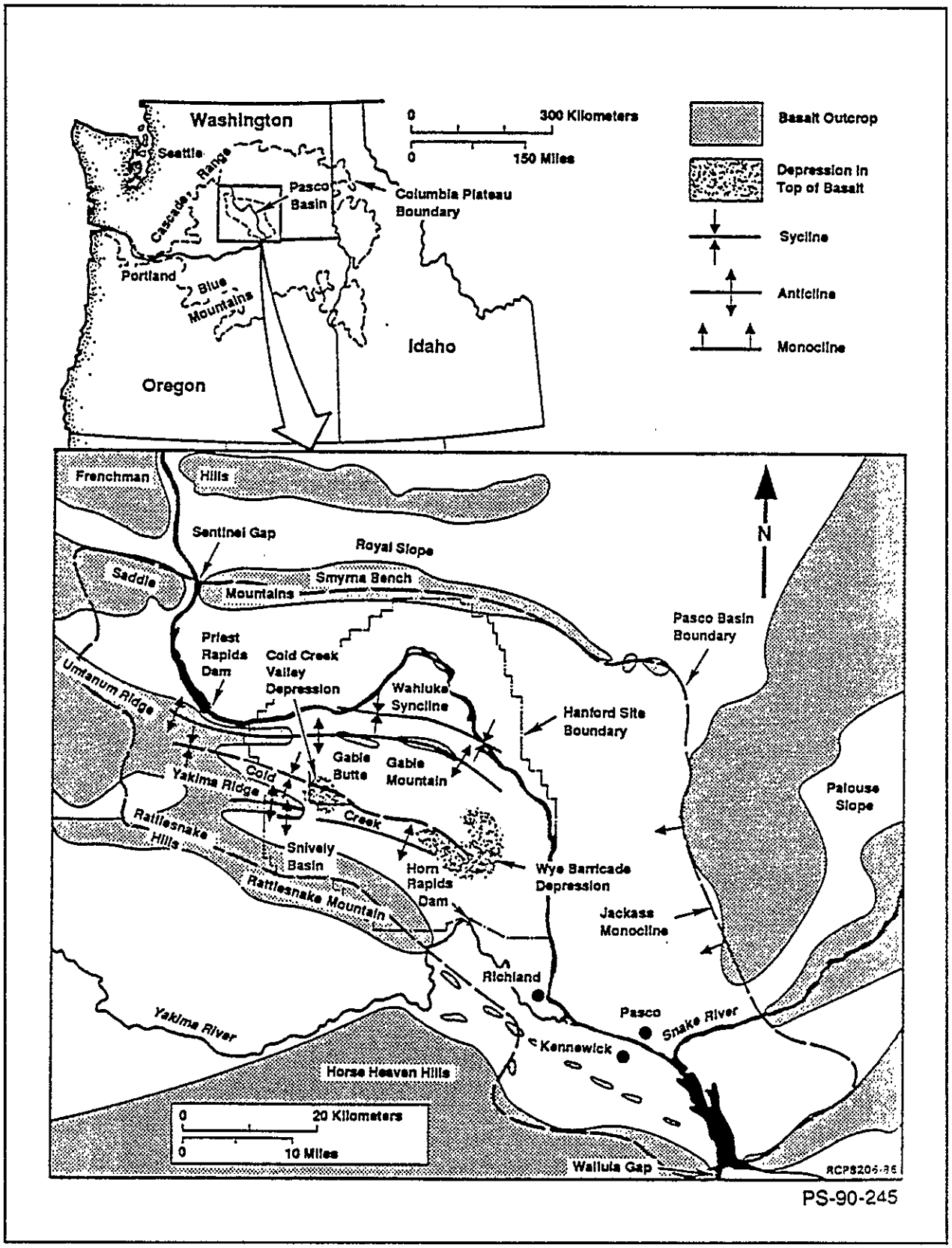
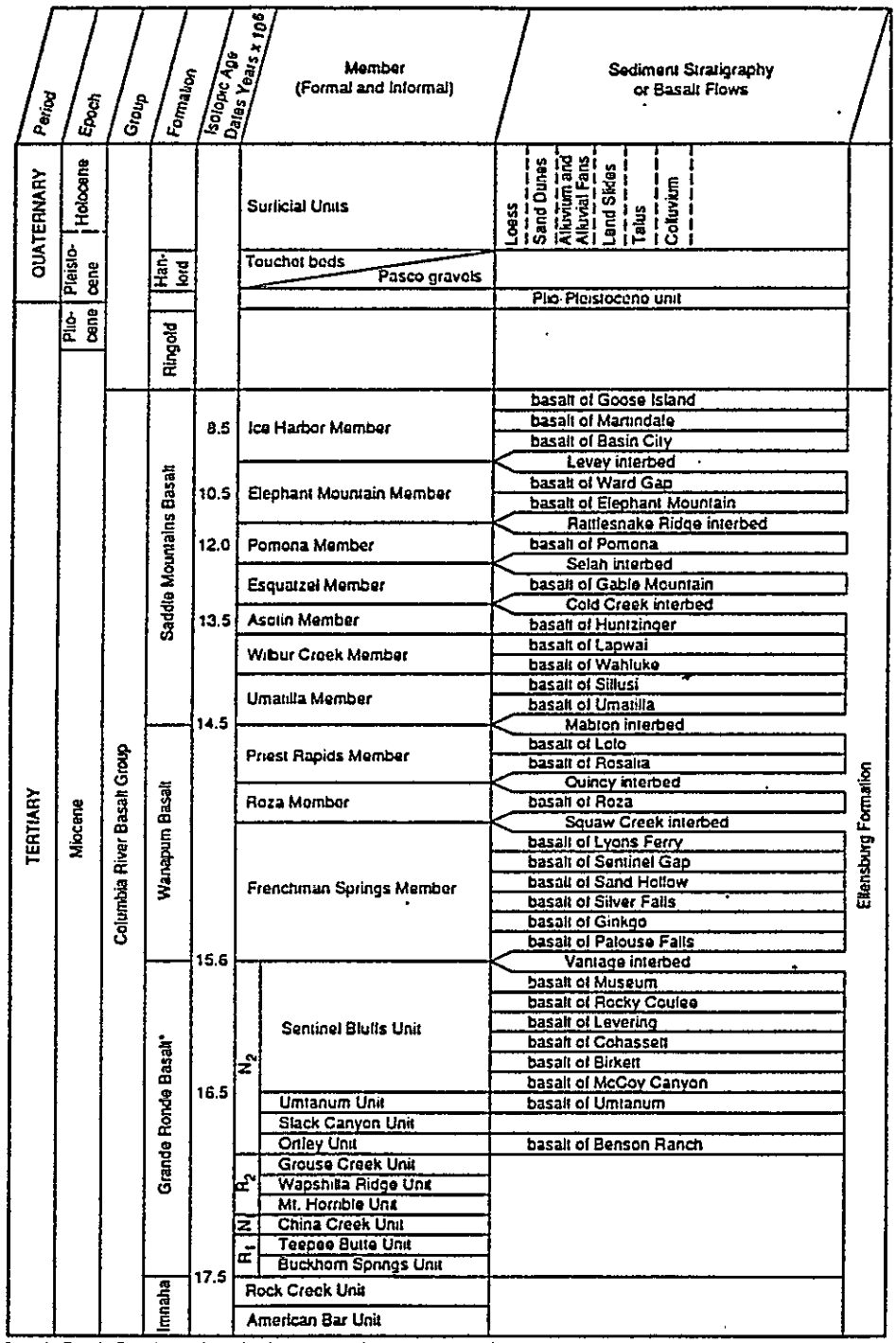


Figure 3-11. Geologic Structures of the Pasco Basin and the Hanford Site.



*The Grande Ronde Basalt consists of at least 120 major basalt flows. Only a few flows have been named.
N_2, R_2, N_1 and R_1 are magnetostratigraphic units.

H9102029 6

Figure 3-12. Generalized Stratigraphy of the Hanford Site.

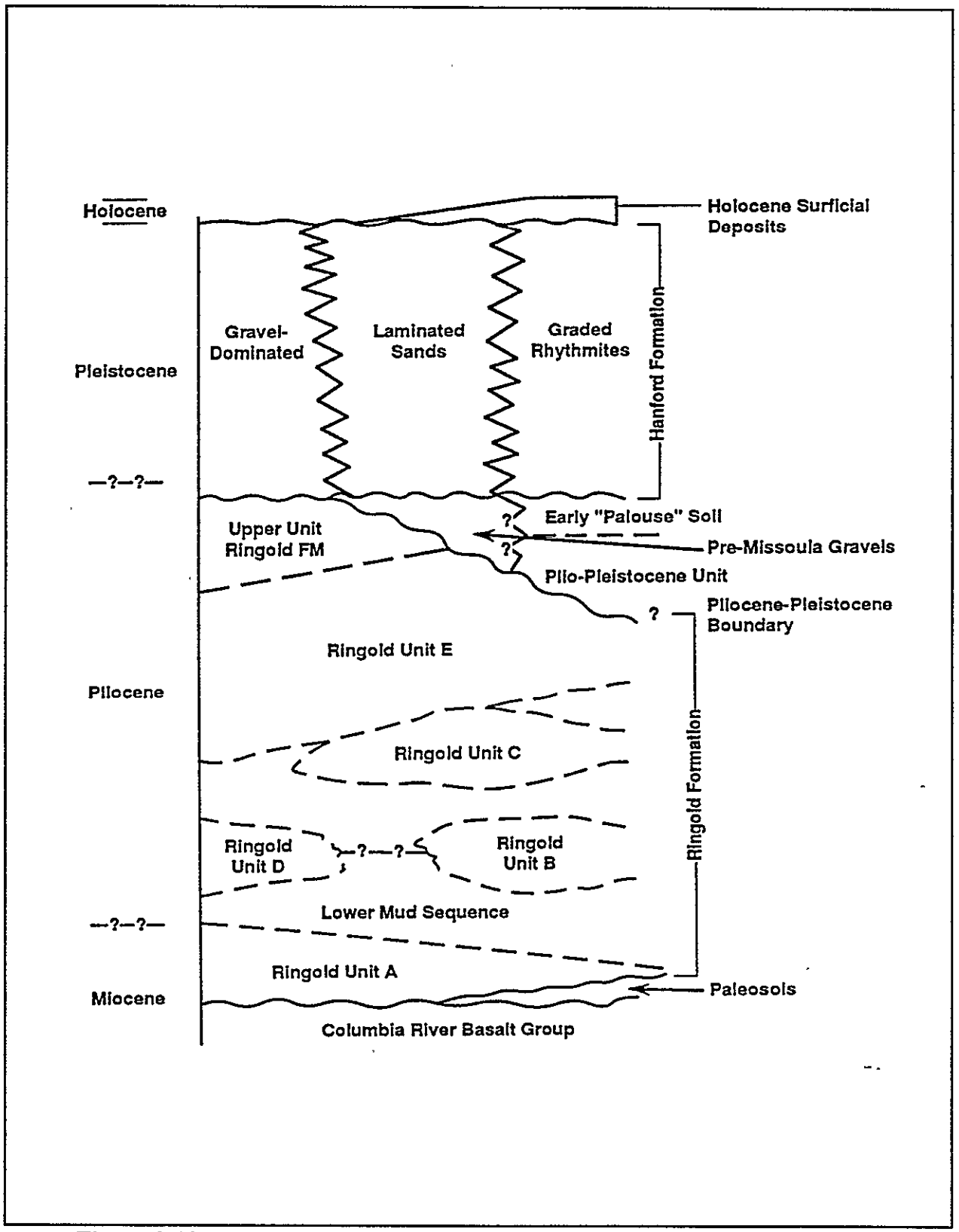


Figure 3-13. Generalized Stratigraphy of the Suprabasalt Sediments Beneath the Hanford Site.

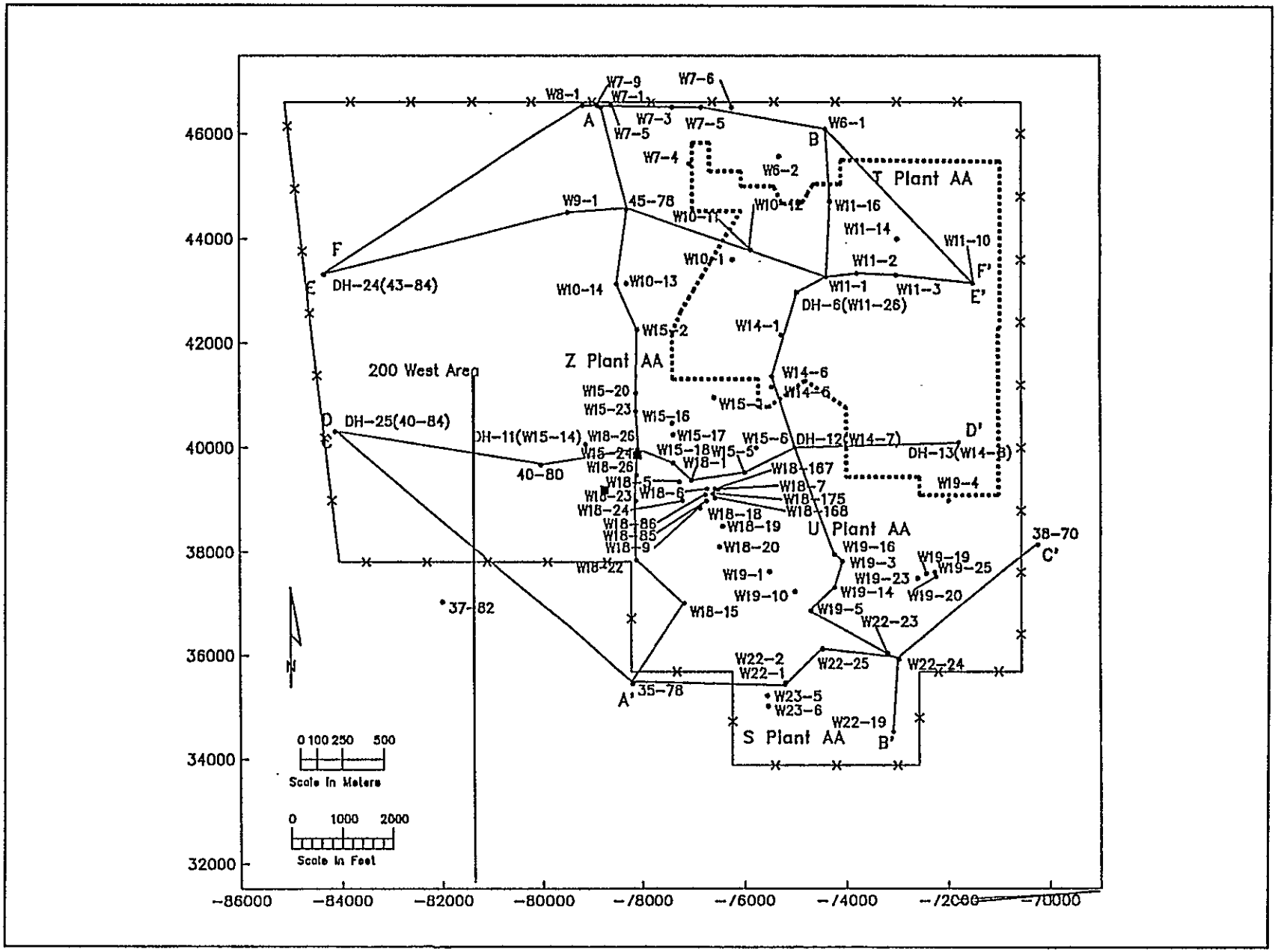


Figure 3-14. Location of T Plant Aggregate Geologic Cross Sections.

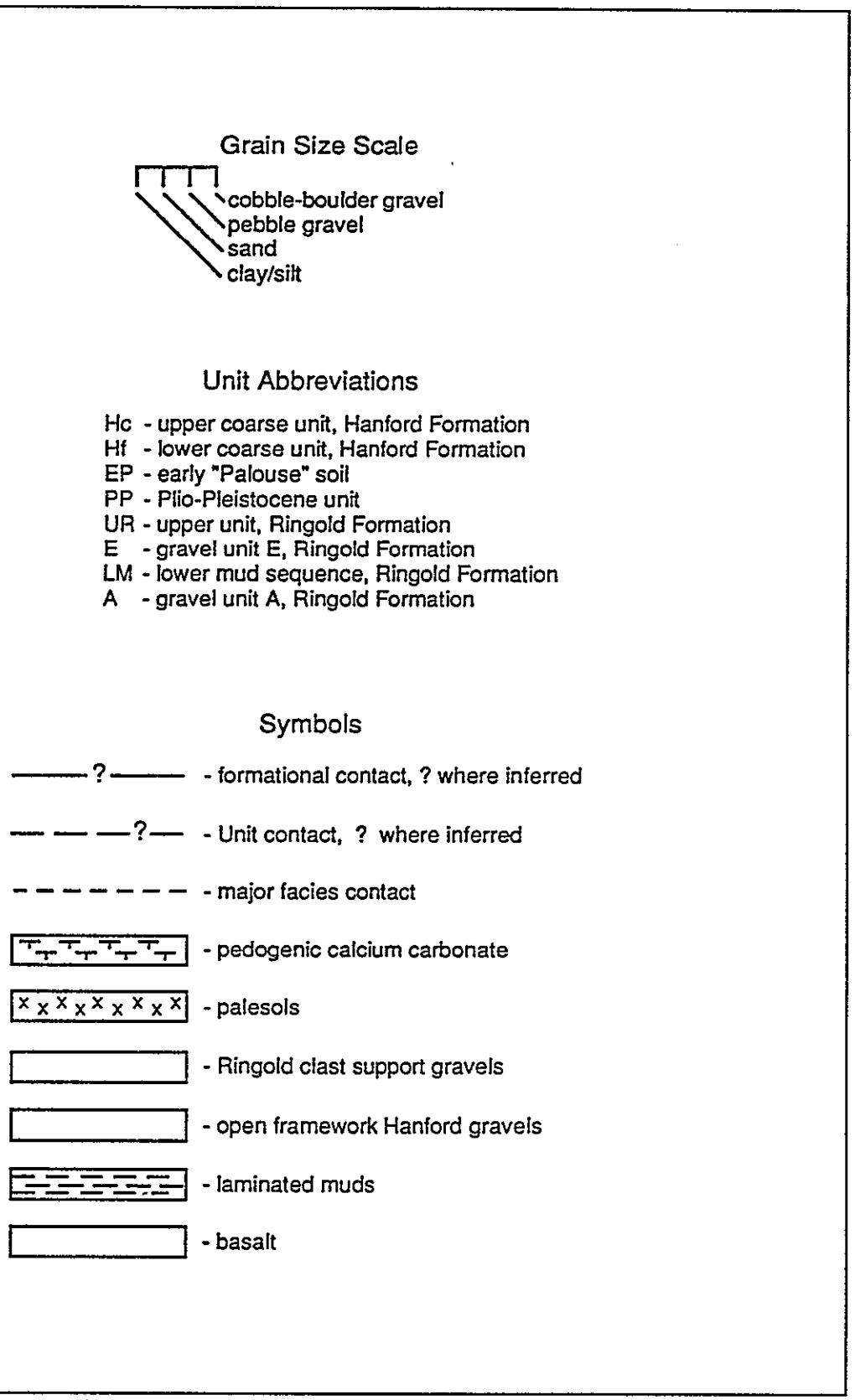


Figure 3-15. Legend for Cross Sections.

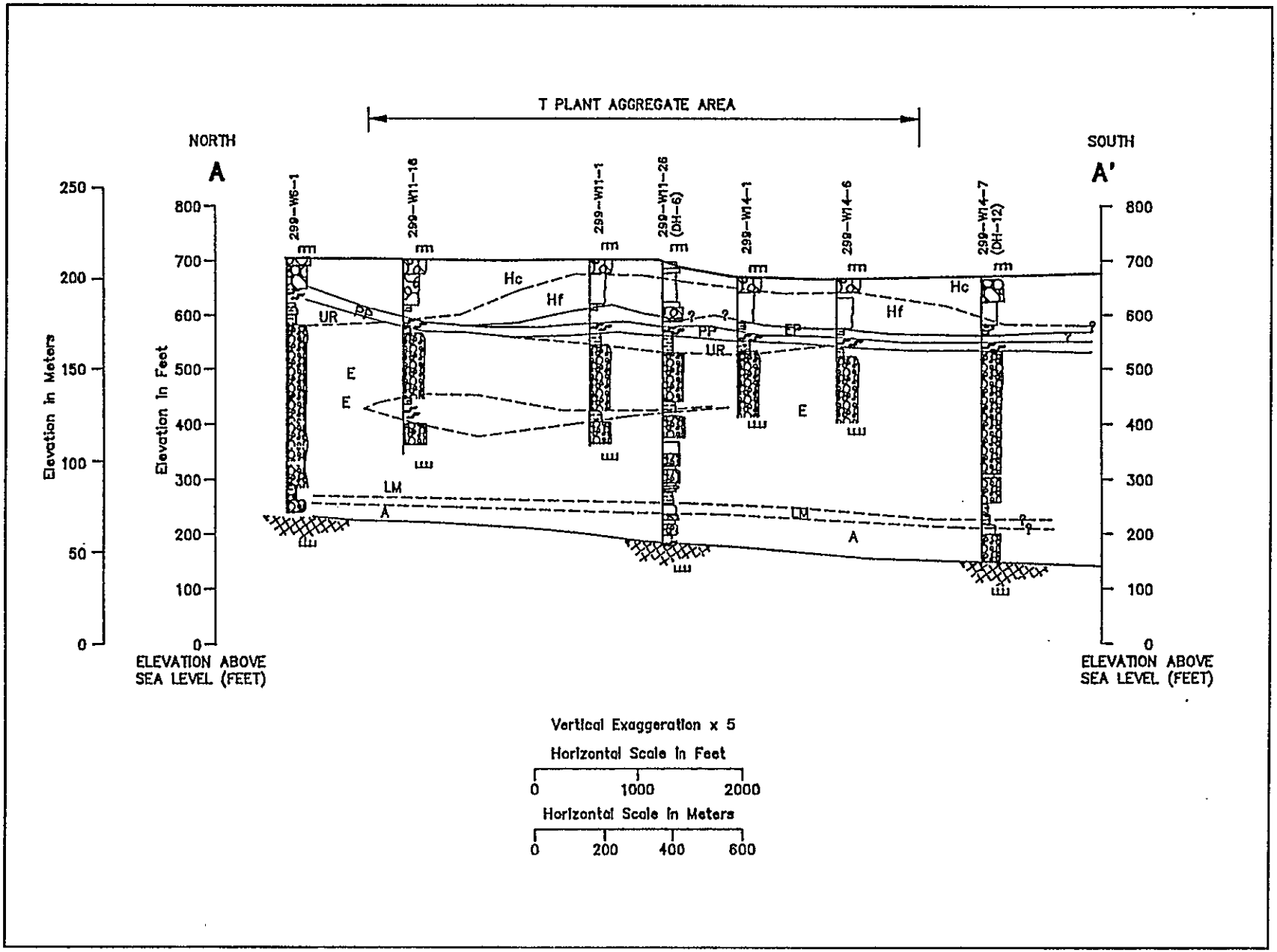


Figure 3-16. Geologic Cross Section A-A'.

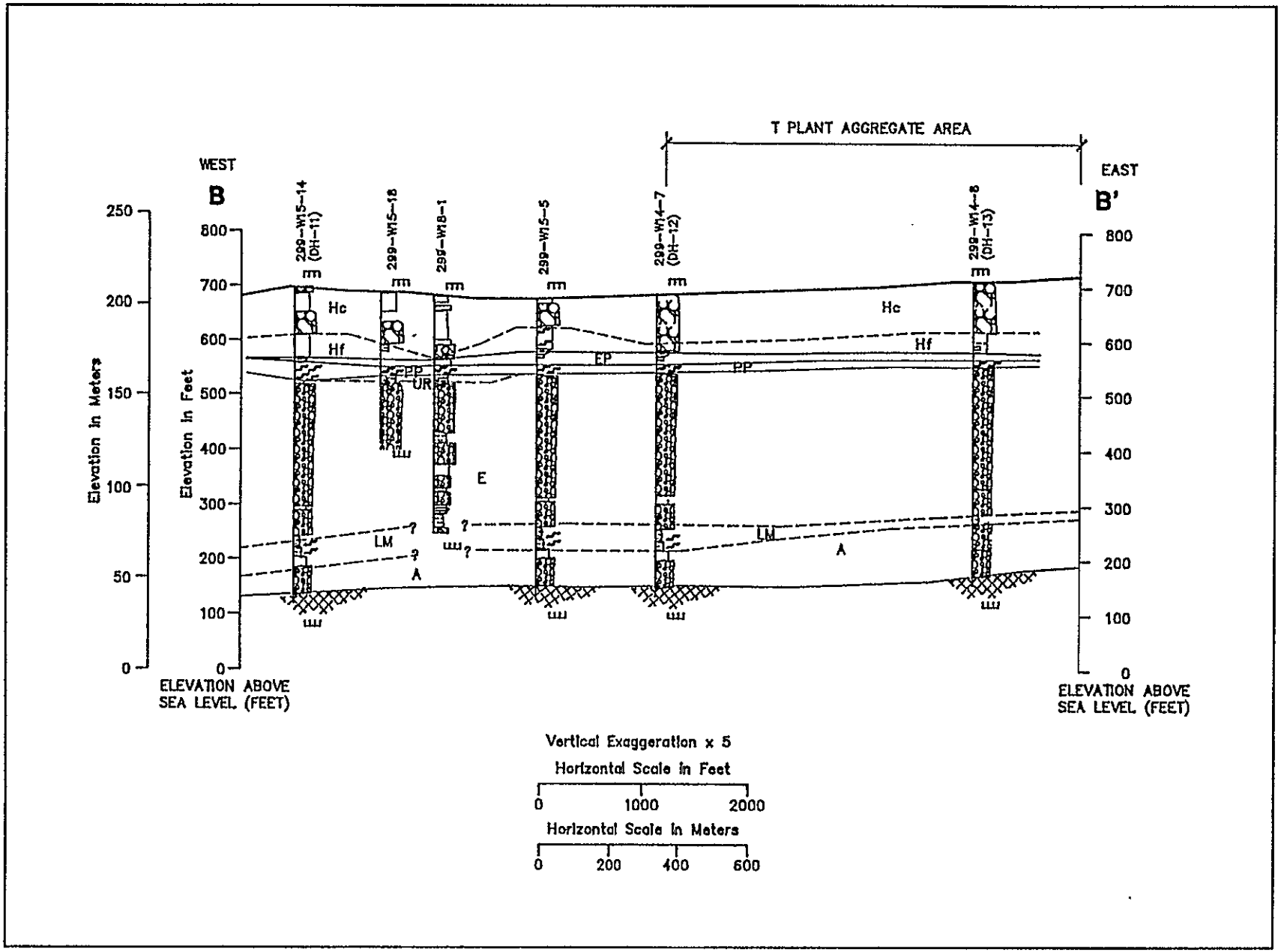


Figure 3-17. Geologic Cross Section B-B'.

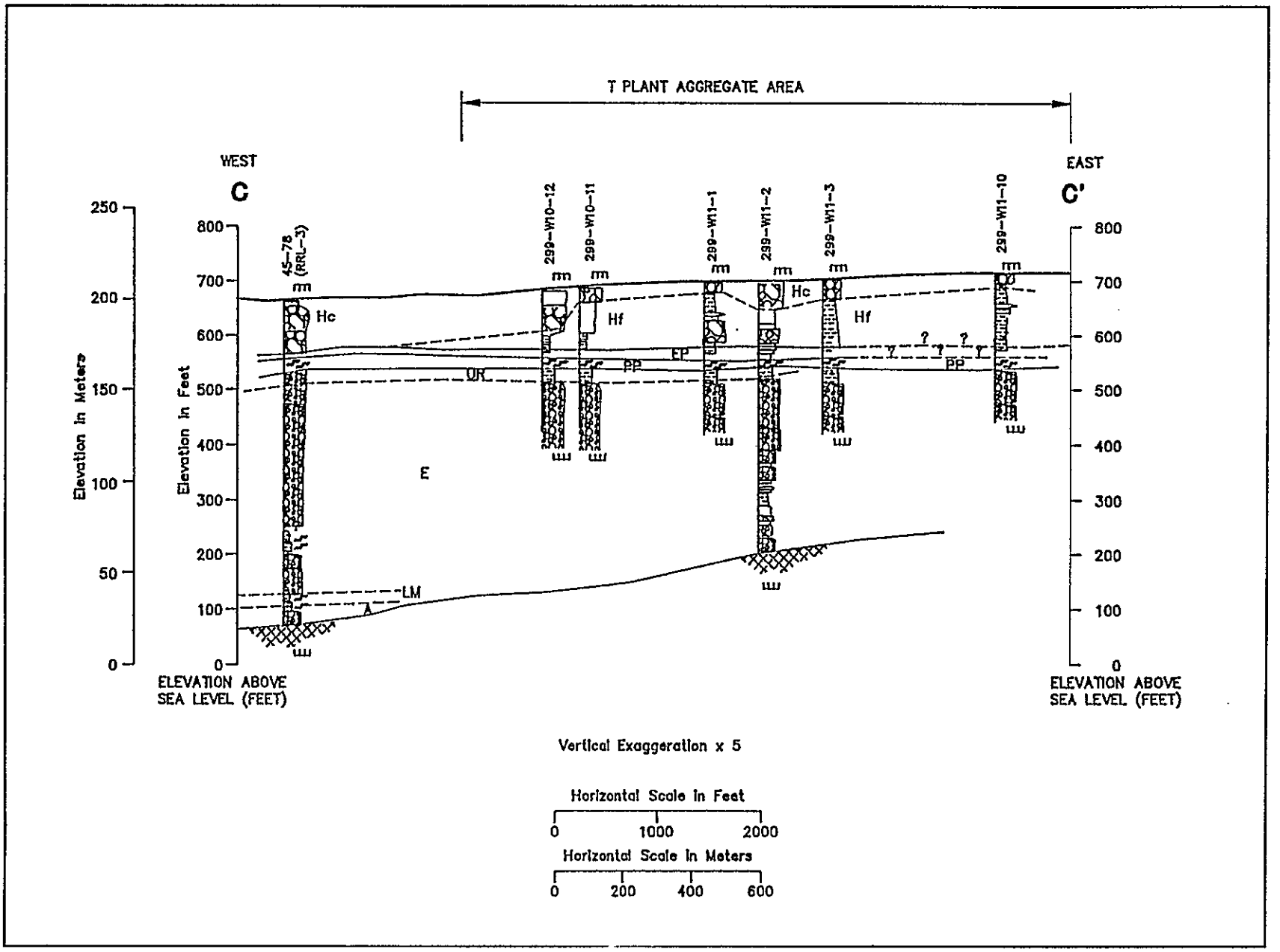


Figure 3-18. Geologic Cross Section C-C'.

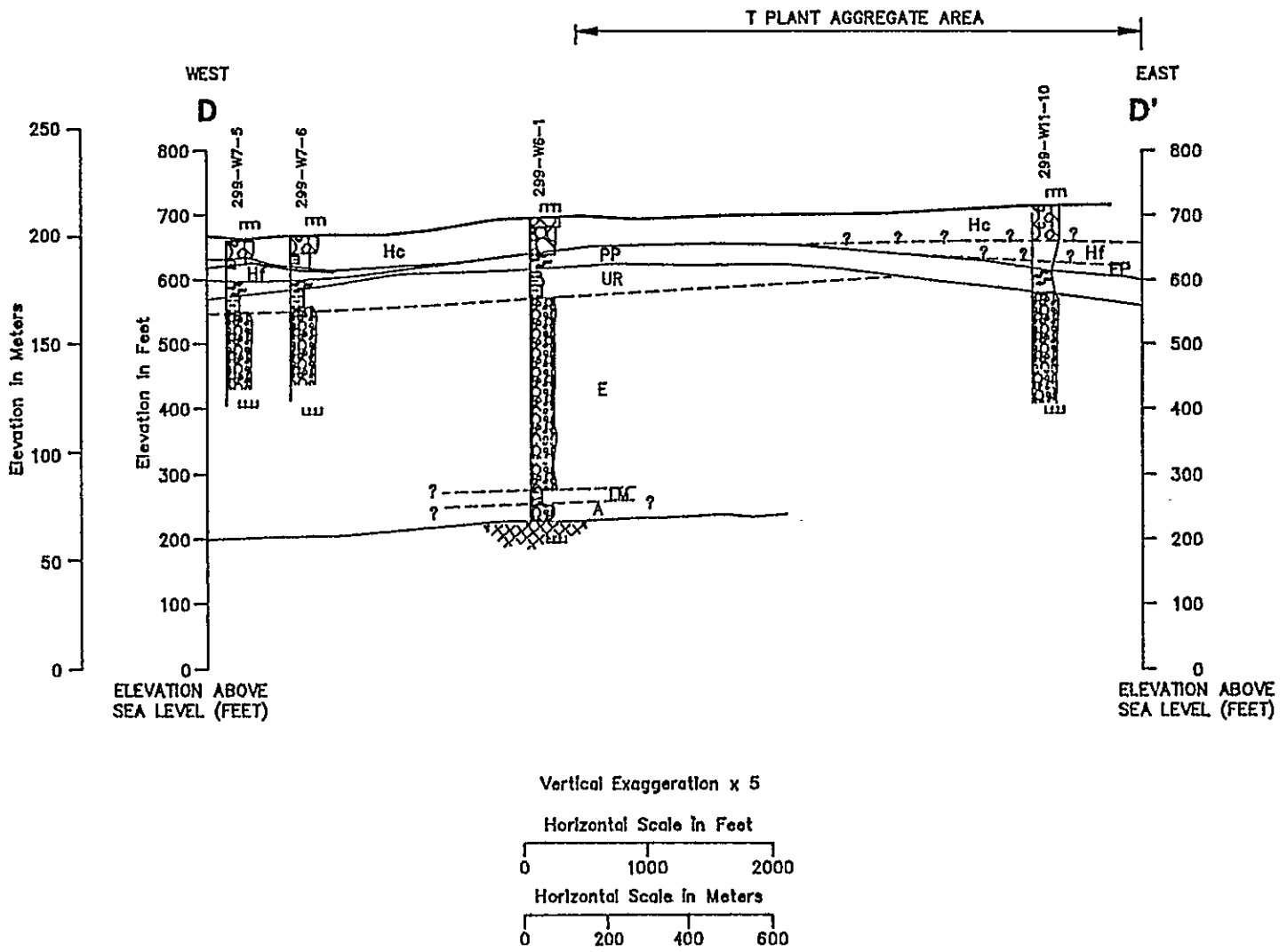
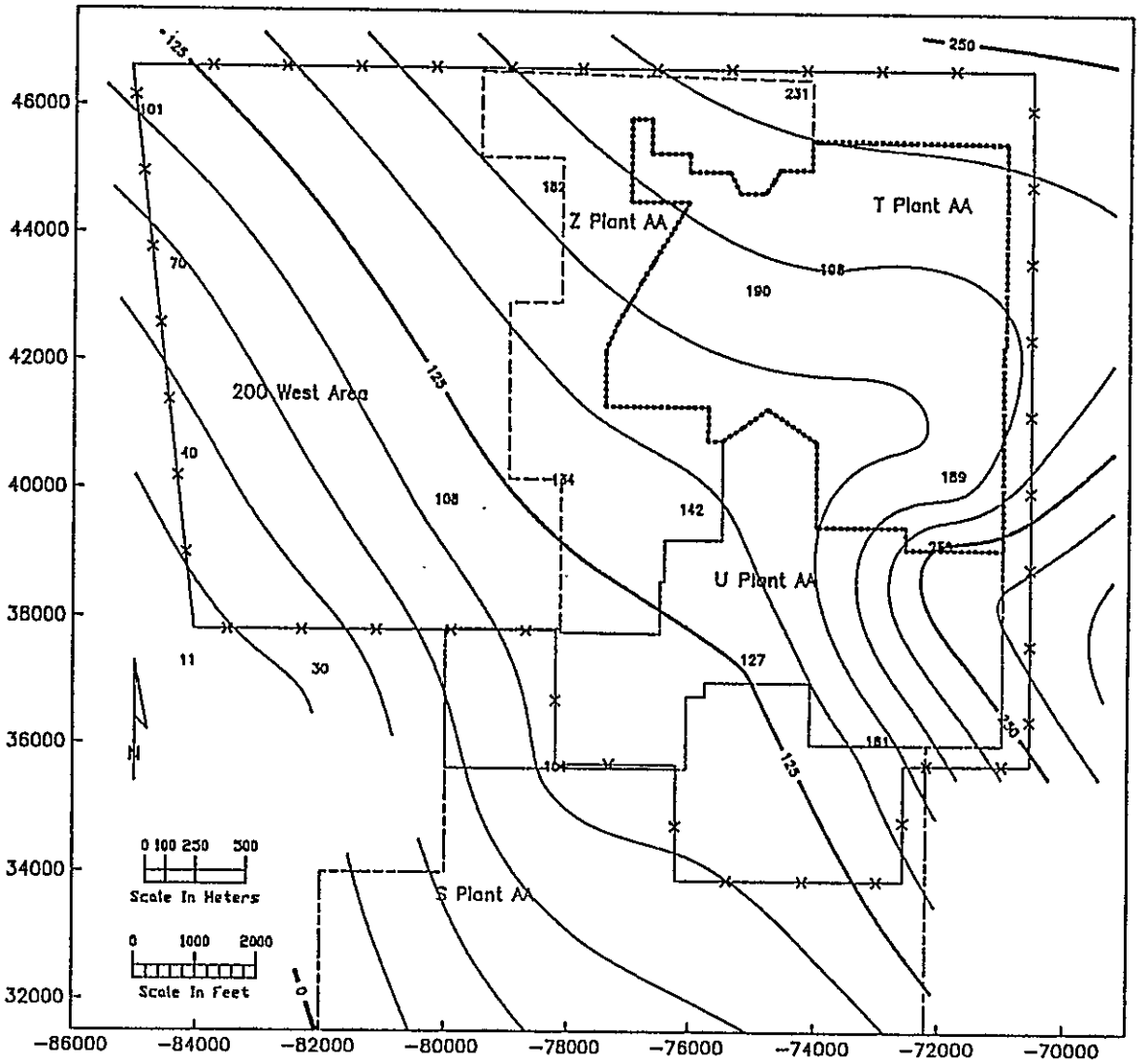
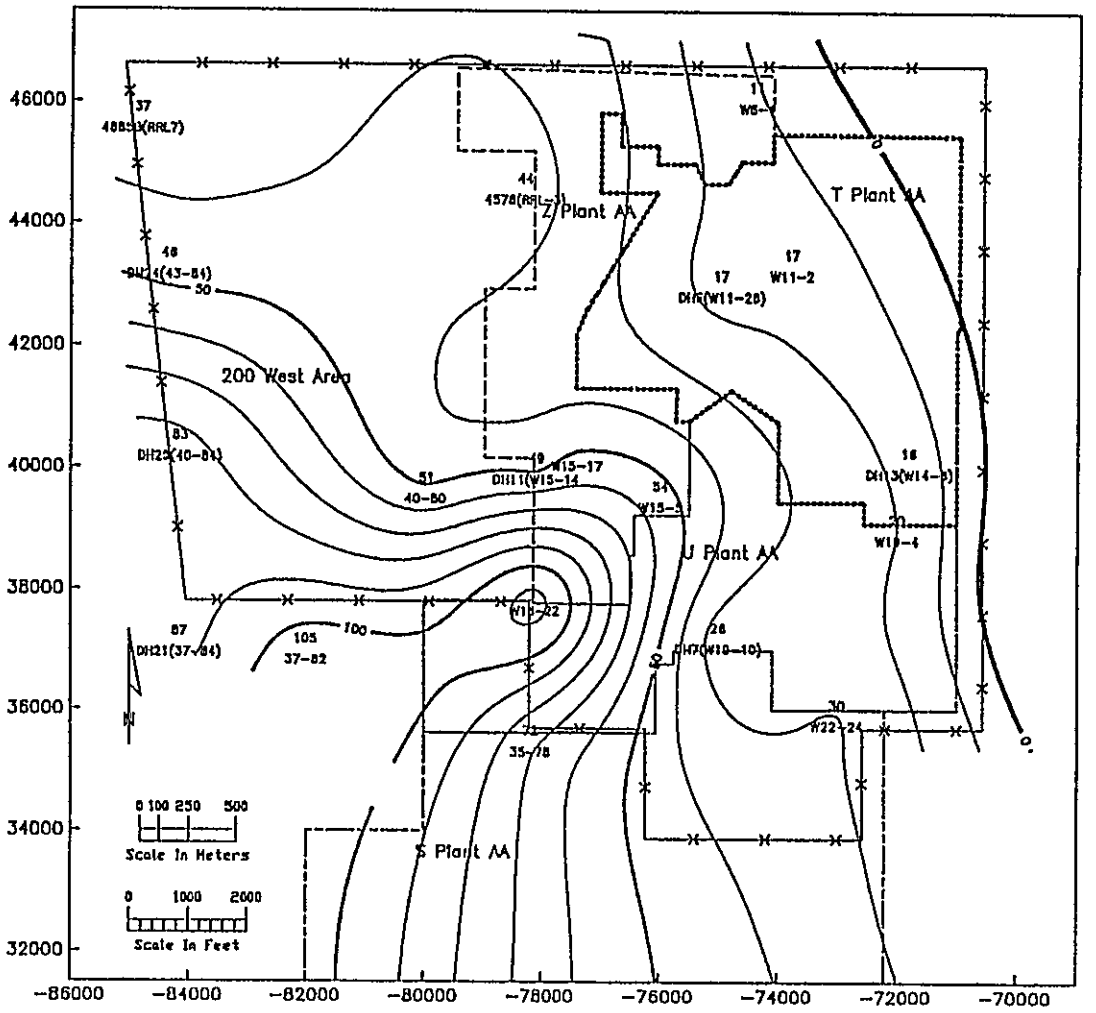


Figure 3-19. Geologic Cross Section D-D'.



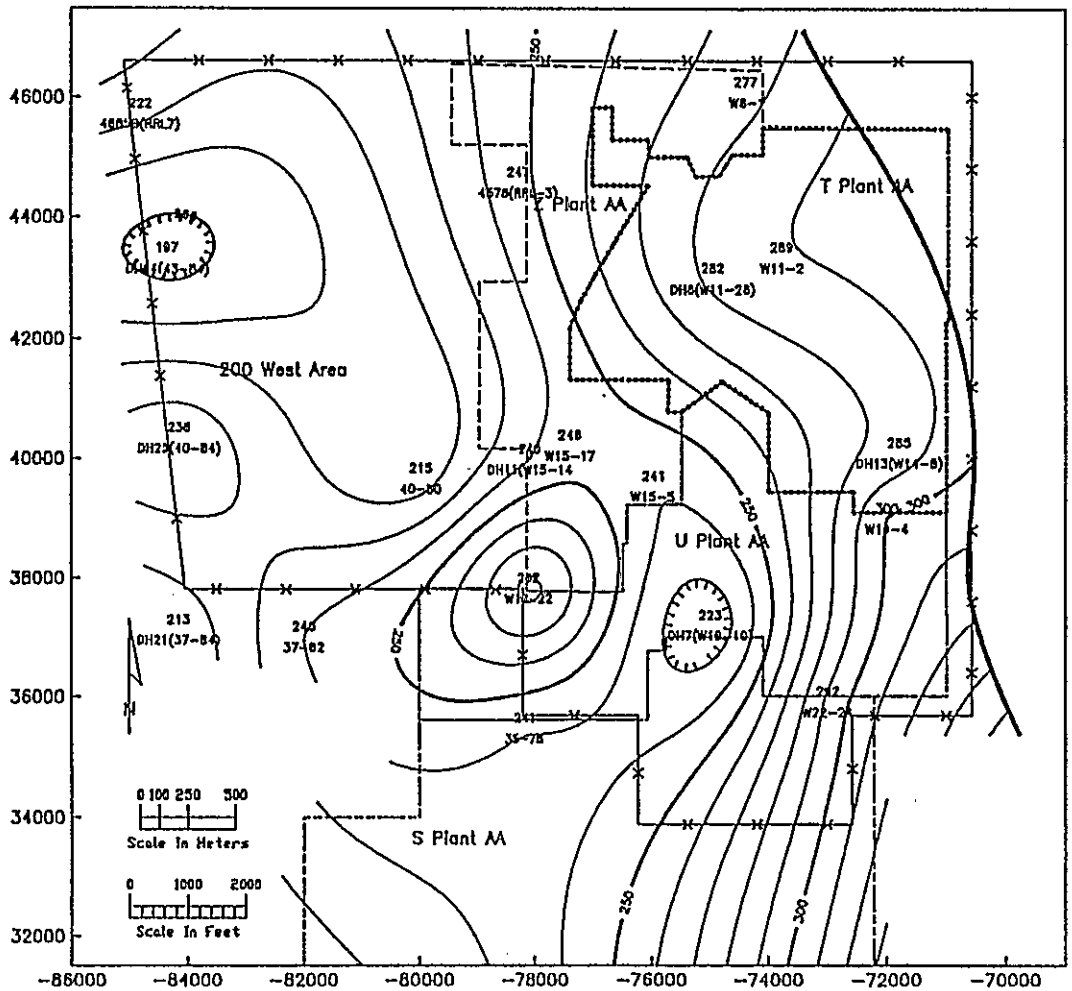
Contour Interval = 25 ft

Figure 3-20. Top of the Elephant Mountain Basalts.



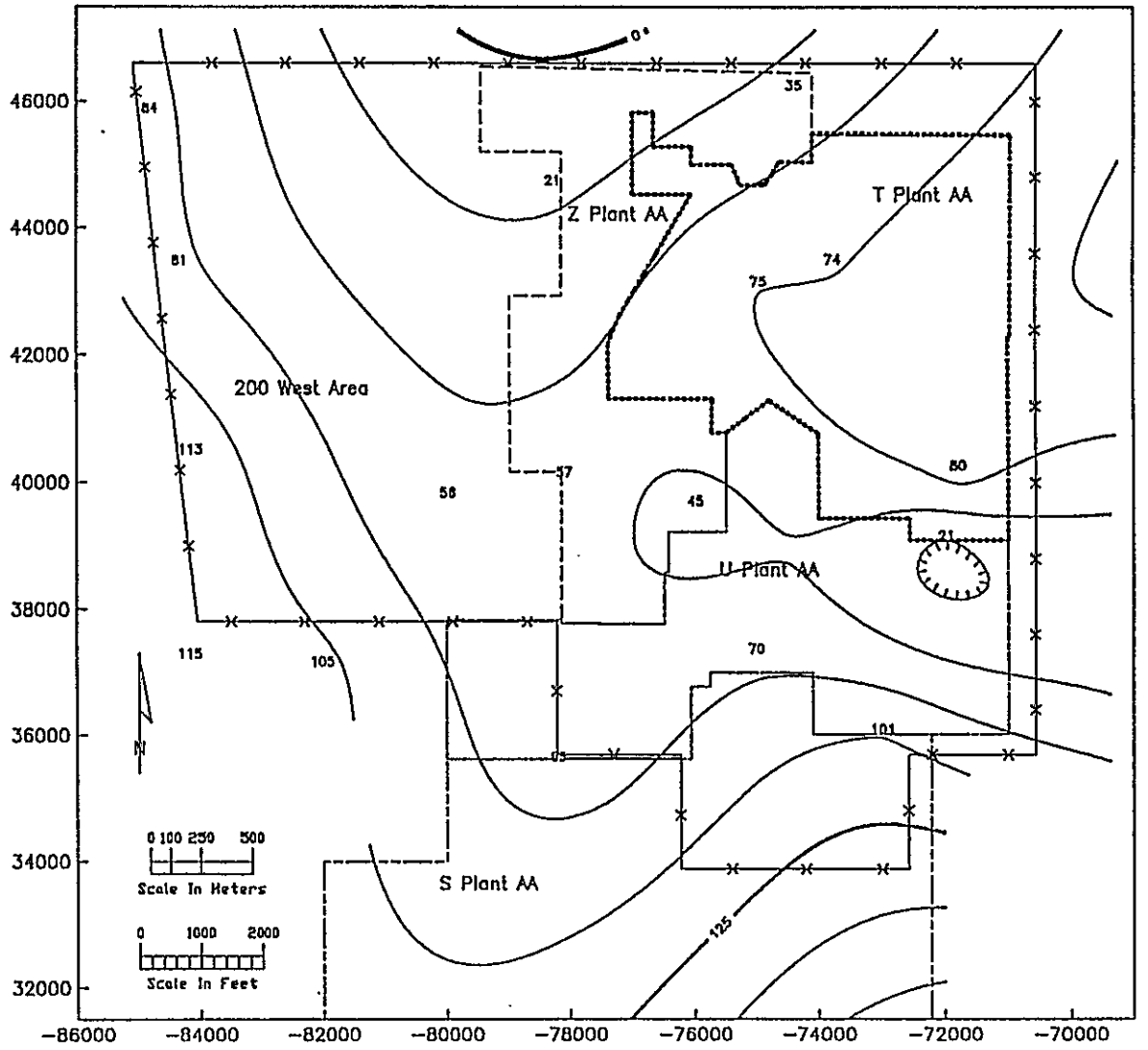
Contour Interval = 10 ft

Figure 3-21. Isopach Map of the Lower Mud Unit of the Ringold Formation.



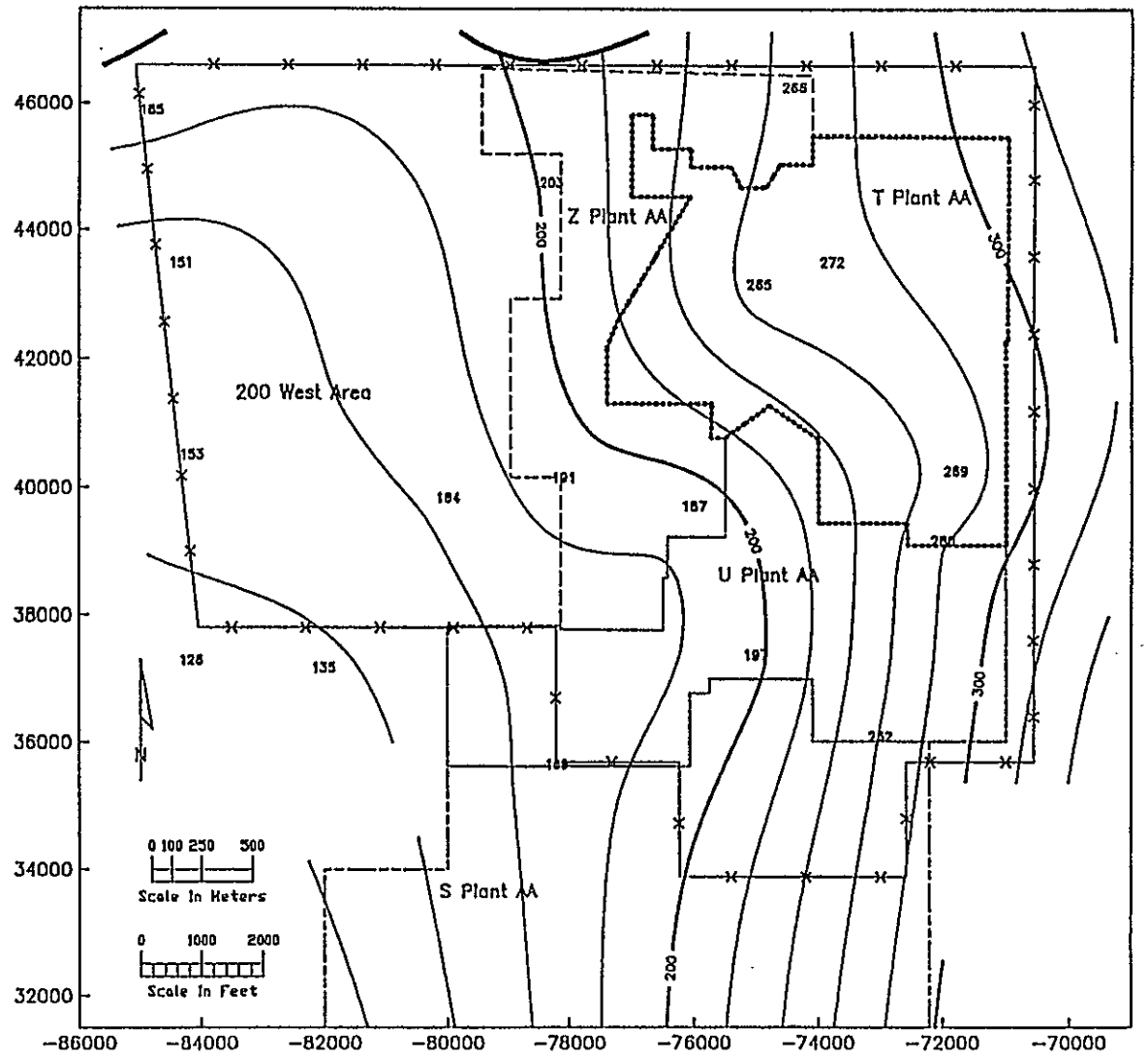
Contour Interval = 10 ft

Figure 3-22. Structure Map of the Lower Mud Unit of the Ringold Formation.



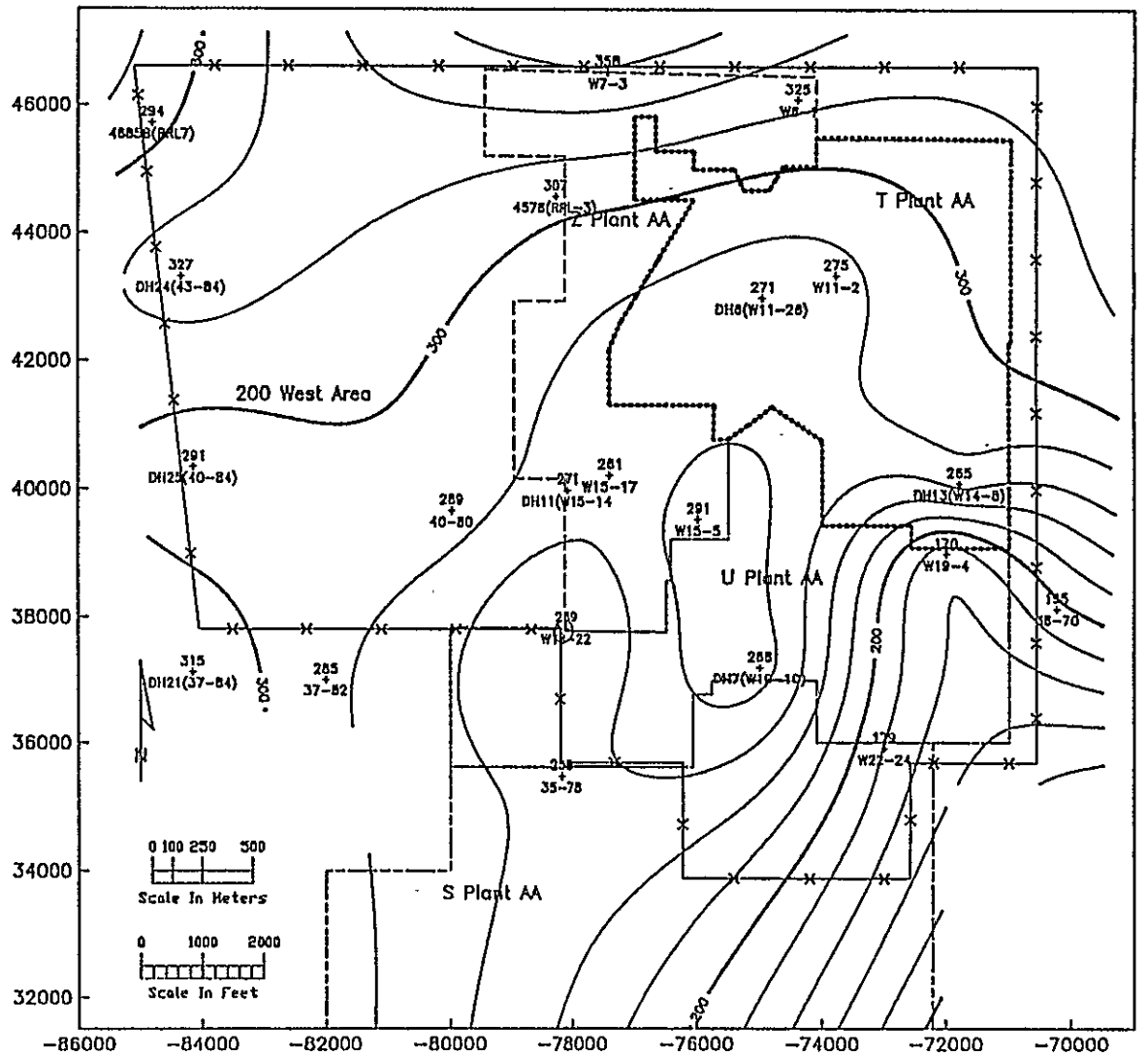
Contour Interval = 25 ft

Figure 3-23. Isopach Map of the Ringold Gravel Unit A.



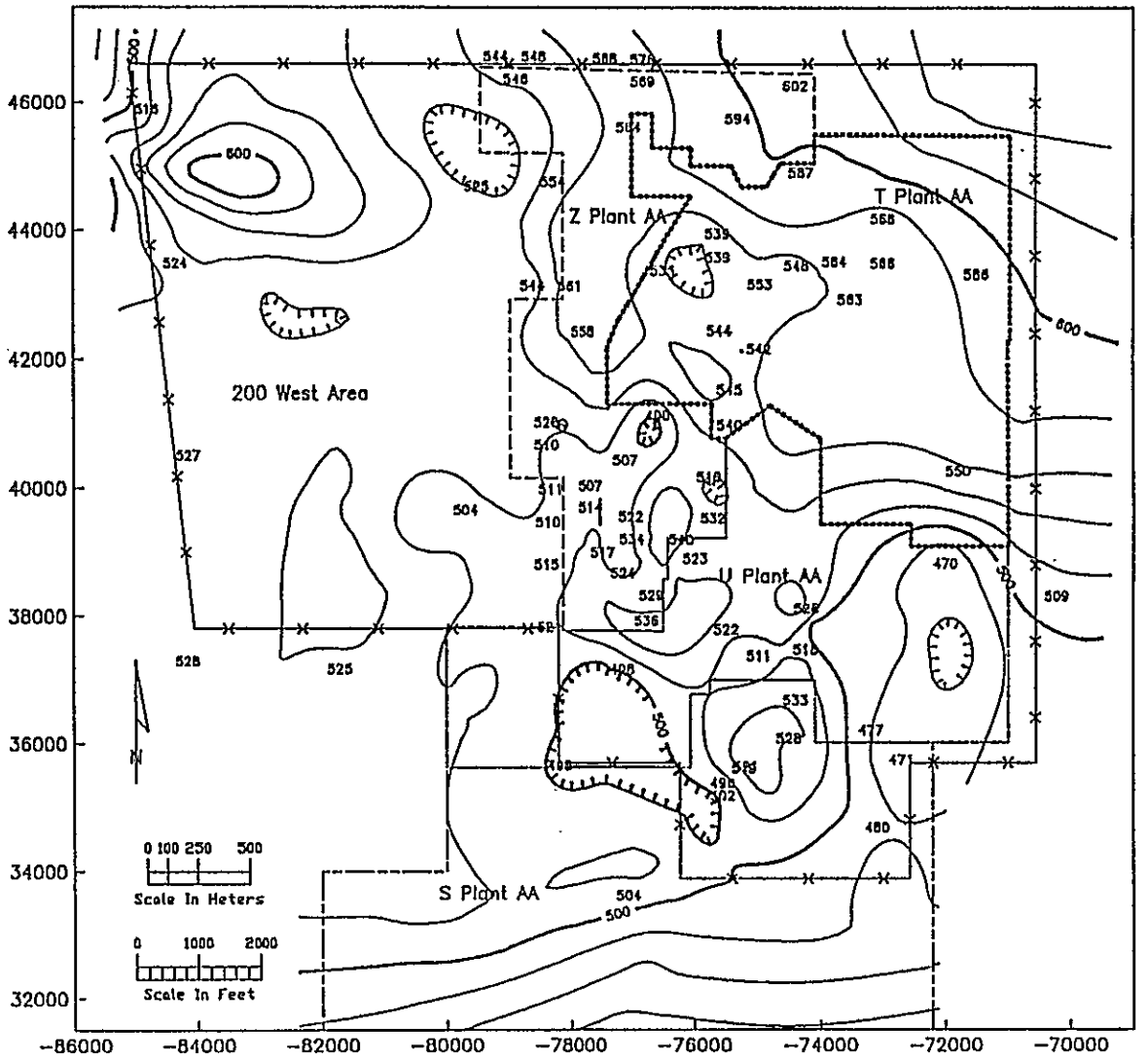
Contour Interval = 20 ft

Figure 3-24. Structure Map of the Ringold Gravel Unit A.



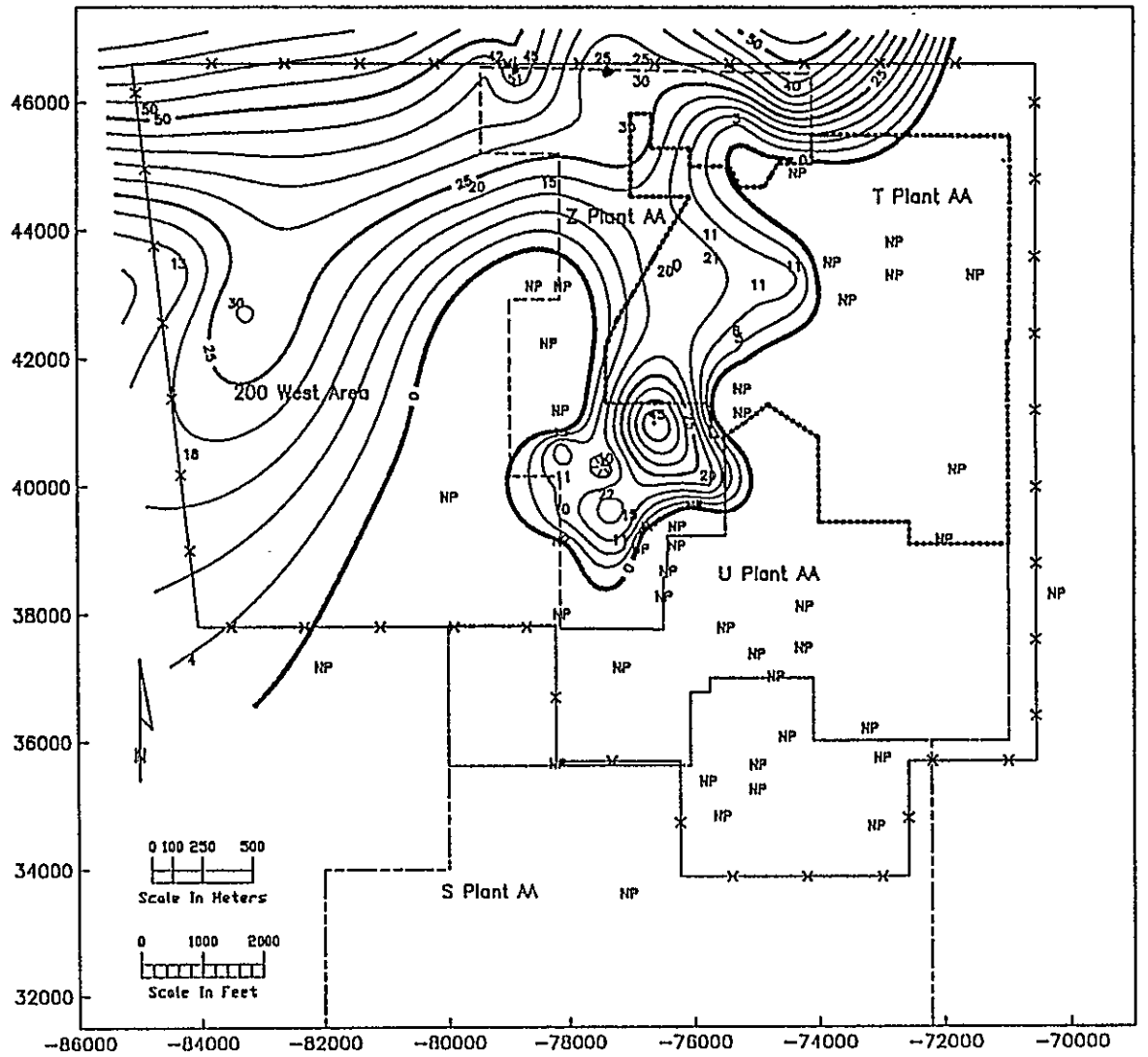
Contour Interval = 20 ft

Figure 3-25. Isopach Map of the Ringold Gravel Unit E.



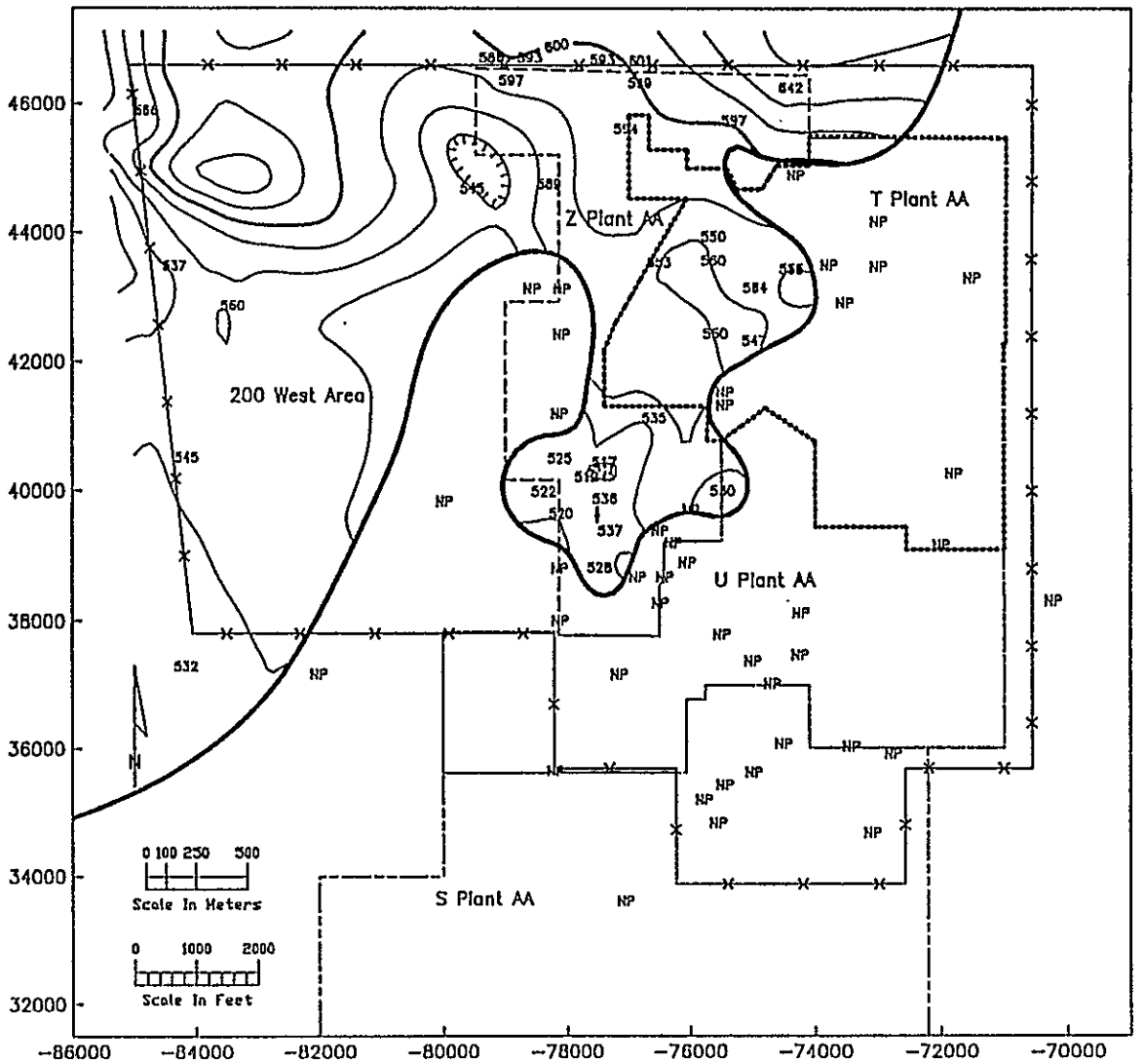
Contour Interval = 20 ft

Figure 3-26. Structure Map of the Ringold Gravel Unit E.



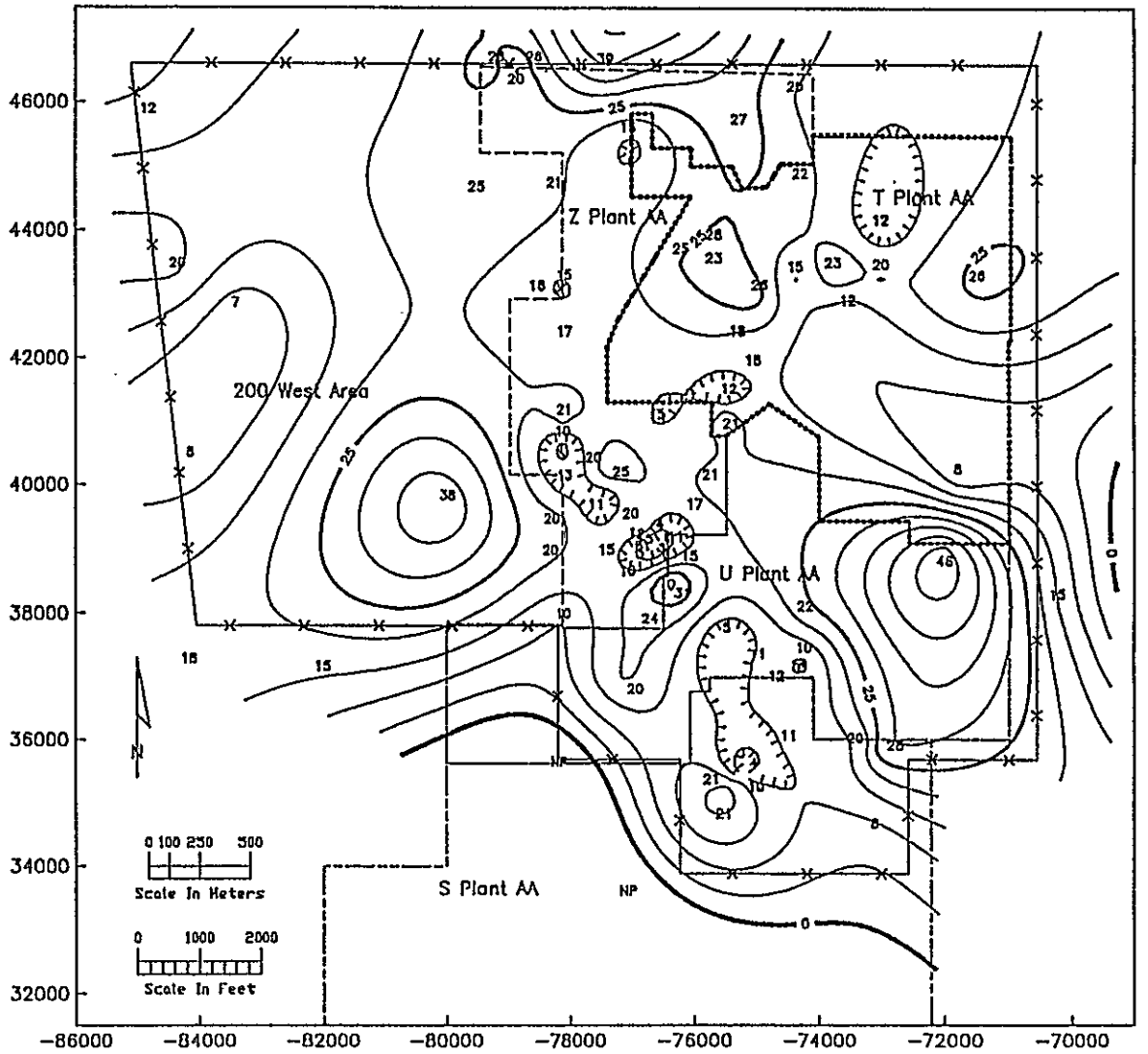
Contour Interval = 5 ft

Figure 3-27. Isopach Map of the Upper Ringold Formation.



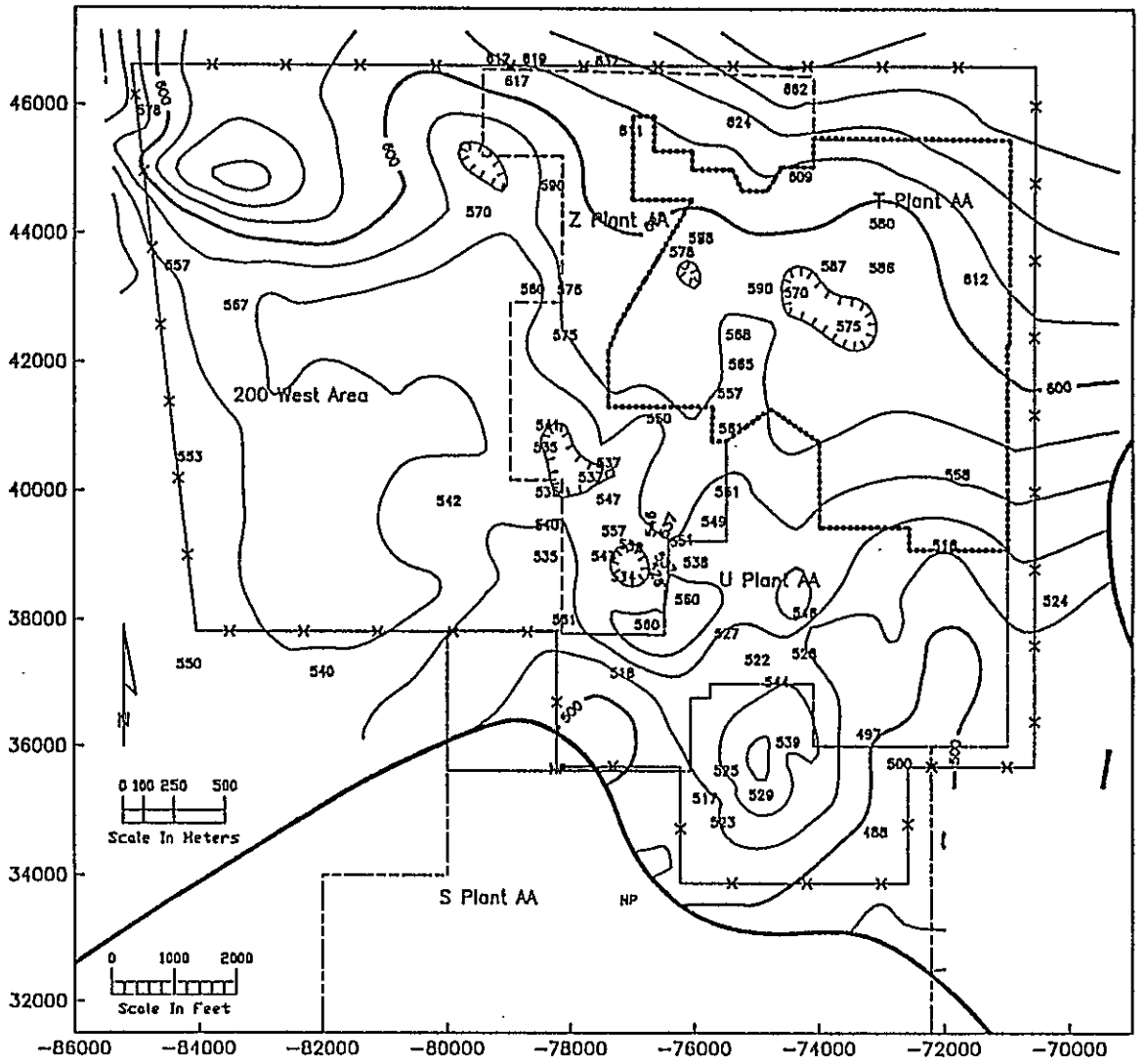
Contour Interval = 20 ft

Figure 3-28. Structure Map of the Upper Ringold Formation.



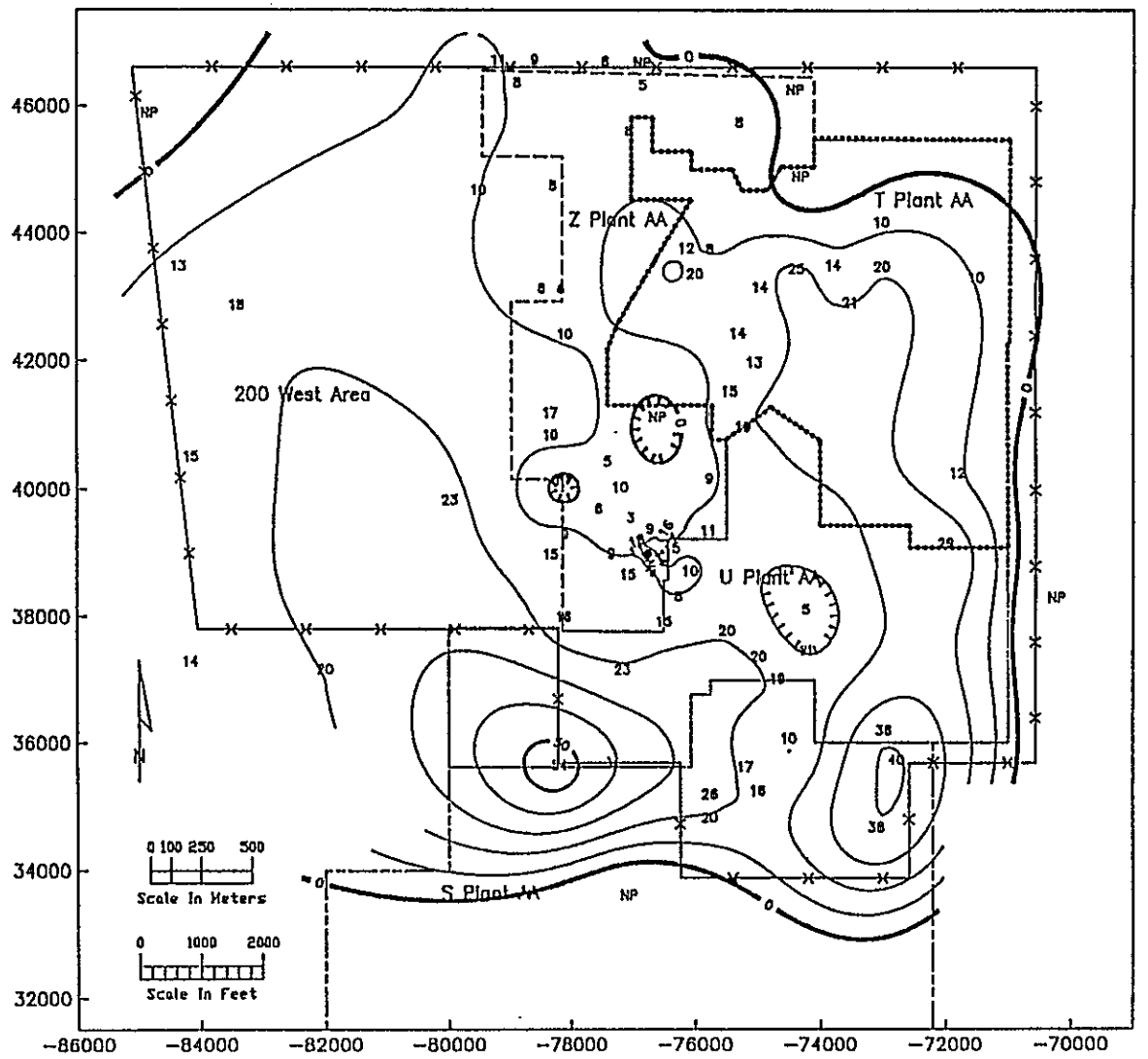
Contour Interval = 5 ft

Figure 3-29. Isopach Map of the Plio-Pleistocene.



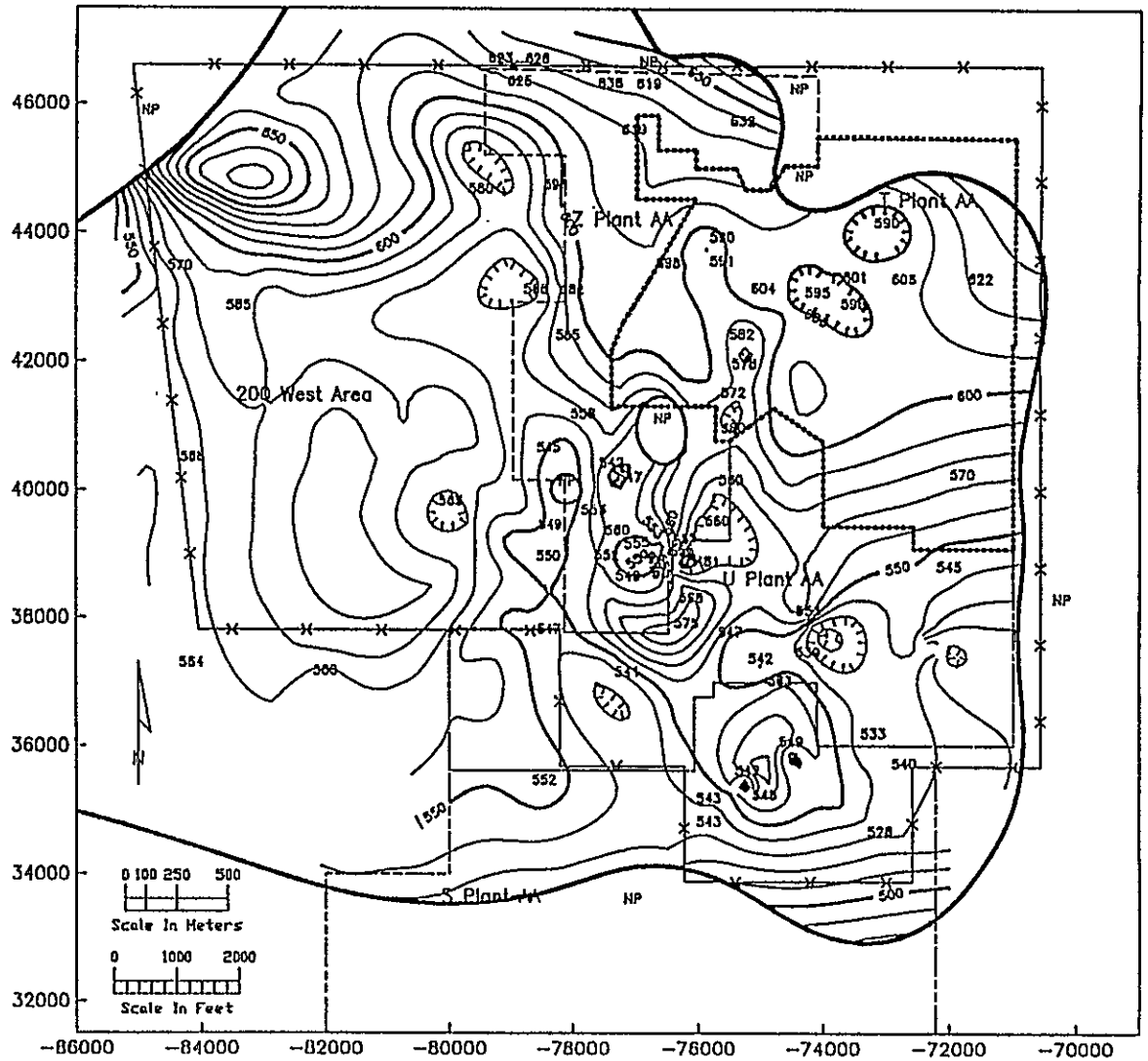
Contour Interval = 20 ft

Figure 3-30. Structure Map of the Plio-Pleistocene.



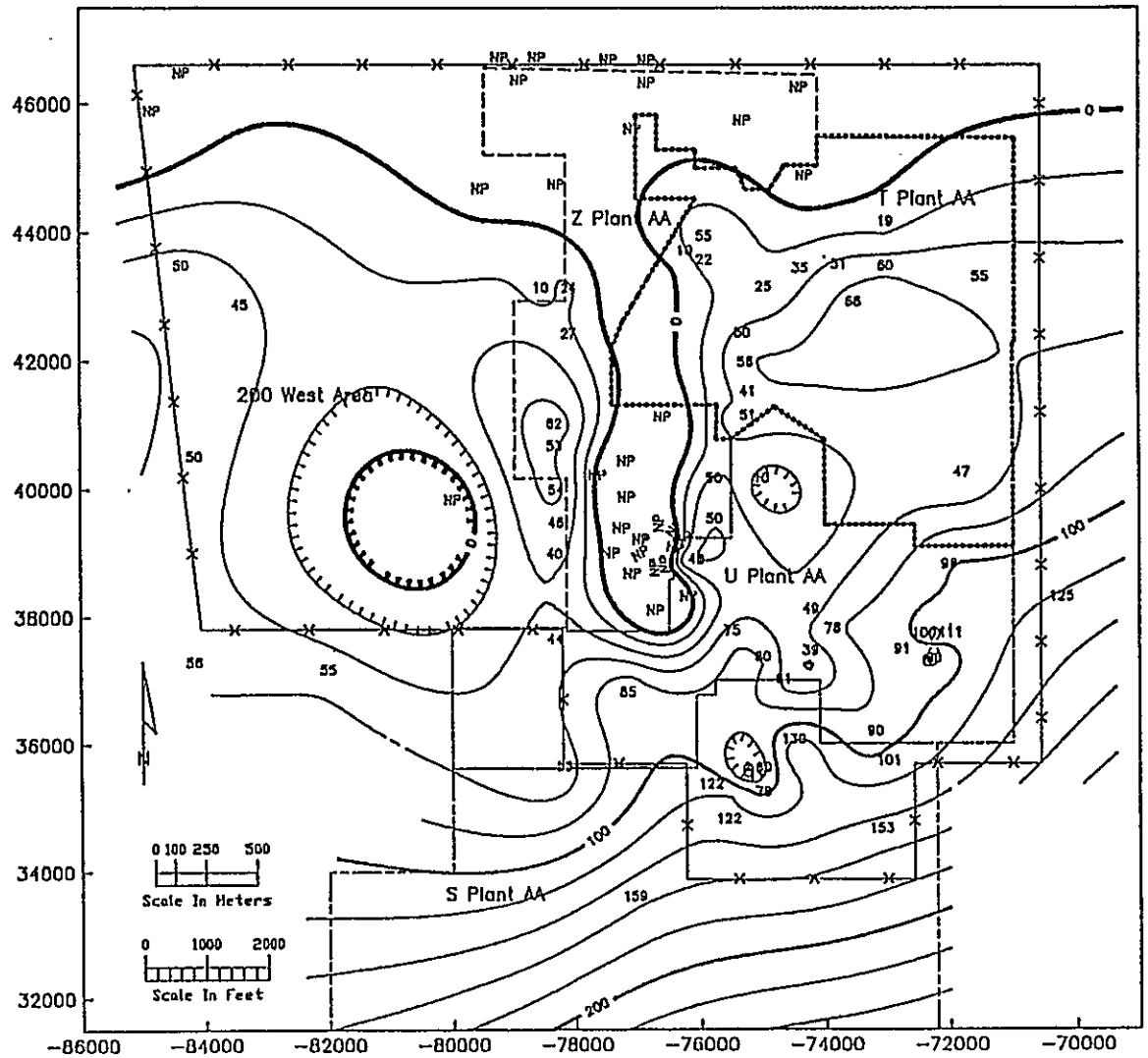
Contour Interval = 10 ft

Figure 3-31. Isopach Map of the Early Palouse Soils.



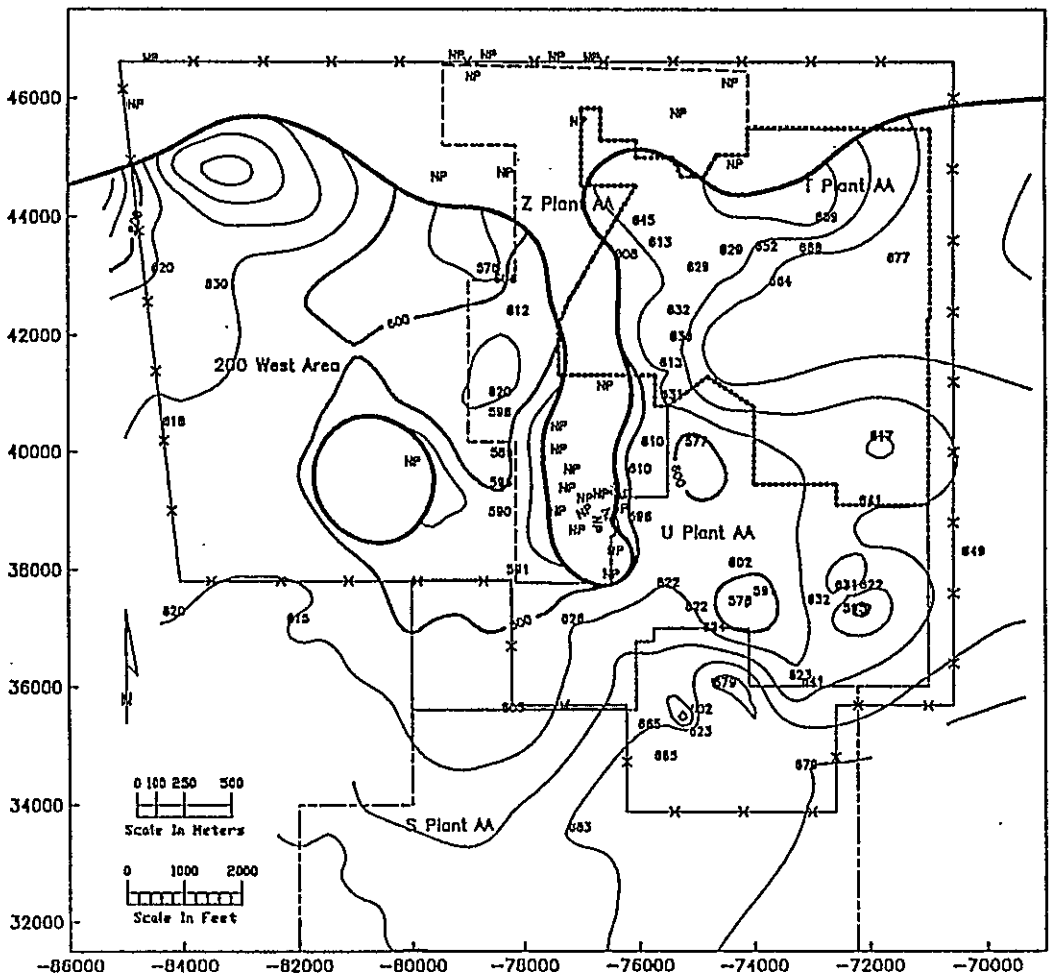
Contour Interval = 10 ft

Figure 3-32. Structure Map of the Early Palouse Soils.



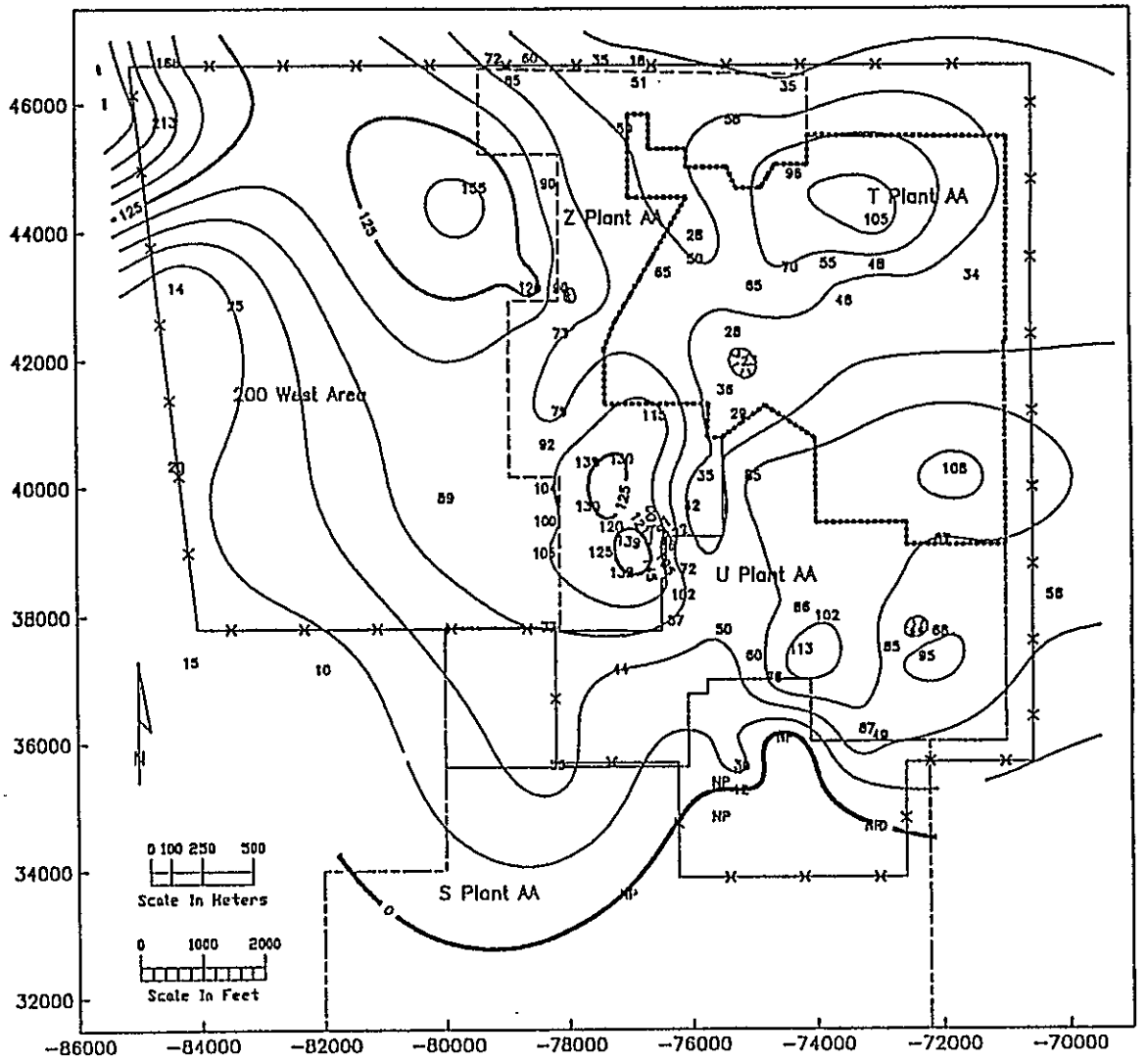
Contour Interval = 20 ft

Figure 3-33. Isopach Map of the Lower Fine Unit of the Hanford Formation.



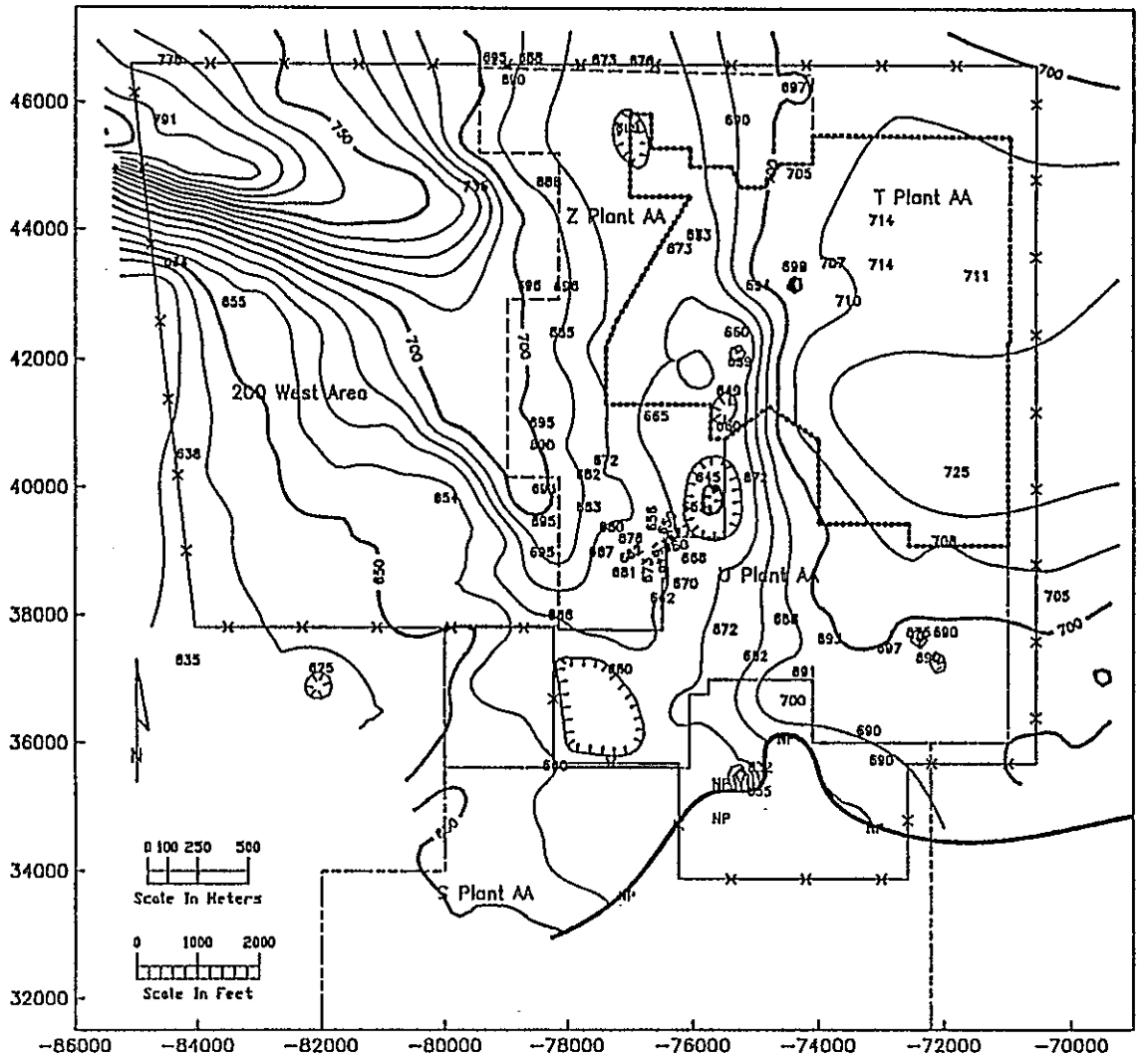
Contour Interval = 10 ft

Figure 3-34. Structure Map of the Lower Fine Unit of the Hanford Formation.



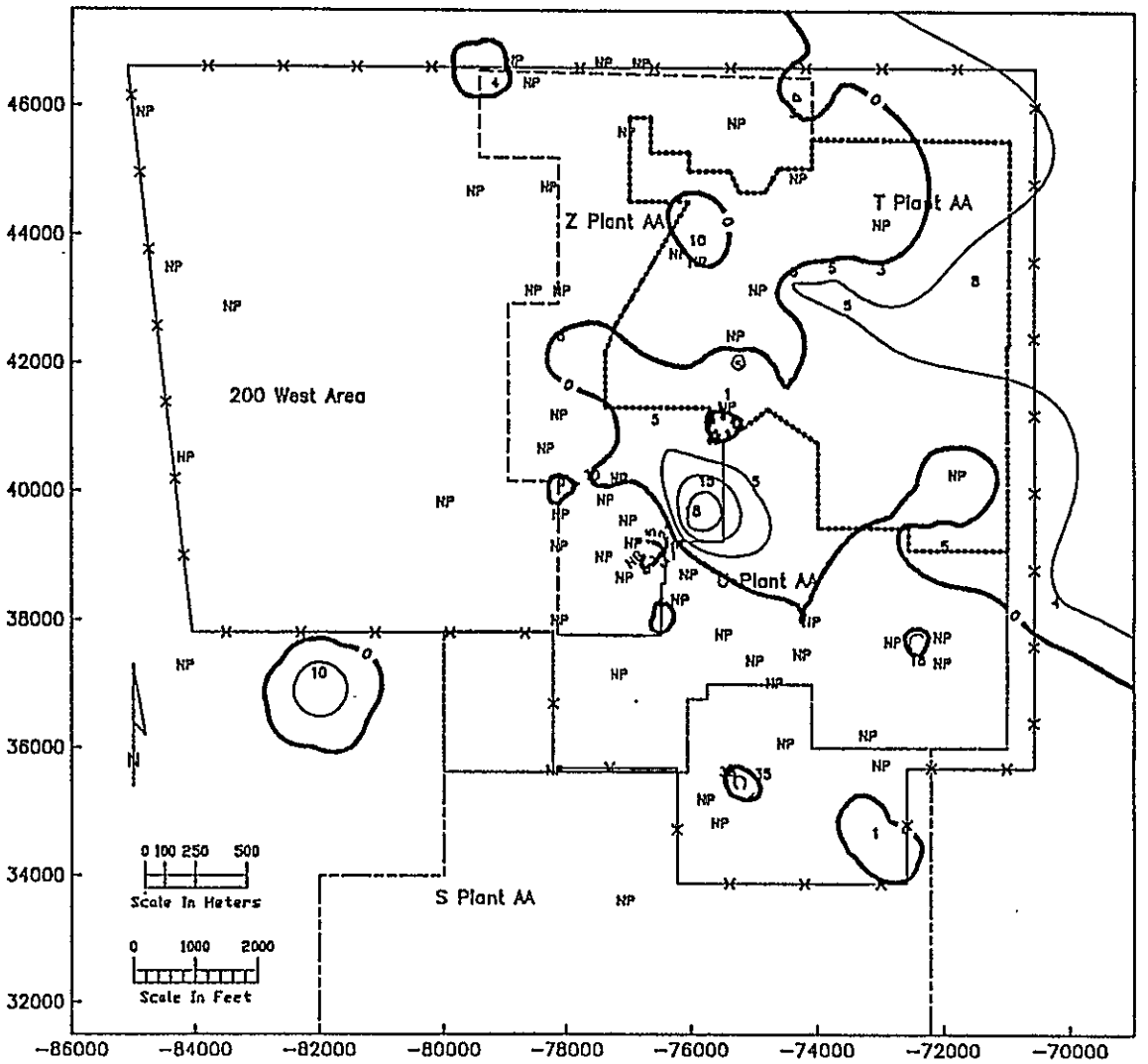
Contour Interval = 5 ft

Figure 3-35. Isopach Map of the Hanford Formation (Upper Coarse Facies).



Contour Interval = 10 ft

Figure 3-36. Structure Map of the Hanford Formation (Upper Coarse Facies).



Contour Interval = 5 ft

Figure 3-37. Isopach Map of the Backfilled Gravels and Eolian Sands.

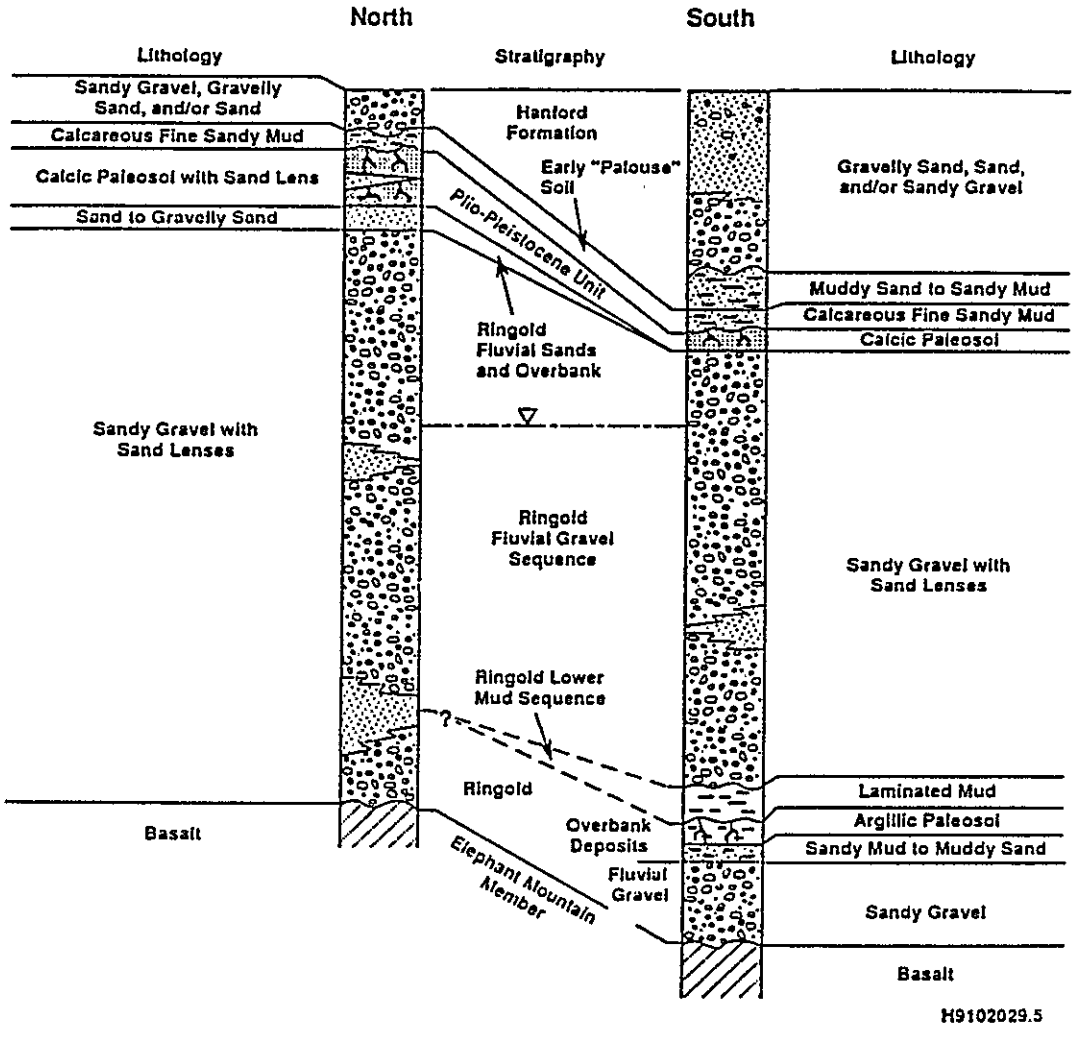


Figure 3-38. Conceptual Geologic and Hydrogeologic Column for the 200 West Area (Last et al. 1989).

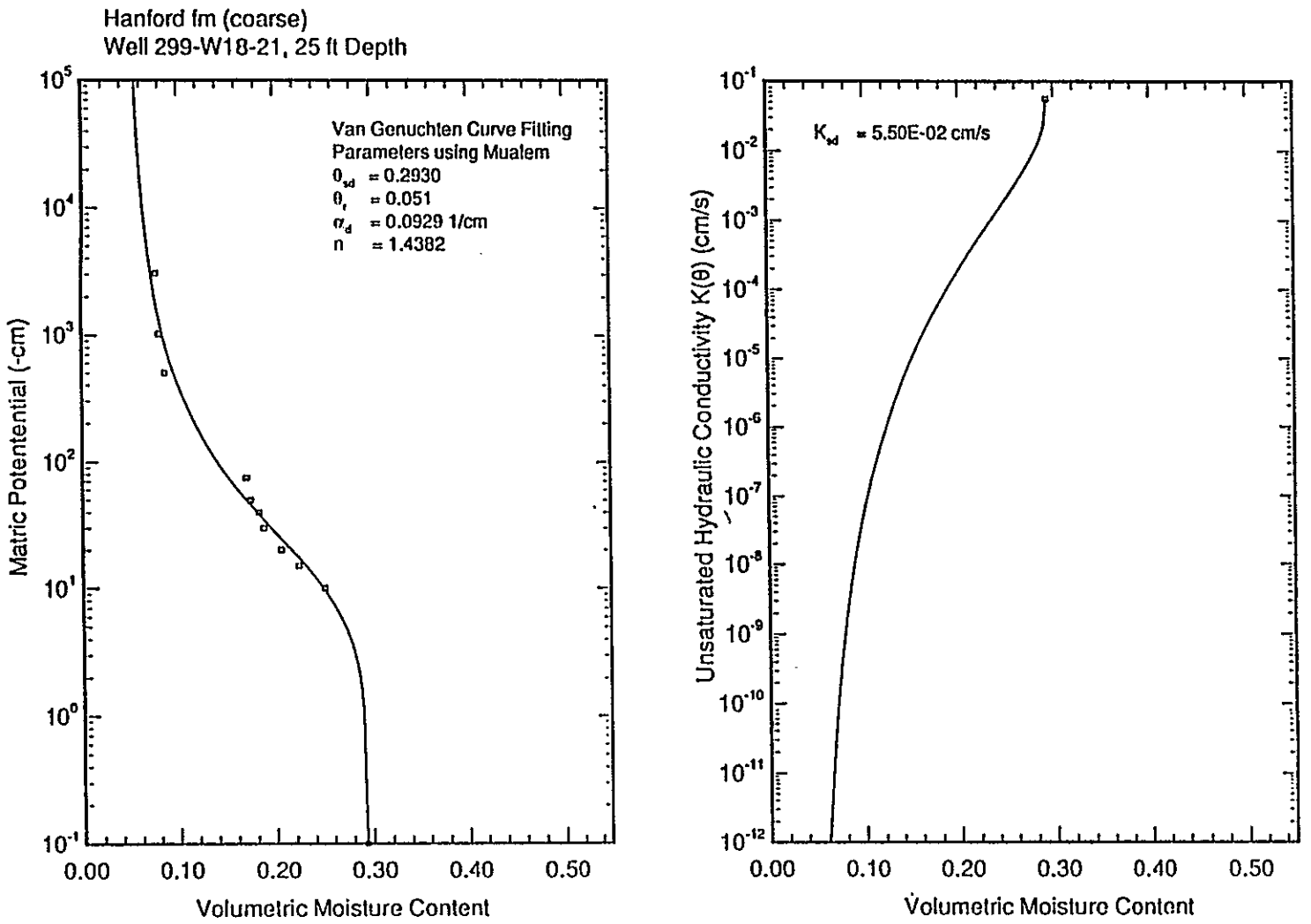
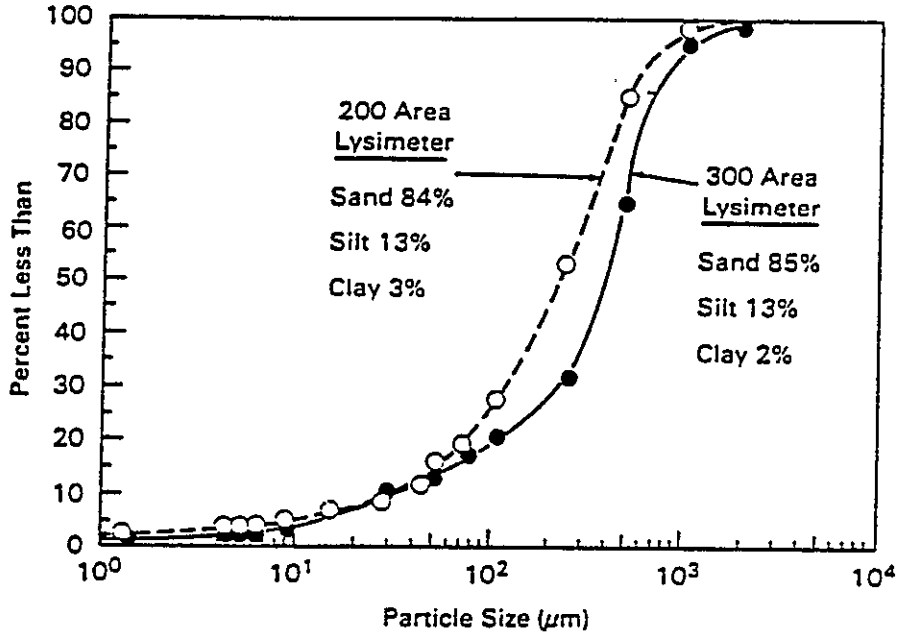
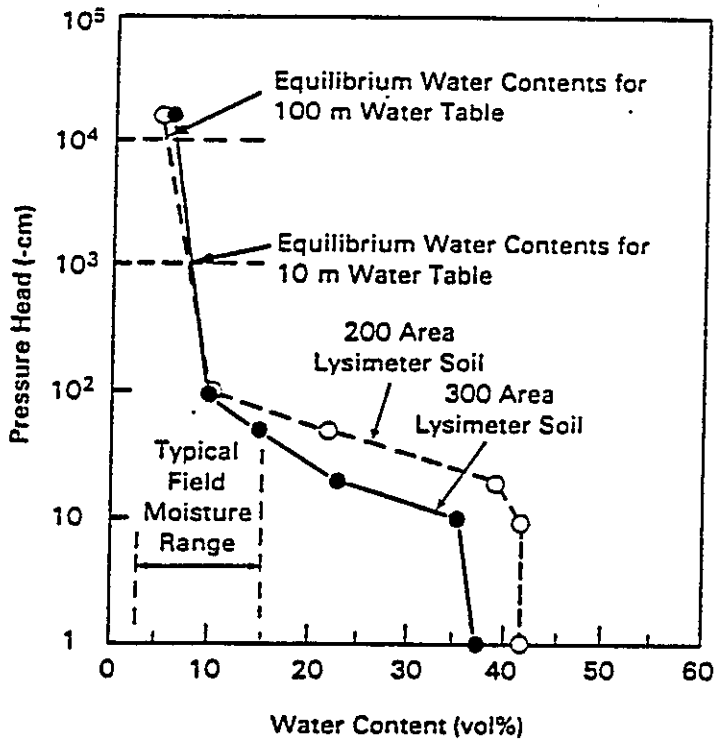


Figure 3-39. Wetting and Drying Curves for Well 299-W18-21.



a. Particle-Size Distribution



b. Water Retention Characteristics

Figure 3-40. Particle-Size Distribution and Water Retention Characteristics of Soils from Hanford Site Lysimeters (Gee and Heller 1985).

Table 3-1. Hydraulic Parameters for Various Areas and Geologic Units at the Hanford Site.

Location	Interval Tested	Hydraulic Conductivity in ft/d	Transmissivity in ft^2/d	Effective Porosity
Pasco Basin	Hanford formation	500 - 20,300		
	Ringold Formation Unit E	20 - 600		
	Ringold Formation Unit A	0.1 - 10		
Hanford Site	Saddle Mountain Basalt Flowtop	10^{-2} - 10^{-6}		5%
Hanford Site	Selah Interbed	3×10^{-3}		
100 Area	Ringold Formation Unit E	29 - 1,297	5,750 - 26,700	
100 Area	Rattlesnake Ridge Interbed	0 - 100		<10%
200 Areas	Hanford formation	2,000 - 10,000		
	Ringold Formation Unit E	9 - 230		
	Ringold Formation Unit A	1 - 12		
200 West Area	Ringold Formation Unit E	0.06 - 200		
	Ringold Formation Unit A	1.7 - 4		
	Lower Ringold laboratory	3×10^{-5} - 8×10^{-5}		
Slug Tests at U-12 Crib	Upper Ringold	8 - 44		
200 East Area	Elephant Mountain Interflow Zone		7.5 - 6,120	
200 Area	Rattlesnake Ridge Interbed		8 - 1,165	
300 Area	Hanford Formation	11,000 - 50,000		
300 Area	Ringold Formation	1.9 - 10,000		
300 Area	Levey Interbed	0.01 - 1,000		
1100 Area	Ringold Formation Units C/B	3×10^{-1} - 5		
1100 Area	Ringold Formation Overbank Deposits	8×10^{-4} - 1×10^{-1}		

Table 3-2. Summary of Reported Hydraulic Conductivity Values for Hanford Site Vadose Zone Sediments. (Sheet 1 of 2)

Reported Hydraulic Conductivity Value or Range of Values in cm/s	Water Content Volume %	Reported Geologic Unit or Sediment Type	Test Area or Sampling Location	Reference	Measurement Method or Basis for Reported Value
6.7×10^{-7} 1.7×10^{-8} 1.7×10^{-9} 1.7×10^{-10} 1.3×10^{-11}	10 7 5.5 5 4.3	Sand	200 Area	Hsieh et al. 1973	Lysimeter Soil Experiments
2.6×10^{-5} 5.7×10^{-4} (sat)	31 56	Sandy soil reported as "typical or many surface materials at the Hanford Site."		Gee and Campbell 1980	Unsaturated column studies.
6.3×10^{-11} 2.2×10^{-11}	2.9 2.8	Near-surface soils	2-km south of 200 East Area	Gee 1987	K estimates by Gee, 1987 using water retention curve data from Figure 7 in Hsieh, et al., 1973.
5.40×10^{-8} 9.78×10^{-3} (sat) 8.4×10^{-3} (Sat, arithmetic mean of four measurements)	8.3 42.2 na	Sandy fill excavated from near-surface soil (Hanford formation) with 1.27-cm particle size fraction screened out.	Buried Waste Test Facility (BWTF): 300 North Area Burial Grounds	Rockhold et al. 1988	Laboratory steady-state flux measurements.
8×10^{-8} 4×10^{-3} (Southeast Caisson) 1×10^{-8} 1×10^{-2} (North Caisson)	11 26 10 29	na na na na	BWTF: Southeast Caisson, and North Caisson	Estimated from Figures 4.3 and 4.8, Rockhold et al. 1988	Unsteady drainage-flux field measurements.
4.5×10^{-3} (arithmetic mean of 15 measurements)	Field Saturation	na	BWTF North Caisson and area north of caisson	Rockhold et al. 1988	Guelph permeameter field measurements
1×10^{-3} (Upper Soil, arithmetic mean of 7 measurements) 9.2×10^{-5} (Lower Soil, arithmetic mean of 4 measurements)	Field Saturation Field Saturation	Loamy sand over sand na	Grass Site: 3 km of BWTF	Rockhold et al. 1988	Guelph permeameter field measurements.
8×10^{-7} 9×10^{-4}	16 40	Loam to sandy loam	McGee Ranch:NW of 200 West Area on State Rt. 240	Estimated from Figure 4.18: Rockhold et al. 1988	Unsteady drainage-flux field measurements.

Table 3-2. Summary of Reported Hydraulic Conductivity Values for Hanford Site Vadose Zone Sediments. (Sheet 2 of 2)

Reported Hydraulic Conductivity Value or Range of Values in cm/s	Water Content Volume %	Reported Geologic Unit or Sediment Type	Test Area or Sampling Location	Reference	Measurement Method or Basis for Reported Value
9×10^{-4} (arithmetic mean of 9 measurements)	Field Saturation	na		Rockhold et al. 1988	Guelph permeameter field measurements.
5×10^{-3} (sat)	50	Sand, gravel	Sediment types are idealized to represent stratigraphic layers commonly encountered below 200 Areas liquid disposal sites.	WHC 1990	K_{sat} values derived from idealized moisture content curves on Figure B-1.
1×10^{-3} (sat)	50	Coarse sand			
5×10^{-4} (sat)	40	Fine Sand			
1×10^{-4} (sat)	40	Sand, Silt			
5×10^{-5} (sat)	40	Caliche			
1.2×10^{-5} (sat)	19.6 to 18.9	Hanford formation	Well 299-W7-9, 218-W-5 Burial Ground	Khaleel et al. 1991	van Genuchten equation fitted to moisture characteristic curves for well 299-W7-9 soil samples
6.7×10^{-6} to 1.4×10^{-5} (sat)	37.6 to 41.4	Early "Palouse" Soils			
6.3×10^{-5} to 2.8×10^{-1} (sat)	20.3 to 40.5	Plio-Pleistocene Unit			
1.10×10^{-5} (sat)	18.3 to 21	Upper Ringold			
1.80×10^{-4} to 3.00×10^{-4} (sat)	24 to 25	Middle Ringold			

Notes:

na - Not identified in source.
sat - Value for saturated soil.
field saturation - Equilibrium water content after several days of gravity drainage.

Table 3-3. Endangered, Threatened, and Sensitive Plant Species Reported on or Near the Hanford Site.

Scientific Name	Common Name	Family	Washington State Status
*Rorippa columbiae*** Suksd. ex Howell	Persistantsepal Yellowcress	Brassicaceae	Endangered
Artemesia campestris L ssp. *borealis* (Pall.) Hall & Clem. var. *wormskioldii*** (Bess.) Cronq.	Northern Wormwood	Asteraceae	Endangered
*Astragulus columbianus*** Barneby	Columbia milk-vetch	Fabaceae	Threatened
*Lomatium tuberosum*** Hoover	Hoover's Desert-Parsley	Apiaceae	Threatened
Astragalus arrectus Gray	Palouse Milk-vetch	Fabaceae	Sensitive
Collinsia sparsiflora Fisch.&Mey. var *bruciae* (Jones) Newsom	Few-Flowered Collinsia	Scrophulariaceae	Sensitive
Cryptantha interrupta (Greene)Pays.	Bristly Cryptantha	Boraginaceae	Sensitive
Cryptantha leucophea Dougl. Pays	Gray Cryptantha	Boraginaceae	Sensitive
Erigeron piperianus Cronq.	Piper's Daisy	Asteraceae	Sensitive
Carex densa L.H. Bailey	Dense Sedge	Cyperaceae	Sensitive
Cyperus rivularis Kunth	Shining Flatsedge	Cyperaceae	Sensitive
Limosella acaulis Ses.&Moc.	Southern Mudwort	Scrophulariaceae	Sensitive
Lindernia anagallidea (Michx.)Pennell	False-pimpernel	Scrophulariaceae	Sensitive
Nicotiana attenuata Torr.	Coyote Tobacco	Solanaceae	Sensitive
Oenothera pygmaea Dougl.	Dwarf Evening-Primrose	Onagraceae	Sensitive

** Indicates candidates on the 1991 Federal Register, Notice of Review.

Table 3-4. Federal and State Classifications of Animals That Could Occur on the 200 Area Plateau.

Common Name	Status Federal*	State
Peregrine Falcon	FE	SE
Sandhill Crane		SE
Bald Eagle	FT	ST
Ferruginous Hawk	FC2	ST
Swainson's Hawk	FC2	SC
Golden Eagle		SC
Burrowing Owl		SC
Loggerhead Shrike		SC
Sage Sparrow		SC
Great Blue Heron		SM
Merlin		SM
Prairie Falcon		SM
Long-billed Curlew	FC2	SM
Striped Whipsnake		SC

*FE - Federal Endangered
FT - Federal Threatened
FC2 - Federal Candidate
SE - State Endangered
ST - State Threatened
SC - State Candidate
SM - State Monitor

Above information taken from Washington Department of Wildlife June 1991. Species of Concern in Washington.

4.0 PRELIMINARY CONCEPTUAL SITE MODEL

Section 4.1 presents the chemical and radiological data available for each waste management unit. These chemical data, along with physical descriptions of the waste management units (Section 2.0) and descriptions of the surrounding environment (Section 3.0) are evaluated in Section 4.2 and 5.0 in order to qualitatively assess the potential impacts of the contamination to human health and to the environment. The quality and sufficiency of the existing data are assessed in Section 8.0. This information is also used to identify applicable or relevant and appropriate requirements (ARARs) (Section 6.0). Contaminant information is assessed in Section 7.0 to provide a basis for selecting technologies that can be implemented at the sites.

Contaminants released into the environment at a waste management unit or unplanned release site may migrate from the point of release into other types of media. The potentially affected media in the T Plant Aggregate Area include surface soil, surface water, vadose zone soil, perched groundwater, air, and biota. The media affected at a specific site will depend upon the quantities, chemical and physical properties of the material that was released, and the subsequent site history. The known or suspected sources sites, and the potentially affected media at each site are listed in Table 4-1 for radionuclide contamination and Table 4-2 for chemical contamination.

4.1 KNOWN AND SUSPECTED CONTAMINATION

There are two major categories of chemical and radiological data available for the T Plant Aggregate Area: site-specific data applicable to individual waste management units and unplanned releases; and area-wide environmental data that are useful in characterizing regional contamination trends.

Some waste management units and unplanned releases have been the subject of chemical and radiological studies in the past. However, most of these studies were limited in scope and did not provide a comprehensive analysis of the character and distribution of the contamination at each site. The types of site-specific data that are available for some sites include inventory information, surface radiological surveys, external radiation monitoring, soil and sediment sampling, biota sampling, borehole geophysics, and groundwater sampling.

Table 4-3 summarizes the types of site-specific data available for each of the waste management units. It should be emphasized that the table only summarizes what types of data are available; it does not indicate the sufficiency of the data, either in terms of quality or quantity. These concerns are addressed in Section 8.0. The site-specific information is presented for each waste management unit in Section 4.1.2.

In addition to these site-specific data, there are area-wide data not directly applicable to any waste management unit within the T Plant Aggregate Area. The most important sources

of this general environmental data are quarterly and annual environmental surveillance reports published by the Westinghouse Hanford Company (Westinghouse Hanford). There are also area-wide geophysical data available that include gravity, magnetic, magnetotelluric, seismic refraction, and seismic reflection surveys (DOE 1988). However, these studies are not useful for characterizing the extent of chemical and radionuclide contamination and so are not presented in Section 4.0. These data are discussed in more detail in Section 8.1.2.

Although groundwater issues are considered outside the scope of this study, some groundwater data have been included. Groundwater contaminant plumes known to have originated from specific waste management units are described because they offer insight into the distribution of contaminants within the overlying vadose zone. A limited amount of groundwater data are presented separately for some of the sites in Section 4.1.2.

The most recent environmental monitoring of the Hanford Site was conducted by the Pacific Northwest Laboratory (PNL) and Westinghouse Hanford. However, most of the data applicable to the T Plant Aggregate Area have been published by Westinghouse Hanford. The latest Quarterly Environmental Radiological Survey Summary Reports (Huckfeldt 1991a, 1991b, 1991c) were reviewed during the current study, as well as the last seven annually published environmental surveillance reports (Elder et al. 1986, 1987, 1988, 1989, Schmidt et al. 1990, 1991, 1992). The quarterly reports contain only surface radiological survey results. The annual reports describe several different sampling and survey programs including surface soil sampling, external radiation measurements, biota sampling, air sampling, surface water sampling, groundwater sampling, and radiological surveys.

Air, soil, surface water, and biota samples were collected each year at the same locations within the 200 West Area. External radiation measurements were also taken annually at several locations. Until 1990, few of the sample locations were directly associated with any of the identified waste management units and so most of this information is only useful in characterizing area-wide trends. In 1990, however, new sampling locations were established near areas of known surface contamination. Currently, only external radiation data are available for these new sample locations. Both the new and old sampling locations are shown on Plate 3.

Section 4.1 describes available data regarding known and suspected contamination in the T Plant Aggregate Area on a media-specific basis (air, surface soil, biota, and vadose zone soil). The text summarizes sources of chemical and radiological sampling information. Section 4.1.1 presents data on a media-specific basis. Section 4.1.1.1 presents results of air quality sampling data. Surface soil data are described in Section 4.1.1.2. Results of surface water sampling are presented in Section 4.1.1.3. Results of vegetation and other biota sample analyses are presented in Section 4.1.1.4. Available vadose zone sampling data are presented in Section 4.1.1.5. Section 4.1.1.5 also discusses evidence for contamination migration within the vadose zone to the unconfined aquifer underlying the site. Additional assessment of the nature and extent of groundwater contamination is presented in the 200 West Groundwater Aggregate Area Management Study (AAMS).

To supplement available radiological and chemical analytical data, historical waste inventory information for the T Plant Aggregate Area waste management units were also included in the evaluation of known and suspected contaminants. Historical waste inventory data are detailed in Section 2.0 of this report (Tables 2-4 and 2-5). As discussed in Section 2.0, the compilation is based on supporting data from the Waste Inventory Data System (WIDS) (WHC 1992a) and the Hanford Inactive Site Survey (HISS) Database.

4.1.1 Affected Media

4.1.1.1 Air. This section discusses results of ambient air monitoring applicable to the T Plant Aggregate Area as reported in RHO/WHC annual environmental surveillance monitoring reports (Elder et al. 1986, 1987, 1988, 1989, Schmidt et al. 1990, 1991). The last five years of data for the T Plant Aggregate Area are summarized in Table 4-4. The complete data set since 1985 is summarized in Appendix A.1.

Ambient air monitoring stations located within the T Plant Aggregate Area or near its boundary include sites N161, N987, N986, and N153, and N177 (Plate 3). As discussed in each of the RHO/WHC annual environmental monitoring reports for 1985 through 1990, the sampling locations are part of a larger network within the 200 Areas to assess the effect of operations on the local environment, and to assess 200 Areas facilities performance. According to the annual reports, sample station locations throughout the 200 Areas were sited based on prevailing wind directions and potential sources of airborne contaminants. Within the T Plant Aggregate Area, samples N986, 987 and 153 are located in and around the 241-TY-Tank Farm (Plate 3). Station N161 is east of Building 221-T, and N177 is south of the Laundry Facility (Building 177).

Air samples are collected by drawing samples through a 47-mm (1.8 in.), open-face filter at about 1 m (3 ft) above the ground with a 56 L/min (2 ft^3/min [cfm]) flow rate. Throughout the 200 Areas, air samplers are operated on a continuous basis. Sample filters are exchanged weekly, held one week to allow for decay of short-lived natural radioactivity, and sent for initial laboratory analyses of gross alpha and beta activity. The initial analyses serve as an indicator of potential environmental problems. After the initial analysis, the filters are stored until the end of the calendar quarter, at which time they are composited by sample location (or as deemed appropriate according to the annual reports) and sent for laboratory analyses of specific radionuclides. Compositing of the filters by sample location provides a larger sample size, and thus a more accurate measurement of the concentration of airborne radionuclides resulting from operations in the 200 Areas. Four laboratory analyses are routinely performed: ^{137}Cs, ^{90}Sr, ^{239}Pu, and total uranium. A more detailed description of the air sampling equipment and analyses methods are provided in the annual reports.

The results from this air sampling program have shown a steady decline in the concentration of these radionuclides since 1979 throughout the 200 West Area because of improvements in operational environmental controls and curtailed operations (Schmidt et al. 1990). In Table 4-4, the values are averages for each year with a detection since 1985.

In the T Plant Aggregate Area, none of the airborne monitoring samples taken resulted in notable comments in the summary sections of any of the annual reports (Elder et al. 1986, 1987, 1988, 1989, Schmidt et al. 1990, 1991).

4.1.1.2 Surface Soil. There are several sources of data available for characterizing surface soil contamination. These include: aerial and ground radiological surveys, external radiation measurements, and surface soil sampling. These data will be presented in the following sections. In addition, there is a limited amount of site-specific radiological and soil sampling data that will be presented in the appropriate subsections of Section 4.1.2.

4.1.1.2.1 Radiological Surveys. Radiological survey results may be influenced by buried or airborne radionuclide contamination but are generally indicative of surface and shallow soil contamination. Depending upon the instrumentation and survey techniques used, results may be reported in ct/min, dis/min, mr/hr, or mrem/yr. Typical natural background levels for these measurements are approximately: 50 ct/min, 2,000 dis/min, (for an NaI detector), .05 mr/hr, and 90 mrem/yr. An aerial gamma-ray radiation survey was performed over the 200 West Area in July and August 1988 (Reiman and Dahlstrom 1988). The survey lines were flown with a 122 m (400 ft) spacing at an altitude of 61 m (200 ft). The data were normalized to a height of 1 m (3.3 ft) above the ground surface. Figure 4-1 presents the gross count data (counts per second) on an isoradiation contour map that covers the entire 200 West Area.

The entire area has gross gamma counts that are above background. However, several high gamma count anomalies can be identified within the aggregate area. The highest gross count results in the T Plant Aggregate Area were between 220,000 and 700,000 ct/s measured over the TX/TY Tank Farm. The second highest results were between 22,000 and 70,000 ct/s measured over the 216-T-4 Pond and over the 241-T Tank Farm. The T Plant buildings, centered on Building 221-T also exhibited significant levels in the range of 7,000 to 22,000 ct/s.

It is nearly impossible to convert these gross gamma counts to a meaningful exposure rate because of the complex distribution of radionuclides on the site (Reiman and Dahlstrom 1988). Many of the spectra do not have readily identifiable photo peaks but rather occur on a smear or continuum. Also, aerial systems integrate radiation levels over an area whose diameter may be ten times the height of the platform above the ground. Because of the large-area integration of the airborne system, localized anomalies will appear to be spread over a larger area with lower activities than actually exist on the ground. Spectra logs were generated for each monitored area with levels greater than 7,000 ct/s. The only radionuclide peaks identified in the T Plant Aggregate Area were ^{137}Cs and ^{60}Co. Both of these relatively high energy gamma emitting fission products were detected at the T Pond. The ^{137}Cs was identified aerially at the T Plant buildings, centered on the 221-T Building, the T Tank Farm, and the TX/TY Tank Farm.

The aerial radiation survey data should only be used as a qualitative tool for identifying more highly contaminated areas within the survey boundaries. In addition, the gamma

counts noted in the survey probably result from both surface and shallow buried radionuclide emissions and pipe/tank radionuclide inventories, and are thus not entirely indicative of surface contamination.

Elevated radiation zones identified by the aerial survey generally correspond to areas where surface contamination has been noted by surface radiation surveys. Figure 4-2 shows areas of known surface contamination, underground contamination and migration identified from surface surveys (Huckfeldt 1991a, 1991b, 1991c). The primary areas of surface contamination noted in the T Plant Aggregate Area include the following:

- The 241-T, TX and TY Tank Farms
- The railroad tracks leading to 221-T Building
- The 216-T-4-2 Ditch and 216-T-4B Pond area
- An area west of 241-TX and 241-TY Tank Farms across Camden Avenue due to past unplanned releases
- The 216-T-14 to 17 Trenches
- The 216-T-21 to 25 Trenches
- Areas surrounding the 271-T Building.

Most of these areas fall within the anomalously high zones noted in the radiation survey. Areas of active surface contaminant migration include the following:

- The area adjacent and west of the 241-T Tank Farm. The T and TY Tank Farms received an extensive decontamination in late 1991 to help control this spread.

Table 4-5 summarizes the radiological survey results for each waste management unit and unplanned release. The areas of surface contamination and contaminant migration are discussed in more detail in the section dealing with the individual waste management units and unplanned releases (Section 4.1.2). Surface radiological surveys are done quarterly, semiannually, or annually at the waste management units. The surface contamination posting may change often because of resurveying and because of cleanups affected under the Radiation Area Remedial Action (RARA) program. This program is concerned with the management and control of surface contamination. These surveys yield data on gross contaminant levels (ct/min and dis/min) which are useful in identifying the presence of contamination at a waste management unit and in making available comparisons between waste management units.

4.1.1.2.2 External Radiation Dose Rate Measurements. Dose rates from penetrating radiation were measured annually at 13 locations in or adjacent to the T Plant Aggregate Area between 1985 and 1990. The sample locations are shown on Plate 3, and the survey results are listed on Table 4-6. The measurements were taken with thermoluminescent dosimeters (TLDs) and are reported in mrem/yr. The TLDs measure dose rates resulting from all types of external radiation sources including cosmic radiation, naturally occurring radioactivity, fallout from nuclear weapons testing and contributions from other Hanford Site activities. The average measured totals that exceeded 100 mrem/yr were in the areas east of 241-TX Tank Farm and north of the 216-T-4 Pond. The highest quarterly reading was located east of the 241-TX Tank Farm in 1988 and resulted in an estimated annual exposure level of 196 mrem/yr. The apparent trend from this data indicates that from 1985 to 1988, the general dose rates for the T Plant Aggregate Area increased. In 1989, there were only two measurement locations. These locations showed a reduction from previous years.

In 1990, new sampling locations were established giving the T Plant Aggregate Area five dosimeter sites. The new sites were generally located on or near areas of known contamination and the results appear to be slightly elevated over the previous sampling rounds. Generally, all facility and surface-water sites showed an approximate 10 percent decrease in 1990 (Schmidt et al, 1992). This overall decrease is believed to be a result of the external radiation monitoring program. Measurements were generally a little above 100 mrem/yr. The highest measured total was again east of the 241-TX Tank Farm (147 mrem/yr). These results are also summarized in Table 4-6 (Schmidt et al, 1990).

4.1.1.2.3 Surface Soil Sampling. Between 1978 and 1989, surface soil samples were collected annually from a regular rectangular grid that covers the 200 West Area with 35 sampling points. Fourteen of these sampling sites are located within or adjacent to the T Plant Aggregate Area. The sample points have never been exactly surveyed, but are generally located close to the intersections of Hanford Site coordinate lines at 610 m (1,000 ft) spacings. In addition, between 1984 and 1989, soils have also been sampled along fences enclosing the three tank farms in the 200 West Area. There are three soil samples associated with the 241-T, -TX, and -TY Tank Farms. None of the soil sampling locations was at waste management units or unplanned release sites, so these data cannot be applied directly to any site.

The results of the two soil sampling programs since 1985 are summarized in Tables 4-7 and 4-8. Tables that present all of the data collected since 1985 are contained in Appendix A.2. Counting errors are included with each analytical result and those entries that are less than the accompanying counting errors are denoted with a minus (-) sign. Entries with a minus sign indicate that the true value of the analytical results cannot be quantified. Analytical results with a minus sign should not, in most cases, be used for evaluations.

The most commonly detected radionuclides were ^{90}Sr, ^{137}Cs, ^{214}Pb, ^{238}Pu, ^{239}Pu, ^{152}Eu, and total uranium. However, only ^{137}Cs, ^{90}Sr, and ^{239}Pu were found consistently at concentrations above counting errors (Schmidt et al. 1990).

The highest radionuclide concentrations were generally noted in the vicinity of the 241-T and -TX Tank Farms. Using ^{137}Cs as an indicator of radionuclide concentrations, the highest most recent levels recorded (1989) were at 2W8, adjacent to the 241-T Tank Farm, and 2W13, east of 241-TX Tank Farm. However, the trend at these locations has been generally downward since 1978 indicating that the elevated ^{137}Cs levels are not because of current operations at the tank farm (Schmidt et al. 1990). The highest most recently recorded (1989) ^{90}Sr and ^{239}Pu concentrations were found at site 2W9, east of Building 221-T.

In 1990, new soil sampling locations were established that are located close to areas of known surface contamination. The locations of these new sites are shown on Plate 3. There are 17 new sample locations within or adjacent to the T Plant Aggregate Area. Two samples, one from the waste of TX Tank Farm, and one from the east of TY Tank Farm, (sample point 13 and 14, respectively), were not sampled because work was occurring in these areas. These two areas will be sampled in 1991 (Schmidt et al, 1992).

In 1990, it was concluded that the 200 Area contains several potential sources of environmental contamination including low-level waste disposal sites, tank farms,and processing facilities. By focusing of these facilities, a more effective program to identify and prevent adverse environmental impact will be achieved. The levels of contaminants, although low, are elevate above that of the off site average. As clean-up efforts progress, there should be a level or decreasing trend of concentrations in these samples (Schmidt et al, 1992).

4.1.1.2.4 Historical Waste Inventory Data. Soil contamination was caused by two primary routes, planned releases (e.g., ditches, trenches), and unplanned releases. The unplanned releases, while not as large in total activity sent to the soil, still resulted in significant quantities of contaminated soil. In the T Plant Aggregate Area, approximately 50% of the unplanned releases were caused by piping failures or diversion box leaks. Each of these releases resulted in some level of soil contamination. Some of these unplanned releases, including UN-200-W-14, 29, and 97 were initially remediated by removing the top layer of contaminated soil and covering the remaining contamination. At other unplanned releases, including UPR-200-W-28, the area of contaminated soil was covered with clean soil and temporarily posted as a radiation zone with the signs subsequently disappearing without available explanation (WHC 1992a). Adjacent to the east side of the 221-T Building, large areas of the ground have been covered with a spray encapsulant to control soil contamination spread.

4.1.1.3 Surface Water. No natural surface water bodies exist within the T Plant Aggregate Area. However, the active man-made 216-T-4-2 Ditch is still receiving waste water from the T Plant complex. Specific information on this trench is provided in Section 4.1.2. A summary of water quality data for the 216-T-4-2 Ditch is provided in Table 4-9. In 1991, the highest monthly result of 111 pCi/L was observed at 216-T-4 Ditch (Schmidt et al, 1992).

The only other active surface water discharge location in the T Plant Aggregate Area, according to WIDS documentation and coordinates, is the powerhouse pond. Field surveys of the powerhouse pond show it to be located south of the WIDS coordinates in the T Plant Aggregate Area as 216-U-14 Crib. For discussion purposes, the powerhouse pond will be addressed in the U Plant Aggregate Area Report (DOE-RL 1991d).

4.1.1.4 Biota. Westinghouse Hanford and PNL have conducted various biota sampling activities beginning in 1971 through 1988 inside as well as outside the Hanford Site. No upward trends in radionuclide concentrations were detected for any of the wildlife species examined (Eberhart et al. 1989). A significant downward trend was exhibited in many sample types, particularly ^{137}Cs.

Three factors are believed to have contributed to the decline in concentration of these radionuclides: the cessation of atmospheric testing, the 1971 shutdown of the last Hanford reactor that discharged once-through cooling water to the river, and the reduction of environmental radionuclide contamination associated with some Hanford Site facilities and operations.

Biota samples have been collected since 1978 from 14 sites within or adjacent to the T Plant Aggregate Area. Vegetation samples were collected from the same locations as the grid soil samples described in Section 4.1.1.2 (Plate 3). Average analytical results from 1985 through 1990 are compiled on Table 4-10. The complete data set from this sampling is presented in Appendix A.2.

Vegetation samples have generally had radionuclide concentrations that are slightly elevated above regional background (Schmidt et al. 1990). The most commonly detected radionuclides include ^{137}Cs, ^{90}Sr, ^{60}Co, ^{238}Pu, and ^{239}Pu. Grid site 2W8, adjacent to the 241-T Tank Farm, has usually had the highest ^{137}Cs concentrations in the area. In 1989, grid site 2W9, east of Building 221-T, had the highest ^{239}Pu and ^{90}Sr concentrations recorded at any of the T Plant Aggregate Area sampling sites. These site locations are consistent with the sites with elevated soil contamination. During 1986, increased contamination, primarily due to increased contaminated tumbleweed growth was found near the 216-T-3 Reverse Well and the 216-T-34 and -35 Cribs with a maximum reading of 5 mrad/hr (Elder et al. 1987). In 1988, increased ^{137}Cs concentrations were noted from vegetation samples from the 216-T-4-Ditch (Elder et al 1989). There have been no statistically significant trends in vegetation radionuclide concentration since 1979 (Schmidt et al. 1990).

In 1990, results from vegetation samples demonstrated that radionuclide concentrations are above regional background levels. These concentration are attributed to root uptake from the contaminated soils and deposition from airborne contaminants. The surface stabilization program, initiated in 1979, has significantly reduced the amount of contaminated vegetation and spread of wind-blown contamination. However, the control of deep-rooted vegetation on waste sites is becoming more of a problem. The restructuring of the herbicide program spray schedule and use of pre-emergent herbicides will help to correct the problem.

Nearly each year special biotic samples have also been analyzed in the T Plant Aggregate Area and found to be radioactively contaminated. Known radioactive samples from the last six years are coyote feces near 222-T Building (Elder et al. 1987), domestic pigeons from T Plant (Schmidt et al. 1990), and contaminated rabbit fecal material found near T Plant (Schmidt et al. 1990).

4.1.1.5 Vadose Zone. The extent of contamination in the vadose zone has been most extensively studied by geophysical well logging. Geophysical well logging has been conducted in the T Plant Aggregate Area since the late 1950s. Gross gamma-ray logs have been used since that time to evaluate radionuclide migration in the vadose zone beneath selected waste management units. Table 4-11 lists all of the logs that were reviewed as part of this study. The log interpretation generally consisted of identifying zones with anomalously high gamma-ray counts that could be indicative of radionuclide contamination. The depths, thicknesses and intensities of these zones were then compared for logs from the same holes. Any significant changes may be indicative of contaminant migration in the vadose zone. Interpretations were complicated by the fact that logging equipment and procedures have not been consistent. Attempts made to normalize data collected at different times met with limited success, and quantitative interpretations were not possible. The log interpretations are discussed in detail in Appendix A.1. The results of the log interpretations are also summarized with the appropriate waste management units in Section 4.1.2.

The only known vadose zone samples analyzed for contaminants have been as a result of a major leak from the 241-T-106 Tank (Rouston et al. 1979, WHC 1992a). Samples taken as a result of this leak, also identified as UPR-200-W-148, were used to determine the extent of contaminant migration. The only contaminants evaluated were ^{106}Ru, ^{144}Ce, and ^{137}Cs. These three radionuclides were chosen for evaluation because they span much of the radionuclide mobility range exhibited in the 241-T-106 Tank leak system. Cesium-137 is the least mobile and ^{106}Ru is the most mobile. It is estimated that 435,000 L (115,000 gal) leaked to the soil in an area extending 7 m (23 ft) horizontally from the tank and 33 m (108 ft) below the ground surface.

There are no known vadose zone chemical samples available from the T Plant Aggregate Area.

Waste management units that have received large volumes of liquid are more likely to cause subsurface contaminant migration. The potential for liquid wastes to migrate through the vadose zone to the groundwater can be estimated by comparing the volume of waste discharged at each waste management unit to the estimated pore volume in the vadose zone soil column below the waste management unit. If the volume of liquid discharged to the ground is larger than the total soil column pore volume, then it is likely that wastewater would reach the groundwater. These calculations are summarized on Table 4-12. They are based upon several conservative assumptions: (1) the discharged water does not spread out laterally from the point of discharge (i.e., the area of affected vadose zone is equal to the depth to groundwater multiplied by the plan view cross-sectional area of the base of the waste management unit), (2) there is no significant change in liquid volume being introduced

to the soil column due to evapotranspiration or precipitation, (3) the average pore volume of the soil column is 0.30, (4) groundwater migration may occur within an effective pore volume of 0.10. According to these calculations, 15 waste management units have the potential for the migration of liquid discharges to the unconfined aquifer based on a soil column pore volume of 0.30. If an effective pore volume of 0.10 is used, 18 total waste management units have the potential for discharge to the unconfined aquifer.

4.1.2 Site Specific Data

This section presents the site-specific data that are available for each waste management unit and unplanned release. The units are discussed in the same groups as were presented in Section 2.0. These groupings are useful because like units tend to have the similar types of available data.

4.1.2.1 Plants, Buildings, and Storage Areas. No site-specific data were compiled for any of the T Plant Aggregate Area plants, buildings, and structures.

4.1.2.2 Tanks and Vaults. The data available for the single-shell waste storage tanks (SSTs) generally include: inventory information, limited waste sampling, surface radiological surveys, vadose zone well geophysics, and internal tank monitoring of chemical and physical parameters. In the past, there has been much less emphasis in characterizing the catch tanks, settling tanks and vaults, and little information is available regarding these units. The following section is subdivided between SSTs and other tanks to reflect this difference. The T Plant Aggregate Area contains one vault-like structure, the 218-W-8 Burial Ground. This waste management unit is described in Section 4.1.2.9.

4.1.2.2.1 Single-Shell Tanks. All of the SSTs in the T Plant Aggregate Area are located within the boundaries of the 241-T, -TX, and -TY Tank Farms. In these areas, large quantities of liquid wastes were intentionally discharged from SSTs at T Plant directly to the ground (Waite 1991). In addition to the tank wastes discharged to the ground, tank wastes have also been released to the ground as a result of leaks from SSTs and transfer lines. Nineteen SSTs are assumed to have leaked at T Plant; the estimate of the volume of waste leaked is 690,000 L (180,000 gal) (WHC 1992a). Most of the long-lived radionuclides still remain in the tanks even though the total volume of liquid discharged exceeds that which is now in the tanks (Waite 1991).

Inventory Studies. Chemical inventories for the SSTs have been modeled with the Tracks Radioactive Components (TRAC) computer code developed by Westinghouse Hanford. This program calculated tank inventories for 68 radioactive constituents and 30 chemical constituents. The estimates were based on the historical records of the quantities of material initially placed in the tanks from nuclear fuel production and later modified by tank transfers and radioactive decay. The TRAC inventories, though recognized as having serious limitations, represent the best current information on the contents of the tanks. The TRAC predictions for ^{14}C, ^{137}Cs, ^{137}Ba, and uranium isotopes show the least agreement with other data sources. The results of this modeling are provided in Table 2-3.

Tank Waste Sampling. Chemical sampling has been performed on some of the tanks. The usefulness of these samples is very limited because: (1) very few radionuclides or organic chemicals were analyzed, (2) much of the sampling was done in the 1970's and material has been moved into and out of the tanks since that time, and (3) no attempt was made to collect samples that were representative of the tank as a whole. Much of the sampling was done in order to characterize the chemical composition of liquid that was to be sent through an evaporator.

The results of the TY Tank Farm sampling effort are documented in *TY Tank Farm Waste Characterization Data*, R.L. Weiss, March 1986, RHO-WM-TI-1 P. The information in Table 4-13 was compiled from analytical data sheets from the MO-037 Library. The table includes any radionuclide data that are available for each sample, as well as pH and total organic carbon (TOC) information. Solutions with low pHs and high TOC (organic solvents) would tend to enhance radionuclide migration through the soil column.

Chemical Explosion Potential. The two most significant flammable materials in Hanford SSTs are ferrocyanide and hydrogen. Ferrocyanide was added to some tanks to act as a cesium scavenger. Hydrogen can be produced as a product of radiation bombardment of water or organic materials as well as other routes. A watch list has been generated that ranks tanks according to their potential for flammable gas generation. The factors in this ranking include: surface level fluctuation, temperature, total curies of waste, organic content, volume of solids, waste type, pressurization, crust formation and past flammable gas detections. Six of the 241-T, 241-TX, and 241-TY Tank Farm tanks are suspected of having a ferrocyanide problem (241-T-101, 241-T-107, 241-TX-118, 241-TY-101, 241-TY-103, and 241-TY-104), one has the potential to generate significant quantities of hydrogen gas (241-T-110), and two are suspect due to high organic content (241-TX-105 and 241-TX-118) (Hanlon 1992).

Vadose Zone Well Geophysical Logging. Most of the SSTs are surrounded by an array of vadose zone wells. Gamma logging is performed on these wells on a regular basis in order to identify new tank leaks and to monitor the migration of existing contaminant releases to the soil. Table 4-14 summarizes the borehole geophysical data available for each tank. All of the assumed leaking tanks in the 241-T, 241-TX, and 241-TY Tank Farms exhibit elevated gamma radiation levels in their associated monitor wells.

241-T Tank Farm. This tank farm contains twelve 1,900,000 L (500,000 gal) and four 208,000 L (55,000 gal) SSTs (Hanlon 1992). The waste streams received by this tank farm were primarily bismuth phosphate first and second cycle metal waste and tributyl phosphate waste from the 221-T Building, and coating waste, ion-exchange waste, and high-level waste from the Reduction/Oxidation (REDOX) plant. The tank farm also received PNL waste, B Plant low-level waste, decontamination waste, evaporator bottoms, and 224-U waste from the 241-B, -BX, -C, and -SX Tank Farms (Hanlon 1992).

Tank 241-T-101. Shift logs, internal memos, and drilling and gamma logs for drywells at this unit suggest a spill occurred some time prior to 1973. The duration and quantity

of the release is unknown. Based on one vadose monitoring well, high-level wastes penetrated up to 37.2 m (122 ft) beneath the surface. Additional characterization is needed to confirm and/or assess the areal and vertical distribution of contaminants from their suspected tank overflow event (WHC 1992a).

Tank 241-T-102. This tank is believed to be sound (Hanlon 1992). No unplanned releases are associated with Tank 241-T-102.

Tank 241-T-103 (UPR-200-W-147). This tank is an assumed leaker (Hanlon 1992). One unplanned release has been associated with this tank (UPR-200-W-147). During drilling of monitoring wells to track the extent of a leak at Tank 241-T-106, radionuclide contamination was encountered near the 241-T-103 Tank. Subsequent investigations revealed that a leak resulted from a failed grout seal in a spare entry line. The data shows the radioactivity has preferentially moved toward the southeast. The greatest depth to which the liquid waste penetrated is about 25 m (82 ft) below the ground surface and is about 37 m (120 ft) above the water table (Cramer 1987).

Tank 241-T-104. This tank is believed to be sound (Hanlon 1992). No unplanned releases are associated with Tank 241-T-104.

Tank 241-T-105. This tank is believed to be sound (Hanlon 1992). No unplanned releases are associated with Tank 241-T-105.

Tank 241-T-106. This tank was removed from service and categorized as a confirmed leaker due to a large unplanned release (UPR-200-W-148). This release was assumed to have started on April 20, 1973 during a routine filling operation, however the leak was not detected until June 8, 1973. It is estimated the leak contaminated over 25,000 m^3 (33,000 yd^3) of soil. This unit was pumped to a minimum heel in June 1973 and was further pumped down to a residual layer of less than 15 cm (6 in.) in July 1974 (WHC 1990c). Test boreholes were made during 1975 to determine the extent of the leak plume for evidence of movement of the plume. Test results indicate that the plume is essentially stable, though some slow migration has been noticed toward the southeast. All wells adjacent to the tank contain significant levels of radioactive contamination. A description of the 241-T Tank Farm subsurface geology can be found in the Hanford report ARH-2874, *241-T-106 Tank Leak Investigation* (Atlantic Richfield 1973). This tank is now classified as an assumed leaker (Hanlon 1992).

Tank 241-T-107. This tank has three active monitoring wells. Readings from Drywell 50-07-07 in 1974 indicated a leak with a peak activity at 13 m (42 ft). Drywell 50-07-03 showed a peak in activity at 13 m (43 ft) in 1975. The peak activity grew to a maximum of 1,100 ct/s in March 1977 and has been slowly receding since September 1977. This tank has been listed as an assumed leaker (Hanlon 1992). No estimate of the volume leaked is available.

Tank 241-T-108. This tank has six active radiation monitoring wells. Tank 241-T-108 was removed from service in 1974 due to an unexplained decrease in liquid level of 0.76 cm (0.30 in.) (<3,800 L [<1,000 gal]). Activity was noted in drywell 50-08-07 and continued to increase through 1979. Exploratory Drywells 50-08-08, 50-08-19, and 50-11-11 were drilled in an effort to identify the leak source. It was concluded that Tank 241-T-106 is a potential source of the activity and the activity is migrating in the direction of Tank 241-T-108.

Tank 241-T-109. This tank is listed as an assumed leaker (Hanlon 1992). It was removed from service in 1974 due to increasing activity in Drywell 50-09-10 which is one of six wells for monitoring this tank. Activity in Drywells 50-09-01 and 50-09-02 has continued to decrease since first monitored in 1975. Activity in Drywells 50-09-09 and 50-09-10 has continued to decrease since 1976 (Stalos & Walker 1977). The volume leaked from this tank is estimated to be < 3,800 L (<1,000 gal).

Tank 241-T-110. This unit has the potential for hydrogen or other flammable gas generation (WHC 1992a). Because this unit contains solids, drywells are the only means of leak detection. Drywell activity remained stable through the mid 1970's (WHC 1990c).

Tank 241-T-111. This unit was categorized as having questionable integrity after an unexplained liquid level decrease of 0.76 cm (0.30 in.) in 1974; the tank is now classified as an assumed leaker (Hanlon 1992).

Tank 241-T-112. This unit received bismuth phosphate second cycle waste, PNL waste, decontamination waste, supernatant containing B Plant low-level waste and ion exchange waste from the 241-T Tanks. Drywells and liquid level measurements have remained stable (WHC 1992a).

Tank 241-T-201. Although this unit is no longer in service, there are repeated indications of increased water levels attributed to precipitation (WHC 1992a). When operational, this unit received 224-U Building waste. This tank is considered a non leaking tank (WHC 1992a).

Tank 241-T-202. Radiation readings in peripheral Drywell 50-00-08 have remained stable during the review period. Surface level measurements and in-tank photographs taken during the review period confirm liquid level increases from intrusions. This unit received 224-U Building waste (WHC 1992a).

Tank 241-T-203. Radiation readings from the one peripheral Drywell 50-00-08 have shown no significant changes. Surface level measurements have remained stable. This unit received 224-U Building waste (WHC 1992a).

Tank 241-T-204. Surface level measurements have remained stable. This unit received 224-U Building waste (WHC 1992a).

241-TX Tank Farm. This tank farm consists of eighteen 2,840,000 L (750,000 gal) SSTs (Hanlon 1992) and a receiver tank. The waste stream received by the TX Tank Farm was generated largely from the bismuth phosphate process used in the 221-T Building and to a lesser extent waste from the REDOX Plant. The waste stream contained uranium compounds and up to 90% of the original fission products, coating wastes from fuel rod processing operations, decontamination waste containing up to 10% of the original fission activity and as much as 1% plutonium, and second decontamination cycle waste that generally contained less than 0.1% of the original fission activity and as much as 1% plutonium. Other waste streams received by the TX Tank Farm include waste from the solidification program and the uranium recovery program (WHC 1992a). The fluid transferred to the tanks during their operation did not contain complexed waste (WHC 1992a).

The total quantity of waste estimated in the PNL Hazard Ranking Report to have entered the groundwater, at the 241-TX Tank Farm, is approximately 30,800,000 kg (34,000 tons) (Stenner et al. 1988). With the exception of Tank 241-TX-112, tanks with more than 2,300,000 L (600,000 gal) of stored waste are assumed to be leaking. Tank 241-TX-107 is the only tank assumed to be leaking that contains less than 3,800,000 L (100,000 gal) of waste (WHC 1992a).

Several drywells within the tank farm are used to monitor the soil for radioactivity, and serve as one form of leak detection. In addition, there are a series of groundwater monitoring wells around both the TX and TY Tank Farms that also monitor subsurface conditions. These wells are listed below:

2W-11-24	2W-14-10	2W-15-7
2W-14-2	2W-15-3	2W-15-10
2W-14-5	2W-15-4	2W-15-11
2W-14-6	2W-15-6	

Tank 241-TX-101. The cover blocks for this tank were sealed in January 1982. However, intrusions of precipitation, via the 241-TXR-152 Diversion Box, were demonstrated in October 1982. Drywells, the only means of leak detection for this tank, remained stable through 1977 (WHC 1990c).

Tank 241-TX-102. Drywells, the only means of leak detection for this tank, remained stable through 1977 (WHC 1990c).

Tank 241-TX-103. In 1977, two exploratory drywells, 51-03-01 and 51-03-11, were drilled to acquire additional data to evaluate high scintillometer measurements in well 51-03-12 at the 15-m (51-ft) level (See 241-TX-107). Drywells, the only means of leak detection for this tank, have remained stable through 1977 (WHC 1990c).

Tank 241-TX-104. Drywells, the only means of leak detection for this tank, remained stable through 1977 (WHC 1990c).

Tank 241-TX-105. Drywells, the only means of leak detection for this tank, remained stable through 1977 (WHC 1990c). Recent data identifies this tank as an assumed leaker (Hanlon 1992).

Tank 241-TX-106. Drywells, the only means of leak detection for this tank, remained stable through 1977 (WHC 1990c).

Tank 241-TX-107. High levels of radioactivity have been found in Well 51-07-18, strongly suggesting that liquid escaping from Tank 241-TX-107 is the source of the activity. The tank was confirmed as a source in May 1984. The leak has been designated UPR-200-W-149. During July 1977, after the tank was first classified as possibly leaking, the tank was pumped to a minimum level to remove as much of the supernatant material as possible (WHC 1992a).

Tank 241-TX-108. Drywells, the only means of leak detection for this tank, remained stable through 1977 (WHC 1990c).

Tank 241-TX-109. Drywells, the only means of leak detection for this tank, remained stable through 1977 (WHC 1990c).

Tank 241-TX-110. On March 27, 1974 the liquid level in the tank was reportedly 1.3 cm (0.5 in.) lower than expected. The tank was removed from service for observation. During the observation period no further declines in fluid level were observed and the drywell showed no readings above normal background. The decline in water level was assumed to be associated with loss to the offgas system (WHC 1990c). Recent data identifies this tank as an assumed leaker (Hanlon 1992).

Tank 241-TX-111. Drywells, the only means of leak detection for this tank, remained stable through 1977 (WHC 1990c). Recent data identifies this tank as being of sound integrity.

Tank 241-TX-112. Drywells, the only means of leak detection for this tank, remained stable through 1977 (WHC 1990c).

Tank 241-TX-113. Drywells, the only means of leak detection for this tank, remained stable through 1977 (WHC 1990c). Recent data identifies this tank as an assumed leaker (Hanlon 1992). The UPR-200-W-129 is associated with this waste management unit.

Tank 241-TX-114. All the drywells surrounding this tank have activity at 13 m (43 ft). Well 51-14-04 displayed an extensive profile change below the 15-m (48-ft) level in

1977 and 1978 (WHC 1992a). Recent data identifies this tank as an assumed leaker (Hanlon 1992).

Tank 214-TX-115. Tank 214-TX-115 was designated a "dormant" leaker in February 1975 because of increasing radiation peaks observed in adjacent drywells (WHC 1990c). The tank is filled with salt cake to a depth of 6.1 m (20 ft), containing the second greatest quantity of waste in the tank farm, only 241-TX-112 contains more waste (WHC 1992a). The tank is now listed as an assumed leaker (Hanlon 1992).

Tank 241-TX-116. Diatomaceous earth was added to this tank and approximately 378,000 L (100,000 gal) of supernatant fluid was removed in an unsuccessful stabilization attempt. Radiation monitoring of Drywell 51-16-11 in 1975 suggest the tank was still leaking. One more attempt to remove the remaining fluid was unsuccessful (WHC 1990c). Recent data identified this tank as an assumed leaker (Hanlon 1992).

Tank 241-TX-117. Photographs taken of the inside of the tank in November 1969 show a radial crack in the concrete dome. Diatomaceous earth was added to this tank in an unsuccessful stabilization attempt (WHC 1990c). Recent data identifies this tank as an assumed leaker (Hanlon 1992).

Tank 241-TX-118. On February 24, 1991 this unit contained up to 3 moles of ferrocyanide. The waste had a maximum temperature of 24 °C (75 °F). The tank contains potentially high concentrations of organic salts (Hanlon 1992). Recent data identified this tank as being of sound integrity (Hanlon 1992).

241-TY Tank Farm. This tank farm contains six 2,840,000 L (750,000 gal) SSTs (Hanlon 1992). The waste stream received by the TY Tank Farm was generated largely from the bismuth phosphate process used in the 221-T Building. The waste stream consisted of metal waste containing all of the uranium with up to 90% of the original fission products, coating wastes from fuel rod processing operations containing small amounts of fission products, decontamination waste containing up to 10% of the original fission activity and as much as 1% plutonium. The tank farm also received second decontamination cycle waste that generally contained less than 0.1% of the original fission activity and as much as 1% plutonium. Other waste streams received by the TX Tank Farm include waste from the solidification program and the uranium recovery program. The supernatant liquid transferred to the tanks during their operation did not contain complexed waste (WHC 1992a).

Several drywells within the tank farm are used to monitor the soil for radioactivity, and serve as one form of leak detection. In addition, there are a series of groundwater monitoring wells around the TX and TY Tank Farms that also monitor subsurface conditions. These wells are listed below:

2W-11-24	2W-14-10	2W-15-7
2W-14-2	2W-15-3	2W-15-10
2W-14-5	2W-15-4	2W-15-11
2W-14-6	2W-15-6	

Tank 241-TY-101. In February 1991 this unit contained up to 30 moles of ferrocyanide. The waste had a maximum temperature of 75 °F. Drywells, the only means of leak detection for this tank, remained stable through 1977 (WHC 1990c). Recent data identifies this tank as an assumed leaker (Hanlon 1992).

Tank 241-TY-102. This is the only tank in the TY Tank Farm containing salt cake. Drywell 52-02-11 was drilled in May 1975 to test the validity of using resistivity measurements as a method of leak detection by injecting a salt solution ($NaNO_3$) and monitoring formation response (WHC 1992a). In January 1989 the activity in the well increased from approximately 70 ct/s at a depth of 12 m (40 ft) to about 160 ct/s, and then stabilized (WHC 1992a). Recent data identifies this tank as the only sound tank in the 241-TY Tank Farm (Hanlon 1992).

Tank 241-TY-103. In February 1991 this unit contained up to 30 moles of ferrocyanide; the waste had a maximum temperature of 18 °C (65 °F). In February 1976, overflow of the 241-TX-155 Diversion Box catch tank (UPR-200-W-150) flowed back into the unit, depositing 3.3 cm (1.3 in.) of sludge waste. Drywells showed no significant increase that was attributable to this flooding event. The unit was removed from service in October 1973 because two drywells, 52-03-06 and 52-03-03, had shown radiation increases, suggesting leakage from this unit or 241-TY-105. Because the unit contains solids, drywells are the only means of leak detection. Activity remained stable through 1977 (WHC 1990c). Recent data identifies this tank as an assumed leaker (Hanlon 1992).

Tank 241-TY-104. In September 1991 this unit contained up to 20 moles of ferrocyanide; the waste had a maximum temperature of 22 °C (72 °F). This tank was classified as a "confirmed" leaker in June 1981 (WHC 1992a). Recent data identifies this tank as an assumed leaker (Hanlon 1992). The UPR-200-W-151 is associated with this waste management unit.

Tank 241-TY-105. Two drywells are associated with this unit. The radioactivity in both drywells may be the result of an unplanned release (UPR-200-W-152) of interstitial liquid (WHC 1992a). The unit was removed from service as a "confirmed" leaker. Recent data identifies this tank as an assumed leaker (Hanlon 1992). The UPR-200-W-152 is associated with this waste management unit.

Tank 241-TY-106. The unit was designated a "confirmed" leaker and removed from service; the leak has been designated UPR-200-W-153. Routine surveillance of

radiation drywells had indicated a change of profile in Drywell 52-06-05, which now appears to have stabilized (WHC 1992a). The waste involved is identified as tributyl phosphate in unknown quantities. The tank was stabilized with diatomaceous earth (Cramer 1987). Recent data identifies this tank as an assumed leaker (Hanlon 1992).

4.1.2.2.2 Settling Tank. The T Plant Aggregate Area contains one settling tank.

241-T-361 Settling Tank. No sample data is available for the contents of this tank.

4.1.2.2.3 Receiver Tank. The T Plant Aggregate Area contains one receiver tank.

244-TX Receiver Tank. This active double contained receiver tank receives waste from the T Farm, TX Farm, TY Farm, and Z Plant. In September 1991 this tank contained 98,480 L (26,019 gal) of waste (Hanlon 1992). No information was found to indicate that this tank has released any waste to the soil.

4.1.2.2.3 Catch Tanks. The T Plant Aggregate Area contains seven catch tanks.

241-T-301 Catch Tank. No information was found to indicate that any releases have occurred from this unit.

241-T-302 Catch Tank. Drainage from the 241-T-152 Diversion Box flowed to this tank. No information was found to indicate that any releases have occurred from this tank.

241-TX-302-A Catch Tank. No information was found to indicate that any releases have occurred from this inactive tank.

241-TX-302-B Catch Tank. This catch tank serviced the 241-TX-155 Diversion Box. The unplanned release UN-200-W-131 resulted from this catch tank leaking 3,800 L (1,000 gal) of metal waste supernatant.

241-TX-302-C Catch Tank. This active catch tank services the 241-TX-153 Diversion Box and is associated with the UPR-200-W-21 and UPR-200-W-160 unplanned releases.

241-TY-302-A Catch Tank. No information was found to indicate that any releases have occurred from this inactive tank. Recent tours of the area indicate that the catch tank is posted as an area of surface contamination.

241-TY-302-B Catch Tank. Drainage from the 241-T-151 Diversion Box flowed to this catch tank. No information was found to indicate that any releases have occurred from this tank.

4.1.2.3 Cribs and Drains. The T Plant Aggregate Area contains 15 cribs and 1 french drain. The types of information available for the cribs, drains, and drain fields include inventory data, radiological survey results, and borehole geophysical data. Soil, vegetation,

and air monitoring data are generally unavailable for these sites. Inventory and radiological information have largely been compiled from the WIDS sheets (WHC 1992a) and the HISS database entries.

4.1.2.3.1 216-T-6 Crib Pair. This pair of cribs (216-T-6-1 and 216-T-6-2) is located just west of the 216-T-3 Reverse Well. Wells W11-1 and W11-54 through W11-67 monitor the two cribs. Most of the radioactive contaminants are concentrated beneath Crib 1 in the upper 15.5 m (50.8 ft) of the sediment column (Fecht et al. 1977). Plutonium contamination was detected as much as 6.1 m (20 ft) below the bottom of the cribs and had spread laterally about 14 m (45 ft) as of 1947. Fission products had penetrated to a depth of 32.6 m (107 ft) below the bottom of the crib and spread laterally 29 m (95 ft) (Maxfield 1979)

4.1.2.3.2 216-T-7-TF Crib and Tile Field. This crib received second-cycle supernatant waste from the 221-T Building via the 241-T-112 Tank and cell drainage from Tank 5-6 in the 221-T Building. It also received waste from the 224-T Building after sludge buildup in the 201 through 204-T Tanks caused the closing of Crib 216-T-32. The 216-T-7-TF Crib and Tile Field was deactivated by capping the pipeline to the crib and re-routing the effluent to the 216-T-19 Crib (WHC 1992a).

Wells W10-3, W10-59, W10-60, W10-61, W10-62, W10-63, W10-66, W10-67, and W10-68 monitor this crib. Wells W10-69, W10-70, W10-71, W10-72, W10-74, W10-77, W10-78, W10-79, W10-80, and W10-81 monitor the tile field. Scintillation profiles from Well W10-3 suggest radionuclides beneath the 216-T-7 Crib have moved downward in the sediment column 1.8 m (6 ft) between 1959 and 1976. The data from this well also indicate that breakthrough to groundwater could have occurred at this waste management unit (Fecht et al. 1977).

4.1.2.3.3 216-T-8 Crib. The 216-T-8 Crib is an inactive waste management unit located 15 m (50 ft) south of Building 222-T. The monitoring well nearest to the 216-T-8 Crib is the W11-3 Well which is 15 m (51 ft) west and 71.6 m (235 ft) south of the crib.

4.1.2.3.4 216-T-18 Crib. Well 299-W11-11 monitors this crib and indicates that breakthrough to groundwater has not occurred at this waste management unit (Fecht et al. 1977). The crib area was surface stabilized in May 1990 (Schmidt et al. 1991).

4.1.2.3.5 216-T-19-TF Crib and Tile Field. Until July 1955, this waste management unit received the process condensate from the waste evaporator in Building 242-T. From December 1955 to August 1956, the waste management unit received cell drainage from Tank 5-6, second-cycle supernatant waste from Building 221-T, and waste from Building 224-T. From January 1966 to April 1976, the crib was bypassed due to a cave-in and the file field received process condensate and steam condensate from the waste evaporator in Building 242-T. The waste management unit received liquid cold-cell drainage from 1976 until 1980 when the line was blanked and the waste management unit retired.

Well W15-4 monitors the 216-T-19 Crib. Wells W14-51, W14-52, W15-65, and W15-66 monitor the 216-T-19 Tile Field. In 1959 radioactive contamination was detected in Well W15-4 from 3.2 m (10 ft) below the ground surface to the water table, 56.7 m (186 ft) beneath the ground surface (Fecht et al. 1977). The four tile field wells show only background levels of radioactivity.

4.1.2.3.6 216-T-26 Crib. The 216-T-26 Crib received first cycle scavenged tributyl phosphate supernatant T Plant wastes (Stenner et al. 1988). Chemical additives were used to settle the ^{137}Cs.

Well W11-70 is a shallow monitoring structure that monitors the 216-T-26 Crib. Radioactive contaminants were detected from near the ground surface to a depth of 28.9 m (94.8 ft). The waste inventory indicates most of the contamination detected in the profiles is ^{137}Cs (WHC 1992a).

For over the past ten years, Russian thistles containing strontium and cesium were often found growing on the surface of this crib waste management unit. Some thistles which were not removed have deteriorated, contaminating the ground surface. A radiation survey performed in May 1975 revealed localized surface contamination to a maximum of 30,000 ct/min (WHC 1992a). A remedial action was performed in 1975, which consisted of blading off the top 15 cm (6 in.) of soil and replacing the excavated material with clean fill to the original grade (WHC 1992a). This crib waste management unit was surface stabilized on May 21, 1990 (WHC 1992a).

4.1.2.3.7 216-T-27 Crib. This crib received 300 Area laboratory wastes from PNL 340 Facility via tank truck (WHC 1992a) and wastes from the 221-T Building via the 241-T-111 and -112 Tanks (WHC 1991a).

Diversion of wastes to the 216-T-27 Crib was initiated following breakthrough of strontium and cesium to the groundwater under Crib 216-T-28 (Section 4.1.2.3.10). A sudden increase (factor of four) in activity occurred beneath the inactive 216-T-28 Crib during the period in which the PNL waste was discharged to 216-T-27. Subsequently, it was determined that this material does not react favorably with soil (WHC 1991a). Each time waste was pumped to 216-T-27, groundwater samples taken near the 216-T-28 Crib increased in radioactivity.

Well 299-W14-53 monitors the 216-T-27 Crib. Radioactive contaminants detected in the well prior to use of the crib are due to waste discharged to the 216-T-28 Crib immediately to the south. Discharges to the crib from 1965 to 1970 increased the size of the contaminated zone and the intensity of radiation. In 1976 the radiation intensity began to decrease due to radionuclide decay. On the basis of the scintillation probe profiles since crib operations were terminated, no measurable movement of radionuclides beneath the 216-T-27 Crib has been detected. The data indicate that breakthrough to the groundwater has not occurred at this waste management unit (Fecht et al. 1977). The evaluation of this data is provided in Appendix A.

Strontium and cesium contamination was discovered in Russian thistles growing on the waste management unit. Stabilization and surface remediation at this crib took place in 1975, along with the 216-T-26 Crib. As of October 1989, the waste management unit had 2,000 to 50,000 dis/min general contamination, with a direct reading on a riser of 25 mR/hr non-smearable (WHC 1992a). The crib was surface stabilized in May 1990 along with Cribs 241-T-26 and 241-T-28.

4.1.2.3.8 216-T-28 Crib. This crib was active from February 1960 until 1966, and received liquid mixed waste (WHC 1992a). Waste constituents included the following:

- Steam condensate decontamination waste
- Miscellaneous effluents from the 221-T Building
- Decontamination waste from the 2706-T Building
- 300 Area laboratory waste from the 340 Facility.

Wells W11-62, W11-82, W14-2, W14-3, W14-4, and W-14-53 monitor the crib (Fecht et al. 1977). Strontium and cesium contamination was discovered in Russian thistles growing on the waste management unit. Stabilization and surface remediation took place in 1975, along with the 216-T-26 and 27 Cribs. As of October 1989, the waste management unit had 2,000 to 50,000 dis/min general contamination, with a direct reading on riser of 25 mR/hr non-smearable (WHC 1992a). The crib was stabilized in May 1990 along with the 241-T-26 and 241-T-27 Cribs.

4.1.2.3.9 216-T-29 Crib. The crib was deactivated when the sand filter bypass water seal was removed, allowing the 221-T Building exhaust air to flow directly to the 291-T-1 Stack (WHC 1991a). The 291-T sand filter inlet trenches drain to a french drain pipe extending into the ground at the north corner of the sand filter. Any moisture condensed from the canyon air on the filter bed will escape to the ground at this location. The amount and the radioactivity are both thought to be very low (Maxfield 1979). Recent site visits indicate that the seams on top of the filter have been coated with plastic and sealed. This waste is considered potentially acidic given the presence of nitric acid (Stenner et al. 1988, Cramer 1987).

4.1.2.3.10 216-T-31 French Drain. This drain is a registered underground injection well which was contaminated by steam condensate from a steam line blowout during efforts to unplug a waste line in October 1954. The drain was replaced in 1959; contaminated gravel and soil were removed and buried in the 200 West Area Dry Burial Ground. The waste management unit was released from radiation zone status in February 1962 (WHC 1992a).

4.1.2.3.11 216-T-32 Crib. The 216-T-32 Crib received waste from the 224-T Building via the 241-T-201 Tank in the 241-T Tank Farm. The crib is monitored by

Wells W10-56, -57, -58, -64, -65, -73, -75, and -76. Low levels of radiation have been detected between 8 and 35 m (26 and 114 ft) below ground surface (Fecht et al. 1977).

4.1.2.3.12 216-T-33 Crib. The waste management unit was used the first two months of 1963 before the perforations in the tile line at the discharge point to the unit became plugged. The amount of liquid that actually reached the unit has been questioned by plant operation management, who believed the line to the unit retained all of the waste. No surface contamination has been found at this crib waste management unit (Maxfield 1979). Sections of the tile line were removed and the building effluent was rerouted to the 216-T-28 Crib via the 112-T Tank in the 241-T Tank Farm (WHC 1991a). The waste management unit surface was stabilized in July 1991.

Wells W-11 through -14 monitor this unit. Data indicate that breakthrough to groundwater has not occurred at this waste management unit (Fecht et al. 1977).

4.1.2.3.13 216-T-34 Crib. Activity was detected in the groundwater beneath the 241-T-34 Crib in 1966 after five months of operation (WHC 1991a). Wells W11-15 and W11-16 monitor the 216-T-34 Crib. Near background levels of radiation are detected in these wells. Breakthrough to the groundwater at this waste management unit is not indicated by scintillation probe data and waste volume (Fecht et al. 1977).

The tanker unloading station and associated underground piping still remains at the northwest corner of this unit. During the construction and tie-in of the companion 216-T-35 Crib in February 1976, low-level beta/gamma soil contamination to 30,000 ct/min was found around the 216-T-34 Unloading Station piping (Maxfield 1979). Forty cubic yards of contaminated soil were removed and buried in the 200 West Dry Burial Ground. Residue contamination still remains near the ground surface at the unloading station (Maxfield 1979). The waste management unit surface was stabilized in July 1990 (Huckfeldt 1990).

4.1.2.3.14 216-T-35 Crib. Low-level subsurface contamination was reported for a small area near the unloading station. (See 216-T-34 crib.) However, radioactive surface contamination at the 216-T-35 Crib has not been documented (Fecht et al. 1977).

Wells W-11, and -17 through -21 monitor this unit. Data indicate that breakthrough to groundwater has not occurred at this waste management unit (Fecht et al. 1977). The surface of this waste management unit was stabilized in July 1990 (Huckfeldt 1990).

4.1.2.3.15 216-T-36 Crib. This crib received steam condensate decontamination and miscellaneous waste from Buildings 221-T and 221-U (WHC 1992a).

Wells W10-2 and W10-4 monitor the 216-T-36 Crib. Scintillation probe profiles indicate that breakthrough to the groundwater has not occurred at this waste management unit.

4.1.2.3.16 216-W-LWC Crib. The active 216-W-LWC Crib receives process wastewater from the laundry, 2724-W, and previously from the respiratory building, 2723-W (WHC 1992a). Wells W14-08, W14-10, and W15-08 monitor the 216-W-LWC Crib.

4.1.2.4 Reverse Wells. The T Plant Aggregate Area contains two reverse wells.

4.1.2.4.1 216-T-2 Reverse Well. The 216-T-2 Reverse Well is a registered underground injection well that received decontamination sink waste and sample slurper waste from the 222-T Building (Stenner et al. 1988, DOE 1988).

4.1.2.4.2 216-T-3 Reverse Well. The 216-T-3 Reverse Well is a 62.8-m (206-ft) deep, registered underground injection well. This well received of cell drainage from Building 221-T (Tank 5-6), as well as overflow from the 241-T-361 Settling Tank consisting of 224-T Building wastes.

In August 1975, the aboveground piping was removed, all sinkholes were filled, and the ground surface was decontaminated and leveled (Maxfield 1979). The well is enclosed in the same compound as the 241-T-361 Settling Tank. Two monitoring wells are located in the compound near the well. The W11-7 Well monitors the 216-T-3 Reverse Well. The October 1988 and 1989 surveys identified general surface contamination at 3,000 dis/min and non-smearable contamination on the riser at 55,000 dis/min. The June 1990 survey detected no contamination around the waste management unit perimeter. Only the waste management unit perimeter was surveyed apparently due to a cave-in potential.

4.1.2.5 Ponds, Ditches, and Trenches. There are 3 ponds, 3 ditches, and 16 trenches in the T Plant Aggregate Area.

4.1.2.5.1 Pond 216-T-4A. This inactive pond received cooling water and steam condensate from 221-T, 224-T, and 242-T, and decontamination waste from 2706-T.

4.1.2.5.2 Pond 216-T-4B. This active pond was placed in operation in May 1972 replacing the 216-T-4A Pond. This pond has been considered dry since 1977 due to the low volume of wastewater discharged to the 216-T-4-2 Ditch which feeds this pond.

4.1.2.5.3 Ditch 216-T-1. This active ditch has received miscellaneous waste from the 221-T head end, cooling water, and steam condensate. The surface of the bottom of the 216-T-1 Ditch is contaminated with very low-level radioactivity. Activity at the head of the ditch reads 1,500 ct/min (Maxfield 1979). A list a chemicals discharged to this ditch is contained in Table 4-15.

4.1.2.5.4 Ditch 216-T-4-1D. This ditch fed wastewater to the 216-T-4A Pond. The berm for the new 216-T-4-2 Ditch was used to cover this ditch in 1972.

4.1.2.5.5 Ditch 216-T-4-2. This active ditch was put into operation in May 1972, replacing the 216-T-4-1D Ditch. A list a chemicals discharged to this ditch is contained in Table 4-16.

4.1.2.5.6 200-W Powerhouse Pond. The powerhouse pond, based on coordinates from WHC 1992a, is located in the T Plant Aggregate Area. Field surveys of the powerhouse pond show it to be located south of the WIDS coordinates in the U Plant Aggregate Area in an excavated portion of the previous 216-U-14 Ditch. Water quality samples are taken weekly, composited, and analyzed monthly for total beta, total alpha, ^{137}Cs, ^{90}Sr, pH, and nitrate. The results of these samples are presented in Table 4-10 of the U Plant AAMS (DOE/RL-91-52). This waste management unit will be recommended for inclusion in the U Plant aggregate area.

4.1.2.5.7 Trench 216-T-5. This trench received second-cycle supernatant waste from the 221-T Building via the 112-T Tank in the 241-T Tank Farm.

When deactivated, the aboveground piping was removed and the trench was backfilled. Well W10-1 is used to monitor the trench. A scintillation probe survey performed in 1959 indicated the presence of radioactivity from the surface to a depth of 38.1 m (125 ft). Since 1959, the activity has decreased and in 1976 the radiation levels were near background (Fecht et al. 1977).

4.1.2.5.8 Trenches 216-T-9, 216-T-10 and 216-T-11. All of these trenches received heavy equipment and vehicle decontamination waste. In 1954, the trenches were backfilled and decontamination operations were transferred to 216-T-13. The waste management units were exhumed in May 1972, and released from radiation zone status. No radioactivity or evidence of chemical buildup was found in the waste management units (Stenner et al. 1988).

4.1.2.5.9 Trench 216-T-12. The 216-T-12 Trench received contaminated sludge from the 207-T Retention Basin in 1954 (Stenner et al. 1988). Activity of the sludge read a maximum of 15 mR/hr at the time of burial. The radioisotopes thought to be present are: ^{137}Cs, ^{106}Ru, and ^{90}Sr (Maxfield 1979). The waste management unit was deactivated when the removal of sludge from the retention basin was completed, by backfilling with clean soil (Maxfield 1979).

Well W11-26 monitors the 216-T-26 Trench. No contamination has been detected in this well.

4.1.2.5.10 Trench 216-T-13. The 216-T-13 Trench received liquid mixed wastes from vehicle decontamination between June 1954 and June 1964. The waste management unit was excavated in April 1972, and 3 m^3 (4 yd^3) of soil were buried in the 200 West Area Dry Waste Burial Ground. The trench is covered with 3 m (10 ft) of backfill. Emissions up to 1,500 ct/min were measured in the excavated soil (WHC 1992a).

4.1.2.5.11 Trenches 216-T-14, 216-T-15, 216-T-16 and 216-T-17. Trenches -14, -15, -16 and -17 received the first cycle supernatant waste from the 221-T Building via the 241-T-104, -105, and -106 Tanks in the 241-T Tank Farm.

In May 1970, radioactive russian thistles were found growing on these units and had a maximum reading of 15 mR/hr. To clean these waste management units, the weeds were removed and the entire surface of the radiation zone was treated with trisden-dimethylamine salts of trichlorobenzonic. The herbicide treatment was completely effective until the summer of 1976, when a few nonradioactive weeds appeared (Maxfield 1979).

Wells W11-68, W11-69, W11-80, and W11-81 monitor the 216-T-14 Trench. Scintillation profiles for Well W11-68 indicate that breakthrough to the groundwater has not occurred at this waste management unit (Fecht et al. 1977).

4.1.2.5.12 Trench 216-T-20. This trench received contaminated nitric acid from the 241-TX-155 Diversion Box catch tank. It was deactivated the same month by backfilling and removing the above-ground piping (WHC 1992a). This trench was excavated in November 1952.

4.1.2.5.13 Trenches 216-T-21, 216-T-22, 216-T-23 and 216-T-24. These units are specific-retention trenches, and received first-cycle supernatant waste from the 221-T Building via the 109, 110, and 111-TX Tanks.

In September 1969, radioactive thistles were found growing above 216-T-21 and 216-T-24. In May 1970, all of the trenches were treated with herbicide. The area recovered the vegetative cover by 1977, but no radioactive weeds were discovered (WHC 1992a).

Shallow Well W15-80 also monitors the 216-T-21 Trench. The W15-80 Well shows bands of contamination at 11 and 17 m (35 and 55 ft) as well as contamination at the bottom of the well (30 m [100 ft]). This well was in place prior to the trench use therefore the contamination at the well bottom could represent waste which flowed down the outside of the well casing. No gamma contamination was detected in well W15-81, located just west of 216-T-22 (Fecht et al. 1977). Groundwater samples taken in 1983 from well W14-2, which monitors the 216-T-24 Trench, showed elevated nitrate concentrations of 155 mg/L. Additionally wells W15-209, W15-210, and W15-211 monitor the 216-T-21 Trench.

4.1.2.5.14 Trench 216-T-25. This trench received first-cycle evaporator bottom, which consists of sludge from condensed first-cycle wastes from the 242-T Building via the 101 and 102-TY Tanks (WHC 1992a).

4.1.2.6 Septic Tanks and Associated Drain Fields. A total of six septic tanks, all active, are located in the T Plant Aggregate Area.

4.1.2.6.1 2607-W1 Septic Tank and Drain Field. This active drain field receives an estimated 18,300 L/day (4,831 gal/day) of sanitary wastewater and sewage (Cramer 1987).

4.1.2.6.2 2607-W2 Septic Tank and Drain Field. This active drain field receives an estimated 10,200 L/day (2,693 gal/day) of sanitary wastewater and sewage (Cramer 1987).

4.1.2.6.3 2607-W3 Septic Tank and Drain Field. This active drain field receives an estimated 14,200 L/day (3,749 gal/day) of sanitary wastewater and sewage (Cramer 1987). An access port to the tank has a radioactive material warning sign.

4.1.2.6.4 2607-W4 Septic Tank and Drain Field. This active drain field receives an estimated 10,600 L/day (2,799 gal/day) of sanitary wastewater and sewage (Cramer 1987).

4.1.2.6.5 2607-WT Septic Tank and Drain Field. This active drain field receives an estimated 20 L/day (5 gal/day) of sanitary wastewater and sewage.

4.1.2.6.6 2607-WTX Septic Tank and Drain Field. This active drain field receives an estimated 740 L/day (195 gal/day) of sanitary wastewater and sewage.

4.1.2.7 Transfer Facilities, Diversion Boxes, and Pipelines This section provides information regarding known and suspected contamination related to 14 diversion boxes and pipelines.

4.1.2.7.1 241-T-151 Diversion Box. This diversion box has been isolated and weather covered. An unplanned release, UN-200-W-7 (alias UPR-200-W-7) occurred during work on the 241-T-151 and -152 Diversion Boxes (ref. HW-60807, WHC 1992a). Catch Tank 241-TY-302-B is associated with this diversion box.

4.1.2.7.2 241-T-152 Diversion Box. This unit has been isolated and weather covered. An unplanned release occurred during work on the 241-T-151 and -152 Diversion Boxes. See Section 4.1.5.1 for description of incident. The 241-T-302 Catch Tank is associated with this diversion box.

4.1.2.7.3 241-T-153 Diversion Box. No information was found to indicate that any releases have occurred from this unit.

4.1.2.7.4 241-T-252 Diversion Box. This unit has been isolated and weather covered. No information was found to indicate that any releases have occurred from this diversion box.

4.1.2.7.5 242-T-151 Diversion Box. No information was found to indicate that any releases have occurred from this inactive unit.

4.1.2.7.6 241-TR-153 Diversion Box. This unit has been isolated and weather covered. No information was found to indicate that any releases have occurred from this diversion box. The diversion box is however posted as an area of surface contamination.

4.1.2.7.7 241-TX-152 Diversion Box. No information was found to indicate that any releases have occurred from this active diversion box.

4.1.2.7.8 241-TX-153 Diversion Box. This unit has been isolated and weather covered. Information was found relating to six unplanned releases related to this diversion box. These unplanned releases are identified as UN-200-W-29, UN-200-W-62, UN-200-W-63, UN-200-W-64, UN-200-W-97, and UPR-200-W-126. The 241-TX-302-A and -B Catch Tanks are associated with this diversion box.

4.1.2.7.9 241-TX-154 Diversion Box. Information was found regarding three unplanned releases related to this active diversion box. These unplanned releases are identified as UN-200-W-38, UPR-200-W-21, UPR-200-W-160. The 241-TX-302-C Catch Tank is associated with this diversion box.

4.1.2.7.10 241-TX-155 Diversion Box. This inactive diversion box has been isolated and weather covered. Six unplanned releases associated with this unit were found. These releases are identified as UN-200-W-76, UN-200-W-113, UN-200-W-135, UPR-200-W-5, UPR-200-W-28, and UPR-200-W-131.

4.1.2.7.11 241-TXR-152 Diversion Box. This unit has been isolated and weather covered. No information was found to indicate that any releases have occurred from this diversion box.

4.1.2.7.12 241-TXR-153 Diversion Box. This unit has been isolated and weather covered. No information was found to indicate that any releases have occurred from this diversion box. A recent waste management unit visit found that the box was posted with surface contamination warning signs.

4.1.2.7.13 241-TY-153 Diversion Box. This unit has been isolated and weather covered. No information was found to indicate that any releases have occurred from this diversion box. The 241-TY-302-A Catch Tank is associated with this unit.

4.1.2.7.14 241-TR-152 Diversion Box. This unit has been isolated and weather covered. No information was found to indicate that any releases have occurred from this diversion box.

4.1.2.8 Basins. One basin is associated with the T Plant Aggregate Area.

4.1.2.8.1 207-T Retention Basin. This active basin currently receives potentially low-level radioactive cooling water and steam condensate from the 221-TA and 224-T facilities which is discharged to the 216-T-4-2 Ditch. In the past this waste management unit has received low-level radioactive waste.

4.1.2.9 Burial Sites. The T Plant Aggregate Area contains two types of burial grounds, the 200-W Powerhouse ash related waste management units and the 218-W-8 Burial Ground

vaults. The 200-W Powerhouse has two ash related waste management units called the 200-W Ash Disposal Basin and the 200-W Powerhouse Ash Pit. Each of these waste management units serves a separate function. In addition, the 200-W Ash Disposal Basin is associated with two other waste management units, the 200-W Ash Pit Demolition Site and the 200-W Burning Pit. The 200-W Ash Pit Demolition Site is included in the Tri-Party Agreement as an active TSD. The 218-W-8 Burial Ground was used for the disposal of radioactive laboratory process wastes. The locations of these sites are shown in Figures 2-12 and 2-13. These burial sites are grouped as follows:

- 200-W Ash Disposal Basin
  200-W Ash Pit Demolition Site
  200-W Burning Pit

- 200-W Powerhouse Ash Pit

- 218-W-8 Burial Ground

4.1.2.9.1 200-W Ash Disposal Basin. The 200-W Burning Pit, and 200-W Ash Pit Demolition Site are located within the boundaries of this active basin.

4.1.2.9.2 200-W Ash Pit Demolition Site. This active treatment, storage, or disposal (TSD) demolition waste management unit is used for treatment of shock-sensitive or potentially explosive chemical wastes. This waste management unit (not included in the Tri-Party Agreement) is located in the northern portion of the 200-W Ash Disposal Pit. Table 4-17 lists the materials burned in this pit during 1984, 1985, and 1986. In that this waste management unit is an active permitted waste management unit, the chemicals detonated in this pit are not considered contaminants of concern for the T Plant Aggregate Area.

4.1.2.9.3 200-W Burning Pit. This pit was used from 1950 to 1970 to burn construction and office waste (15,000 m^3 [19,600 yd^3]), paint waste, and chemical solvents (1,000 L [264 gal])). This pit is located on the south end of the 200-W Ash Disposal Basin. With the exception of the three unplanned releases (UPR-200-W-37, UPR-200-W-70, and UN-200-W-8) no radioactive material was discarded to this waste management unit.

4.1.2.9.4 200-W Powerhouse Ash Pit. This pit currently contains 43,800 m^3 (57,290 yd^3) of ash from the 284-W Power Plant. This pit is not physically associated with the 200-W Ash Disposal Basin. No radioactive materials have been discharged to this pit.

4.1.2.9.5 218-W-8 Burial Ground. This inactive burial waste management unit was used for disposal of process sample waste from the 222-T Laboratory. No chemical inventory data was found.

4.1.2.10 Unplanned Releases. There is very little chemical or radiological data available for any of the unplanned releases. Any information which was found is summarized in Section 2.3.10 and Table 2-6. No information regarding contamination materials or

quantities were found for the UN-200-W-3, UN-200-W-27, and UN-200-W-77 unplanned releases. It should be noted that some of the wastes contained significantly higher radionuclide levels at the time of discharge because of short lived fission products. For example, wastes discharged to the ground from the uranium recovery process contained very high levels of ^{106}Ru. Ruthenium-106 has a half-life of 373 days and has decayed to insignificant levels (Waite 1991).

4.2 POTENTIAL IMPACTS TO HUMAN HEALTH AND THE ENVIRONMENT

This preliminary assessment is intended to provide a qualitative evaluation of potential human health and environmental hazards associated with the known and suspected contaminants at the T Plant Aggregate Area. The assessment includes a discussion of release mechanisms, potential transport pathways, develops a conceptual model of human and environmental exposure based on these pathways, and presents the physical, radiological, and toxicological characteristics of the known or suspected contaminants.

In developing the conceptual model, potential exposures to groundwater have not been addressed in detail. Since migration to groundwater is the primary route for potential future exposures to many of the chemicals disposed of at the site, this pathway (i.e., travel time, receptors) will be addressed in the 200 West Groundwater AAMS.

It is important to note that these evaluations do not attempt to quantify potential human health or environmental risks associated with exposure to T Plant Aggregate Area waste management unit contaminants. Such a risk assessment cannot be performed until additional waste unit characterization data are acquired. Risk assessment activities will be performed in accordance with the *Hanford Baseline Risk Assessment Methodology* document (DOE-RL 1991c) being prepared in response to the M-29 milestone, which incorporates the requirements established in the *Risk Assessment Guidance for Superfund* (EPA 1989) and the *EPA Region 10 Supplemental Risk Assessment Guidance for Superfund* (EPA 1991a).

The ability of this qualitative assessment to address potential environmental and ecological risks is severely constrained by the relative lack of data regarding potentially exposed biotic populations and exposure pathways. As discussed in Section 3.6, past studies of biota have been mostly conducted on a site-wide basis and do not provide useful data to evaluate the potential impacts of the T Plant Aggregate Area. The extent of T Plant Aggregate Area biota sampling has been limited to vegetation sampling (Section 4.1.1.4). The role of biota in transporting contaminants is currently constrained by the lack of data. This data gap is addressed in Section 5.0, and is discussed further in Section 8.2.3.

4.2.1 Release Mechanisms

T Plant Aggregate Area waste management units can be divided into two general categories based on the nature of the waste released: (1) units where waste was discharged directly to the environment and (2) units where waste was disposed of inside a containment structure and bypassed an engineered barrier to reach the environment.

In the first group are those waste management units where release of wastes to the soil column was an integral part of the waste disposal strategy. Included in this group are tile fields, septic system drain fields, ditches, french drains, seepage basins, cribs without liners, reverse wells, and some disposal trenches. Also in this group are unplanned releases that involved waste material released to the soil. For this group of waste management units, if discharges to the unit contained contaminants of concern, it can be assumed that soils underlying the waste management unit are contaminated. The first task in developing a conceptual model for these units is to determine whether contaminants of concern are retained in soil near the waste management unit, or are likely to migrate to the underlying aquifer and then to receptor points such as drinking water wells or surface water bodies. Factors affecting migration of chemicals away from the point of release will be discussed in the following section.

In the second group are waste management units that were intended to act as a barrier to environmental releases. Included in this group are burial grounds containing drums or other containers, cribs with membrane liners, vaults, tanks, waste transfer facilities, and unplanned releases that occurred within containment structures. Waste management units that received only dry waste could also be included in this category, since the potential for wastes to migrate to soils outside of the unit is low due to the negligible natural recharge rate at the Hanford Site. For these waste management units, the first consideration to be addressed in developing a conceptual model is the integrity of the containment structure.

The ability of this report to evaluate the efficacy of engineered barriers is limited by the lack of vadose zone soil sampling data and air sampling data for many waste management units. Available sampling information for the waste management units and unplanned releases has been summarized in Section 4.1. The data indicate that membrane liner systems used in waste management units with significant liquid inputs were ineffective in preventing releases to the subsurface.

The efficacy and integrity of concrete liners (207-T Retention Basin) and concrete and steel tanks (vaults) have not been determined. For those units that received only dry wastes, such as gloves, pumps, contaminated dirt, and process equipment, the potential for release is expected to be low. However, small amounts of liquid wastes (e.g., tritium lab wastes) are known to have been disposed of in these waste management units, and early disposal records (prior to about 1968) are incomplete. Thus, releases from these structures to the surrounding soil are possible.

In addition to evaluating releases to the subsurface, the conceptual model must address the potential for releases to air and, for radionuclides, the potential for direct irradiation. All units have some type of barrier to releases to the surface; however, barriers can fail over time or may not be designed to prevent migration by certain transport pathways (e.g., volatilization).

At least four of the cribs in the T Plant Aggregate Area, 216-T-6, -8, -19, and -32, have been identified as having a high probability of cave-in potential (WHC 1992a) due to

decomposition of the wooden framework of the cribs. A cave-in has previously occurred at Crib 216-T-19 which resulted in its abandonment in 1956. Such collapse can lead to high levels of direct radiation at the surface and the potential for spread of contaminated materials by wind erosion. Westinghouse Hanford has an ongoing program to detect and remediate cave-ins by covering the cribs with additional soil, and any exposures from these incidents are generally short-term.

4.2.2 Transport Pathways

Transport pathways expected within the T Plant Aggregate Area are summarized in this section, including:

- Drainage and leaching from soil to groundwater
- Volatilization from wastes and shallow soils
- Wind erosion of contaminated surface soils
- Deposition of fugitive dust on soils, plants, and surface water
- Uptake from soils by vegetation
- Uptake from soils by animals via direct contact with soils or ingestion of soils, vegetation, and other animals
- Direct radiation.

In addition, transport within the saturated zone and subsequent release to groundwater wells or to offsite surface water (i.e., the Columbia River) is of potential concern, but will not be addressed in this document, since this topic will be the focus of the 200 West Groundwater AAMS.

Following transport, exposure may occur through the following pathways:

- Inhalation of volatilized contaminants or suspended particulates
- Ingestion of contaminants in soils, vegetation, or animals
- Direct dermal contact with contaminants in soils
- Direct exposure to radiation

4.2.2.1 Transport from Soils to Groundwater. Soil is the initial receiving medium for waste discharges in the T Plant Aggregate Area, whether the release is directly to soil or through failure of a containment system. Several factors determine whether chemicals that

are introduced into the vadose zone will reach the unconfined aquifer, which lies at a depth of approximately 60 m (200 ft) below ground surface. These factors are discussed in the following sections.

4.2.2.1.1 Depth of Release. Waste management units that released wastes at a greater depth below the surface are more likely to contaminate groundwater than waste management units where the release was shallow. The 216-T-3 Reverse Well is the primary examples of a deep release at the T Plant Aggregate Area. This unit discharged wastes to the vadose zone approximately 62 m (204 ft) below the surface, or approximately 14 m (45 ft) above the water table in the unconfined aquifer.

4.2.2.1.2 Liquid Volume or Recharge Rate. For waste constituents to migrate to the underlying water table, some source of recharge must be present. In the T Plant Aggregate Area, the primary source of moisture for mobilizing contaminants are waste management units that discharge liquid waste to the soil column and precipitation recharge. As discussed in Section 3.5.2, estimates of natural precipitation recharge range from 0 to 10 cm/yr (0 to 3.9 in./yr), primarily depending on surface soil type, vegetation, and topography. Gravelly surface soils with no or minor shallow rooted vegetation appear to facilitate precipitation recharge. One modelling study (Smoot et al. 1989) indicated that some radionuclide (e.g., ^{106}Ru) transport could occur with as little as 5 cm/yr (2 in./yr) of natural recharge. However, other researchers (Routson and Johnson 1990) have concluded that no net precipitation recharge occurs in the 200 Areas, particularly at waste management units that are capped with fine-grained soils or impermeable covers.

With respect to artificial recharge, some waste management units (e.g., the 216-T-12 Trench and 216-T-33 Crib) were identified in which the known volume of liquid waste discharged substantially exceeded the total estimated soil pore volume present below the footprint of the facility. In this case, the moisture content of soil below the waste management units likely approached saturation during the periods of use of these facilities. Because vadose zone hydraulic conductivities are maximized at water contents near saturation, the volume of liquid wastewater historically discharged to the waste management units probably enhanced fluid migration in the vadose zone beneath these units.

Contaminants that are not initially transported to the water table by drainage may be mobilized at a later date if a large volume of liquid is added to the waste management unit. In addition, liquids discharged to one unit could mobilize wastes discharged to an adjacent unit if lateral migration takes place within the vadose zone. An example of this process occurred at the 216-T-27 Crib, which received trucked waste from the 300 Area. Each time this waste was pumped to the 216-T-27 Crib, groundwater samples taken near the 216-T-28 Crib increased in radioactivity.

It is also thought that the septic fields have the potential to may mobilize contaminants. In the T Plant Aggregate Area, there are no known areas of vadose zone contamination within 50 m (160 ft) of any of the septic tanks or the 241-T-4-2 Ditch.

4.2.2.1.3 Soil Moisture Transport Properties. The moisture flux in the vadose zone is dependent on hydraulic conductivity as well as gradients of moisture content or matrix suction. Higher unsaturated hydraulic conductivities are associated with higher moisture contents. However, higher unsaturated hydraulic conductivities may be associated with fine-grained soils compared to coarse-grained soils at low moisture contents. Due to the stratified nature of the Hanford Site vadose zone soils and the moisture content dependence of unsaturated hydraulic conductivity, vadose zone soils are likely to be more permeable in the horizontal direction than in the vertical. This may reduce the potential for contaminant migration to the unconfined aquifer.

4.2.2.1.4 Retardation. The rate at which contaminants will migrate out of a complex waste mixture and be transported through unsaturated soils depends on a number of characteristics of the chemical, the waste, and the soil matrix. In general, chemicals that have low solubilities in the leaching fluid or are strongly adsorbed to soils will be retarded in their migration velocity compared to the movement of soil pore water. Studies have been conducted of soil parameters affecting waste migration at the Hanford Site to attempt to identify the factors that control migration of radionuclides and other chemicals. Recent studies of soil sorption are summarized in Serne and Wood (1990). Some of the processes that have been shown to control the rate of transport are:

- **Adsorption to Soils.** Most contaminants are chemically attracted to some degree to the solid components of the soil matrix. For organic compounds, the adsorption is generally to the organic fraction of the soil, although in extremely low-organic soils, adsorption to inorganic components may be of greater importance. Soil components contributing to adsorption of inorganic compounds include clays, organic matter, and iron and aluminum oxyhydroxides. In general, Hanford surface soils are characterized as sandy or gravelly with very low organic content (<0.1%) and low clay content (<12%) (Tallman et al. 1981). Thus, site-specific adsorption factors are likely to be lower, and rate of transport higher, than the average for soils nationwide.

- **Filtration.** Filtration of suspended particulates by fine-grained sediments has been suggested as a mechanism for concentration of radionuclides in certain sedimentary layers. This finding suggests that migration of suspended particulates may be an important mechanism of transport for poorly soluble contaminants.

- **Solubility.** The rate of release of some chemicals is controlled by the rate of dissolution of the chemical from a solid form. The concentration of these chemicals in the pore water will be extremely low, even if they are poorly sorbed. An example cited by Serne and Wood (1990) is the solubility of plutonium oxide, which appears to be the limiting factor controlling the release of plutonium from waste materials at neutral and basic pH.

- **Ionic Strength of Waste.** For some inorganics, the dominant mechanism leading to desorption from the soil matrix is ion exchange. Leachate having high ionic strength (high salt content) can bias the sorption equilibrium toward desorption, leading to higher concentrations of the contaminant in the soil pore water. Wastes within the T Plant Aggregate Area that can be considered to have high ionic strength include the waste management units that received first-cycle supernatant waste from the 221-T Building. These waste management units include the 216-T-14, -15, -16, and -17 Trenches.

- **Waste pH.** The pH of a leachant has a strong effect on inorganic contaminant transport. Acidic leachates tend to increase migration both by increasing the solubility of precipitates and by changing the distribution of charged species in solution. The exact impact of acidic or basic wastes will depend on whether the chemical is normally in cationic, anionic, or neutral form, and the form that it takes at the new pH. Cationic species tend to be more strongly adsorbed to soils than neutral or anionic species. The extent to which addition of acidic leachate will cause a contaminant to migrate will also depend on the buffering or neutralizing capacity of the soil, which is correlated with the calcium carbonate ($CaCO_3$) content of the soil. The soils in the Hanford formation beneath the T Plant Aggregate Area generally have carbonate contents in the range of 0.1 to 5%. Higher carbonate contents (20 to 30%) are observed within the Plio-Pleistocene caliche layer.

  Once the leaching solution has been neutralized, the dissolved constituents may re-precipitate or become reabsorbed to the soil. There are no known studies involving pH impacts in the T Plant Aggregate Area. However, observations of pH impacts on waste transport in the Z Plant Aggregate Area identified the following:

  - Mobilization of plutonium and americium isotopes beneath the 216-Z-1A Crib by acid liquid waste depends on a combination of pH effects and complexation by organic components of the waste. These processes were implicated in migration of the radionuclides to a depth of 30 m (98 ft) below the bottom of the crib

  - Leaching of americium from 216-Z-9 Crib sediments was found to be solubility controlled and correlated to solution pH (Rai et al. 1981).

4.2.2.1.5 Complexation by Organics. Certain organic materials disposed of at the T Plant Aggregate Area are known to form complexes with inorganic ions, which can enhance their solubility and mobility. As an example, cyanide compounds have been shown to complex ^{60}Co. Tributyl phosphate is the primary organic complexing agent disposed of at the T Plant Aggregate Area.

4.2.2.1.6 Contaminant Loss Mechanisms. Processes that can lead to loss of chemicals from soils, and thus decrease the amount of chemical available for leaching to groundwater, include:

- **Radioactive Decay.** Radioactivity decays over time, generally decreasing the quantities and concentrations of radioactive isotopes.

- **Biotransformation.** Microorganisms in the soil may degrade organic contaminants such as kerosene and inorganic chemicals such as nitrate.

- **Chemical Transformation.** Hydrolysis, oxidation, reduction, radiolytic degradation and other chemical reactions are possible degradation mechanisms for contaminants.

- **Vegetative Uptake.** Vegetation may remove chemicals from the soil, bring them to the surface, and introduce them to the food web.

- **Volatilization.** Organic chemicals and volatile radionuclides can be transported in the vapor phase through open pores in soil either to adjacent soil or to the atmosphere. These volatilized compounds could include acetone, radon (a decay product of uranium), and tritium. Some elements (mainly fission products such as iodine, ruthenium, cerium, and antimony) are referred to as "semivolatiles" because they have a lesser tendency to volatilize.

4.2.2.2 Transport from Soils to Air. Transport of contaminants from waste management units to the atmosphere can occur by means of vapor transport or by fugitive dust emissions.

Vapor transport may occur from waste management units where volatile organics (e.g., CCl_4) or volatile radionuclides (^{14}C, $^{14}CO_2$, ^{129}I, or ^{3}H) have been released. Transport mechanisms include diffusion down a concentration gradient and gas-driven flow. Situations where the latter process may occur include production of methane gas from degradation of organic compounds in soil, or production of hydrogen and oxygen gases by radiolytic hydrolysis of water.

In order for fugitive dust emissions to occur, contaminants must be exposed at the surface of the waste management unit. A number of mechanisms could lead to exposure of contaminants in soil-covered waste management units. These mechanisms include uptake by vegetation, transport by animals, disruption of the waste management unit (e.g., cave-ins at cribs), and wind erosion. Wind erosion can strip off surface soil and uncover waste materials. This mechanism has been identified as an ongoing problem in some of the waste management unit areas. The processes by which biota may expose contaminated soils are discussed in Section 4.2.2.4.

The contribution of the T Plant Aggregate Area to the overall fugitive dust emissions at the Hanford Site boundary is expected to be relatively minor, based on results of air

monitoring downwind of the T Plant Aggregate Area waste management units (Schmidt et al, 1992).

4.2.2.3 Transport from Soils to Surface Water. The only surface water present in the T Plant Aggregate Area is at the 216-4-2 Ditch and at the powerhouse pond. According to coordinates contained in WHC 1992a, the powerhouse pond is located in the T Plant Aggregate Area. Field surveys of the powerhouse pond show it to be located south of the WIDS coordinates in the U Plant Aggregate Area as 216-U-14 Crib. For discussion purposes the powerhouse pond will be addressed in the U Plant Aggregate Area report (WHC 1992a).

Transport of contaminants to surface water bodies outside of the T Plant Aggregate Area via groundwater discharge and deposition of fugitive dust on water bodies are the primary pathways of potential concern for surface water effects. Groundwater discharge will be addressed in the 200 West Groundwater AAMS.

4.2.2.4 Transport from Soils to Biota. Biota, plants and animals, have the potential for taking up (bio-uptake), concentrating (bioaccumulating), transporting, and depositing contamination beyond its original extent. Transfer from one species to another in the food chain is also possible because of predation. The possibility of these processes contributing significantly to the transport of contamination from the T Plant Aggregate Area waste management units resulting in damage to affected ecosystems is unclear. The currently available data, as described in Sections 3.6 and 4.1, are too general and do not adequately evaluate biotic transport or ecological risk. This data gap is discussed further in Sections 5.0 and 8.0. The future acquisition of additional data will be guided by the requirements for human health and ecological risk assessments in the *Hanford Baseline Risk Assessment Methodology* (DOE/RL 1991) being prepared in response to the M-29 milestone.

4.2.2.4.1 Uptake by Vegetation. Release of radioactivity to the surface by growth of vegetation is an ongoing problem at T Plant waste management units. Roots of sagebrush and other native species can take up radionuclides from soils below the surface and transport these chemicals to the foliage. Wind dispersal of portions of the contaminated vegetation, or entire plants (tumbleweeds) can lead to transport of contaminants outside of the unit. Westinghouse Hanford has an ongoing vegetation control (herbicide application, reseeding with shallow-rooted vegetation, and mechanical removal) and radiological survey program to prevent radioactivity from being transported by this mechanism. However, the program does not ensure complete removal of vegetation, and incidents of detection of contaminated vegetation are reported occasionally in the radiological surveys.

4.2.2.4.2 Transport by Animals. Disturbance of waste management unit barriers by animals occasionally leads to release of contaminants to the surface. Subsurface soils can be transported to the surface by burrowing animals, thus exposing contaminants for release to the air. Additionally, animals that become contaminated by direct contact with subsurface waste or through ingestion of subsurface contaminants (e.g., chemical salts) and

contaminated vegetation, water, or other animals can spread contamination in their feces on the surface and outside of the waste management unit.

4.2.3 Conceptual Model

Figure 4-3 and in more details on Plate 4, presents a graphical summary of the physical characteristics and mechanisms at the site which could potentially affect the generation, transport, and impact of contamination in the T Plant Aggregate Area on humans and biota (conceptual model).

The sources of contamination include process wastes (e.g., condensates, cooling water, and sewage) from T Plant, first and second cycle supernatant waste, component and vehicle decontamination waste, laundry waste, evaporator bottom waste, 222-T Laboratory waste, and waste from facilities outside the T Plant Aggregate Area. The known contamination sources originating from outside the T Plant Aggregate Area are identified in Table 4-18.

From these waste management units, various release mechanisms may have transported contamination to the potentially affected media. Volatilization could release chemicals from surface waters into the atmosphere. Materials in the 216-T-4-2 Ditch flowing toward the 216-T-4B Pond may have seeped into the vadose zone, or deposited into the sediments in the ditch. The 207-T Retention Basins may have released contaminants in a similar fashion, with the exception of offsite flow. Biota may have taken up contaminants from the surface water and near-surface contaminated soils (via deep roots or burrowing animals).

Many waste management units discharge their waste effluents directly to the near surface (vadose zone) soils. The trenches are potential release points via leaching or drainage of the liquid portion of the disposed materials. The cribs provide seepage discharge and similarly the french drains, reverse wells, and septic system drain fields directly inject their effluents into the subsurface sediments. The unplanned releases have mainly impacted surface soils although some contamination may have also taken place on building surfaces. Fugitive dust from sediment and surface soils has also been released or resuspended due to wind effects or surface disturbances, and some surface soils have been buried or removed to offsite disposal.

The primary mechanism of vertical contaminant migration is the downward movement of water from the surface through the vadose zone to the unconfined aquifer. The contaminants generally move as a dissolved phase in the water and their rate of migration is controlled both by groundwater movement rates and by adsorption and desorption reactions involving the surrounding sediments. Some contaminants are strongly sorbed on sediments and their downward movement through the stratigraphic column is greatly retarded. Significant lateral migration of contaminants is restricted to perched water zones and to the unconfined aquifer, where water is moving laterally. Again adsorption and desorption reactions may greatly retard lateral contaminant migration. Contaminants that were introduced to the soil column outside of the aggregate area may migrate into the area along

with perched or aquifer water.There are four exposure routes by which humans (offsite and onsite) and other biota (plants and animals) can be exposed to these possible contaminants:

- Inhalation of airborne volatiles or fugitive dusts with adsorbed contamination
- Ingestion of surface water, fugitive dust, surface soils, biota (either directly or through the food chain), or groundwater
- Direct contact with the waste materials (such as those exhumed by burrowing animals), contaminated surface soils, buildings, or plants
- Direct radiation from waste materials, surface soils, building surfaces, or fugitive dusts.

4.2.4 Characteristics of Contaminants

Table 4-19 is a list of radioactive and nonradioactive chemical substances that represent candidate contaminants of potential concern for this study based on their known presence in wastes, usage, disposal in waste management units, historical association, or detection in environmental media in the T Plant Aggregate Area. Table 4-20 summarizes the types of known or suspected contamination that are thought to exist at the individual waste sites. Known contaminants have been proven to exist from sampling and inventory data (Tables 2-3, 2-4, and 2-5). Suspected contaminants are those that could occur at a site based upon historical practices or chemical associations. Given the large number of chemicals known or suspected to be present, it is appropriate to focus this assessment on those contaminants that have been detected through sampling efforts and which pose the greatest risk to human health or the environment.

The EPA Region 10 guidance on risk-based contaminant screening (EPA 1991a), as summarized in the *Hanford Baseline Risk Assessment Methodology* (DOE/RL 1991), was consulted to establish the T Plant Aggregate Area contaminants of potential concern. The risk-based contaminant screening mostly involves comparing maximum contaminant concentrations to risk-based benchmark concentrations. However, contaminant concentrations in environmental media are not available for the T Plant Aggregate Area, and direct risk-based screening could not be performed. To ensure that the intent of the EPA Region 10 approach could be achieved an alternative and more conservative approach was developed. This requires T Plant Aggregate Area contaminants with potential risks to be included in the list of contaminants of potential concern. The alternative approach retains any contaminant that is known or suspected of being carcinogenic or toxic, regardless of quantity or concentration.

Table 4-21 lists the contaminants of concern for the T Plant Aggregate Area. This list was developed from Table 4-19 and includes only those contaminants which meet the following criteria:

- Radionuclides that have a half-life of greater than one year. Radionculides with half-lives less than one year will not persist in the environment at concentrations sufficient to contribute to overall risks.

- Radionuclides with a half-life of less than 1 yr and are part of long-lived decay chains that result in the buildup of the short-lived radionuclide activity to a level of 1% or greater of the parent radionuclide's activity within the time period of interest. Although daughter radionuclides are adequately identified during normal parent radionuclide investigations, they are also identified as contaminants of concern through this criterion. This provides an additional level of assurance that all primary contaminants will be addressed.

- Contaminants that are known or suspected carcinogens or have a U.S. Environmental Protection Agency (EPA) noncarcinogenic toxicity factor. In addition, chemicals with known toxic effects but no toxicity criteria are presently available. In some instances the criteria have been withdrawn by EPA pending review of the toxicological data and will be reissued at a future date. Chemicals with known toxicity for which toxicity factors are presently not available include lead, selenium, kerosene, and tributyl phosphate.

The following characteristics will be discussed for the contaminants listed in Table 4-21:

- Detection of contaminants in environmental media

- Historical association with plant activities

- Mobility

- Persistence

- Toxicity

- Bioaccumulation.

4.2.4.1 Detection of Contaminants in Environmental Media. The nature and extent of surface and subsurface soils, surface water, groundwater, air, and biota contamination have not yet been adequately characterized for the T Plant Aggregate Area. All recent environmental monitoring data were reviewed and summarized for each media in Section 4.1.

The most extensive monitoring data available has been for groundwater. Because groundwater will be evaluated in the 200 West Groundwater AAMS, it will not be discussed further here. Surface soil and biota samples have been collected from locations on a regular rectangular grid. These sampling locations do not correspond to any of the waste

management units, but are intended to characterize the T Plant Aggregate Area as a whole. Air and external radiation samples have been collected at several locations within or adjacent to the T Plant Aggregate Area. These sampling stations are also not located directly on any of the waste management units and therefore the sampling results cannot be attributed to any particular unit. The only routine sampling data that correspond directly to waste management units are the external radiation surveys, which are performed on a regular basis. There is little soil or vegetation sampling data available for any of the units.

4.2.4.2 Historical Association with T Plant Activities. Radionuclides that are known components of T Plant waste streams are listed in Tables 2-8 through 2-10. These lists include chemicals in the process wastes as well as chemicals that were detected at elevated levels in wastewater. Since these waste streams are known to have been disposed of directly to the soil column in some waste management units, it is probable that the chemicals on this list have affected environmental media.

Based on the WIDS data (WHC 1992a), radionuclides that are known to have been disposed of to T Plant waste management units in the greatest quantities are as follows:

- Plutonium-239
- Plutonium-240
- Cesium-137
- Strontium-90
- Uranium-238.

Note that a complete radionuclide analysis of the T Plant waste streams is not available. Thus, it is possible that additional radionuclides were disposed of to T Plant Aggregate Area waste management units that are not included in the waste inventories.

Nonradioactive chemicals reportedly released into T Plant Aggregate Area waste management units in large quantities include nitric acid, nitrates, sodium, phosphate, sodium hydroxide, fluorides, tributyl phosphate, carbon tetrachloride, dibutyl phosphate, calcium, magnesium, and iron.

In addition to the releases due specifically to T Plant activities, effects from other areas, particularly U Plant and Z Plant, due to cross connection of facilities, tanks, drain fields, cribs, etc. must be considered.

4.2.4.3 Mobility. Since most wastes at the T Plant Aggregate Area were released directly to subsurface soils via injection, infiltration, or burial, the mobility of the wastes in the subsurface will determine the potential for future exposures. The mobility of the contaminants listed in Table 4-21 varies widely and depends on site-specific factors as well

as the intrinsic properties of the contaminant. Much of the site-specific information needed to characterize mobility is not available and will need to be obtained during future field investigations. However, it is possible to make general statements about the relative mobility of the candidate contaminants of concern.

4.2.4.3.1 Transport to the Subsurface. The mobility of radionuclides and other inorganic elements in groundwater depends on the chemical form and charge of the element or molecule, which in turn depends on site-related factors such as the pH, REDOX state, and ionic composition of the groundwater. Cationic species (e.g., Cd^{2+}, Pu^{4+}) generally are retarded in their migration relative to groundwater to a greater extent than anionic species such as nitrate (NO_3^-). The presence in groundwater of complexing or chelating agents can increase the mobility of metals by forming neutral or negatively charged compounds.

The chemical properties of radionuclides are essentially identical to the nonradioactive form of the element; thus, discussions of the chemical properties affecting the transport of contaminants can apply to both radionuclides and nonradioactive chemicals.

A soil-water distribution coefficient (K_d) can be used to predict mobility of inorganic chemicals in the subsurface. Table 4-22 presents a summary of K_ds that have been developed for many of the inorganic chemicals of concern at the T Plant Aggregate Area. As discussed above, the pH and ionic strength of the leaching medium has an impact on the absorption of inorganics to soil; thus, the listed K_ds are valid only for a limited range of pH and waste composition. In addition, soil sorption of inorganics is highly dependent on the mineral composition of the soil, the ionic composition of the soil pore water, and other site-specific factors. Thus, a high degree of uncertainty is involved with use of K_ds that have not been verified by experimentation with site soils.

Serne and Wood (1990) recommended K_ds for use with Hanford waste assessments for a limited number of important radionuclides (americium, cesium, cobalt, copper, iodine, plutonium, ruthenium, strontium, and tritium) based on soil column or batch desorption studies, and have proposed conservative average values for a more extensive list of elements based on a review of the literature. An assumed retardation of <1 is recommended for americium, cesium, plutonium, and strontium under acidic conditions.

Strenge and Peterson (1989) developed default K_ds for a large number of elements for use in the Multimedia Environmental Pollution Assessment System (MEPAS), a computerized waste management unit evaluation system. The K_ds were based on findings in the scientific literature, and include non-site-specific as well as Hanford Site values. Values are provided for nine sets of environmental conditions: three ranges of waste pH and three ranges of soil adsorbent material (sum of percent clay, organic material, and metal hydrous oxides). The values presented in Table 4-22 are for conditions of neutral waste pH and less than 10% adsorbent material, which is likely to be most representative of Hanford Site soils.

The mobility of inorganic species in soil can be divided roughly into three classes, using site-specific values (Serne and Wood 1990) where available and generic values

otherwise: highly mobile ($K_d < 5$), moderately mobile ($5 < K_d < 100$), and low mobility ($K_d > 100$).

The tendency of organic compounds to adsorb to the organic fraction of soils is indicated by the soil organic matter partition coefficient (K_{oc}). Partition coefficients for the organic chemicals of concern at the T Plant Aggregate Area are listed in Table 4-23. Chemicals with low K_{oc} values are weakly absorbed by soils and will tend to migrate in the subsurface, although their rate of travel will be retarded somewhat relative to the pore water or groundwater flow. Soils at the Hanford Site have very little organic carbon content and thus sorption to the inorganic fraction of soils may dominate over sorption to soil organic matter.

4.2.4.3.2 Transport to Air. Transport between soils and air can occur either by fugitive dust emissions or volatilization. Chemicals subject to transport via airborne dust dispersion are those that are non-volatile and persistent on the soil surface, including most radionuclides and inorganics, and some organics such as creosote and coal tar.

Chemicals subject to volatilization are mostly organic compounds; however, some of the radionuclides detected at the site are subject to evaporation and could be lost from shallow soils to the ambient air. The most important species in this category are ^{14}C, ^{3}H, and ^{129}I.

The tendency of an organic compound to volatilize can be predicted from its Henry's Law Constant (K_h) a measured or calculated parameter with units of atmospheres per cubic meter per mole of chemical. Henry's Law Constants of the organic candidate contaminants of concern are presented in Table 4-23. Compounds with a K_h greater than about 10^{-3} will be lost rapidly to the atmosphere from surface water and shallow soils. Organic contaminants that fall into this class include:

- Carbon tetrachloride
- Chloroform
- Methylene chloride
- Toluene
- Tributyl phosphate.

4.2.4.4 Persistence. Once released to environmental media, the concentration of a contaminant may decrease because of biological or chemical transformation, radioactive decay, or the intermediate transfer processes discussed previously that remove the chemical from the medium (e.g., volatilization to air). Radiological, chemical, and biological decay processes affecting the persistence of the T Plant Aggregate Area contaminants of concern are discussed in the following paragraphs.

The persistence of radionuclides depends primarily on their half-lives. A comparison of the half-lives and specific activities for most radionuclide contaminants of concern for T Plant is presented in Table 4-24. The specific activity is the decay rate per unit mass, and is inversely proportional to the half-life of the radionuclide. Half-lives for the radionuclides listed in Table 4-24 range from seconds to over one billion years. Also listed are the decay mechanisms of primary concern for the radionuclide. Note that radionuclides often undergo several decay steps in quick succession, (e.g., an alpha decay followed by release of one or more gamma rays). The daughter products of these decays are often themselves radioactive.

Decay will occur during transport (e.g., through the vadose zone to the aquifer, through the aquifer) and may lead to significant reductions in levels discharging to the Columbia River. For direct exposures (e.g., to surface soils or air), the half-life of the radionuclide is of less importance, unless the half-life is so short that the radionuclide undergoes substantial decay between the time of disposal and release to the environment.

Nonradioactive inorganic chemicals detected at the site are generally persistent in the environment, although they may decline in concentration due to transport processes or change their chemical form due to chemical or biological reactions. Nitrate undergoes chemical and biological transformations that may lead to its loss to the atmosphere (as N_2) or incorporation into living organisms, depending on the REDOX environment and microbiological communities present in the medium.

Biotransformation rates for organics vary widely and are highly dependent on site-specific factors such as soil moisture, REDOX conditions, and the presence of nutrients and of organisms capable of degrading the compound. Ketones, such as acetone and methyl isobutyl ketone (MIBK), are easily degraded by microorganisms in soil and thus would tend not to persist. Chlorinated solvents (e.g., carbon tetrachloride) may undergo slow biotransformation in the subsurface under anoxic conditions. Volatile aromatics such as toluene are generally intermediate in their biodegradability.

4.2.4.5 Toxicity. Contaminants may be of potential concern for impacts to human health if they are known or suspected to have carcinogenic properties, or if they have adverse noncarcinogenic human health effects. The toxicity characteristics of the chemicals detected at the operable unit are summarized below.

4.2.4.5.1 Radionuclides. All radionuclides are classified by EPA as known human carcinogens based on their property of emitting ionizing radiation and on the evidence provided by epidemiological studies of radiation-induced cancers in humans. Noncarcinogenic health effects associated with radiation exposure include genetic and teratogenic effects; however, these effects generally occur at higher exposure levels than those required to induce cancer. Thus, the carcinogenic effect of radionuclides is the primary identified health concern for these chemicals (EPA 1989).

Risks associated with radionuclides differ for various routes of exposure depending on the type of ionizing radiation emitted. Nuclides that emit alpha or beta particles are

hazardous primarily if the materials are inhaled or ingested, since these particles expend their energy within a short distance after penetrating body tissues. Gamma-emitting radioisotopes, which deposit energy over much larger distances, are of concern as both external and internal hazards. A fourth mode of radioactive decay, neutron emission, is generally not of major health concern, since this mode of decay is much less frequent than other decay processes. In addition to the mode of radioactive decay, the degree of hazard from a particular radionuclide depends on the rate at which particles or gamma radiation are released from the material.

Excess cancer risks for exposure to the primary radionuclide contaminants of concern by inhaling air, drinking water, ingesting soil, and by external irradiation are shown in Table 4-25. These values represent the increase in probability of cancer to an individual exposed for a lifetime to a radionuclide at a level of 1 pCi/m^3 in air, 1 pCi/L in drinking water, 1 pCi/g in ingested soil, or to external radiation from soil having a radionuclide content of 1 pCi/g (EPA 1991b). These values are computed as the slope factor (risk per unit intake or exposure) multiplied by the inhalation or ingestion rate and the number of days in a 70 year lifetime (EPA 1991b).

For those radionuclides without EPA slope factors, the *Hanford Baseline Risk Assessment Methodology* (DOE/RL 1991a) will be consulted. This document proposes to consult the EPA Office of Radiation Programs to request the development of a slope factor or to use the dose conversion factors developed by the International Commission on Radiological Protection to calculate a risk value. Any Hanford Site risk assessments will be performed in accordance with the *Hanford Baseline Risk Assessment Methodology* document (DOE-RL 1991a), which includes the guidance established in the *Risk Assessment Guidance for Superfund* (EPA 1989) and the *EPA Region 10 Supplemental Risk Assessment Guidance for Superfund* (EPA 1991c).

The unit risk factors for different radionuclides are roughly proportional to their specific activities, but also incorporate factors to account for distribution of each radionuclide within various body organs, the type of radiation emitted, and the length of time that the nuclide is retained in the organ of interest.

Based on the factors listed in Table 4-25, the highest risk for exposure to 1 pCi/m^3 in air is from plutonium, americium and uranium isotopes, which are alpha emitters. Among the radionuclides contaminants of concern for the T Plant Aggregate Area, the highest risks from ingestion of soil at 1 pCi/g are for ^{227}Ac, ^{241}Am, ^{243}Am, ^{238}Pu, ^{244}Cm, ^{134}Cs, ^{129}I, ^{237}Np, ^{231}Pa, ^{226}Ra, ^{228}Ra, ^{229}Th, and the uranium isotopes. The primary gamma-emitters are ^{214}Bi, ^{60}Co, ^{134}Cs, ^{137}Cs (because of its metastable decay product, ^{137m}Ba), ^{152}Eu, ^{154}Eu, ^{239}Np, and ^{214}Pb. It is important to note that this table only presents unit risk factors for the listed radionuclides and does not include potential contributions from daughter products.

The standard EPA risk assessment methodology assumes that the probability of a carcinogenic effect increases linearly with dose at low dose levels; i.e., there is no threshold for carcinogenic response. The EPA methodology also assumes that the combined effect of

exposure to multiple carcinogens is additive without regard to target organ or cancer mechanism. However, the additive risk resulting for radionuclides and carcinogenic chemicals should be computed separately (EPA 1989).

4.2.4.5.2 Hazardous Chemicals. Carcinogenic and noncarcinogenic health effects associated with chemicals anticipated at the aggregate area are summarized in Table 4-26. Health effects were developed according to the hierarchy established in the *Risk Assessment Guidance for Superfund* (EPA 1989). References were consulted in the following order: IRIS (Integrated Risk Information System) (EPA 1991a), HEAST (Health Effects Assessment Summary Tables) (EPA 1991b), and other toxicity articles and documents.

Several of the chemicals have known toxic effects but no toxicity criterion is presently available. In some instances the criteria have been withdrawn by EPA pending review of the toxicological data and will be reissued at a future date. Chemicals with known toxicity for which toxicity factors are presently not available include lead, kerosene and tributyl phosphate.

4.2.4.6 Bioaccumulation potential. Contaminants may be of concern for exposure if they have a tendency to accumulate in plant or animal tissues at levels higher than those in the surrounding medium (bioaccumulation) or if their levels increase at higher trophic levels in the food chain (biomagnification). Contaminants may be bioaccumulated because of element-specific uptake mechanisms (e.g., incorporation of strontium into bone) or by passive partitioning into body tissues (e.g., concentration of organic chemicals in fatty tissues).

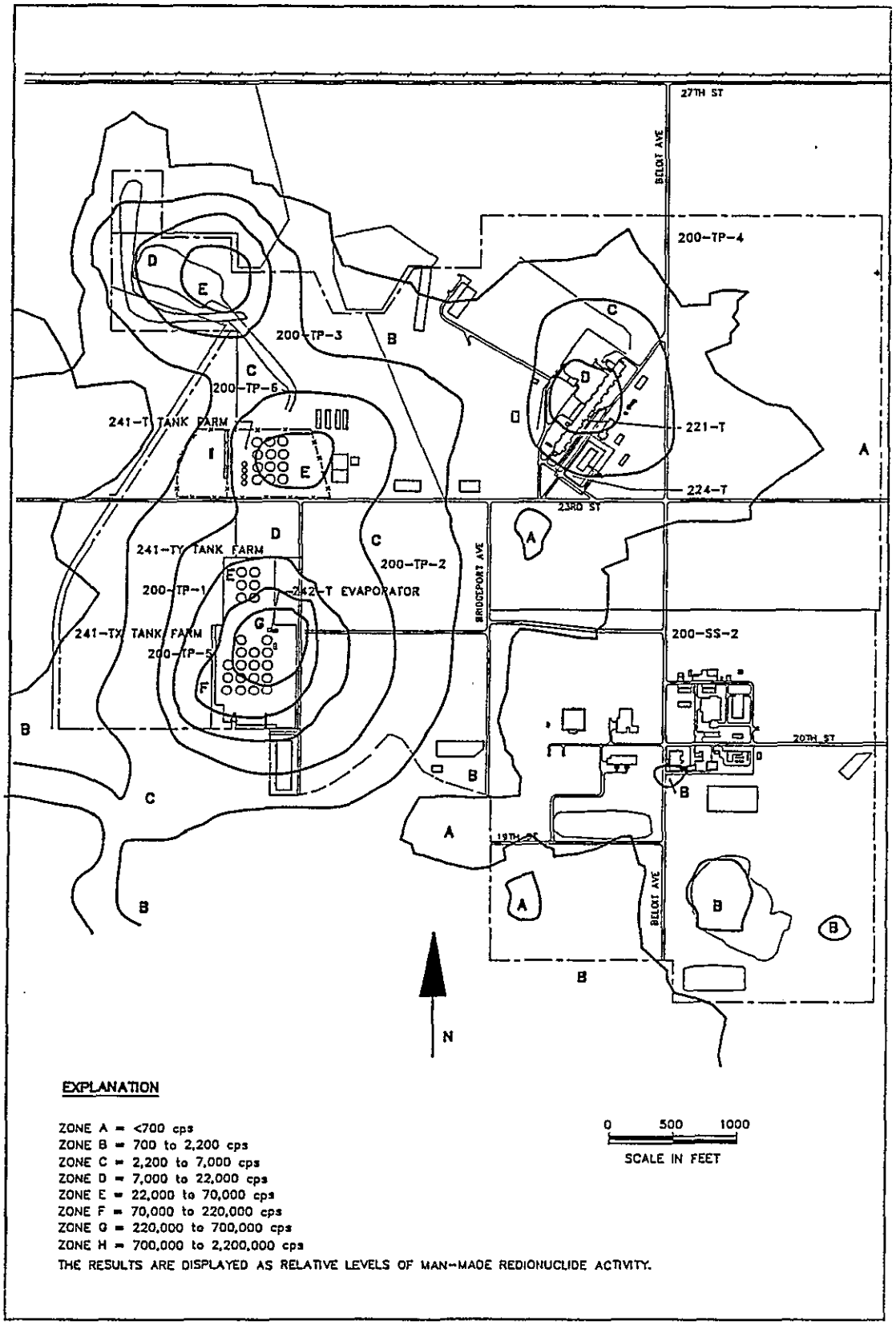


Figure 4-1. Gamma Isoradiation Contour Map.

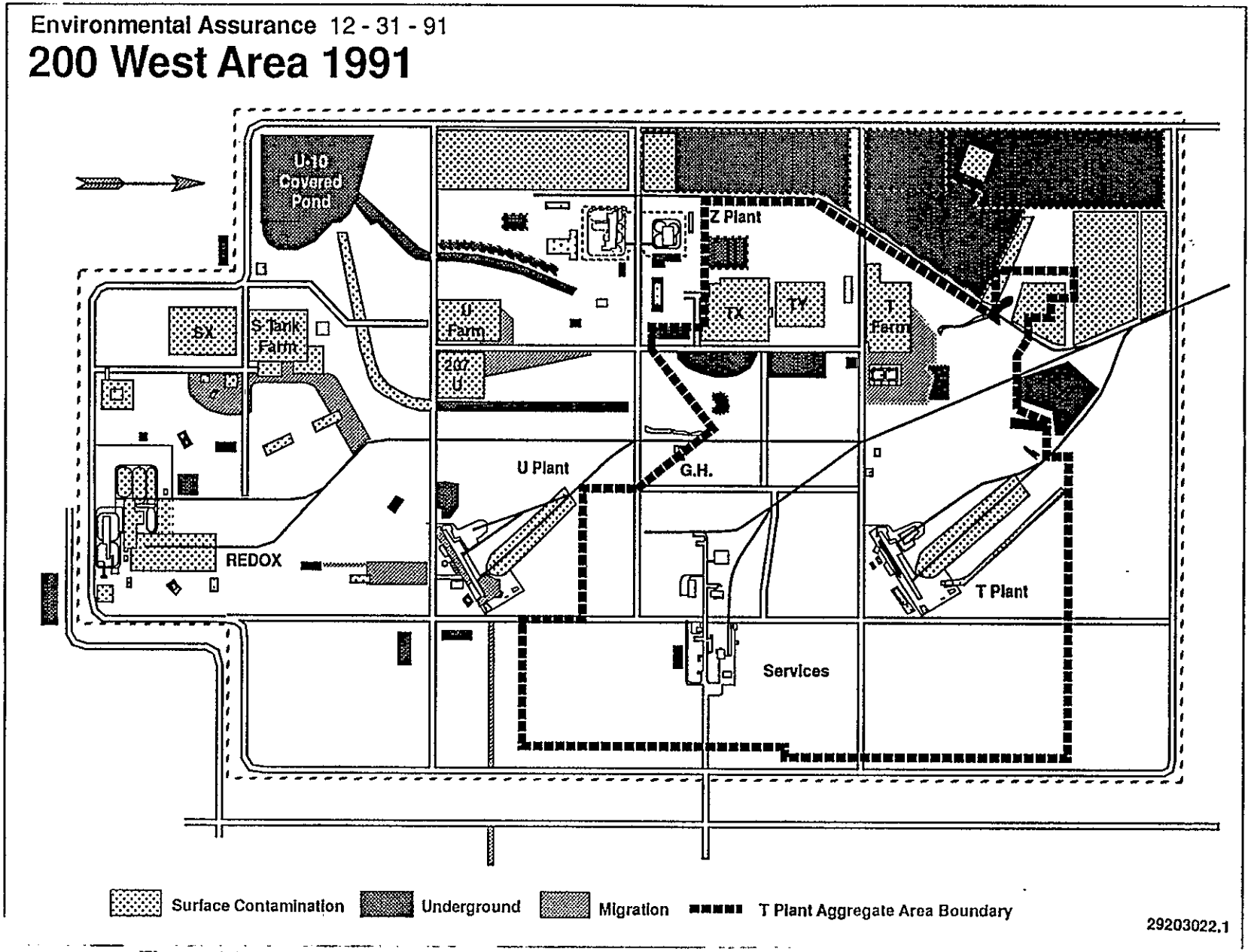


Figure 4-2. Shallow, Underground and Migration Contamination Map of the 200 Area (Hacksfelt 1991b).

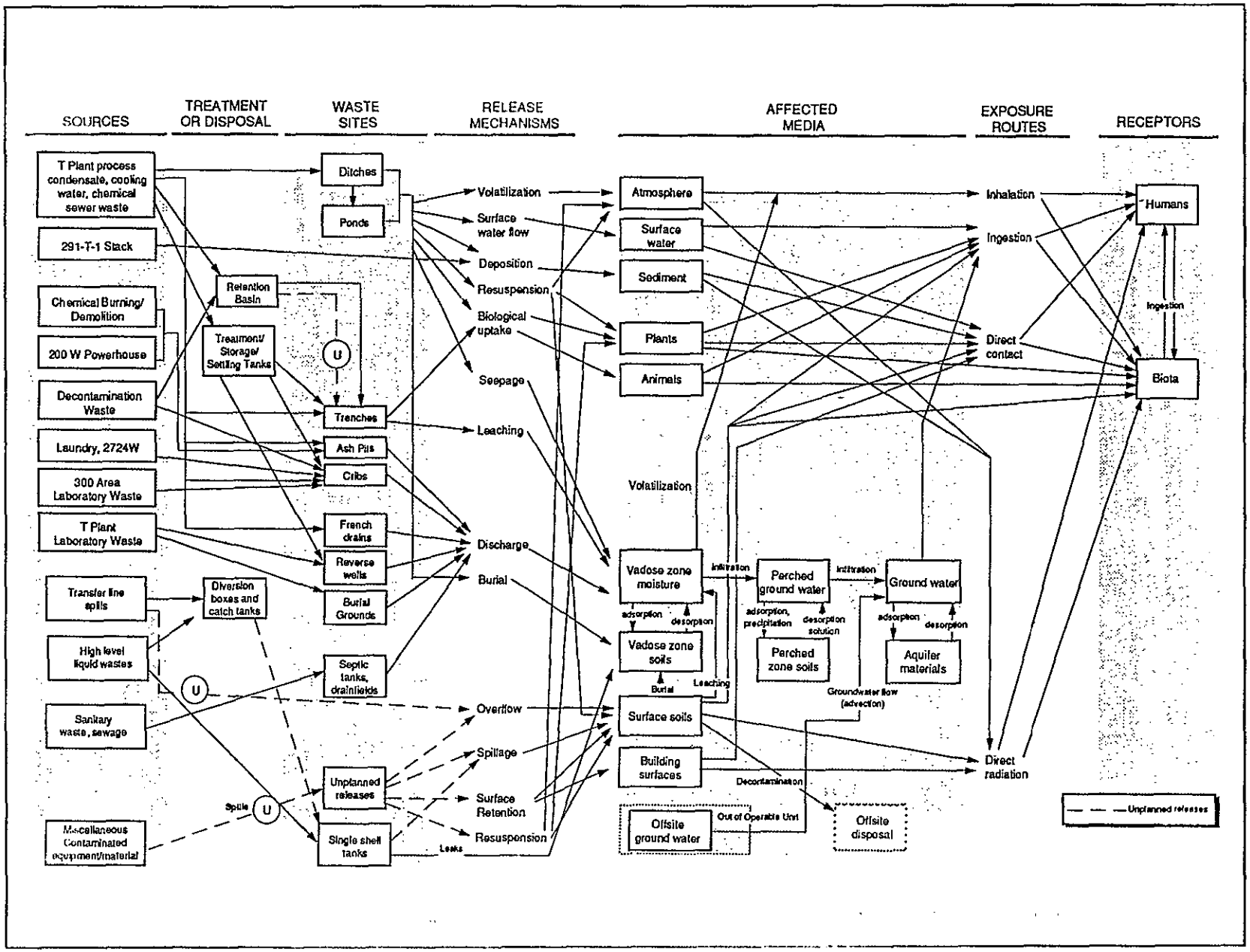


Figure 4-3. Conceptual Model of the T Plant Aggregate Area.

Table 4-1. Summary of Radionuclide Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 1 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Vadose Zone Soil Greater than 5 meters	Remarks
Tanks and Vaults							
241-T-101 Single-Shell Tank					k	k	FeCN tank line overflowed.
241-T-102 Single-Shell Tank					k	k	From 241-T-106 leak.
241-T-103 Single-Shell Tank					k	k	Assumed leaker (UPR-200-W-147).
241-T-104 Single-Shell Tank					k	k	
241-T-105 Single-Shell Tank					k	k	Due to 241-T-106 -RHO-ST-14.
241-T-106 Single-Shell Tank					k	k	Confirmed leaker (UPR-200-W-148).
241-T-107 Single-Shell Tank					k	k	Assumed leaker.
241-T-108 Single-Shell Tank					k	k	Assumed leaker.
241-T-109 Single-Shell Tank					k	k	Assumed leaker.
241-T-110 Single-Shell Tank					s	s	H_2 build-up possible.
241-T-111 Single-Shell Tank					s	s	Assumed leaker.
241-T-112 Single-Shell Tank							
241-T-201 Single-Shell Tank							Received 224-U Bldg. waste.
241-T-202 Single-Shell Tank							Received 224-U Bldg. waste.
241-T-203 Single-Shell Tank							Received 224-U Bldg. waste.
241-T-204 Single-Shell Tank							Received 224-U Bldg. waste.
241-TX-101 Single-Shell Tank		s					
241-TX-102 Single-Shell Tank		s					

Table 4-1. Summary of Radionuclide Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 2 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Vadose Zone Soil Greater than 5 meters	Remarks
241-TX-103 Single-Shell Tank		s			k	k	Due to 241-TX-107 leak.
241-TX-104 Single-Shell Tank		s					
241-TX-105 Single-Shell Tank		s			s		Assumed leaker.
241-TX-106 Single-Shell Tank		s					
241-TX-107 Single-Shell Tank		s			k	k	Assumed leaker.
241-TX-108 Single-Shell Tank		s					
241-TX-109 Single-Shell Tank		s					
241-TX-110 Single-Shell Tank		s			s	s	Assumed leaker.
241-TX-111 Single-Shell Tank		s					
241-TX-112 Single-Shell Tank		s					
241-TX-113 Single-Shell Tank		s			s	s	Assumed leaker (UPR-200-W-129).
241-TX-114 Single-Shell Tank		s			k	k	Assumed leaker.
241-TX-115 Single-Shell Tank		s			s	s	Assumed leaker.
241-TX-116 Single-Shell Tank		s			s	s	Assumed leaker.
241-TX-117 Single-Shell Tank		s			s	s	Assumed leaker.
241-TX-118 Single-Shell Tank		s					FeCN Tank
241-TY-101 Single-Shell Tank		s			s	s	Assumed leaker; FeCN tank.
241-TY-102 Single-Shell Tank		s			k	k	
241-TY-103 Single-Shell Tank		s			k	k	Confirmed leaker; FeCN tank.

Table 4-1. Summary of Radionuclide Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 3 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Vadose Zone Soil Greater than 5 meters	Remarks
241-TY-104 Single-Shell Tank		s			s	s	Assumed leaker (UPR-200-W-151).
241-TY-105 Single-Shell Tank		s			s	s	Assumed leaker (UPR-200-W-152).
241-TY-106 Single-Shell Tank		s			s	s	Assumed leaker (UPR-200-W-153).
241-T-361 Settling Tank							
244-TX Receiver Tank							
241-T-301 Catch Tank							
241-T-302 Catch Tank							
241-TX-302A Catch Tank							
241-TX-302B Catch Tank							UPR-200-W-131 occurred here.
241-TX-302C Catch Tank							UPR-200-W-21 & 160 occurred here.
241-TY-302A Catch Tank		k					
241-TY-302B Catch Tank							
Cribs and French Drains							
216-T-6 Crib		k			k	k	
216-T-7TF Crib and Tile Field		k			k	k	
216-T-8 Crib		k			k	k	
216-T-18 Crib		r?			k	k	Stabilized in 1990.
216-T-19TF Crib and Tile Field		k			k	k	Received U Plant waste.
216-T-26 Crib		r?		r?	k		Stabilized in 1990.

Table 4-1. Summary of Radionuclide Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 4 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Vadose Zone Soil Greater than 5 meters	Remarks
216-T-27 Crib		r?		r?	k		Stabilized in 1990.
216-T-28 Crib		r?		r?	k		Stabilized in 1990.
216-T-29 Crib							
216-T-31 French Drain		r			r		Exhumed in 1959.
216-T-32 Crib		k			k	k	
216-T-33 Crib		k			k		
216-T-34 Crib		r?			k	k	Stabilized '90; rec'd 300 Area lab waste.
216-T-35 Crib					k	k	Stabilized '90; rec'd 300 Area lab waste.
216-T-36 Crib					k	k	
216-W-LWC Crib					k	k	
Reverse Wells							
216-T-2 Reverse Well					k	k	
216-T-3 Reverse Well		r?			k	k	Ground surface decontaminated in 1975.
Ponds, Ditches, and Trenches							
216-T-4A Pond		r?			s		Radionuclides exhumed.
216-T-4B Pond		r?			s		Actively dredged since 1977.
216-T-1 Ditch		k	s		s		
216-T-4-1D Ditch		r?	k		k	s	Dredged in 1989.
216-T-4-2 Ditch		k	k	s	k	s	

Table 4-1. Summary of Radionuclide Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 5 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Vadose Zone Soil Greater than 5 meters	Remarks
200-W Powerhouse Pond							
216-T-5 Trench		k			k	s	
216-T-9 Trench		r			r		Site exhumed in 1972.
216-T-10 Trench		r			r		Site exhumed in 1972.
216-T-11 Trench		r			r		Site exhumed in 1972.
216-T-12 Trench		k			k	s	
216-T-13 Trench					s	s	
216-T-14 Trench		k		r?	k	s	
216-T-15 Trench		k		r?	k	s	
216-T-16 Trench		k		r?	k	s	
216-T-17 Trench		k		r?	k	s	
216-T-20 Trench		r?			k	k	
216-T-21 Trench				r?	k	s	
216-T-22 Trench				r?	k	s	
216-T-23 Trench				r?	k	s	
216-T-24 Trench				r?	k	s	
216-T-25 Trench					k		

Table 4-1. Summary of Radionuclide Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 6 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Vadose Zone Soil Greater than 5 meters	Remarks
Septic Tanks and Drain Fields							
2607-W1 Septic Tank							
2607-W2 Septic Tank							
2607-W3 Septic Tank							
2607-W4 Septic Tank							
2607-WT Septic Tank							
2607-WTX Septic Tank							
Transfer Facilities, Diversion Boxes, and Pipelines							
241-T-151 Diversion Box							No leaks reported.
241-T-152 Diversion Box							No leaks reported.
241-T-153 Diversion Box							No leaks reported.
241-T-252 Diversion Box							No leaks reported.
241-TR-152 Diversion Box							No leaks reported.
241-TR-153 Diversion Box							No leaks reported.
241-TX-152 Diversion Box							No leaks reported.
241-TX-153 Diversion Box							UPR-200-W-126 occurred here.
241-TX-154 Diversion Box		k					Ground cave-in in process line.
241-TX-155 Diversion Box							UPR-200-W-5 & 28 occurred here.
241-TXR-152 Diversion Box							No leaks reported.

Table 4-1. Summary of Radionuclide Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 7 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Vadose Zone Soil Greater than 5 meters	Remarks
241-TXR-153 Diversion Box							No leaks reported.
241-TY-153 Diversion Box							No leaks reported.
242-T-151 Diversion Box							No leaks reported.
Basins							
207-T Retention Basin		k			s		
Burial Sites							
200-W Ash Disposal Basin							Chemical detonation site
200-W Ash Pit Demolition Site							
200-W Burning Pit							
200-W Powerhouse Ash Pit							
218-W-8 Burial Ground		s			s	s	
Unplanned Releases							
UN-200-W-2		k			s		Failed waste line 10 ft. below surface.
UN-200-W-3		s					
UN-200-W-4		s					
UN-200-W-7		s					
UN-200-W-8		k					Covered with 10 ft. of soil.
UN-200-W-14		k			s		Covered with 1 ft. of soil.
UN-200-W-17		s					

Table 4-1. Summary of Radionuclide Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 8 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Vadose Zone Soil Greater than 5 meters	Remarks
UN-200-W-27		s					
UN-200-W-29		s			s		See UPR-200-W-93 also.
UN-200-W-38		s					
UN-200-W-58		s					
UN-200-W-62		s			s		Covered with sand and gravel.
UN-200-W-63		s					Covered with sand and gravel.
UN-200-W-64		s					
UN-200-W-65		s					
UN-200-W-67		s					
UN-200-W-73		s					
UN-200-W-76				r?			Near 241-TX-155 diversion box.
UN-200-W-77				r?			
UN-200-W-85		r		r			Decontaminated to background levels.
UN-200-W-88		r					Contamination removed.
UN-200-W-97		k			s		
UN-200-W-98		k		k	s		
UN-200-W-99		k			s		Related to 241-TX-153 diversion box.
UN-200-W-100		s					Area covered with 1 ft. of soil.
UN-200-W-102		s			s		

Table 4-1. Summary of Radionuclide Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 9 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Vadose Zone Soil Greater than 5 meters	Remarks
UN-200-W-113		s			s		
UN-200-W-135		s			s		
UN-200-W-137		s					Received sample waste from 222-S Bldg. Geographically in S Plant Aggregate Area.
UPR-200-W-5							Removed from radiation zone status.
UPR-200-W-12		s					
UPR-200-W-21		s			s		
UPR-200-W-28		s					Leak from 241-TX-155 diversion box.
UPR-200-W-30							
UPR-200-W-37							
UPR-200-W-70		k					200-W Burning Ground.
UPR-200-W-126							Employee contamination.
UPR-200-W-129		s					At 241-TX-113 tank.
UPR-200-W-131		s					Leak from 241-TX-155 diversion box.
UPR-200-W-147					k	k	Near 241-T-103 tank.
UPR-200-W-148					k	k	Leak from 241-T-106 tank.
UPR-200-W-149		s			k	s	Possibly a leak from 241-TX-107 tank.
UPR-200-W-150		s			k	s	Leak from 241-TY-103 tank.
UPR-200-W-151		s			k		Leak from 241-TY-104 tank.

Table 4-1. Summary of Radionuclide Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 10 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Vadose Zone Soil Greater than 5 meters	Remarks
UPR-200-W-152		s			k	s	Leak from 241-TY-105 tank.
UPR-200-W-153		s			k	s	Leak from 241-TY-106 tank.
UPR-200-W-160		k			s	s	

Notes:

s Suspected contamination, based on WIDS, other waste inventory data, and available sampling and analysis information.
k Known contamination, based on WIDS, or other source.
r Complete remediation reported.
r? Remediation attempted, effectiveness not documented.
nc No contamination indicated by available data.

Table 4-2. Summary of Chemical Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 1 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Remarks
Tanks and Vaults						
241-T-101 Single-Shell Tank					k	FeCN tank-line overflowed.
241-T-102 Single-Shell Tank					k	From 241-T-106 tank leak.
241-T-103 Single-Shell Tank					k	Assumed leaker (UPR-200-W-147).
241-T-104 Single-Shell Tank					k	
241-T-105 Single-Shell Tank					k	Due to 241-T-106 -RHO-ST-14.
241-T-106 Single-Shell Tank					k	Confirmed leaker (UPR-200-W-148).
241-T-107 Single-Shell Tank					k	Assumed leaker.
241-T-108 Single-Shell Tank					k	Assumed leaker.
241-T-109 Singel-Shell Tank					k	Assumed leaker.
241-T-110 Single-Shell Tank					s	H_2 build-up possible.
241-T-111 Single-Shell Tank					s	Assumed leaker.
241-T-112 Single-Shell Tank						
241-T-201 Single-Shell Tank						Received 224-U Bldg. waste.
241-T-202 Single-Shell Tank						Received 224-U Bldg. waste.
241-T-203 Single-Shell Tank						Received 224-U Bldg. waste.
241-T-204 Single-Shell Tank						Received 224-U Bldg. waste.
241-TX-101 Single-Shell Tank		s				
241-TX-102 Single-Shell Tank		s				

Table 4-2. Summary of Chemical Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 2 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Remarks
241-TX-103 Single-Shell Tank		s			k	Due to 241-TX-107 leak.
241-TX-104 Single-Shell Tank		s				
241-TX-105 Single-Shell Tank		s			s	Assumed leaker.
241-TX-106 Single-Shell Tank		s				
241-TX-107 Single-Shell Tank		s			k	Assumed leaker.
241-TX-108 Single-Shell Tank		s				
241-TX-109 Single-Shell Tank		s				
241-TX-110 Single-Shell Tank		s			s	Assumed leaker.
241-TX-111 Single-Shell Tank		s				
241-TX-112 Single-Shell Tank		s				
241-TX-113 Single-Shell Tank		s			s	Assumed leaker (UPR-200-W-129).
241-TX-114 Single-Shell Tank		s			s	Assumed leaker.
241-TX-115 Single-Shell Tank		s			s	Assumed leaker.
241-TX-116 Single-Shell Tank		s			s	Assumed leaker.
241-TX-117 Single-Shell Tank		s			s	Assumed leaker.
241-TX-118 Single-Shell Tank		s				FeCN Tank
241-TY-101 Single-Shell Tank		s			s	Assumed leaker; FeCN tank.
241-TY-102 Single-Shell Tank		s			s	
241-TY-103 Single-Shell Tank		s			k	Confirmed leaker; FeCN tank.

Table 4-2. Summary of Chemical Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 3 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Remarks
241-TY-104 Single-Shell Tank		s			s	Assumed leaker (UPR-200-W-151).
241-TY-105 Single-Shell Tank		s			s	Assumed leaker (UPR-200-W-152).
241-TY-106 Single-Shell Tank		s			s	Assumed leaker (UPR-200-W-153).
241-T-361 Settling Tank						
244-TX Receiver Tank						
241-T-301 Catch Tank						
241-T-302 Catch Tank						
241-TX-302A Catch Tank						
241-TX-302B Catch Tank						UPR-200-W-131 occurred here.
241-TX-302C Catch Tank						UPR-200-W-21 & 160 occurred here.
241-TY-302A Catch Tank		k				
241-TY-302B Catch Tank						
Cribs and French Drains						
216-T-6 Crib		k			k	
216-T-7TF Crib and Tile Field		k			k	
216-T-8 Crib		k			k	
216-T-18 Crib		r?			k	Stabilized in 1990.
216-T-19TF Crib and Tile Field		k			k	Received U Plant waste.
216-T-26 Crib					k	Stabilized in 1990.

Table 4-2. Summary of Chemical Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 4 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Remarks
216-T-27 Crib					k	Stabilized in 1990.
216-T-28 Crib					k	Stabilized in 1990.
216-T-29 Crib						
216-T-31 French Drain						Exhumed in 1959.
216-T-32 Crib		k			k	
216-T-33 Crib		k			k	
216-T-34 Crib		r?			k	Stabilized '90; rec'd 300 Area lab waste.
216-T-35 Crib					k	Stabilized '90; rec'd 300 Area lab waste.
216-T-36 Crib					k	
216-W-LWC Crib					s	
Reverse Wells						
216-T-2 Reverse Well					k	
216-T-3 Reverse Well		r?			k	
Ponds, Ditches, and Trenches						
216-T-4A Pond		r?			s	Radionuclides exhumed.
216-T-4B Pond		k			s	Actively dredged since 1977.
216-T-1 Ditch		k	s			
216-T-4-1D Ditch		r?	k		k	Dredged in 1989.

Table 4-2. Summary of Chemical Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 5 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Remarks
216-T-4-2 Ditch		k	k		k	
200-W Powerhouse Pond						
216-T-5 Trench		k			k	
216-T-9 Trench		r			r	Site exhumed in 1972.
216-T-10 Trench		r			r	Site exhumed in 1972.
216-T-11 Trench		r			r	Site exhumed in 1972.
216-T-12 Trench		k			k	
216-T-13 Trench					s	
216-T-14 Trench		k			k	
216-T-15 Trench		k			k	
216-T-16 Trench		k			k	
216-T-17 Trench		k			k	
216-T-20 Trench		r?			k	
216-T-21 Trench					k	
216-T-22 Trench					k	
216-T-23 Trench					k	
216-T-24 Trench					k	
216-T-25 Trench					k	

Table 4-2. Summary of Chemical Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 6 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Remarks
Septic Tanks and Drain Fields						
2607-W1 Septic Tank						
2607-W2 Septic Tank						
2607-W3 Septic Tank						
2607-W4 Septic Tank						
2607-WT Septic Tank						
2607-WTX Septic Tank						
Transfer Facilities, Diversion Boxes, and Pipelines						
241-T-151 Diversion Box						No leaks reported.
241-T-152 Diversion Box						No leaks reported.
241-T-153 Diversion Box						No leaks reported.
241-T-252 Diversion Box						No leaks reported.
241-TR-152 Diversion Box						No leaks reported.
241-TR-153 Diversion Box						No leaks reported.
241-TX-152 Diversion Box						No leaks reported.
241-TX-153 Diversion Box						UPR-200-W-126 occurred here.
241-TX-154 Diversion Box		k				Ground cave-in in process line.
241-TX-155 Diversion Box						UPR-200-W-5 & 28 occurred here.

Table 4-2. Summary of Chemical Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 7 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Remarks
241-TXR-152 Diversion Box						No leaks reported.
241-TXR-153 Diversion Box						No leaks reported.
241-TY-153 Diversion Box						No leaks reported.
242-T-151 Diversion Box						No leaks reported.
Basins						
207-T Retention Basin		k			s	
Burial Sites						
200-W Ash Disposal Basin		s				Chemical detonation site
200-W Ash Pit Demolition Site						
200-W Burning Pit		s				
200-W Powerhouse Ash Pit						
218-W-8 Burial Ground		s			s	
Unplanned Releases						
UN-200-W-2		k			s	Failed waste line 10 ft. below surface.
UN-200-W-3		s				
UN-200-W-4		s				
UN-200-W-7		s				
UN-200-W-8		k				Covered with 10 ft. of soil.
UN-200-W-14		k			s	Covered with 1 ft. of soil.

Table 4-2. Summary of Chemical Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 8 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Remarks
UN-200-W-17		s				
UN-200-W-27		s				
UN-200-W-29		s			s	See UPR-200-W-97 also.
UN-200-W-38		s				
UN-200-W-58		r?				
UN-200-W-62		r?			s	Covered with sand and gravel.
UN-200-W-63		r?				Covered with sand and gravel.
UN-200-W-64		s				
UN-200-W-65		s				
UN-200-W-67		s				
UN-200-W-73		s				
UN-200-W-76						Near 241-TX-155 diversion box.
UN-200-W-77						
UN-200-W-85		r				Decontaminated to background levels.
UN-200-W-88		r				Contamination removed.
UN-200-W-97		k			s	
UN-200-W-98		k			s	
UN-200-W-99		k				Related to 241-TX-153 diversion box.
UN-200-W-100		s				Area covered with 1 ft. soil.

Table 4-2. Summary of Chemical Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 9 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Remarks
UN-200-W-102		s			s	
UN-200-W-113		s			s	
UN-200-W-135		s			s	
UN-200-W-137		s				Rec'd sample waste from 222-S Bldg. Geographically in S Plant Aggregate Area.
UPR-200-W-5						Removed from radiation zone status.
UPR-200-W-12		s				
UPR-200-W-21		s			s	
UPR-200-W-28		s				Leak from 241-TX-155 diversion box.
UPR-200-W-30						
UPR-200-W-37						
UPR-200-W-70		k				200-W Burning Ground.
UPR-200-W-126						Employee contamination.
UPR-200-W-129		s				At 241-TX-113 tank.
UPR-200-W-131		s				Leak from 241-TX-155 diversion box.
UPR-200-W-147					k	Near 241-T-103 tank.
UPR-200-W-148					k	Leak from 241-T-106 tank.
UPR-200-W-149		s			k	Possibly a leak from 241-TX-107 tank.
UPR-200-W-150		s			k	Leak from 241-TY-103 tank.

Table 4-2. Summary of Chemical Contamination in Various Affected Media at the T Plant Aggregate Area. (Sheet 10 of 10)

Waste Management Unit	Air	Surface Soil	Surface Water	Biota	Vadose Zone Soil 0 to 5 meters	Remarks
UPR-200-W-151		s			k	Leak from 241-TY-104 tank.
UPR-200-W-152					k	Leak from 241-TY-105 tank.
UPR-200-W-153		s	s		k	Leak from 241-TY-106 tank.
UPR-200-W-160		k			s	

Notes:

s Suspected contamination, based on WIDS, other waste inventory data, and available sampling and analysis information.
k Known contamination, based on WIDS, or other source.
r Complete remediation reported.
r? Remediation attempted, effectiveness not documented.
nc No contamination indicated by available data.

Table 4-3. Types of Data Available at the T Plant Aggregate Area. (Sheet 1 of 10)

Waste Management Unit	Waste Inventory Database (WIDS)	Air Sampling Data	Surface Soil/Sediment Data	External Radiation Monitoring Data	Biota Sampling Data	Subsurface Vapor/Soil Sampling Data	Borehole Geophysics Data
Tanks and Vaults							
241-T-101 Single-Shell Tank	C,R					R	
241-T-102 Single-Shell Tank	C,R					R	
241-T-103 Single-Shell Tank	C,R					R	
241-T-104 Single-Shell Tank	C,R					R	
241-T-105 Single-Shell Tank	C,R					R	
241-T-106 Single-Shell Tank	C,R					R	
241-T-107 Single-Shell Tank	C,R					R	
241-T-108 Single-Shell Tank	C,R					R	
241-T-109 Single-Shell Tank	C,R					R	
241-T-110 Single-Shell Tank	C,R					R	
241-T-111 Single-Shell Tank	C,R					R	
241-T-112 Single-Shell Tank	C,R					R	
241-T-201 Single-Shell Tank	C					R	
241-T-202 Single-Shell Tank	C,R					R	
241-T-203 Single-Shell Tank	C,R					R	
241-T-204 Single-Shell Tank	C,R					R	
241-TX-101 Single-Shell Tank	C,R	R				R	
241-TX-102 Single-Shell Tank	C,R	R				R	

Table 4-3. Types of Data Available at the T Plant Aggregate Area. (Sheet 2 of 10)

Waste Management Unit	Waste Inventory Database (WIDS)	Air Sampling Data	Surface Soil/Sediment Data	External Radiation Monitoring Data	Biota Sampling Data	Subsurface Vapor/Soil Sampling Data	Borehole Geophysics Data
241-TX-103 Single-Shell Tank	C,R	R				R	
241-TX-104 Single-Shell Tank	C,R	R				R	
241-TX-105 Single-Shell Tank	C,R	R				R	
241-TX-106 Single-Shell Tank	C,R	R				R	
241-TX-107 Single-Shell Tank	C,R	R				R	
241-TX-108 Single-Shell Tank	C,R	R				R	
241-TX-109 Single-Shell Tank	C,R	R				R	
241-TX-110 Single-Shell Tank	C,R	R				R	
241-TX-111 Single-Shell Tank	C,R	R				R	
241-TX-112 Single-Shell Tank	C,R	R				R	
241-TX-113 Single-Shell Tank	C,R	R				R	
241-TX-114 Single-Shell Tank	C,R	R				R	
241-TX-115 Single-Shell Tank	C,R	R				R	
241-TX-116 Single-Shell Tank	C,R	R				R	
241-TX-117 Single-Shell Tank	C,R	R				R	
241-TX-118 Single-Shell Tank	C,R	R				R	
241-TY-101 Single-Shell Tank	C,R	R				R	
241-TY-102 Single-Shell Tank	C,R	R				R	
241-TY-103 Single-Shell Tank	C,R	R				R	

Table 4-3. Types of Data Available at the T Plant Aggregate Area. (Sheet 3 of 10)

Waste Management Unit	Waste Inventory Database (WIDS)	Air Sampling Data	Surface Soil/Sediment Data	External Radiation Monitoring Data	Biota Sampling Data	Subsurface Vapor/Soil Sampling Data	Borehole Geophysics Data
241-TY-104 Single-Shell Tank	C,R	R				R	
241-TY-105 Single-Shell Tank	C,R	R				R	
241-TY-106 Single-Shell Tank	C,R	R				R	
241-T-361 Settling Tank	R	R					
244-TX Receiver Tank							
241-T-301 Catch Tank							
241-T-302 Catch Tank							
241-TX-302A Catch Tank		R					
241-TX-302B Catch Tank		R					
241-TX-302C Catch Tank		R					
241-TY-302A Catch Tank		R					
241-TY-302B Catch Tank		R					
Cribs and French Drains							
216-T-6 Crib	C,R			R			
216-T-7TF Crib and Tile Field	C,R			R			
216-T-8 Crib	C,R			R			
216-T-18 Crib	C,R						
216-T-19TF Crib and Tile Field	C,R						
216-T-26 Crib	C,R				R		

Table 4-3. Types of Data Available at the T Plant Aggregate Area. (Sheet 4 of 10)

Waste Management Unit	Waste Inventory Database (WIDS)	Air Sampling Data	Surface Soil/Sediment Data	External Radiation Monitoring Data	Biota Sampling Data	Subsurface Vapor/Soil Sampling Data	Borehole Geophysics Data
216-T-27 Crib	C,R			R	R		
216-T-28 Crib	C,R				R		
216-T-29 Crib	C						
216-T-31 French Drain	C,R						
216-T-32 Crib	C,R						
216-T-33 Crib	C,R						
216-T-34 Crib	C,R						
216-T-35 Crib	C,R						
216-T-36 Crib	C,R						
216-W-LWC Crib	C,R						
Reverse Wells							
216-T-2 Reverse Well	C,R			R			
216-T-3 Reverse Well	C,R						
Ponds, Ditches, and Trenches							
216-T-4A Pond	R			R	R		
216-T-4B Pond	R			R	R		
216-T-1 Ditch	C,R			R			
216-T-4-1D Ditch	C,R			R	R		
216-T-4-2 Ditch	C,R		C,R	R	R		

Table 4-3. Types of Data Available at the T Plant Aggregate Area. (Sheet 5 of 10)

Waste Management Unit	Waste Inventory Database (WIDS)	Air Sampling Data	Surface Soil/Sediment Data	External Radiation Monitoring Data	Biota Sampling Data	Subsurface Vapor/Soil Sampling Data	Borehole Geophysics Data
200-W Powerhouse Pond	C						
216-T-5 Trench	C,R			R			
216-T-9 Trench							
216-T-10 Trench							
216-T-11 Trench							
216-T-12 Trench	C,R			R			
216-T-13 Trench	C,R						
216-T-14 Trench	C,R			R	R		
216-T-15 Trench	C,R				R		
216-T-16 Trench	C,R				R		
216-T-17 Trench	C,R				R		
216-T-20 Trench	C,R						
216-T-21 Trench	C,R				R		
216-T-22 Trench	C,R				R		
216-T-23 Trench	C,R				R		
216-T-24 Trench	C,R				R		
216-T-25 Trench	C,R						

Table 4-3. Types of Data Available at the T Plant Aggregate Area. (Sheet 6 of 10)

Waste Management Unit	Waste Inventory Database (WIDS)	Air Sampling Data	Surface Soil/Sediment Data	External Radiation Monitoring Data	Biota Sampling Data	Subsurface Vapor/Soil Sampling Data	Borehole Geophysics Data
Septic Tanks and Drain Fields							
2607-W1 Septic Tank							
2607-W2 Septic Tank							
2607-W3 Septic Tank							
2607-W4 Septic Tank							
2607-WT Septic Tank							
2607-WTX Septic Tank							
Transfer Facilities, Diversion Boxes, and Pipelines							
241-T-151 Diversion Box		R					
241-T-152 Diversion Box		R					
241-T-153 Diversion Box		R					
241-T-252 Diversion Box		R					
241-TR-152 Diversion Box		R					
241-TR-153 Diversion Box		R					
241-TX-152 Diversion Box		R					
241-TX-153 Diversion Box		R					
241-TX-154 Diversion Box		R		R			
241-TX-155 Diversion Box		R					
241-TXR-152 Diversion Box		R					

Table 4-3. Types of Data Available at the T Plant Aggregate Area. (Sheet 7 of 10)

Waste Management Unit	Waste Inventory Database (WIDS)	Air Sampling Data	Surface Soil/Sediment Data	External Radiation Monitoring Data	Biota Sampling Data	Subsurface Vapor/Soil Sampling Data	Borehole Geophysics Data
241-TXR-153 Diversion Box		R					
241-TY-153 Diversion Box							
242-T-151 Diversion Box							
Basins							
207-T Retention Basin	R				R		
Burial Sites							
200-W Ash Disposal Basin	C						
200-W Ash Pit Demolition Site							
200-W Burning Pit	C						
200-W Powerhouse Ash Pit							
218-W-8 Burial Ground	C,R						
Unplanned Releases							
UN-200-W-2	C,R						
UN-200-W-3	C,R						
UN-200-W-4	C,R			R			
UN-200-W-7	C,R			R			
UN-200-W-8	C,R			R			
UN-200-W-14	C,R						
UN-200-W-17	C,R						

Table 4-3. Types of Data Available at the T Plant Aggregate Area. (Sheet 8 of 10)

Waste Management Unit	Waste Inventory Database (WIDS)	Air Sampling Data	Surface Soil/Sediment Data	External Radiation Monitoring Data	Biota Sampling Data	Subsurface Vapor/Soil Sampling Data	Borehole Geophysics Data
UN-200-W-27	C,R						
UN-200-W-29	C,R			R			
UN-200-W-38	C,R			R			
UN-200-W-58	C,R			R			
UN-200-W-62	C,R			R			
UN-200-W-63	C,R			R			
UN-200-W-64	C,R						
UN-200-W-65	C,R			R			
UN-200-W-67	C,R						
UN-200-W-73	C,R			R			
UN-200-W-76	C,R			R	R		
UN-200-W-77	C,R				R		
UN-200-W-85	C,R				R		
UN-200-W-88	C,R						
UN-200-W-97	C,R			R			
UN-200-W-98	C,R			R	R		
UN-200-W-99	C,R						
UN-200-W-100	C,R			R			
UN-200-W-102	C,R						

Table 4-3. Types of Data Available at the T Plant Aggregate Area. (Sheet 9 of 10)

Waste Management Unit	Waste Inventory Database (WIDS)	Air Sampling Data	Surface Soil/Sediment Data	External Radiation Monitoring Data	Biota Sampling Data	Subsurface Vapor/Soil Sampling Data	Borehole Geophysics Data
UN-200-W-113	C,R						
UN-200-W-135	C,R			R			
UN-200-W-137	C,R						
UPR-200-W-5	C,R						
UPR-200-W-12	C,R			R			
UPR-200-W-21	C,R						
UPR-200-W-28	C,R						
UPR-200-W-30	C,R						
UPR-200-W-37	C,R						
UPR-200-W-70	C,R						
UPR-200-W-126	C,R						
UPR-200-W-129	C,R						
UPR-200-W-131	C,R						
UPR-200-W-147	C,R						
UPR-200-W-148	C,R						
UPR-200-W-149	C,R						
UPR-200-W-150	C,R						
UPR-200-W-151	C,R						
UPR-200-W-152	C,R						

Table 4-3. Types of Data Available at the T Plant Aggregate Area. (Sheet 10 of 10)

Waste Management Unit	Waste Inventory Database (WIDS)	Air Sampling Data	Surface Soil/Sediment Data	External Radiation Monitoring Data	Biota Sampling Data	Subsurface Vapor/Soil Sampling Data	Borehole Geophysics Data
UPR-200-W-153	C,R						
UPR-200-W-160	C,R						

Notes: C = Nonradioactive organic or inorganic constituents R = Radiological constituents

Table 4-4. Summary of Air Monitoring Results at the T Plant Aggregate Area.

Radionuclide (pCi/m^3)	Site				
	N153[a]	N161[a]	N177[a]	N986[a]	N987[a]
^{90}Sr	6.50×10^{-04}	6.46×10^{-04}	8.20×10^{-04}	3.74×10^{-04}	1.75×10^{-04}
^{137}Cs	3.05×10^{-03}	1.54×10^{-04}	2.58×10^{-04}	7.23×10^{-04}	5.47×10^{-04}
^{239}Pu	2.88×10^{-05}	2.27×10^{-05}	3.28×10^{-05}	2.35×10^{-05}	6.88×10^{-06}
U (total)	3.52×10^{-05}	2.36×10^{-05}	1.15×10^{-04}	3.15×10^{-05}	2.48×10^{-05}

[a] Values are averages for each year with a detection since 1985.
(Site locations are shown on Plate 3)

Table 4-5. Radiation and Dose Rate Surveys at the T Plant Aggregate Area. (Sheet 1 of 8)

			Radiation Survey				
Waste Management Unit	Ref.	Inspection Date	ct/min	dis/min	mrem/hr	Smearable Alpha in d/m	Radiation Type, Notes
Tanks and Vaults							
241-T-361 Settling Tank	1	--	--	--	--	--	--
241-T-301 Catch Tank	1	--	--	--	--	--	--
241-T-302 Catch Tank	1	--	--	--	--	--	--
241-TX-302A Catch Tank	1	--	--	--	--	--	--
241-TX-302B Catch Tank	1	--	--	--	--	--	--
241-TX-302C Catch Tank	1	--	--	--	--	--	--
241-TY-302A Catch Tank	1	--	--	--	--	--	--
241-TY-302B Catch Tank	1	--	--	--	--	--	--
Cribs and French Drains							
216-T-6 Crib	1	June 1990	na	na	ND	na	No change since 10/88 survey.
216-T-7TF Crib and Tile Field	1	Oct. 1987	na	na	ND	na	No change since 10/86 survey.
216-T-8 Crib	1	June 1990	na	na	ND	na	No change since 10/88 survey.
216-T-18 Crib	1	June 1990	na	na	ND	na	Surface stabilized 5/22/90.
216-T-19TF Crib and Tile Field	1	Oct. 1989	na	3,000	na	na	β, γ
216-T-26 Crib	1	Oct. 1989	na	5,000	ND	na	β, γ Surface stabilized 5/21/90.
216-T-27 Crib	1	Oct. 1989	na	50,000	25	na	Surface stabilized 5/21/90. 25 mR/h non-smearable on riser.
216-T-28 Crib	1	Oct. 1989	na	50,000	ND	na	Surface stabilized 5/21/90.

Table 4-5. Radiation and Dose Rate Surveys at the T Plant Aggregate Area. (Sheet 2 of 8)

			Radiation Survey				
Waste Management Unit	Ref.	Inspection Date	ct/min	dis/min	mrem/hr	Smearable Alpha in d/m	Radiation Type, Notes
216-T-29 Crib	1	--	--	--	--	--	--
216-T-31 French Drain	1	--	--	--	--	--	Contaminated gravel/soil excavated and buried in 200-W Dry Burial Ground in 1959.
216-T-32 Crib	1	Oct. 1987	na	na	ND	na	No change since 10/86 survey.
216-T-33 Crib	1	June 1990	na	3,000	na	na	na
216-T-34 Crib	1	June 1990	na	100,000	na	na	Surface stabilized 7/26/90
216-T-35 Crib	1	June 1990	na	na	ND	na	Surface stabilized 7/26/90. Spotty contamination up to 5,000 d/m noted in 10/88 and 10/89 surveys.
216-T-36 Crib	1	June 1990	na	na	ND	na	General contamination from 2,000 to 4,000 d/m noted in 10/89 survey.
216-W-LWC Crib	1	Jan. 1990	na	na	ND	na	No change since 12/88 survey.
Reverse Wells							
216-T-2 Reverse Well	1	June 1990	na	na	ND	na	No change since 10/88 survey.
216-T-3 Reverse Well	1	June 1990	na	ND	ND	na	Ground surface decontaminated 8/75.
Ponds, Ditches, and Trenches							
216-T-4A Pond	1	--	--	--	--	--	--
216-T-4B Pond	1	--	--	--	--	--	--
216-T-1 Ditch	1	Nov. 1990	na	na	ND	na	na
216-T-4-1D Ditch	1	Feb. 1990	na	na	ND	na	Dredged in 7/89.
216-T-4-2 Ditch	1	Feb. 1989	na	na	ND	na	No change since 2/88 survey.

Table 4-5. Radiation and Dose Rate Surveys at the T Plant Aggregate Area. (Sheet 3 of 8)

			Radiation Survey				
Waste Management Unit	Ref.	Inspection Date	ct/min	dis/min	mrem/hr	Smearable Alpha in d/m	Radiation Type, Notes
200-W Powerhouse Pond	1	--	--	--	--	--	--
216-T-5 Trench	1	Oct. 1987	na	na	ND	na	No change since 10/86 survey.
216-T-9 Trench	1	--	--	--	ND	--	Backfilled 1954. Exhumed 1972.
216-T-10 Trench	1	--	--	--	ND	--	Backfilled 1954. Exhumed 1972.
216-T-11 Trench	1	--	--	--	ND	--	Backfilled 1954. Exhumed 1972.
216-T-12 Trench	1	June 1984	500	na	na	na	β, γ
216-T-13 Trench	1	--	--	--	--	--	Surface stabilized (excavated and backfilled).
216-T-14 Trench	1	Jan. 1990	na	4,000	na	na	β, γ
216-T-15 Trench	1	Jan. 1990	na	4,000	na	na	β, γ
216-T-16 Trench	1	Jan. 1990	na	4,000	na	na	β, γ
216-T-17 Trench	1	Jan. 1990	na	4,000	na	na	β, γ
216-T-20 Trench	1	June 1990	na	na	ND	na	No change since 10/88 survey.
216-T-21 Trench	1	Dec. 1990	na	na	ND	na	No change since 9/88 survey.
216-T-22 Trench	1	Dec. 1990	na	na	ND	na	No change since 9/88 survey.
216-T-23 Trench	1	Dec. 1990	na	na	ND	na	No change since 9/88 survey.
216-T-24 Trench	1	Dec. 1990	na	na	ND	na	No change since 9/88 survey.
216-T-25 Trench	1	Dec. 1990	na	na	ND	na	No change since 9/88 survey.
Septic Tanks and Drain Fields							
2607-W1 Septic Tank	1	--	--	--	--	--	--

Table 4-5. Radiation and Dose Rate Surveys at the T Plant Aggregate Area. (Sheet 4 of 8)

			Radiation Survey				
Waste Management Unit	Ref.	Inspection Date	ct/min	dis/min	mrem/hr	Smearable Alpha in d/m	Radiation Type, Notes
2607-W2 Septic Tank	1	--	--	--	--	--	--
2607-W3 Septic Tank	1	--	--	--	--	--	--
2607-W4 Septic Tank	1	--	--	--	--	--	--
2607-WT Septic Tank	1	--	--	--	--	--	--
2607-WTX Septic Tank	1	--	--	--	--	--	--
Transfer Facilities, Diversion Boxes, and Pipelines							
241-T-151 Diversion Box	1	--	--	--	--	--	--
241-T-152 Diversion Box	1	--	--	--	--	--	--
241-T-153 Diversion Box	1	--	--	--	--	--	--
241-T-252 Diversion Box	1	--	--	--	--	--	--
241-TR-152 Diversion Box	1	--	--	--	--	--	--
241-TR-153 Diversion Box	1	--	--	--	--	--	--
241-TX-152 Diversion Box	1	--	--	--	--	--	--
241-TX-153 Diversion Box	1	--	--	--	--	--	--
241-TX-154 Diversion Box	1	--	--	--	--	--	--
241-TX-155 Diversion Box	1	--	--	--	--	--	--
241-TXR-152 Diversion Box	1	--	--	--	--	--	--
241-TXR-153 Diversion Box	1	--	--	--	--	--	--
241-TY-153 Diversion Box	1	--	--	--	--	--	--

Table 4-5. Radiation and Dose Rate Surveys at the T Plant Aggregate Area. (Sheet 5 of 8)

			Radiation Survey				
Waste Management Unit	Ref.	Inspection Date	ct/min	dis/min	mrem/hr	Smearable Alpha in d/m	Radiation Type, Notes
242-T-151 Diversion Box	1	--	--	--	--	--	--
Basins							
207-T Retention Basin	1	July 1990	na	na	ND	na	No change since 7/89 survey.
Burial Sites							
200-W Ash Disposal Basin	1	--	--	--	--	--	--
200-W Ash Pit Demolition Site	1	--	--	--	--	--	--
200-W Burning Pit	1	--	--	--	--	--	--
200-W Powerhouse Ash Pit	1	--	--	--	--	--	--
218-W-8 Burial Ground	1	July 1990	na	na	ND	na	No change since 12/88 survey.
Unplanned Releases							
UN-200-W-2	1	--	--	--	--	--	--
UN-200-W-3	1	--	--	--	--	--	Contamination covered with 10 in. clean gravel in 1950.
UN-200-W-4	1	--	--	--	--	--	β, γ
UN-200-W-7	1	--	--	--	--	--	β, γ Portion of contamination removed and covered with clean soil. Posted.
UN-200-W-8	1	--	--	--	--	--	Covered with 10 ft. soil
UN-200-W-14	1	--	--	--	--	--	Contaminated areas covered with 1 ft. clean soil/gravel.
UN-200-W-17	1	--	--	--	--	--	--

Table 4-5. Radiation and Dose Rate Surveys at the T Plant Aggregate Area. (Sheet 6 of 8)

			Radiation Survey				
Waste Management Unit	Ref.	Inspection Date	ct/min	dis/min	mrem/hr	Smearable Alpha in d/m	Radiation Type, Notes
UN-200-W-27	1	--	--	--	--	--	--
UN-200-W-29	1	--	--	--	--	--	Backfilled with earth; covered with gravel.
UN-200-W-38	1	--	--	--	--	--	--
UN-200-W-58	1	--	--	--	--	--	β, γ Contaminated soil removed from railroad bed.
UN-200-W-62	1	--	--	--	--	--	β, γ Area covered with sand and gravel.
UN-200-W-63	1	--	--	--	--	--	β, Spotty contamination (max 500 mR/h) on road removed. Remaining soil contamination covered with 6 in. soil.
UN-200-W-64	1	--	--	--	--	--	β, γ No documentation of remedial action.
UN-200-W-65	1	--	--	--	--	--	β, γ Original readings up to 150 mrad/hr.
UN-200-W-67	1	--	--	--	--	--	β, γ Original readings up to 20,000 mrad/hr.
UN-200-W-73	1	--	--	--	--	--	β, γ Original readings up to 40 mrad/hr.
UN-200-W-76	1	--	--	--	--	--	β, γ Rabbit feces and soil. Contaminated soil to dry waste burial. Remainder covered with 6 in. clean soil.
UN-200-W-77	1	--	--	--	--	--	--
UN-200-W-85	1	--	--	--	--	--	β, γ Decontaminated to background levels.
UN-200-W-88	1	--	--	--	--	--	Uranyl Nitrate. All detectable contamination removed.

Table 4-5. Radiation and Dose Rate Surveys at the T Plant Aggregate Area. (Sheet 7 of 8)

			Radiation Survey				
Waste Management Unit	Ref.	Inspection Date	ct/min	dis/min	mrem/hr	Smearable Alpha in d/m	Radiation Type, Notes
UN-200-W-97	1	Dec. 1990	600	na	na	na	β, γ Contamination removed to 3 ft. and buried in 200-W Burial Ground. Adjacent contamination removed 3-4 ft. Backfilled with clean soil.
UN-200-W-98	1	Oct. 1990	300	na	na	na	β, γ Covered with 4 ft. clean soil. Road constructed over site.
UN-200-W-99	1	Sept. 1989	4,000	na	0.2 (a)	na	β, γ Surface stabilized 7/11/90.
UN-200-W-100	1	--	--	--	--	--	β, γ Covered with 1 ft. clean soil.
UN-200-W-102	1	Oct. 1975	na	na	ND	na	No surface contamination in 10/75 survey.
UN-200-W-113	1	Dec. 1990	na	na	ND	na	Covered with clean gravel.
UN-200-W-135	1	--	--	--	--	--	β γ, within boundaries of UN-200-W-113.
UN-200-W-137	1	--	--	--	--	--	
UPR-200-W-5	1	--	--	--	--	--	Released from zone status 1970.
UPR-200-W-12	1	--	--	--	--	--	Contamination partially removed. Remainder covered with 1 ft. clean soil.
UPR-200-W-21	1	--	--	--	--	--	Blacktopped and posted.
UPR-200-W-28	1	--	--	--	--	--	Covered with clean soil.
UPR-200-W-37	1	--	--	--	--	--	Waste cartons removed; pit decontaminated.
UPR-200-W-40	1	--	--	--	--	--	--
UPR-200-W-70	1	--	--	--	--	--	Barricaded, posted, surface stabilized.

Table 4-5. Radiation and Dose Rate Surveys at the T Plant Aggregate Area. (Sheet 8 of 8)

			Radiation Survey				
Waste Management Unit	Ref.	Inspection Date	ct/min	dis/min	mrem/hr	Smearable Alpha in d/m	Radiation Type, Notes
UPR-200-W-126	1	--	--	--	--	--	--
UPR-200-W-129	1	--	--	--	--	--	--
UPR-200-W-131	1	--	--	--	--	--	--
UPR-200-W-147	1	--	--	--	--	--	--
UPR-200-W-148	1	--	--	--	--	--	--
UPR-200-W-149	1	--	--	--	--	--	--
UPR-200-W-150	1	--	--	--	--	--	--
UPR-200-W-151	1	--	--	--	--	--	--
UPR-200-W-152	1	--	--	--	--	--	--
UPR-200-W-153	1	--	--	--	--	--	Tank stabilized with diamataceous earth.
UPR-200-W-160	1	--	--	--	--	--	Backfilled, sprayed with tar, and posted.

Notes:

-- indicates information not reported.
ND Unless specifically identified, ND is approximately 0.1 mr/hr for mR/hr readings and ≤ background for ct/min & dis/min readings.
na Parameter was not available (not measured) in most recent survey.
ct/min Counts per minute
dis/min Disintegrations per minute
mrem/hr Millirem per hour

(1) Waste Inventory Data Sheets (WHC 1991a)

Table 4-6. Results of External Radiation Monitoring: TLD at the T Plant Aggregate Area. (Sheet 1 of 2)

Location	Readings in mrem/yr						
	1985	1986	1987	1988	1989	1990	Annual Average
274-W							
max	--	--	--	--	--	88	
min	--	--	--	--	--	38	
total	--	--	--	--	--	73	73
218-W-2A							
max	--	--	--	--	--	124	
min	--	--	--	--	--	100	
total	--	--	--	--	--	108	108
221-T East							
max	--	--	--	--	--	124	
min	--	--	--	--	--	104	
total	--	--	--	--	--	109	109
241-TX Tank Farm East							
max	--	--	--	--	--	160	
min	--	--	--	--	--	136	
total	--	--	--	--	--	147	147
2W2							
max	160	178	131	156	--	--	156
min	96	134	106	123	--	--	115
total	126	152	118	133	--	--	132
2W3							
max	80	93	105	118	--	--	99
min	64	65	79	90	--	--	75
total	74	76	89	101	--	--	85
2W4							
max	82	96	100	114	--	--	98
min	64	74	80	92	--	--	78
total	73	81	88	99	--	--	85
2W5							
max	80	97	107	105	--	--	97
min	64	64	77	93	--	--	75
total	73	78	90	99	--	--	85
2W7							
max	98	118	115	136	120	--	117
min	69	74	91	94	60	--	77
total	85	93	102	110	99	--	98

Table 4-6. Results of External Radiation Monitoring: TLD at the T Plant Aggregate Area. (Sheet 2 of 2)

Location	Readings in mrem/yr						
	1985	1986	1987	1988	1989	1990	Annual Average
2W9							
max	84	106	107	123	--	--	105
min	69	70	80	97	--	--	79
total	76	85	92	109	--	--	91
2W10							
max	77	101	109	115	--	--	101
min	59	66	83	92	--	--	75
total	71	78	91	100	--	--	85
2W12							
max	76	89	99	125	--	--	97
min	62	64	69	89	--	--	71
total	68	74	82	101	--	--	81
2W13							
max	141	169	145	196	160	--	162
min	69	101	117	125	96	--	127
total	105	131	135	150	133	--	131
2W14							
max	71	90	98	101	--	--	90
min	58	60	72	86	--	--	69
total	64	70	83	92	--	--	77
2W15							
max	84	107	122	111	--	--	106
min	64	66	80	90	--	--	75
total	76	81	96	100	--	--	88
2W19							
max	80	94	116	109	--	--	100
min	62	63	79	85	--	--	72
total	72	74	96	96	--	--	85
2W20							
max	76	104	117	124	--	--	105
min	62	64	80	93	--	--	75
total	71	80	93	105	--	--	87

Notes:
-- indicates results not reported.
Monthly/quarterly dose rates normalized to annual dose rate equivalent.
max - maximum quarterly value reported.
min - minimum quarterly value reported.
total - annual average value reported.
Data Sources: Elder et al. 1986 through 1989, Schmidt et al. 1990 and 1991.
See Plate 2 for sample locations.

Table 4-7. Summary of Grid Soil Sampling at the T Plant Aggregate Area. (Sheet 1 of 6)

Radionuclide (pCi/g)	Site						
	2W2[a]	2W3[a]	2W4[a]	2W5[a]	2W7[a]	2W8[a]	2W9[a]
^{7}Be							
^{141}Ce	0.00E+00		1.40E-02		-5.63E-02	2.35E-02	1.03E-02
^{144}Ce	0.00E+00		2.80E-02		-2.48E-02	-2.33E-01	2.81E-02
^{58}Co	0.00E+00	1.30E-01	4.96E-02		-6.28E-03	-7.41E-03	6.94E-03
^{60}Co	-4.60E-03	-1.50E-03	-1.15E-03	3.65E-02	7.59E-03	8.66E-02	7.57E-03
^{134}Cs	0.00E+00	5.00E-02	1.80E-02	7.00E-02	-2.23E-01	-1.07E-03	9.07E-03
^{137}Cs	6.40E+00	1.74E+00	1.89E+00	1.98E+00	4.51E+00	4.75E+01	4.91E+00
^{152}Eu	5.90E-02	9.80E-02	1.68E-01	1.59E-01	7.55E-02	1.35E-01	1.10E-01
^{154}Eu	-2.30E-02	1.80E-02	-4.00E-03	-3.40E-02	-2.90E-02	3.58E-02	1.23E-02
^{155}Eu	5.50E-02	2.60E-02	5.60E-02	4.40E-02	3.31E-02	-2.27E-02	7.99E-02
^{129}I					-1.58E-02	-1.74E+00	-9.97E-01
^{40}K							
^{54}Mn	1.30E-02	1.70E-02	1.27E-02	4.10E-02	2.07E-02	2.01E-02	1.15E-02
^{95}Nb	-3.20E-02	3.90E-03	-3.40E-03	-2.90E-02	-4.88E-02	-9.56E-03	-2.32E-02
^{212}Pb							
^{214}Pb	6.00E-01	6.20E-01	6.60E-01	7.80E-01	5.36E-01	5.64E-01	5.36E-01
^{238}Pu	1.70E-03	1.07E-03	3.11E-03	2.53E-03	3.41E-03	4.93E-03	1.10E-02
^{239}Pu	7.90E-01	9.23E-02	2.50E-01	1.60E-01	5.63E-02	1.01E-01	1.26E+00
^{225}Ra							
$^{105/106}Ru$	6.10E-02	0.00E+00	2.92E-01	2.30E-02	1.44E-01	-7.66E-02	-5.15E-02
^{125}Sb							
^{90}Sr	9.10E-01	5.43E-01	9.03E-01	7.20E-01	4.39E-01	1.07E+00	1.96E+00
^{99}Tc					1.27E-01	3.47E-01	5.03E-02
U	3.00E-01	3.50E-01	4.13E-01	4.10E-01	3.17E-01	3.36E-01	2.59E-01
^{235}U							
^{238}U							
^{65}Zn		4.40E-01	-2.20E-02		-1.04E-01	-6.15E-02	-3.82E-02
^{95}Zr	3.70E-03	2.00E-02	5.00E-03	1.10E-02	-1.67E-03	1.27E-02	3.49E-02

Table 4-7. Summary of Grid Soil Sampling at the T Plant Aggregate Area. (Sheet 2 of 6)

Radionuclide (pCi/g)	Site						
	2W10[a]	2W12[a]	2W13[a]	2W14[a]	2W15[a]	2W19[a]	2W20[a]
^{7}Be							
^{141}Ce			-4.07E-02	-1.69E-02	6.50E-03	1.27E-01	
^{144}Ce			-1.02E-01	3.06E-02	2.60E-02	8.60E-02	
^{58}Co	3.00E-02		1.20E-02	3.03E-02	-4.60E-04	-7.90E-04	
^{60}Co	1.20E-02	-1.20E-02	-5.62E-03	2.52E-02	1.01E-02	2.80E-02	-1.00E-02
^{134}Cs	6.50E-02	6.00E-02	2.41E-02	4.18E-02	6.20E-02	6.70E-02	8.00E-02
^{137}Cs	1.44E+00	1.11E+00	1.88E+01	2.93E+00	3.03E+00	7.38E+00	1.74E+00
^{152}Eu	1.35E-01	9.20E-02	6.73E-02	8.72E-02	1.18E-01	1.67E-01	1.30E-01
^{154}Eu	-2.80E-02	2.90E-03	2.36E-02	-1.17E-02	6.66E-02	6.74E-02	-2.92E-02
^{155}Eu	7.95E-02	7.30E-02	3.82E-02	2.33E-02	5.00E-02	5.75E-02	7.80E-02
^{129}I			-1.43E+00	-2.29E-01			
^{40}K							
^{54}Mn	1.30E-03	1.59E-01	8.11E-03	5.30E-03	-8.75E-03	1.35E-02	-5.20E-03
^{95}Nb	-2.00E-02	-1.80E-02	-1.95E-02	1.43E-02	-9.20E-03	-3.20E-02	-9.10E-03
$^{212/214}Pb$	6.60E-01	5.30E-01	6.17E-01	6.92E-01	7.60E-01	6.30E-01	6.90E-01
^{238}Pu	2.60E-03	2.17E-03	1.87E-03	3.57E-03	6.68E-03	9.18E-03	4.30E-03
^{239}Pu	2.97E-01	9.77E-02	1.06E-01	2.79E-01	6.68E-01	4.45E-01	2.33E-01
^{225}Ra							
$^{105/106}Ru$	-3.80E-02	4.00E-02	-8.10E-02	4.27E-02	-1.20E-01	3.31E-01	1.20E-02
^{125}Sb							
^{90}Sr	5.87E-01	3.27E-01	2.48E+00	4.14E-01	8.90E-01	7.18E-01	7.23E-01
^{99}Tc			-1.12E-01	-1.15E-01			
U	4.43E-01	3.80E-01	3.83E-01	3.53E-01	6.03E-01	4.45E-01	4.43E-01
^{235}U							
^{238}U							
^{65}Zn			-1.05E-01	-6.70E-02	-1.50E-02	-5.00E-03	
^{95}Zr	1.80E-02	3.30E-03	9.60E-03	6.18E-02	5.45E-03	1.05E-03	1.60E-02

Table 4-7. Summary of Grid Soil Sampling at the T Plant Aggregate Area. (Sheet 3 of 6)

Radionuclide (pCi/g)	Site						
	12[b]	13[b]	14[b]	15[b]	16[b]	17[b]	18[b]
^{7}Be	-4.40E+01	NS	NS	-2.58E+01	-1.04E+01	-2.43E+01	1.82E+01
^{141}Ce							
$^{144}CePr$	-2.00E-01	NS	NS	-1.70E-02	-1.39E-02	-4.18E-01	-2.42E-01
^{58}Co							
^{60}Co	1.22E-03	NS	NS	4.50E-02	2.56E-02	5.16E-03	6.24E-03
^{134}Cs	-1.48E-01	NS	NS	-1.30E-01	-3.43E-01	-5.09E-02	-1.14E-01
^{137}Cs	3.97E+00	NS	NS	4.24E+00	6.21E+00	4.11E+00	1.31E+00
^{152}Eu							
^{154}Eu	5.19E-03	NS	NS	5.67E-02	2.37E-02	4.39E-02	6.80E-02
^{155}Eu	7.15E-02	NS	NS	-2.78E-02	2.82E-02	3.57E-02	8.11E-03
^{129}I							
^{40}K	1.23E+01	NS	NS	1.22E+01	1.55E+01	1.34E+01	1.39E+01
^{54}Mn							
^{212}Pb	6.61E-01	NS	NS	NR	8.04E-01	6.46E-01	6.46E-01
^{214}Pb	5.96E-01	NS	NS	6.08E-01	7.54E-01	5.62E-01	5.63E-01
^{238}Pu	2.15E-03	NS	NS	9.67E-04	1.78E-03	1.17E-03	2.98E-03
$^{239/240}Pu$	7.46E-02	NS	NS	4.00E-02	7.00E-02	5.76E-02	2.57E-01
^{225}Ra	5.53E-01	NS	NS	NR	6.03E-01	5.82E-01	5.04E-01
^{105}Ru	1.88E-01	NS	NS	4.11E-01	3.24E-02	-3.46E-01	-2.35E-01
^{125}Sb	2.53E-02	NS	NS	-1.85E-02	1.13E-01	5.38E-02	-4.04E-02
^{90}Sr	3.81E-01	NS	NS	4.47E-01	2.25E-01	3.40E-01	2.62E+00
U	2.34E-01	NS	NS	1.37E-01	1.86E-01	1.38E-01	2.60E-01
^{235}U	NR	NS	NS	NR	NR	NR	NR
^{238}U	NR	NS	NS	NR	NR	NR	NR
^{65}Zn	-4.08E-01	NS	NS	-4.47E-01	-3.51E-01	-4.64E-01	-4.59E-01
$^{95}ZrNb$	4.41E-01	NS	NS	-5.18E-01	-4.63E-01	-1.41E+00	1.28E+00

Table 4-7. Summary of Grid Soil Sampling at the T Plant Aggregate Area. (Sheet 4 of 6)

Radionuclide (pCi/g)	Site						
	19[b]	20[b]	21[b]	22[b]	23[b]	24[b]	25[b]
^{7}Be	1.21E+01	-7.41E+00	0.00	0.00	0.00	0.00	0.00
^{141}Ce							
$^{144}CePr$	2.01E-01	-3.52E-03	-5.38E-01	-1.10E-01	-2.12E+00	-2.96E-01	1.25E+00
^{58}Co							
^{60}Co	6.16E-03	-2.25E-02	4.13E-02	-2.39E-02	-1.11E-02	-2.50E-03	9.89E-02
^{134}Cs	-8.62E-02	-3.39E-01	-2.35E-01	-2.44E-01	-1.45E-01	-1.23E-02	4.40E-02
^{137}Cs	3.32E+00	3.07E+00	4.20E+00	2.78E+00	9.91E+00	3.04E-01	2.56E+01
^{152}Eu							
^{154}Eu	-3.53E-02	3.48E-02	5.33E-02	4.23E-02	9.77E-03	-4.70E-02	2.72E-02
^{155}Eu	-4.69E-02	7.79E-02	3.65E-02	1.18E-01	4.37E-02	7.69E-03	4.85E-02
^{129}I							
^{40}K	1.29E-01	1.40E+01	1.64E+01	1.71E+01	1.73E+01	1.35E+01	1.53E+01
^{54}Mn							
^{212}Pb	6.04E-01	6.86E-01	NR	NR	NR	NR	NR
^{214}Pb	6.61E-01	6.49E-01	NR	NR	NR	NR	NR
^{238}Pu	1.07E-03	8.87E-04	3.14E-02	3.78E-03	1.97E-03	6.73E-04	1.28E-02
$^{239/240}Pu$	3.38E-02	6.62E-02	8.24E-02	1.12E-01	1.34E-02	2.55E-02	1.07E+00
^{225}Ra	5.50E-01	6.33E-01	NR	NR	NR	NR	NR
^{105}Ru	-1.34E-01	-7.91E-02	2.20E-01	2.67E-02	6/30E-01	2.85E-01	3.72E-01
^{125}Sb	2.70E-02	-4.82E-03	-7.02E-02	-5.14E-02	1.12E-02	4.72E-02	-6.67E-02
^{90}Sr	3.14E-01	5.17E-01	7.88E-01	3.17E-01	9.26E-01	1.55E-01	3.11E+00
^{99}Tc							
U	2.97E-01	1.65E-01	5.83E-01	6.00E-01	1.04E+00	6.12E-01	5.86E-01
^{235}U	NR	NR	3.41E-02	3.08E-02	5.92E-02	3.52E-02	1.27E-02
^{238}U	NR	NR	6.34E-01	6.73E-01	9.93E-01	6.14E-01	6.32E-01
^{65}Zn	-4.91E-01	-4.18E-01	-4.94E-01	-9.16E-01	-4.40E-01	1.67E-02	-3.51E-01
$^{95}ZrNb$	3.19E+00	-1.40E+00	0.00	0.00	0.00	0.00	0.00

Table 4-7. Summary of Grid Soil Sampling at the T Plant Aggregate Area. (Sheet 5 of 6)

Radionuclide (pCi/g)	Site						
	26[b]	36[b]	50[b]				
^{7}Be	0.00	NR	1.60E+01				
^{141}Ce							
$^{144}CePr$	-4.09E-01	-1.39E+00	-1.38E-01				
^{58}Co							
^{60}Co	-1.14E-01	4.39E-02	1.67E-02				
^{134}Cs	-3.49E-02	-9.89E-02	-3.33E-01				
^{137}Cs	4.40E+00	1.54E+01	6.64E-01				
^{152}Eu							
^{154}Eu	2.19E-01	7.60E-02	4.51E-02				
^{155}Eu	1.13E-01	-1.39E-01	6.04E-02				
^{129}I							
^{40}K	1.24E+01	1.25E+01	1.57E+01				
^{54}Mn							
^{212}Pb	NR	NR	8.00E-01				
^{214}Pb	NR	NR	7.34E-01				
^{238}Pu	9.20E-03	9.08E-04	9.23E-04				
$^{239/240}Pu$	9.29E-01	4.65E-02	4.60E-02				
^{225}Ra	NR	NR	6.24E-01				
^{105}Ru	8.69E-01	8.25E-01	1.24E-02				
^{125}Sb	2.77E-03	-3.01E-02	1.61E-02				
^{90}Sr	2.02E+00	1.12E+00	4.41E-02				
^{99}Tc							
U	5.26E-01	7.07E-01	9.54E-01				
^{235}U	3.01E-02	4.04E-02	3.80E-02				
^{238}U	5.94E-01	6.96E-01	8.88E-01				
^{65}Zn	-4.18E-01	-4.05E-01	-4.01E-01				
$^{95}ZrNb$	0.00	NR	-3.02E+00				

Table 4-7. Summary of Grid Soil Sampling at the T Plant Aggregate Area. (Sheet 6 of 6)

Source: Schmidt et al. 1990, 1992; Elder et al. 1986, 1987, 1988, 1989.

a Values are averages for each year with a detection since 1985.
b Sample locations for 1990.

Note: Negative values indicate concentrations at or near bakcground levels of radioactivity.
NR = Not result reported
NS = No sample taken

Table 4-8. Summary of Fenceline Soil Sampling Results at the T Plant Aggregate Area.

Radionuclide (pCi/g)	Site		
	TX-TF-SE[a]	TX-TF-W[a]	TX-TF-NE[a]
^{141}Ce	7.50E-03	4.60E-03	1.03E-02
^{144}Ce	6.90E-02	1.40E-01	-4.90E-02
^{58}Co	6.80E-03	-1.60E-02	-8.90E-03
^{60}Co	-2.30E-02	-5.70E-03	1.40E-02
^{134}Cs	2.60E-02	1.43E-02	3.33E-04
^{137}Cs	2.11E+01	1.11E+01	3.36E+01
^{152}Eu	1.50E-01	9.93E-02	8.63E-02
^{154}Eu	-9.20E-03	4.73E-02	2.35E-02
^{155}Eu	1.30E-01	1.03E-01	1.90E-02
^{54}Mn	1.80E-02	1.11E-02	-1.90E-03
^{238}Pu	9.30E-04	6.50E-04	5.77E-04
^{239}Pu	4.10E-02	1.95E-02	3.41E-01
^{106}Ru	-5.90E-02	7.35E-02	7.62E-02
^{90}Sr	4.08E+00	5.29E+00	3.07E+00
U	2.70E-01	3.35E-01	3.82E-01
^{65}Zn	2.60E-02	-4.70E-02	1.70E-02
^{95}Zr	4.40E-03	2.10E-02	5.15E-02

Source: Elder et al. 1986, 1987, 1988, 1989.

a Values are averages for each year with a detection since 1985.

Note: Negative values indicate concentrations at or near background levels of radioactivity.

Table 4-9. Results of Surface Water Sampling at the T Plant Aggregate Area.

Radionuclide	1985 Result	1985 Error	1986 Result	1986 Error	1987 Result	1987 Error	1988 Result	1988 Error	1989 Result	1989 Error	1990 Result	1990 Error
RM3: 216-T-4-2 Ditch												
beta (total)	9.79E+02 3.5E+01 1.59E+02	5.11E+02	3.60E+02 2.90E+01		3.36E+02 <1.00E+02		2.76E+02 <1.00E+02		<1.00E+02 <1.00E+02		2.02E+02 <1.00E+02	
alpha (total)	2.3E+02 2.0E+01 6.0E+01	9.20E+01	2.20E+01 <4.0E+01		7.0E+00 <4.0E+01		<4.0E+02 <4.0E+02		<4.0E+02 <4.0E+02		1.11E+02 <4.0E+02	
^{137}Cs	2.4E+02 4.3E+01 8.0E+01	1.04E+02	3.38E+02 <2.0E+02		1.89E+02 2.7E+01		<2.5E+02 <2.0E+02		<2.0E+02 <2.0E+02		<2.0E+02 <2.0E+02	
^{90}Sr	3.7E+02 1.4E+01 6.3E+01	1.89E+02	<9.2E+01 <1.0E+02		3.0E+01 1.0E+02		<1.0E+02 <1.0E+02		<1.0E+02 <1.0E+02		<1.0E+02 <1.0E+02	
pH			8.0 7.6 7.4		8.3 5.7 7.1		8.0 6.1 7.5		8.8 6.9 7.8		9.06 6.78 7.76	
NO_3 (ppm)	<1.2 <1.2 <1.2		2.7 <1.2 <1.2		<1.2 <1.2 <1.2		<1.2 <1.2 <1.2		<1.2 <1.2 <1.2		<1.2 <1.2 <1.2	

Source: Schmidt et al. 1990, 1992; Elder et al. 1986, 1987, 1988, 1989.

Note: Ditch 216-T-4-2 receives 221-T and 224-T waste water.
+ Indicates Positive Detection (Result Greater Than Error)

Table 4-10. Summary of Vegetation Sampling at the T Plant Aggregate Area. (Sheet 1 of 3)

Radionuclide (pCi/g)	Site						
	2W2[a]	2W3[a]	2W4[a]	2W5[a]	2W7[a]	2W8[a]	2W9[a]
^{7}Be					1.19E+00		2.92E+00
$^{144}CePr$							
^{141}Ce					-1.56E-02		6.82E-03
^{60}Co	-5.20E-03	5.30E-03	1.75E-02	-4.20E-03	-7.49E-03	8.57E-03	1.94E-03
^{134}Cs		9.60E-02	1.24E-01	1.03E-01	1.12E-01	1.08E-01	3.81E-01
^{137}Cs	1.40E-01	1.84E-01	1.65E-01	2.05E-01	3.85E-01	1.34E+00	5.40E-01
^{152}Eu	1.60E-02	2.30E-02	5.63E-02	-7.60E-02	2.72E-02	-5.10E-02	2.04E-02
^{154}Eu	3.50E-02	1.20E-02	2.57E-02	3.53E-02	2.1E-02	6.97E-02	2.62E-03
^{155}Eu	1.90E-02	4.70E-04	8.70E-03	6.80E-03	1.04E-02	8.67E-02	2.88E-02
^{129}I					-1.84E-02	-2.53E-02	2.47E-02
^{40}K					1.56E+01	1.05E+01	8.29E+00
^{95}Nb	-5.40E-02	-3.60E-02	-1.67E-02	3.50E-02	-4.90E-03	3.26E-02	-4.17E-03
^{212}Pb					4.10E-01	9.26E-02	2.30E-02
^{214}Pb					3.23E-01	1.03E-01	3.83E-02
^{238}Pu					1.04E-03	3.41E-04	3.06E-04
$^{239/240}Pu$				2.20E-03	4.68E-03	8.01E-03	4.09E-02
^{103}Ru		1.19E-01	1.15E-01	1.64E-01	1.70E-01	1.02E-01	3.92E-02
^{106}Ru			2.27E-01		2.88E-01		
^{125}Sb							
^{90}Sr			8.30E-02	2.41E-01	1.19E-01	4.63E-01	2.05E+00
^{99}Tc					1.43E+00	8.41E-01	8.07E-01
U							
^{65}Zn							
^{95}Zr			1.10E-02		2.88E-02	6.49E-02	-2.35E-02

Table 4-10. Summary of Vegetation Sampling at the T Plant Aggregate Area. (Sheet 2 of 3)

Radionuclide (pCi/g)	Site						
	2W10[a]	2W12[a]	2W13[a]	2W14[a]	2W15[a]	2W19[a]	2W20[a]
^{7}Be			1.78E+00	2.25E+00			
$^{144}CePr$							
^{141}Ce			-2.49E-02	-3.43E-03			
^{60}Co	-1.20E-02	8.05E-03	3.98E-02	-2.50E-05	-5.40E-03	3.16E-02	3.93E-03
^{134}Cs	1.52E-01	1.64E-01	7.60E-02	2.21E-01	7.60E-02	9.45E-02	6.80E-02
^{137}Cs	1.77E-01	9.80E-02	1.38E+00	2.45E-01	1.80E-01	2.50E-01	1.54E-01
^{152}Eu	-1.00E-02	5.20E-02	-3.00E-03	-7.30E-03	3.37E-02	4.00E-03	9.05E-02
^{154}Eu	7.90E-02	9.40E-02	-3.56E-02	1.84E-02	-1.20E-02	1.87E-02	6.00E-03
^{155}Eu	4.41E-02		3.02E-02	1.09E-02	1.90E-02	-4.20E-03	
^{129}I		2.90E-02	-7.42E-02	-1.94E-02			
^{40}K		-1.70E-01	1.06E+01	1.17E+01			
^{95}Nb	-5.00E-02		6.59E-02	-3.18E-03	3.82E-02	-2.10E-02	3.30E-02
^{212}Pb							
^{214}Pb							
^{238}Pu							
$^{239/240}Pu$			7.90E-03	6.97E-03			
^{103}Ru	2.35E-01	1.07E-01	9.50E-02	2.03-E01	1.61E-01	9.10E-02	1.61E-01
^{106}Ru	3.31E-01	5.41E-01			2.87E-01		
^{125}Sb							
^{90}Sr		7.20E-02	4.20E-01	7.70E-02			9.20E-02
^{99}Tc		1.80E+00	7.54E-01	8.68E-01			
U							
^{65}Zn							
^{95}Zr		9.50E-02	-8.19E-03	-1.10E-02	3.80E-02	9.40E-03	

Table 4-10. Summary of Vegetation Sampling at the T Plant Aggregate Area. (Sheet 3 of 3)

Radionuclide (pCi/g)	Site		
	20[b]	25[b]	50[b]
^{7}Be	-4.19E-02	3.02E-02	3.36E-01
$^{144}CePr$	3.34E-03	8.89E-03	5.25E-02
^{60}Co	1.69E-02	-4.14E-03	7.96E-03
^{134}Cs	4.15E-03	8.06E-04	-1.34E-01
^{137}Cs	3.31E-01	1.68E-01	4.52E+00
^{154}Eu	5.22E-02	1.09E-02	1.43E-01
^{155}Eu	2.67E-03	3.90E-03	-7.29E-03
^{40}K	1.48E+01	1.58E+01	1.30E+02
^{212}Pb	3.50E-02	2.08E-02	8.45E-01
^{214}Pb	NR	NR	6.92E-01
^{238}Pu	1.85E-04	1.85E-04	5.97E-04
$^{239/240}Pu$	5.12E-03	1.01E-02	4.64E-02
^{106}Ru	-3.81E-02	2.24E-02	-4.91E-02
^{125}Sb	-1.20E-02	-7.65E-03	-4.25E-03
^{90}Sr	8.20E-02	7.62E-02	3.46E+00
U	5.04E-02	1.45E-02	1.04E-01
^{65}Zn	-1.55E-02	-1.54E-02	-2.40E-01
^{95}Zr	3.09E-02	8.37E-03	2.43E-02

Source: Schmidt et al. 1990 and 1992; Elder et al. 1986, 1987, 1988, 1989.

a Values are averages for each year with a detection since 1985.
b Sample locations for 1990.

Note: Negative values indicate concentrations at or near background levels of radioactivity.
NR = Not Reported

Table 4-11. Summary of Gross Gamma Logging Results. (Sheet 1 of 6)

Waste Management Unit	Well Number	Relative Location	Remarks
		Cribs and Drains	
216-T-6 Crib	299-W11-01	Southeast of Crib #1.	Elevated contamination.
	299-W11-54	Center of Crib #1.	Elevated contamination.
	299-W11-55	North center of Crib #1.	Elevated contamination.
	299-W11-56	Southeast of Crib #1.	Elevated contamination.
	299-W11-57	North of Crib #1.	No detection.
	299-W11-58	Southwest of Crib #1.	Elevated contamination.
	299-W11-59	Southeast of Crib #1.	Elevated contamination.
	299-W11-60	West of Crib #2.	Elevated contamination.
	299-W11-61	Southwest of Crib #1.	Elevated contamination.
	299-W11-62	Southeast of Crib #1.	Elevated contamination.
	299-W11-63	South of Crib #1.	Elevated contamination.
	299-W11-64	Northeast of Crib #1.	No Detection.
	299-W11-65	South of Crib #1.	No Detection.
	299-W11-66	Southeast of Crib #2.	No Detection.
	299-W11-67	Southeast of Crib #1.	No Detection.

Table 4-11. Summary of Gross Gamma Logging Results. (Sheet 2 of 6)

Waste Management Unit	Well Number	Relative Location	Remarks
216-T-7TF Crib and Tile Field	299-W10-59	Northwest corner of crib.	Elevated contamination - shallow zone.
	299-W10-60	North central part of crib.	Elevated contamination.
	299-W10-61	Southeast corner of crib.	Elevated contamination.
	299-W10-62	Northwest corner of crib.	Elevated contamination.
	299-W10-63	Southeast corner of crib.	Elevated contamination.
	299-W10-66	Southeast corner of crib.	Elevated contamination.
	299-W10-67	Northeast corner of crib.	Elevated contamination.
	299-W10-68	Southwest corner of crib.	Elevated contamination.
	299-W10-69	North central portion of tile field.	Possible contamination.
	299-W10-70	Northwest corner of tile field.	No detection.
	299-W10-71	Center line of west end of tile field.	No detection.
	299-W10-72		Elevated contamination.
	299-W10-74	South central portion of tile field.	Elevated contamination.
	299-W10-77	Center of crib.	Elevated contamination.
	299-W10-78	North central portion of tile field.	No detection.
	299-W10-79		No detection.
	299-W10-80	South west corner of tile field.	
	299-W10-81	North corner of tile field.	No detection.

Table 4-11. Summary of Gross Gamma Logging Results. (Sheet 3 of 6)

Waste Management Unit	Well Number	Relative Location	Remarks
216-T-8 Crib	no monitoring wells		
216-T-18 Crib	299-W11-11	South of crib	Elevated gamma response between 5 and 28 meters.
216-T-19 Crib	299-W14-51	Northeast corner of tile field.	
	299-W14-52	Southeast corner of tile field.	No detection.
	299-W15-04		Elevated gamma response at depth of 18 meters.
	299-W15-65	Northwest corner of tile field.	No detection.
	299-W15-66	Southwest corner of tile field.	No detection.
216-T-26 Crib	299-W11-70		Elevated gamma response between 3 and 48 meters.
	299-W11-82		Elevated gamma response between 10 and 20 meters.
216-T-27 Crib	299-W14-62		Elevated gamma response between 7 and 21 meters.
216-T-28 Crib	299-W14-03		Elevated gamma response between 2 and 40 meters.
	299-W14-04		Elevated gamma response between 2 and 40 meters.
	299-W14-53		Elevated gamma response between 2 and 48 meters.
216-T-29 Crib	no monitoring wells		

Table 4-11. Summary of Gross Gamma Logging Results. (Sheet 4 of 6)

Waste Management Unit	Well Number	Relative Location	Remarks
216-T-32 Crib	299-W10-56	Southwest corner of Crib #1.	No detection.
	299-W10-57	Northwest corner of Crib #1.	No detection.
	299-W10-58	Southeast corner of Crib #1.	
	299-W10-64	Southeast corner of Crib #1.	
	299-W10-65	Southeast of Crib #1.	No detection.
	299-W10-73	Southwest of Crib #2.	Elevated gamma response from 12 to 20 meters.
	299-W10-75	East of Crib #1.	No detection.
216-T-33 Crib	299-W11-14	North of crib.	No detection.
216-T-34 Crib	299-W11-15	Northwest corner of crib.	No detection.
	299-W11-16	Southwest corner of crib.	No detection.
216-T-35 Crib	299-W11-17	Southeast section of crib.	No detection.
	299-W11-18	Northeast portion of crib.	Elevated gamma response from 5 to 30 meters.
	299-W11-19	Northeast corner of crib.	No detection.
	299-W11-20	East central portion of crib.	No detection.
	299-W11-21	East central portion of crib.	
216-T-36 Crib	299-W10-02	Northwest corner of crib.	No detection.
	299-W10-04	Southeast corner of crib.	No detection.

Table 4-11. Summary of Gross Gamma Logging Results. (Sheet 5 of 6)

Waste Management Unit	Well Number	Relative Location	Remarks
216-W-LWC Crib	299-W14-08	Southeast of crib.	No detection.
	299-W14-10	East central portion of crib.	No detection.
216-T-31 French Drain	no monitoring wells		
Reverse Wells			
216-T-2 Reverse Well	no monitoring wells		
216-T-3 Reverse Well	299-W11-07	North of reverse well	Elevated gamma response between 3 and 37 meter depth.
Ponds, Ditches and Trenches			
216-T-1 Ditch	no monitoring wells		
216-T-4A Pond	no monitoring wells		
216-T-4B Pond	no monitoring wells		
216-T-4-1D Ditch	no monitoring wells		
216-T-4-2 Ditch	no monitoring wells		
216-T-5 Trench	299-W10-01	North central portion of trench	No detection.
216-T-9 Trench	no monitoring wells		
216-T-10 Trench	no monitoring wells		

Table 4-11. Summary of Gross Gamma Logging Results. (Sheet 6 of 6)

Waste Management Unit	Well Number	Relative Location	Remarks
216-T-11 Trench	no monitoring wells		
216-T-12 Trench	no monitoring wells		
216-T-13 Trench	no monitoring wells		
216-T-14 Trench	299-W11-68 299-W11-69	West central portion of trench.	
216-T-15 Trench	299-W11-80	Northwest corner of trench.	No detection.
216-T-16 Trench	no monitoring wells		
216-T-17 Trench	299-W11-81	Southeast corner of trench.	
216-T-20 Trench	no monitoring wells		
216-T-21 Trench	299-W15-80 299-W15-210	South central portion of crib.	 Elevated gamma response between the surface and 32 meters.
216-T-22 Trench	299-W15-81 299-W15-209	 South central portion of crib.	No detection. Elevated gamma response between the surface and 16 meters.
216-T-23 Trench	299-W15-220		
216-T-24 Trench	299-W15-211	Northeast corner of crib.	Elevated gamma response between the surface and 33 meters.
216-T-25 Trench	299-W15-212	North central portion of crib.	

Source: Fecht et al. 1977, Chamness et al. 1991.

Table 4-12. Potential for Migration of Liquid Discharges to the Unconfined Aquifer. (Sheet 1 of 2)

Waste Management Unit	Range of Soil Column Pore Volumes (m^3)[a]	Liquid Effluent Volume Received in (m^3)	Potential Migration to Unconfined Aquifer
Cribs			
216-T-6 Crib	435 to 1,305	45,000	Yes
216-T-7TF Crib and Tile Field	2,969 to 8,906	110,000	Yes
216-T-8 Crib	373 to 1,120	500	Yes[b]
216-T-18 Crib	233 to 699	1,000	Yes
216-T-19TF Crib and Tile Field	4,169 to 12,508	455,000	Yes
216-T-26 Crib	227 to 680	12,000	Yes
216-T-27 Crib	227 to 680	7,190	Yes
216-T-28 Crib	227 to 680	42,300	Yes
216-T-29 Crib	899 to 2,697	74	No
216-T-32 Crib	881 to 2,644	29,000	Yes
216-T-33 Crib	224 to 671	1,900	Yes
216-T-34 Crib	2,070 to 6,209	17,300	Yes
216-T-35 Crib	4,290 to 12,871	5,720	Yes[b]
216-T-36 Crib	1,270 to 3,810	522	No
216-W-LWC Crib	1,974 to 5,922	1,200,000	Yes
Ponds, Ditches and Trenches			
216-T-4A Pond	4,556 to 13,668	42,500,000	Yes
216-T-1 Ditch	12,571 to 37,712	178,000	Yes
216-T-5 Trench	318 to 953	2,600	Yes
216-T-12 Trench	71 to 214	5,000	Yes
216-T-14 Trench	1,648 to 4,943	1,000	No

Table 4-12. Potential for Migration of Liquid Discharges to the Unconfined Aquifer. (Sheet 2 of 2)

Waste Management Unit	Range of Soil Column Pore Volumes (m^3)[a/]	Liquid Effluent Volume Received in (m^3)	Potential Migration to Unconfined Aquifer
216-T-15 Trench	1,648 to 4,943	1,000	No
216-T-16 Trench	1,648 to 4,943	1,000	No
216-T-17 Trench	1,648 to 4,943	1,000	No
216-T-20 Trench	22 to 66	18.9	No
216-T-21 Trench	1,243 to 3,730	460	No
216-T-22 Trench	1,243 to 3,730	1,530	Yes[b/]
216-T-23 Trench	1,243 to 3,730	1,480	Yes[b/]
216-T-24 Trench	1,243 to 3,730	1,530	Yes[b/]
216-T-25 Trench	932 to 2,797	3,000	Yes
Reverse Wells			
216-T-2 Reverse Well		6,000	Yes
216-T-3 Reverse Well		11,300	Yes

Assumptions:

- Based on sites for which reported waste disposal volumes are available
- Depth to groundwater based on WIDS, 1991, approximately 50m (164 ft)
- Area for infiltration equal to the dimension of the base of crib/trench/tile field
- No evapotranspiration
- No lateral flow assumed

a/ Pore volume calculation: (waste unit section area) x (nominal depth to groundwater) x (porosity). Lower pore volume value reflects 0.10 porosity, higher pre volume reflects 0.3 porosity. Pore volume calculation does not account for the ability of the soil to retain the liquid discharged.

b/ The effluent volume received by these units exceeds the lower pore volume estimate but is below the high estimated. Given the high permeability of the soil column in general, it is likely that some of the discharged waste volume reached groundwater.

Table 4-13. Summary of Single-Shell Waste Tank Sampling Data at the T Plant Aggregate Area. (Sheet 1 of 2)

Description	Date	Pu (g/gal)	^{137}Cs (uCi/gal)	^{134}Cs (uCi/gal)	$^{89,90}Sr$ (uCi/gal)	^{60}Co (uCi/gal)	pH	Total Organic Carbon (g/gal)
Tank 241-T-104								
Sludge	11/13/79		1.30×10^{0}		5.0×10^{0}			
Tank 241-T-204								
Liquid	12/04/78	1.23×10^{-6}	2.1×10^{-2}		2.23×10^{-1}			
Tank 241-TX-118								
Liquid	5/12/72		1.40×10^{6}	1.02×10^{4}				
Liquid	2/11/75		2.09×10^{4}	9.51×10^{-3}				
Liquid	3/31/77	1.04×10^{-6}	7.30×10^{1}		1.60×10^{1}			0.105
Average		1.04×10^{-6}	4.74×10^{5}	5.1×10^{3}	1.60×10^{1}			0.105
Tank 241-TY-102								
Cake	02/01/80	1.195×10^{-7}	1.20×10^{1}		9.93×10^{0}			0.00236
Tank 241-TY-103								
Sludge	02/01/80	3.65×10^{-4}	2.16×10^{1}		1.90×10^{1}			
Tank 241-TY-104								
Liquid	12/20/79	3.00×10^{-6}			3.10×10^{0}			0.004
Liquid	09/04/85		1.43×10^{1}			<0.002	1.25×10^{1}	0.000164
Average		3.00×10^{-6}	1.43×10^{1}		3.10×10^{0}	<0.002	1.25×10^{1}	0.0021

Table 4-13. Summary of Single-Shell Waste Tank Sampling Data at the T Plant Aggregate Area. (Sheet 2 of 2)

Description	Date	Pu (g/gal)	^{137}Cs (uCi/gal)	^{134}Cs (uCi/gal)	$^{89,90}Sr$ (uCi/gal)	^{60}Co (uCi/gal)	pH	Total Organic Carbon (g/gal)
Tank 241-TY-105								
Sludge	02/01/80	3.77×10^{-6}	9.16×10^{1}		1.20×10^{3}			
Tank 241-TY-106								
Liquid	12/20/79	1.07×10^{-7}			7.43×10^{1}			0.294
Liquid	09/04/85		1.50×10^{1}		2.35×10^{2}	<0.01	8.81×10^{0}	0.00025
Average		1.07×10^{-7}	1.50×10^{1}		1.55×10^{2}	<0.01	8.81×10^{0}	0.147

Table 4-14. Summary of Tank Farm Vadose Zone Well Geophysical Logging Results at the T Plant Aggregate Area. (Sheet 1 of 4)

Tank	Number of Associated Dry Wells	Geophysical Evidence of Leaking	Comments
241-T Tank Farm			
241-T-101	5	no	Contamination in wells 50-01-04, 50-01-06, and 50-00-03, source leakage from a spare fill line overfill. Activity in dry well 50-01-12, at 11 m (35 ft) is unexplained.
241-T-102	6	no	Radiation levels in the vadose zone wells have remained stable. Slightly elevated readings in wells 50-02-08 and 50-02-09 attributed to the 106-T tank leak.
241-T-103	6	yes	Radiation levels in the vadose zone wells have remained stable. Slightly elevated readings in wells 50-03-04, 50-03-05, and 50-03-06 is attributed to the 106-T tank. Contamination at 6 m (20 ft) level of well 50-03-04 due to spare fill line overfilling.
241-T-104	5	no	Radiation levels in the vadose zone wells have remained stable. Dry wells 50-04-08 and 50-04-10 have unexplained peaks between 20 and 21 m (65 and 70 ft) and the increasing activity in well 50-05-08 (1980) has stabilized.
241-T-105	3	no	Radiation levels in the vadose zone wells have remained stable. Tank categorized as an assumed leaker.
241-T-106	9	yes	Leak plume is essentially stable, some slight migration to southeast causing activity in dry wells in proximity of tanks 108 and 105-T. Radiation levels in vadose zone have shown no significant changes.
241-T-107	3	yes	Radiation levels in vadose zone wells have remained stable. Tank categorized as an assumed leaker because of increased radiation levels in wells 50-07-07 and 50-07-03.
241-T-108	6	yes	Radiation levels in vadose zone wells have remained stable. Dry well studies conducted in 1978 concluded that elevated dry activity associated with 106-T leak.
241-T-109	6	yes	Radiation levels in vadose zone wells have remained stable. Tank removed from service as a result of increasing activity in well 50-09-10 at 12 m (39 ft). Activity in wells 50-09-01, 50-09-02, 50-09-09, and 50-09-10 continue to decrease since 1976.
241-T-110	4	no	Radiation levels in vadose zone wells have remained stable.

Table 4-14. Summary of Tank Farm Vadose Zone Well Geophysical Logging Results at the T Plant Aggregate Area. (Sheet 2 of 4)

Tank	Number of Associated Dry Wells	Geophysical Evidence of Leaking	Comments
241-T-111	5	yes	Tank categorized as an assumed leaker after unexplained liquid level decrease. Radiation levels in the vadose zone wells have remained stable.
241-T-112	3	no	Radiation levels in the vadose zone wells have remained stable.
241-T-201	none	no	
241-T-202	none	no	
241-T-203	none	no	
241-T-204	none	no	
241-TX Tank Farm			
241-TX-101	5	no	Radiation levels in the vadose zone wells have remained stable.
241-TX-102	5	no	Radiation levels in the vadose zone wells have remained stable.
241-TX-103	6	no	Radiation levels in the vadose zone wells have remained stable with the exception of well 51-03-09. Activity in this well continues to increase (~ 140 c/s) at a depth of approximately 18 to 21 m (60 to 70 ft).
241-TX-104	6	no	Radiation levels in the vadose zone wells have remained stable with the exception of well 51-04-05. Dry well 51-04-05 continues to show an increase in activity (~100 c/s at 22 m [73 ft]).
241-TX-105	6	yes	Tank categorized as an assumed leaker because of activity in 5 of the 6 dry wells associated with this tank. Radiation levels in vadose zone wells have remained stable.
241-TX-106	5	no	Radiation level in vadose zone wells have remained stable.
241-TX-107	7	yes	Tank categorized as an assumed leaker due to a gradual increase in activity in dry well 51-07-07. Activity in dry well 51-07-07 appears to be increasing. The radiation levels in the remaining dry wells have remained stable.

Table 4-14. Summary of Tank Farm Vadose Zone Well Geophysical Logging Results at the T Plant Aggregate Area. (Sheet 3 of 4)

Tank	Number of Associated Dry Wells	Geophysical Evidence of Leaking	Comments
241-TX-108	3	no	Radiation levels in vadose zone wells have remained stable.
241-TX-109	5	no	Radiation levels in vadose zone wells have remained stable.
241-TX-110	6	yes	Tanks categorized as an assumed leaker due to increased activity at 17 m (55 ft) in dry well 51-10-01 and increased activity in dry well 51-10-13. The radiation levels in the remaining dry wells have remained stable.
241-TX-111	5	no	Radiation levels in vadose zone wells have remained stable.
241-TX-112	6	no	Radiation levels in vadose zone wells have remained stable.
241-TX-113	3	yes	Tank categorized as an assumed leaker. Radiation levels in vadose zone wells have remained stable.
241-TX-114	3	yes	Tank categorized as an assumed leaker because all dry wells have activity at 13 M (43 ft), with well 51-14-04 having shown an extensive profile change below 15 m (48 ft). Radiation levels in vadose zone wells have remained stable.
241-TX-115	4	yes	Tank categorized as an assumed leaker. Radiation levels in vadose zone wells have remained stable.
241-TX-116	3	yes	Tank categorized as an assumed leaker because of increased radiation levels in well 51-16-11. Radiation levels in remaining wells have remained stable.
241-TX-117	4	yes	Tank categorized as an assumed leaker. Radiation levels in vadose zone wells have remained stable.
241-TX-118	7	no	Radiation levels in vadose zone wells have remained stable.
241-TY Tank Farm			
241-TY-101	3	yes	Tank categorized as an assumed leaker due to a liquid level decrease of greater than 0.76 m (0.30 in.). Radiation levels in the vadose zone wells have remained stable.

Table 4-14. Summary of Tank Farm Vadose Zone Well Geophysical Logging Results at the T Plant Aggregate Area. (Sheet 4 of 4)

Tank	Number of Associated Dry Wells	Geophysical Evidence of Leaking	Comments
241-TY-102	5	no	Radiation levels in vadose zone wells have remained stable.
241-TY-103	3	yes	Tank categorized as an assumed leaker because of increased radiation levels in well 52-03-06 and 52-03-03. Activity levels of Cobalt-60 in well 52-03-06 to the bottom of this well (~30 m [100 ft]) were observed.
241-TY-104	5	yes	Tank categorized as an assumed leaker. Radiation levels in vadose zone wells have remained stable.
241-TY-105	1	yes	Tank categorized as an assumed leaker because of increased activity in well 52-05-07. Radiation levels in the vadose well has remained stable.
241-TY-106	5	yes	Tank categorized as an assumed leaker. Radiation levels in vadose zone wells have remained stable.

Table 4-15. Deposition Rate for 221-T Building Head-End Wastewater 2 Stream -- Plasma Torch Standby to 216-T-1 Ditch at the T Plant Aggregate Area. (Sheet 1 of 2)

Constituent	Concentration (kg/L)[a]	Deposition Rate (kg/mo)[b]
Aluminum	1.62e-07	1.42e-01
Barium	2.70e-08	2.36e-02
Boron	1.32e-08	1.15e-02
Calcium	1.74e-05	1.52e+01
Chloride	3.25e-06	2.84e+00
Copper	1.45e-08	1.27e-02
Fluoride	1.30e-07	1.14e-01
Iron	2.63e-07	2.30e-01
Lead	7.00e-09	6.12e-03
Magnesium	3.82e-06	3.34e+00
Manganese	1.23e-07	1.07e-01
Nitrate	5.25e-07	4.59e-01
Potassium	6.85e-07	5.98e-01
Silicon	2.00e-06	1.75e+00
Sodium	1.95e-06	1.70e+00
Strontium	8.60e-08	7.51e-02
Sulfate	1.22e-05	1.07e+01
Uranium	3.86e-10	3.37e-04
Zinc	6.02e-08	5.26e-02
Acetone	1.17e-08	1.02e-02
Ammonia	5.15e-08	4.50e-02
Trichloromethane	2.65e-08	2.32e-02
Unknown	4.50e-08	3.93e-02
Alpha activity*	7.62e-13	6.66e-07
Beta activity*	3.78e-12	3.30e-06
TDS	5.71e-05	4.99e+01
Total carbon	1.29e-05	1.13e+01

Table 4-15. Deposition Rate for 221-T Building Head-End Wastewater 2 Stream -- Plasma Torch Standby to 216-T-1 Ditch at the T Plant Aggregate Area. (Sheet 2 of 2)

Constituent	Concentration (kg/L)[a]	Deposition Rate (kg/mo)[b]
TOX (as Cl)	1.99e-07	1.74e-01
60Co*	1.14e-12	9.96e-07
137Cs*	1.34e-12	1.17e-06
Radium total	1.34e-13	1.17e-07

Source: WHC 1990b.

NOTE:

The plasma torch standby flowrate is 8.74E+-5 L/mo.
The flowrate is the average of rates from Section 2.0.
The data was collected from October 1989 through March 1990.

a Constituent concentrations are average values from Table 3-2.
Concentration units flagged (*) constituents are reported as curies per liter.

b Deposition rate units of flagged (*) constituents are reported as curies per month.

TDS = total dissolved solids
TOX = total organic halides

Table 4-16. Deposition Rate for T Plant Wastewater to 216-T-4-2 Ditch. Flowrate: 1.60 E+-6 L/mo. (Sheet 1 of 2)

Constituent	Concentration (kg/L)[a]	Deposition rate (kg/mo)[b]
Barium	3.00e-08	4.80e-02
Boron	2.00e-08	3.20e-02
Cadmium	2.00e-09	3.20e-03
Calcium	1.90e-05	3.04e+01
Chloride	1.17e-06	1.87e+00
Copper	1.75e-08	2.80e-02
Fluoride	1.45e-07	2.32e-01
Iron	5.40e-08	8.64e-02
Magnesium	3.97e-06	6.35e+00
Manganese	9.00e-09	1.44e-02
Nitrate	5.00e-07	8.00e-01
Potassium	7.57e-07	1.21e+00
Silicon	2.05e-06	3.28e+00
Sodium	2.03e-06	3.25e+00
Strontium	9.55e-08	1.53e-01
Sulfate	1.01e-05	1.62e+01
Uranium	4.70e-10	7.52e-04
Zinc	5.42e-08	8.67e-02
Ammonia	5.40e-08	8.64e-02
1-Butanol	1.20e-08	1.92e-02
Unknown amide	2.60e-08	4.16e-02
Beta Activity*	2.59e-12	4.14e-06
TDS	6.05e-05	9.68e+01
TOC	1.00e-06	1.60e+00
Total carbon	1.54e-05	2.46e+01
TOX (as Cl)	1.27e-08	2.03e-02
137Cs*	7.67e-13	1.23e-06
Radium total*	1.08e-13	1.73e-07

Table 4-16. Deposition Rate for T Plant Wastewater to 216-T-4-2 Ditch.
Flowrate: 1.60 E+-6 L/mo. (Sheet 2 of 2)

Source: Ayster, August 1990, T Plant Wastewater Stream-Specific Report.

NOTE:

Data was collected from October 1989 through March 1990.
Flowrate is the average of rates from Section 2.0.
Constituent concentrations are average values from the Statistics Report in Section 3.0.
Concentration units flagged (*) constituents are reported as curies per liter.
Deposition rate units of flagged (*) constituents are reported as curies per month.

Table 4-17. Detonation of Chemicals at 200-W Ash Pit Demolition Site at the T Plant Aggregate Area. (Sheet 1 of 2)

CHEMICAL	WEIGHT
1984 Detonations	
p-dioxane	3.4 kg
tetrahydronaphthalene	3.76 kg
tetrahydrofuran	9.08 kg
benzene	9.47 kg
diisopropyl benzene	6.06 kg
bromobenzene	15.1 kg
1,4-dioxane	757 g
polyethylene glycol monoethyl ether	757 g
1,2-bis(2-chlorethoxy)ethane	3.02 kg
dioxane	567 g
2-butoxyethanol	3.02 kg
1985 Detonations	
none	

Source: WHC 1991a.

Table 4-17. Detonation of Chemicals at 200-W Ash Pit Demolition Site at the T Plant Aggregate Area. (Sheet 2 of 2)

CHEMICAL	WEIGHT
1986 Detonations	
tetrahydrofuran	6.1 kg
triethylborane	500 g
lithium hydride	230 g
acrolein	400 g
hydrazine	1 kg
aluminum chloride	450 g
unsymmetrical dimethyl hydrazine	10 g
p-nitrobenzoyl chloride	100 g
sodium peroxide	340 g
benzene/butyl lithium solution	900 g
hexane/benzene/butyl lithium/tetrahydrofuran	1 kg
chromium metal powder	454 g
toluene/ether/benzene/ethylacetate	4 g
heptane/diethyl ether	4 kg
ethyl ether/allyl magnesium bromide	1 kg
benzene/ethyl acetate/tetrahydrofuran/ether /toluene/hydrogen sulfide/methanol	4 kg
ethyl ether	29.7 kg
picric acid	460 g
isopropyl ether	1 kg
butoxyethanol	946 g
butyl cellosolve	89 g
carbon trichloride	455 g
butyl ethanol	9.46 kg
phenylether	235 g

Source: WHC 1991a.

Table 4-18. Known Contamination Sources Originating Outside the T Plant Aggregate Area.

Waste Management Unit	Contaminant Source & Information
200-W Ash Pit Demolition Site	a) Active site for treatment of shock sensitive of potentially explosive chemical wastes
241-T Tank Farm	a) Coating waste, ion exchange waste and high level waste from the Redox plant b) PNL waste c) 224-U waste from the 241-B, -BX, -C, and -SX tank farms (Jungfleish, 1983) d) B Plant low level waste e) Redox high-level waste f) U Tank Farm
241-TX Tank Farm	a) Waste from Redox plant
241-TY-104	a) Redox ion exchange waste b) Purex organic wash waste
216-T-27 Crib	a) 300 Area 340 Laboratory PNL wastes
216-T-28 Crib	a) 300 Area lab waste from the 340 building
216-T-34 Crib	a) 300 Area 340 Laboratory PNL wastes
216-T-35 Crib	a) 300 Area 340 Laboratory PNL wastes
216-T-36 Crib	a) 221-U Processing Facility
244-TX Receiver Tank	a) Z Plant
UN-200-W-88	a) Uranyl Nitrate Trailer Spill

Table 4-19. Candidate Contaminants of Potential Concern for the T Plant Aggregate Area. (Sheet 1 of 3)

RADIONUCLIDES

Gross alpha
Gross beta

TRANSURANICS

Americium-241[a]
Americium-242
Americium-242m
Americium-243
Curium-242
Curium-244
Curium-245
Einstenium-254*
Neptunium-237
Neptunium-239
Plutonium
Plutonium-238
Plutonium-239/240
Plutonium-241

URANIUM

Uranium-233
Uranium-234
Uranium-235
Uranium-236
Uranium-238

FISSION PRODUCTS

Actinium-225
Actinium-227
Aluminium-28*
Antimony-122*
Antimony-124*
Antimony-125
Antimony-126
Antimony-126m
Astitine-217*
Barium-135m*
Barium-137m
Beryllium-7*
Beryllium-10
Bismuth-210
Bismuth-211
Bismuth-213
Bismuth-214
Cadmium-109
Carbon-14
Cerium-141*
Cerium-144*
Cesium-134
Cesium-135
Cesium-137
Chlorine-36
Chromium-51*
Cobalt-57*
Cobalt-58*
Cobalt-60
Europium-152
Europium-154
Europium-155
Francium-221
Francium-223*
Gadonlinium-153*
Germanium-68*
Gold-195*
Iodine-123*
Iodine-125*
Iodine-129
Iodine-131*
Iron-55
Iron-59*
Krypton-85
Lead-209
Lead 210
Lead 211
Lead-212*
Lead-214
Manganese-54*
Molybdenum-93
Nickel-59
Nickel 63
Niobium-91
Niobium-93m
Niobium-94
Niobium-95*
Palladium-107*
Phosphorous-32*
Polonium-210
Polonium-213*
Polonium-214
Polonium-215
Polonium-218
Potassium-40
Promethium-147
Protactinium-231
Protactinium-233*
Protactinium-234m*
Radium-223
Radium-225
Radium-226
Radium-228
Rhenium-187
Ruthenium-103*
Ruthenium-106
Samarium-151
Scandium-46*
Selenium-75*
Selenium-79
Silver-108
Silver-110m*
Sodium-22
Strontium-85*
Strontium-90
Tantalum-182*
Technetium-99
Tellurium-127*
Tellurium-129m
Thallium-204
Thallium-207
Thorium-227
Thorium-229
Thorium-230
Thorium-231
Thorium-232
Thorium-233*
Thorium-234
Thulium-170*
Tin-113*
Tin-123m*
Tin-126*
Tritium
Yttrium-90
Zinc-65*
Zirconium-93
Zirconium-95*

HEAVY METALS

Aluminum
Arsenic
Barium
Bismuth
Cadmium

Table 4-19. Candidate Contaminants of Potential Concern for the T Plant Aggregate Area.
(Sheet 2 of 3)

HEAVY METALS (cont.)

Cerium
Chromium
Copper
Iron
Lanthanum
Lead
Manganese
Mercury
Nickel
Selenium
Silver
Strontium
Thorium[a/]
Tin
Titanium
Uranium
Vanadium
Zinc

OTHER INORGANICS

Ammonium ion
Ammonium fluoride
Ammonium nitrate
Ammonium oxalate
Asbestos
Barium nitrate
Bismuth phosphate
Boric acid
Boron
Calcium
Carbonate
Ceric Iodate
Chloride
Chloroplatinic acid
Chromus sulfate
Cyanide
Ferric cyanide
Fluoride
Hydrobromic acid
Hydrochloric acid
Hydrofluoric acid
Hydroiodic acid
Hydroxide
Lanthanum fluoride
Lithium
Magnesium
Molybdate - Citrate reagent
Nitrate
Nitric acid
Nitrite
Oxalic acid
Phosphate
Phosphoric acid
Phosphorous pentoxide
Potassium
Potassium carbonate
Potassium fluoride
Potassium hydroxide
Potassium permanganate
Silica
Silicon
Sodium
Sodium fluoride
Sodium hydroxide
Sodium nitrate
Sulfamic acid
Sulfate
Sulfuric acid
Uranium oxide
Uranyl nitrate hexahydrate
Zirconium oxide

VOLATILE ORGANICS

Acetone
Butyl Alcohol
Carbon tetrachloride
Chloroform
Decane
Ethyl ether
Methylene chloride
MIBK ("Hexone")
Toluene

SEMIVOLATILE ORGANICS

Citrate
Dibutyl phosphate
Ethanol
Ethylene diamine tetraacetate (EDTA)
Gylcolate
Kerosene[a/]
Monobutyl phosphate
N-(2-hydroxyethyl) ethylenediaminetriacetate (HEDTA)
Oxalate
Paraffin hydrocarbons
Tributyl phosphate[a/]
1,1,1-Trichloroethane

Table 4-19. Candidate Contaminants of Potential Concern for the T Plant Aggregate Area.
(Sheet 3 of 3)

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[a] Candidate chemicals of concern are those that were reported in waste management unit inventories, detected at elevated levels in environmental media within the aggregate area, or are expected to occur based on historical association with waste processes.

* The radionuclide has a half-life of <1 year and if it is a daughter product, the parent has a half-life of <1 year, or the buildup of the short-lived daughter would result in an activity of <1% of the parent radionuclide's initial activity.

Table 4-20. Summary of Known and Suspected Contamination at the T Plant Waste Management Units and Unplanned Releases. (Sheet 1 of 11)

Waste Management Unit or Unplanned Release	TRU	Fission Products	Uranium	Heavy Metals	Other Organics	Volatiles	Semi-volatiles
Tanks and Vaults							
241-T-101 Single-Shell Tank	K	K	K	S	K	S	K
241-T-102 Single-Shell Tank	K	K	K	S	K	S	K
241-T-103 Single-Shell Tank (UPR 200-W-147)	K	K	K	S	K	S	K
241-T-104 Single-Shell Tank	K	K	K	S	K		S
241-T-105 Single-Shell Tank	K	K	K	S	K	S	S
241-T-106 Single-Shell Tank (UPR-200-W-148)	K	K	K	S	K	S	K
241-T-107 Single-Shell Tank	K	K	K	S	K		K
241-T-108 Single-Shell Tank	K	K	K	S	K	S	K
241-T-109 Single-Shell Tank	K	K	K	S	K		K
241-T-110 Single-Shell Tank	K	K	K	S	K		S
241-T-111 Single-Shell Tank	K	K	K	S	K		S
241-T-112 Single-Shell Tank	K	K	K	S	K		S
241-T-201 Single-Shell Tank (224-U Bldg. Waste)					S		
241-T-202 Single-Shell Tank (224-U Bldg. Waste)				S	S		
241-T-203 Single-Shell Tank (224-U Bldg. Waste)	K			S	S		

Table 4-20. Summary of Known and Suspected Contamination at the T Plant Waste Management Units and Unplanned Releases. (Sheet 2 of 11)

Waste Management Unit or Unplanned Release	TRU	Fission Products	Uranium	Heavy Metals	Other Organics	Volatiles	Semi-volatiles
241-T-204 Single-Shell Tank (224-U Bldg. Waste)					S		
241-TX-101 Single-Shell Tank	K	K	K	S	K		K
241-TX-102 Single-Shell Tank	K	K	K	S	K		S
241-TX-103 Single-Shell Tank	K	K	K	S	K		K
241-TX-104 Single-Shell Tank	K	K	K	S	K		K
241-TX-105 Single-Shell Tank	K	K	K	S	K		S
241-TX-106 Single-Shell Tank	K	K	K	S	K		K
241-TX-107 Single-Shell Tank (UPR-200-W-149)	K	K	K	S	K		S
241-TX-108 Single-Shell Tank	K	K	K	S	K		K
241-TX-109 Single-Shell Tank	K	K	K	S	K		S
241-TX-110 Single-Shell Tank	K	K	K	S	K		S
241-TX-111 Single-Shell Tank	K	K	K	S	K		K
241-TX-112 Single-Shell Tank	K	K	K	S	K		S
241-TX-113 Single-Shell Tank (UPR-200-W-129)	K	K	K	S	K		S
241-TX-114 Single-Shell Tank	K	K	K	S	K		S
241-TX-115 Single-Shell Tank	K	K	K	S	K		K
241-TX-116 Single-Shell Tank	K	K	K	S	K		S

Table 4-20. Summary of Known and Suspected Contamination at the T Plant Waste Management Units and Unplanned Releases. (Sheet 3 of 11)

Waste Management Unit or Unplanned Release	TRU	Fission Products	Uranium	Heavy Metals	Other Organics	Volatiles	Semi-volatiles
241-TX-117 Single-Shell Tank	K	K	K	S	K		S
241-TX-118 Single-Shell Tank	K	K	K	S	K		K
241-TY-101 Single-Shell Tank	K	K	K	S	K	K	K
241-TY-102 Single-Shell Tank	K	K	K	S	K		
241-TY-103 Single-Shell Tank (UPR-200-W-150)	K	K	K	S	K		K
241-TY-104 Single-Shell Tank (UPR-200-W-151)	K	K	K	S	K	K	K
241-TY-105 Single-Shell Tank (UPR-200-W-152)	K	K	K	S	K		K
241-TY-106 Single-Shell Tank (UPR-200-W-153)	K	K	K	S	K		K
241-T-361 Settling Tank (overflow to 216-T-3)							
244-TX Receiver Tank							
241-T-301 Catch Tank							
241-T-302 Catch Tank							
241-TX-302A Catch Tank							
241-TX-302B Catch Tank (UPR-200-W-131)							
241-TX-302C Catch Tank (UPR-200-W21/160)							

Table 4-20. Summary of Known and Suspected Contamination at the T Plant Waste Management Units and Unplanned Releases. (Sheet 4 of 11)

Waste Management Unit or Unplanned Release	TRU	Fission Products	Uranium	Heavy Metals	Other Organics	Volatiles	Semi-volatiles
241-TY-302A Catch Tank	S	S	S		S		S
241-TY-302B Catch Tank							
Cribs and French Drains							
216-T-6 Crib	K	K	K		K		S
216-T-7TF Crib and Tile Field	K	K	K		K		S
216-T-8 Crib	K	K	K		K		
216-T-18 Crib	K	K	K		K		K
216-T-19TF Crib and Tile Field	K	K	K		K		S
216-T-26 Crib	K	K	K		K		K
216-T-27 Crib	K	K	K		K		
216-T-28 Crib	K	K	K		K		
216-T-29 Crib					K		
216-T-31 French Drain							
216-T-32 Crib	K	K	K		K		S
216-T-33 Crib	K	K	K		K		
216-T-34 Crib	K	K	K		K		
216-T-35 Crib	K	K	K		K		
216-T-36 Crib	K	K	K		K		
216-W-LWC Crib	K	K	K		S		S

Table 4-20. Summary of Known and Suspected Contamination at the T Plant Waste Management Units and Unplanned Releases. (Sheet 5 of 11)

Waste Management Unit or Unplanned Release	TRU	Fission Products	Uranium	Heavy Metals	Other Organics	Volatiles	Semi-volatiles
Reverse Wells							
216-T-2 Reverse Well		K			K		
216-T-3 Reverse Well	K	K			K		
Ponds Ditches and Trenches							
216-T-4A Pond	S	S	S				
216-T-4B Pond	K	K	K				
216-T-1 Ditch	K	K		S	K	S	
216-T-4-1D Ditch	K	K	K				
216-T-4-2 Ditch	K	K	K				
200-W Powerhouse Pond							
216-T-5 Trench	K	K	K		K		S
216-T-9 Trench							
216-T-10 Trench							
216-T-11 Trench							
216-T-12 Trench	K	K	K		K		S
216-T-13 Trench							
216-T-14 Trench	K	K	K		K		S
216-T-15 Trench	K	K	K		K		S
216-T-16 Trench	K	K	K		K		S

Table 4-20. Summary of Known and Suspected Contamination at the T Plant Waste Management Units and Unplanned Releases. (Sheet 6 of 11)

Waste Management Unit or Unplanned Release	TRU	Fission Products	Uranium	Heavy Metals	Other Organics	Volatiles	Semi-volatiles
216-T-17 Trench	K	K	K		K		S
216-T-20 Trench		K	K		K		
216-T-21 Trench	K	K	K		K		S
216-T-22 Trench	K	K	K		K		S
216-T-23 Trench	K	K	K		K		S
216-T-24 Trench	K	K	K		K		S
216-T-25 Trench	K	K	K		K		S
Septic Tanks and Drain Fields							
2607-W1 Septic Tank							
2607-W2 Septic Tank							
2607-W3 Septic Tank		S					
2607-W4 Septic Tank							
2607-WT Septic Tank							
2607-WTX Septic Tank							
Transfer Facilities, Diversion Boxes and Pipelines							
241-T-151 Diversion Box (UPRs)	S	S	S		K		S
241-T-152 Diversion Box (UPRs)							
241-T-153 Diversion Box (no reported leaks)							

Table 4-20. Summary of Known and Suspected Contamination at the T Plant Waste Management Units and Unplanned Releases. (Sheet 7 of 11)

Waste Management Unit or Unplanned Release	TRU	Fission Products	Uranium	Heavy Metals	Other Organics	Volatiles	Semi-volatiles
241-T-252 Diversion Box (no reported leaks)							
241-TR-152 Diversion Box							
241-TR-153 Diversion Box							
241-TX-152 Diversion Box (no reported leaks)							
241-TX-153 Diversion Box (UPR-200-W-126)	K	K	K		K		K
241-TX-154 Diversion Box (UN-200-W-38,UPR-200-W21/60)	K	K	K	S	K		S
241-TX-155 Diversion Box (UPR-200-W-5 & UPR-200-W-28)	S	K	S		K		S
241-TXR-152 Diversion Box (no reported leaks)							
241-TXR-153 Diversion Box (no reported leaks)							
241-TY-153 Diversion Box (no reported leaks)	S	S	S		S		S
242-T-151 Diversion Box (no reported leaks)							
Basins							
207-T Retention Basin		K					

Table 4-20. Summary of Known and Suspected Contamination at the T Plant Waste Management Units and Unplanned Releases. (Sheet 8 of 11)

Waste Management Unit or Unplanned Release	TRU	Fission Products	Uranium	Heavy Metals	Other Organics	Volatiles	Semi-volatiles
Burial Sites							
200-W Ash Disposal Basin				S	S	S	S
200-W Ash Pit Demolition Site							
200-W Burning Pit (UPR 200-W-37/70, UN-200-W-8)	S	S	S	S	S	S	S
200-W Powerhouse Ash Pit							
218-W-8 Burial Ground	K	K	K				
Unplanned Releases							
UN-200-W-2	S	S	S		S		S
UN-200-W-3	S	S	S	S	S	S	S
UN-200-W-4	S	S	S	S	S	S	S
UN-200-W-7 (241-T-151/152)	S	S	S		K		S
UN-200-W-8		K			S		
UN-200-W-14	S	S	S		S		S
UN-200-W-17	S	K	S		S		S
UN-200-W-27	S	S	S		S		S
UN-200-W-29 (241-TX-153)	K	K	K		S		S
UN-200-W-38 (241-TX-154)	S	S	S	S	S		S
UN-200-W-58	S	S	S		S		

Table 4-20. Summary of Known and Suspected Contamination at the T Plant Waste Management Units and Unplanned Releases. (Sheet 9 of 11)

Waste Management Unit or Unplanned Release	TRU	Fission Products	Uranium	Heavy Metals	Other Organics	Volatiles	Semi-volatiles
UN-200-W-12		S			S		S
UN-200-W-62 (241-TX-153)	S	K	S		S		K
UN-200-W-63 (241-TX-153)		K					
UN-200-W-64 (241-TX-153)		K					
UN-200-W-65	S	S	S				
UN-200-W-67	S	K	S		S		
UN-200-W-73	S	K	S		S		
UN-200-W-76 (241-TX-155)		K			S		S
UN-200-W-77	K				S		S
UN-200-W-85	S	S	S				
UN-200-W-88	S	S	S		K		
UN-200-W-97 (241-TX-153)	S	K	S		K		S
UN-200-W-98		K			K		S
UN-200-W-99 (241-TX-153)		K			S		
UN-200-W-100	S	K	S		K		S
UN-200-W-102	K						
UN-200-W-113 (241-TX-155)	S	S	S		S		S
UN-200-W-135 (241-TX-155)		K			S		S
UN-200-W-137	K	K	K	S	S	S	S

Table 4-20. Summary of Known and Suspected Contamination at the T Plant Waste Management Units and Unplanned Releases. (Sheet 10 of 11)

Waste Management Unit or Unplanned Release	TRU	Fission Products	Uranium	Heavy Metals	Other Organics	Volatiles	Semi-volatiles
UPR-200-W-5 (241-TX-155)	S	S	S		S		S
UPR-200-W-12	S	K	S		K		S
UPR-200-W-21 (241-TX-154)	S	S	S		S		S
UPR-200-W-28 (241-TX-155)	S	S	S		S		S
UPR-200-W-30							
UPR-200-W-70	S	S	S	S	S	S	S
UPR-200-W-126 (241-TX-153)	S	S	S		K		
UPR-200-W-129 (241-TX-113)	K	K	K		K		S
UPR-200-W-131 (241-TX-155)	S	S	S		K		S
UPR-200-W-037							
UPR-200-W-147 (241-T-103)	K	K	K	S	K	S	K
UPR-200-W-148 (241-T-106)	K	K	K	S	K	S	K
UPR-200-W-149 (241-TX-107)	K	K	K		K		S
UPR-200-W-150 (241-TY-103)	K	K	K		K		K
UPR-200-W-151 (241-TY-104)	K	K	K		K	K	K
UPR-200-W-152 (241-TY-105)	K	K	K		K		K

Table 4-20. Summary of Known and Suspected Contamination at the T Plant Waste Management Units and Unplanned Releases. (Sheet 11 of 11)

Waste Management Unit or Unplanned Release	TRU	Fission Products	Uranium	Heavy Metals	Other Organics	Volatiles	Semi-volatiles
UPR-200-W-153 (241-TY-106)	S	S	S				K
UPR-200-W-160 (241-TX-154)	K	K	K		K		S

Notes:

Known: Based on specific media sampling data and liquid disposal inventories.
Suspected: Specific sampling media data or liquid disposal inventory data lacking but historical process information indicates that contamination of media could occur.

Table 4-21. Contaminants of Potential Concern for the T Plant Aggregate Area.

RADIONUCLIDES

Gross alpha
Gross beta

TRANSURANICS

Americium-241
Americium-242
Americium-242m
Americium-243
Curium-242
Curium-244
Curium-245
Neptunium-237
Neptunium-238
Plutonium-239/240
Plutonium-241
Plutonium-239/240
Plutonium-241

URANIUM

Uranium-233
Uranium-234
Uranium-235
Uranium-238

FISSION PRODUCTS

Actinium-225
Actinium-227
Antimony-126
Antimony-126m
Barium-135m
Barium-137m
Bismuth-210
Bismuth-211
6Bismuth-213
Bismuth-214
Carbon-14
Cesium-134
Cesium-135
Cesium-137
Cobalt-60
Europium-152
Europium-154
Europium-155
Francium-221
Iodine-129
Lead-209
Lead 211
Lead-212

FISSION PRODUCTS (cont.)

Lead-214
Nickel-59
Niobium-93m
Polonium-214
Polonium-215
Polonium-218
Potassium-40
Protactinium-231
Protactinium-234m
Radium-225
Radium-226
Ruthenium-106
Samarium-151
Selenium-79
Sodium-22
Strontium-90
Technetium-99
Thallium-207
Thorium-227
Thorium-229
Thorium-230
Thorium-231
Tritium
Yttrium-90
Zirconium-93

HEAVY METALS

Arsenic
Barium
Cadmium
Chromium
Copper
Iron
Lead
Manganese
Mercury
Nickel
Selenium
Silver
Titanium
Vanadium
Zinc

OTHER INORGANICS

Boron
Cyanide
Fluoride
Nitrate

VOLATILE ORGANICS

Acetone
Carbon tetrachloride
Chloroform
Methylene chloride
MIBK
Toluene
1,1,1-Trichloroethane

SEMIVOLATILE ORGANICS

Kerosene
Tributyl phosphate

Table 4-22. Soil-Water Distribution Coefficient K_d for Radionuclides[a] and Inorganics of Concern at T Plant Waste Management Units. (Sheet 1 of 2)

Element or Chemical	Recommended K_d for Hanford Site (Serne and Wood 1990) in mL/g	Conservative Default K_d[b] (Serne and Wood 1990) in mL/g	MEPAS Default K_d pH 6-9[c] (Strenge and Peterson 1989) in mL/g	Mobility Class
Actinium	-	-	228	low
Americium	2 100 - 1000 (<1 @ pH 1-3)	100	82	low
Antimony	—	—	2	high
Arsenic	-	0	5.86	moderate
Barium	—	50	530	moderate
Bismuth	-	20	-	moderate
Boron	-	-	0.19	high
Cadmium	—	15	14.9	moderate
Carbon (^{14}C)	—	—	0	high
Cesium	200 - 1,000 1 - 200 (acidic waste)	50	51	low
Chromium	-	0	16.8	moderate
Cobalt	500 - 2000	10	1.9	low
Copper	-	15	41.9	moderate
Curium	100 - >2,000	100	82	low
Cyanide	-	-	-	unknown
Europium	—	—	228	low
Fluoride	—	—	0	high
Francium	-	-	-	unknown
Iodine	<1	0	0	high
Iron	—	20	15	moderate
Lead	—	30	234	moderate
Manganese	—	20	16.5	moderate
Mercury	-	-	322	low
Neptunium	<1-5	3	3	high
Nickel	—	15	12.2	moderate
Niobium	—	—	50	moderate

Table 4-22. Soil-Water Distribution Coefficient K_d for Radionuclides[a] and Inorganics of Concern at T Plant Waste Management Units. (Sheet 2 of 2)

Element or Chemical	Recommended K_d for Hanford Site (Serne and Wood 1990) in mL/g	Conservative Default K_d[b] (Serne and Wood 1990) in mL/g	MEPAS Default K_d pH 6-9[c] (Strenge and Peterson 1989) in mL/g	Mobility Class
Nitrate/nitric acid	—	—	0	high
Plutonium	100 - 1,000 < 1 at pH 1 - 3	100	10	low
Polonium	—	—	5.9	high
Protactinium	—	—	0	high
Radium	—	20	24.3	moderate
Ruthenium	20 - 700 (<2 at >1 M nitrate)	—	274	moderate
Samarium	—	—	228	low
Selenium	—	0	5.91	moderate
Silver	-	20	0.4	moderate
Sodium	—	3	0	high
Strontium	5 - 100 3 - 5 (acidic conditions) 200 - 500 (w/phosphate or oxalate)	10	24.3	moderate
Technetium	0 - 1	0	3	high
Thallium	—	—	0	high
Thorium	-	50	100	moderate
Titanium	-	-	-	unknown
Tritium	0	0	0	high
Uranium	—	0	0	high
Vanadium	—	—	50	moderate
Yttrium	—	—	278	low
Zinc	—	15	12.7	moderate
Zirconium	-	30	50	moderate

a/ Radionuclides with half-lives of greater than 3 months.
b/ Average K_Ds for low salt and organic solutions with neutral pH.
c/ Default values for pH 6-9 and soil content of [clay + organic matter + metal oxyhydroxides] < 10% (Strenge and Peterson 1989).

Table 4-23. Physical and Chemical Properties of Organics at the T Plant Aggregate Area.

Compound	Molecular Weight (g/mole)	Water Solubility (mg/liter)	Vapor Pressure (mm Hg)	Henry's Law Constant (atm-m^3/mo)	Soil/Organic Matter Partition Coef. K_{oc} (ml/g)
Acetone	58.0	miscible	270	2.1×10^{-5}	2.2
Butyl alcohol	74.1	77,000	4.2		
Carbon tetrachloride	154.0	758	90	2.4×10^{-2}	110
Chloroform (trichloromethane)	119	8,200	150	2.9×10^{-3}	31
Citrate (Citric Acid)	192	590,000			
Ethylene diamine tetraacetate (EDTA)	292	500	NA	NA	
Glycolate (Glycol)	62	Infinite	0.05	NA	
N-(2-hydroxyethyl) ethylenediaminetriacetate (HEDTA)	344				
Kerosene[a]	142.2	32	0.045	2.9×10^{-4}	4,500
Methylene chloride	84.9	20,000	360	2×10^{-3}	8.8
Methyl isobutyl ketone (MIBK)	100.16	19,000	6	4.2×10^{-5}	19
Oxalate (Oxalac Acid)	90.0	95,000	0.0003	-0.4	
Paraffin hydrocarbons (Octane)	114	20	11	3.2	
Toluene	92.2	1,550[b]	28.4	6.4×10^{-3}	300
Tributyl phosphate	266.3	280	15	1.9×10^{-2}	6,000

Source: Strenge and Peterson 1989, except as noted in footnotes below.

a Kerosene properties are represented by 2-methyl napthalene.

b Value from Mackay and Shiu 1981.

Table 4-24. Radiological Properties of Candidate Radionuclides of Potential Concern for T Plant Waste Management Units. (Sheet 1 of 4)

Radionuclide	Half-Life	Specific Activity[a] in Ci/g	Radiation of Concern[b]
^{225}Ac	10 d	5.8×10^{4}	α
^{227}Ac	21.8 yr	7.2×10^{1}	β, α
^{108}Ag	2.4 min	2.7×10^{13}	β
^{110}Ag	24.6 sec	4.2×10^{9}	β
^{28}Al	2.24 min	3.0×10^{9}	β, γ
^{241}Am	432 yr	3.4×10^{0}	α
^{242}Am	16 hr	8.1×10^{5}	β
^{242m}Am	152 yr	9.7×10^{0}	α
^{243}Am	7,380 yr	2.0×10^{-1}	α
^{195}Au	30.5 sec	1.9×10^{9}	γ [c]
^{133}Ba	10.5 yr	2.5×10^{2}	γ [c]
^{137m}Ba	2.6 min	5.3×10^{8}	γ
^{7}Be	53.4 d	3.5×10^{-5}	γ
^{10}Be	1.6×10^{6} yr	2.2×10^{-2}	β
^{210}Bi	5.01 d	1.2×10^{5}	β
^{211}Bi	2.13 min	4.2×10^{8}	α, β
^{213}Bi	45.6 min	1.9×10^{7}	β, α
^{214}Bi	19.9 min	4.4×10^{7}	β, γ
^{14}C	5,730 yr	4.5×10^{0}	β
^{45}Ca	163.8 d	1.8×10^{4}	β
^{109}Cd	453 d	2.6×10^{3}	γ [c]
^{141}Ce	32.5 d	2.8×10^{4}	β, γ [c]
^{144}Ce	284.9 d	3.2×10^{3}	β, γ [c]
^{36}Cl	3.0×10^{5} yr	3.3×10^{-2}	β
^{242}Cm	163.2 d	3.3×10^{3}	α
^{243}Cm	28.5 yr	5.2×10^{1}	α
^{244}Cm	18.1 yr	8.1×10^{1}	α
^{245}Cm	8,500 yr	1.7×10^{-1}	α, γ
^{57}Co	271.8 d	8.5×10^{3}	γ [c]
^{58}Co	70.92 d	3.2×10^{4}	γ [c]
^{60}Co	5.3 yr	1.1×10^{3}	γ
^{51}Cr	27.7 d	9.2×10^{4}	γ [c]
^{134}Cs	2.06 yr	1.3×10^{3}	γ
^{137}Cs	30 yr	8.7×10^{1}	γ [c]

Table 4-24. Radiological Properties of Candidate Radionuclides of Potential Concern for T Plant Waste Management Units. (Sheet 2 of 4)

Radionuclide	Half-Life	Specific Activity[a] in Ci/g	Radiation of Concern[b]
^{254}Es	275 d	1.9×10^{3}	α, γ
^{152}Eu	13.3 yr	7.7×10^{2}	β, γ [c]
^{154}Eu	8.8 yr	2.7×10^{2}	β, γ [c]
^{155}Eu	4.96 yr	4.6×10^{2}	β
^{55}Fe	2.73 yr	2.5×10^{3}	γ [c]
^{59}Fe	44.5 d	4.9×10^{4}	β
^{153}Gd	241.6 d	3.5×10^{3}	γ [c]
^{68}Ge	287 d	6.7×10^{3}	γ [c]
^{3}H	12.3 yr	9.7×10^{3}	β
^{123}I	13.2 hr	1.9×10^{6}	γ [c]
^{125}I	60.14 d	1.7×10^{4}	γ [c]
^{129}I	1.6×10^{7} yr	1.7×10^{-4}	β
^{131}I	8.0 d	1.2×10^{5}	β, γ [c]
^{40}K	1.3×10^{9} yr	6.7×10^{-6}	β, γ [c]
^{85}Kr	10.7 yr	3.9×10^{2}	β
^{54}Mn	312.2 d	7.7×10^{3}	γ [c], e^-
^{93}Mo	5,300 yr	1.1×10^{0}	γ [c]
^{22}Na	2.6 yr	6.3×10^{3}	β, γ [c]
^{91}Nb	10,000 yr	3.9×10^{-1}	γ [c]
^{93m}Nb	14.6 yr	2.8×10^{2}	γ [c]
^{94}Nb	20,300 yr	1.87×10^{-1}	β, γ [c]
^{95}Nb	34.97 d	3.9×10^{4}	β, γ
^{59}Ni	75,000 yr	7.6×10^{4}	γ [c]
^{63}Ni	100.1 yr	6.2×10^{1}	β
^{237}Np	2.14×10^{6} yr	7.0×10^{-4}	α, γ
^{239}Np	2.35 d	2.3×10^{5}	β
^{32}P	14.3 d	2.9×10^{5}	β
^{231}Pa	32,800 yr	4.7×10^{-2}	α
^{209}Pb	3.25 hr	4.5×10^{6}	β
^{210}Pb	22.3 yr	7.6×10^{1}	β
^{211}Pb	36.1 min	2.5×10^{7}	β
^{212}Pb	10.6 hr	1.4×10^{6}	β, γ [c]

Table 4-24. Radiological Properties of Candidate Radionuclides of Potential Concern for T Plant Waste Management Units. (Sheet 3 of 4)

Radionuclide	Half-Life	Specific Activity[a] in Ci/g	Radiation of Concern[b]
^{214}Pb	26.8 min	3.3×10^{7}	β, γ [c]
^{147}Pm	2.62 yr	9.3×10^{2}	β
^{210}Po	128 d	4.9×10^{3}	α
^{214}Po	6×10^{-5} sec	8.8×10^{14}	α
^{215}Po	7.8×10^{-4} sec	2.9×10^{13}	α
^{218}Po	3.05 min	2.8×10^{8}	α
^{238}Pu	87.7 yr	1.7×10^{1}	α
^{239}Pu	24,400 yr	6.2×10^{-2}	α
^{240}Pu	6,560 yr	2.3×10^{-1}	α
^{241}Pu	14.4 yr	1.0×10^{2}	β
^{225}Ra	14.8 d	3.9×10^{4}	β
^{226}Ra	1,600 yr	9.9×10^{-1}	α
^{228}Ra	5.75 yr	2.3×10^{2}	β
^{86}Rb	18.7 d	8.1×10^{4}	β
^{187}Re	5×10^{10} yr	3.8×10^{8}	β
^{103}Ru	39.2 d	3.2×10^{4}	β, γ [c]
^{106}Ru	1.0 yr	3.4×10^{3}	β, γ [c]
^{35}S	87.5 d	4.3×10^{4}	β
^{122}Sb	2.7 d	4.0×10^{5}	β, γ [c]
^{124}Sb	60.2 d	1.8×10^{4}	β, γ [c]
^{125}Sb	2.73 yr	1.0×10^{3}	β, γ [c]
^{126}Sb	12.4 d	8.4×10^{4}	β, γ [c]
^{46}Sc	83.8 d	3.4×10^{4}	β, γ [c]
^{75}Se	119.8 d	1.5×10^{4}	γ [c]
^{79}Se	<65,000 yr	7.0×10^{-2}	β
^{151}Sm	90 yr	2.6×10^{1}	β
^{113}Sn	115.1 d	1.0×10^{4}	γ [c]
^{123m}Sn	129 d	8.2×10^{3}	β, γ [c]
^{82}Sr	25 d	6.4×10^{4}	γ [c]
^{90}Sr	28.5 yr	1.4×10^{2}	β
^{182}Ta	115 d	6.3×10^{3}	β, γ [c]
^{99}Tc	213,000 yr	1.7×10^{-2}	β
^{121}Te	16.8 d	6.4×10^{4}	γ [c]
^{125m}Te	58 d	1.8×10^{4}	e^{-}, γ [c]

Table 4-24. Radiological Properties of Candidate Radionuclides of Potential Concern for T Plant Waste Management Units. (Sheet 4 of 4)

Radionuclide	Half-Life	Specific Activity[a] in Ci/g	Radiation of Concern[b]
^{127}Te	9.35 hr	2.6×10^{6}	β
^{129m}Te	33.6 d	3.0×10^{4}	β, γ [c]
^{227}Th	18.7 d	3.1×10^{4}	α
^{229}Th	7,340 yr	2.1×10^{-1}	α
^{230}Th	77,000 yr	2.1×10^{-2}	α
^{231}Th	25.5 hr	5.3×10^{5}	β
^{232}Th	1.4×10^{10} yr	1.1×10^{-7}	α
^{234}Th	24.1 d	2.3×10^{-4}	β
^{204}Tl	3.78 yr	4.6×10^{4}	β
^{170}Tm	128.6 d	4.3×10^{3}	β
^{233}U	159,000 yr	9.7×10^{-3}	α
^{234}U	244,500 yr	6.2×10^{-3}	α
^{235}U	7.0×10^{8} yr	2.2×10^{-6}	α, γ
^{236}U	2.3×10^{7} yr	6.5×10^{-5}	α
^{238}U	4.5×10^{9} yr	3.4×10^{-7}	α
^{49}V	330 d	8.1×10^{3}	γ [c]
^{87}Y	80.3 hr	4.5×10^{5}	γ [c]
^{88}Y	106.6 d	5.6×10^{5}	γ [c]
^{90}Y	6.41 hr	5.4×10^{5}	β
^{65}Zn	244 d	8.2×10^{3}	γ [c]
^{95}Zr	64 d	2.1×10^{4}	β

[a] Source: Calculated from half-life and atomic weight.
[b] α - alpha decay; β - negative beta decay; γ - release of gamma rays.
[c] Gamma radiation due to daughter product.

Table 4-25. Comparisons of Radionuclide Relative Risks at the T Plant Aggregate Area. (Sheet 1 of 2)

Radionuclide	Half-Life[a]	Air Unit Risk[b] $(pCi/m^3)^{-1}$	Drinking Water Unit Risk[c] $(pCi/L)^{-1}$	Soil Ingestion Unit Risk[d] $(pCi/g)^{-1}$	External Exposure Unit Risk[e] $(pCi/g)^{-1}$
^{241}Am	433 yr	2.1×10^{-2}	1.6×10^{-5}	8.4×10^{-7}	1.6×10^{-5}
^{14}C	5,730 yr	3.2×10^{-9}	4.7×10^{-8}	2.5×10^{-9}	0
^{144}Ce	284.9 d	1.7×10^{-4}	3.0×10^{-7}	1.6×10^{-8}	1.2×10^{-5}
^{57}Co	271.8 d	na	na	na	na
^{60}Co	5.3 yr	8.1×10^{-5}	7.8×10^{-7}	4.1×10^{-8}	1.3×10^{-3}
^{134}Cs	2.06 yr	1.4×10^{-5}	2.1×10^{-6}	1.1×10^{-7}	8.9×10^{-4}
^{137}Cs	30 yr	9.6×10^{-6}	1.4×10^{-6}	7.6×10^{-8}	0 (3.4×10^{-4})[f]
^{152}Eu	13.3 yr	6.1×10^{-3}	1.1×10^{-7}	5.7×10^{-9}	6.3×10^{-4}
^{154}Eu	8.8 yr	7.2×10^{-5}	1.5×10^{-7}	8.1×10^{-9}	6.8×10^{-4}
^{155}Eu	4.96 yr	na	na	na	na
^{3}H	12.3 yr	4.0×10^{-8}	2.8×10^{-9}	1.5×10^{-10}	0
^{129}I	1.6×10^{7} yr	6.1×10^{-5}	9.6×10^{-6}	5.1×10^{-7}	1.5×10^{-5}
^{40}K	1.3×10^{9} yr	4.0×10^{-6}	5.7×10^{-7}	3.0×10^{-8}	7.8×10^{-5}
^{54}Mn	312.2 d	2.6×10^{-6}	5.7×10^{-8}	3.0×10^{-9}	4.8×10^{-4}
^{22}Na	2.6 yr	na	na	na	na
^{93m}Nb	13.6 yr	na	na	na	na
^{59}Ni	75,000 yr	3.5×10^{-7}	4.4×10^{-9}	2.3×10^{-10}	3.4×10^{-7}
^{63}Ni	100.1 yr	8.7×10^{-7}	1.2×10^{-8}	6.2×10^{-10}	0
^{231}Pa	32,800 yr	2.0×10^{-2}	9.7×10^{-6}	5.1×10^{-7}	2.0×10^{-5}
^{210}Po	128 d	1.4×10^{-6}	1.3×10^{-5}	7.0×10^{-7}	4.8×10^{-9}
^{238}Pu	87.7 yr	2.1×10^{-2}	1.4×10^{-5}	7.6×10^{-7}	5.9×10^{-7}
^{239}Pu	24,400 yr	2.6×10^{-2}	1.6×10^{-5}	8.4×10^{-8}	2.6×10^{-7}
^{240}Pu	6,560 yr	2.1×10^{-2}	1.6×10^{-5}	8.4×10^{-8}	5.9×10^{-7}
^{106}Ru	1.0 yr	2.3×10^{-4}	4.9×10^{-7}	2.6×10^{-8}	0
^{79}Se	<65,000 yr	na	na	na	na
^{151}Sm	90 yr	na	na	na	na
^{90}Sr	28.5 yr	2.8×10^{-5}	1.7×10^{-6}	8.9×10^{-8}	0

Table 4-25. Comparisons of Radionuclide Relative Risks at the T Plant Aggregate Area. (Sheet 2 of 2)

Radionuclide	Half-Life[a]	Air Unit Risk[b] $(pCi/m^3)^{-1}$	Drinking Water Unit Risk[c] $(pCi/L)^{-1}$	Soil Ingestion Unit Risk[d] $(pCi/g)^{-1}$	External Exposure Unit Risk[e] $(pCi/g)^{-1}$
^{241}Am	433 yr	2.1×10^{-2}	1.6×10^{-5}	8.4×10^{-7}	1.6×10^{-5}
^{99}Tc	213,000 yr	4.2×10^{-6}	6.6×10^{-8}	3.5×10^{-9}	0
$^{00234}U$	244,500 yr	1.4×10^{-2}	7.2×10^{-6}	3.8×10^{-7}	5.6×10^{-7}
^{235}U	7.0×10^{8} yr	1.3×10^{-2}	6.6×10^{-6}	3.5×10^{-7}	9.7×10^{-5}
^{238}U	4.5×10^{9} yr	1.2×10^{-2}	6.6×10^{-6}	3.5×10^{-7}	4.5×10^{-7}
^{65}Zn	244 d	na	na	na	na

a Source: DOE/EML 1990 or calculated from half-life and atomic weight.

b Excess cancer risk associated with lifetime exposure to 1 pCi/m^3 per day in air (EPA 1991).

c Excess cancer risk associated with lifetime exposure to 1pCi per day in drinking water (EPA 1991).

d Excess cancer risk associated with lifetime exposure to 1 pCi/g per day in soil (EPA 1991).

e Excess cancer risk associated with lifetime exposure to surface soils containing 1 pCi/g of gamma-emiting radionuclides (EPA 1991).

f External radiation risk from ^{137m}Ba, a short-lived decay product of ^{137}Cs.

na No information available.

Table 4-26. Potential Chronic Health Effects of Candidate Chemicals of Potential Concern at the T Plant Aggregate Area. (Sheet 1 of 2)

Chemical	Tumor Site Inhalation Route; Oral Route [Weight of Evidence Group[a]]	Non-carcinogenic Chronic Health Effects Inhalation Route; Oral Route
INORGANIC CHEMICALS		
Aluminum		
Ammonium ion		odor
Ammonium nitrate		odor
Arsenic	respiratory tract[b] [A]	skin cancer
Barium		fetotoxicity,
Boron		testicular lesions
Cadmium	respiratory tract[b] [B1]	cancer[b] - renal damage
Chloride		
Chromium (III)		liver toxicity
Chromium (VI)	lung[b] [A]	cancer[b]
Copper		gastrointestinal irritation
Cyanide		weight loss, thyroid effects,
Fluoride		dental fluorosis at high levels
Iron		gastrointestinal irritation,
Lead	[B2][d]	neurotoxicity[d]
Lithium		
Manganese		central nervous system effects[b]
Mercury		neurotoxicity, kidney effects
Nickel	respiratory tract[b] [A]	cancer[b], reduced body weight
Nitrate		methemoglobinemia in infants[e]
Nitric acid		irritant
Nitrite		methemoglobinemia in infants
Phosphate		
Potassium		
Selenium	skin[c]	somnolence, pulmonary edema, fetotoxicity[b]
Silicon		
Sodium		

Table 4-26. Potential Chronic Health Effects of Candidate Chemicals of Potential Concern at the T Plant Aggregate Area. (Sheet 2 of 2)

Chemical	Tumor Site Inhalation Route; Oral Route [Weight of Evidence Group[a]]	Non-carcinogenic Chronic Health Effects Inhalation Route; Oral Route
Strontium		
Sulfate		
Titanium	lymphoma[c]	fetotoxicity[c]
Uranium		
Vanadium		respiratory irritation
Zinc		anemia
ORGANIC CHEMICALS		
Acetone		kidney and liver effects
Carbon tetrachloride	liver [B2]	liver lesions
Chloroform	liver, kidney [B2]	liver lesions
DDT[d]	liver [B2]	liver lesions
Kerosene (mixture)		pulmonary edema, endocrine effects, coma[c]
Methylene chloride	lung, liver [B2]	liver toxicity
MIBK (Hexone)[c]		liver and kidney effects
Normal paraffins		
Toluene		central nervous system effects
Tributyl phosphate[c]		reproductive system, respiratory effects[c]

Source: EPA, 1991; EPA, 1989.

a Weight of Evidence Groups for carcinogens: A - Human carcinogen (sufficient evidence of carcinogenicity in humans); B - probable Human Carcinogen (B1 - limited evidence of carcinogenicity in humans; B2 - sufficient evidence of carcinogenicity in animals with inadequate of lack of data in humans); C - Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data); D -Not Classifiable as to Human Carcinogenicity (inadequate or no evidence).

b Considered to be toxic or carcinogenic by inhalation only.

c Verified toxicity information was not available from EPA 1991 or EPA 1989. Toxicity information was obtained from EPA Registry of Toxic Effects of Chemicals Systems (RTECS). A blank space means that no information was available from above sources.

d Lead is considered by EPA to have both neurotoxic and carcinogenic effects; however, no toxicity criteria are available for lead at the present time.

e Toxic effect is considered to occur from exposure to nitrite; nitrate can be converted to nitrite in the body by intestinal bacteria.

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5.0 HEALTH AND ENVIRONMENTAL CONCERNS

This preliminary qualitative evaluation of potential human health and environmental concerns is intended to provide input to the T Plant Aggregate Area waste management unit recommendation process (Section 9.0). This process requires consideration of immediate and long-term impacts to human health and the environment. As discussed in Section 4.2, existing T Plant Aggregate Area and waste management unit data are not adequate to support an evaluation of potential impacts on the environment. Although ecological impacts are an integral part of the complete assessment of aggregate area and waste unit potential risks, they cannot be evaluated further at this time. Ecological risk assessment is included in the listing of data uses presented in Section 8.0 with the associated data needs identified as a data gap to be addressed in future investigations. The approach that has been taken to identify potential health concerns related to individual waste management units and unplanned releases is as follows.

- Contaminants of potential concern are identified for each exposure pathway that is likely to occur within the T Plant Aggregate Area. Selection of contaminants was discussed in Section 4.2. Contaminants of potential concern were selected from the list of candidate contaminants of potential concern presented in Table 4-19. This table includes contaminants that are likely to be present in the environment based on occurrence in the liquid process wastes that were discharged to soils, and also contaminants that have been detected in environmental samples within the aggregate area but have not been identified as components of T Plant waste streams.

- Exposure pathways potentially applicable to individual waste management units are identified based on the presence of the above contaminants of potential concern in wastes in the waste management units, consideration of known or suspected releases from those waste management units, and the physical and institutional controls affecting site access and use over the period of interest. The relationships between waste management units and exposure pathways are summarized in the conceptual model (Section 4.2).

- Estimates of relative hazard derived for the T Plant waste management units are identified using the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Hazard Ranking System (HRS), modified Hazard Ranking System (mHRS), surface radiation survey data, and by Westinghouse Hanford Company (Westinghouse Hanford) Environmental Protection Group scoring. Other indicators of relative hazard, such as rate of release of contaminants and irreversible results of continuing residence of contaminants, were not used because they generally require unit-specific data that are not available for most units.

The human health concerns, and various hazard ranking scores listed above, are used to establish whether or not a site is considered a "high" priority. In the data evaluation process presented in Section 9.0, "high" priority sites are evaluated for the potential implementation of an interim remedial measure (IRM). "Low" priority sites are evaluated to determine what type of additional investigation is necessary to establish a final remedy. Further detail is presented in Section 9.0.

The data used for this evaluation are presented in the earlier sections of this report. The types of data that have been assessed include site histories and physical descriptions (Section 2.0), descriptions of the physical environment of the study area (Section 3.0) and a summary of the available chemical and radiological data for each waste management unit (Section 4.0).

The quality and sufficiency of these data are assessed in Section 8.0. This information is also used to identify applicable or relevant and appropriate requirements (ARARs) (Section 6.0).

5.1 CONCEPTUAL FRAMEWORK FOR RISK-BASED SCREENING

The range of potential human health and environmental exposure pathways at the T Plant Aggregate Area was summarized in Section 4.2. In Section 4.2 the role of biota in transporting contaminants through the environment is also discussed, and biota are included as receptors in the conceptual model. However, the assessment of potential ecological risks associated with biota exposure to T Plant Aggregate Area contaminants is currently constrained by the lack of data. This gap in the T Plant Aggregate Area data is discussed in Section 8.2.3. As a result, the risk-based screening of waste management unit priorities discussed in this section is by necessity limited to potential human health risks.

The U.S. Environmental Protection Agency (EPA 1989b) considers a human exposure pathway to consist of four elements: (1) a source and mechanism for contaminant release, (2) a retention or transport medium (or media), (3) a point of potential human contact, and (4) an exposure route (e.g., ingestion) at the contact point. The probability of the existence of a particular pathway is dependent upon the physical and institutional controls affecting site access and use. In the absence of site access controls and other land use restrictions, the identified potential exposure pathways could all occur. For example, it could be hypothesized that an individual could establish a residence within the boundaries of the T Plant Aggregate Area, disrupt the soil surface and contact buried contamination, and drill a well and withdraw contaminated groundwater for drinking water and crop irrigation. However, within the five- to ten-year period of interest associated with identification and prioritization of remedial actions within the T Plant Aggregate Area, unrestricted access and uncontrolled disruption of buried contaminants have a negligible probability of occurrence.

The conceptual model presented in Section 4.2 was evaluated to identify an appropriate framework for screening waste management units and establishing their remediation priorities based on potential health hazards. While work activities are assumed to include occasional contact with surface soils, it is assumed that no contact with buried contaminants will take place without proper protective measures.

Workers may be exposed via the following routes at the T Plant Aggregate Area:

- Ingestion of surface soils
- Inhalation of volatilized contaminants and resuspended particles
- Direct dermal contact with surface soils
- Direct exposure to radiation from surface soils and airborne resuspended particles.

Since evaluation of migration in the saturated zone is not within the scope of a source area aggregate area management study (AAMS), ingestion or contact with groundwater was not evaluated as an exposure pathways. However, since migration of waste constituents within the saturated zone will be addressed in the 200 West Groundwater AAMS, contaminants likely to migrate to the water table and waste management units that have a high potential to impact groundwater will be identified.

5.2 POTENTIAL EXPOSURE SCENARIOS AND HUMAN HEALTH CONCERNS

The routes by which a Hanford Site worker could potentially be exposed to contamination at the waste management units include ingestion, inhalation, direct contact with soils, and direct exposure to radiation. To evaluate the potential for exposure at individual waste management units, it is necessary to have data available for surface soils, air, and radiation levels. Although samples have been collected from each of these media, only the surface radiation survey data (contamination levels and dose rate) are specific to individual waste management units. Therefore, only pathways associated with the surface radiological contamination and external dose rates can be evaluated with confidence at this time. Exposures by other pathways were evaluated based on available knowledge about contaminants disposed of to the waste management unit and the engineered barriers to releases.

5.2.1 External Exposure

External dose rate surveys, which are performed on a waste management unit basis, were used as the measure of a unit's potential for impacting human health through direct external radiation exposure. The contaminants of potential concern for this pathway are the radionuclides that emit moderate to high energy penetrating gamma radiation. The radiation doses from direct external exposure from the available survey data are presented in Table 4-5. Recent survey data were available for only 38 of the 119 T Plant Aggregate Area waste management units and unplanned release sites evaluated in this table.

Westinghouse Hanford manual WHC-CM-4-10, Section 7 (WHC 1988b) was used as the basis for setting one of the criteria that are used to identify waste management units that can be considered high priority sites. The manual indicates that posting ("Radiation Area") and access controls are to be implemented at a level of 2 mrem/hr for the purpose of personnel protection. With the same objective in mind, the level of 2 mrem/hr is recommended as one of the criteria for distinguishing high priority from lower priority waste management units. For those units that do have recent radiation survey data, only four were reported as having a dose rate of greater than 2 mrem/hr measured for surface radiation contamination areas (Huckfeldt 1991c). A dose rate of 5 mrem/hr was measured at the 216-T-34 Crib in June 1990. A dose rate of 25 mrem/hr was also reported at the 216-T-27, 28, and 29 Cribs in June 1990. This high reading was from a non-smearable survey on the risers.

Radiation surveys were not available for settling tanks, septic tanks, catch tanks, french drains, or the transfer facilities.

High levels of radiation (up to 500 mR/hr) were reportedly associated with some of the unplanned releases (WHC 1991a), as noted in Table 5-1. However, many of these releases occurred in the early days of the Hanford Site and recent survey data are not available. Some of the releases were reportedly remediated by removing contaminated soil for disposal in burial grounds, paving or covering the area with soil, or flushing the soil with water. Other releases consisted of ^{106}Ru, which has a decay half-life of under 1 year, and would be largely decayed 40 years after release.

The effectiveness of the various remediation measures is not known, and confirmatory survey measurements are not available. Thus, with the exception of unplanned releases located within engineered waste units, which are routinely surveyed, information on the current radiological status of remediated unplanned releases is deficient, and is identified as a data gap in Section 8.0.

Relatively few of the unplanned release sites have had recent surveys. The sites with known surveys more recent than 1988 are the following:

- UN-200-W-97
- UN-200-W-98
- UN-200-W-98
- UN-200-W-113.

5.2.2 Ingestion of Soil or Inhalation of Fugitive Dust

Radionuclides and nonradioactive chemicals of concern for the soil ingestion and fugitive dust inhalation pathways are those that are nonvolatile, persistent in surface soils, and have appreciable carcinogenic or toxic affects by ingestion or inhalation. However, little information is available to evaluate the presence of specific radionuclides or nonradioactive chemicals in surface soils. Available gross activity survey data for the T Plant Aggregate Area waste management units are provided in Table 5-1.

The Westinghouse Hanford Environmental Protection group policies state that the presence of any smearable alpha constitutes a potential threat to human health and qualifies a waste management unit for a high remediation priority (Huckfeldt 1991b). Waste management units that exhibit elevated alpha readings in radiological surveys can be presumed to have surface contamination since alpha radiation cannot penetrate solids.

Westinghouse Hanford manual WHC-CM-4-10 (WHC 1988b) was used to set criteria for identifying waste management units that can be considered high remediation priority sites. The manual indicates that posting ("Surface Contamination Area") and access controls are to be implemented at a level of 100 ct/min above background beta/gamma, and/or 20 ct/min alpha, for the purpose of personnel protection. With the same objective in mind, the levels of 100 ct/min above background beta/gamma and 20 ct/min alpha are recommended as two of the criteria for identification of high priority waste management units. For those survey readings that are in units of dis/min, a conversion will be made to ct/min assuming an efficiency of 10%. Available sources indicate that measurements of smearable alpha were not made at any of the T Plant Aggregate Area Waste Management Units.

It should be noted that these radiation readings may indicate transient conditions (e.g., presence of contaminated vegetation) and that routine stabilization of surface contamination is carried out under the auspices of the Westinghouse Hanford Radiation Area Remedial Action (RARA) program.

Units subject to collapse of containment structures pose a potential threat of exposure by release of chemicals to surface soils. Units with high release potential based on potential occurrence of cave-ins include the following:

- 216-T-19 TF/Crib
- 216-T-32 Crib
- 216-T-3 Reverse Well
- 216-T-6 Crib
- 216-T-8 Crib.

However, all cribs that were constructed with wood are likely to suffer structural failure, and should be considered to pose a risk of releases to surface soil.

Units subject to wind erosion because of insufficient soil cover or erodible cover materials pose a potential threat of exposure via surface soil. Wind erosion has been noted as a problem in the area east of the 241-T Tank Farm. This area of active radionuclide migration has been steadily expanding on the past several years. Recent efforts to stabilize the soil in the 241-T Tank Farm may help to reduce this expansion.

Animal burrows have been noted throughout the 200 West Area. Although contamination as a result of burrowing has not been demonstrated, surveys in the T Plant Aggregate area have found contaminated herbivore feces, bird nests, and coyote feces. These results demonstrate the real possibility for soil assisted radionuclide migration.

5.2.3 Inhalation of Volatiles

As summarized in Section 4.1, the distribution of volatile organics in soils is not well defined in the T Plant Aggregate Area. Most of the volatile organics were used at facilities other than T Plant and would exist in the T Plant Aggregate Area due to migration. Volatile organics (e.g., methylene chloride, toluene, and isopropanol) were used for equipment decontamination at the 221-T Plant Equipment Decontamination Facility between 1964 and 1980 (Klem 1990). The quantities and potential soil locations of these volatile organics is unknown.

Waste management units (WMU) that are known to have contained equipment decontamination waste are the following:

WMU	Status
• 216-T-10	Exhumed radiologically
• 216-T-11	Exhumed radiologically
• 216-T-13	Surface stabilized

The primary volatile radionuclide of concern, tritium, is not known to have been disposed of directly in the T Plant Aggregate Area. Large quantities of tritium have been disposed of in areas near the T Plant Aggregate Area, including approximately 280,000 Ci (decayed through 1990) to the 218-W-3 Burial Ground (Anderson et al. 1991). Exposure to tritium (as tritiated water vapor) is of concern as is the potential for tritium release via radiolytic production of hydrogen from aqueous radioactive wastes.

5.2.4 Migration to Groundwater

Risks that could potentially occur due to migration of contaminants in groundwater to existing or potential receptors will be addressed in the 200 West Groundwater AAMS and thus, will not be discussed in the T Plant AAMS. However, the potential for individual units to impact groundwater was discussed in Section 4.1, and is summarized below.

Based on the available information on known or potential contamination of vadose zone and saturated zone soils summarized in Section 4.1 and the comparison of liquid waste volumes to effective pore space presented in Table 4-12, the following units have a high potential to have impacted area groundwater with either radionuclides or hazardous nonradioactive chemicals and could pose a risk of adverse human health effects if groundwater beneath or downgradient from the unit were to be used for a water supply in the future:

- 216-T-1 Ditch
- 216-T-2 Reverse Well
- 216-T-3 Reverse Well
- 216-T-4A Pond
- 216-T-5 Trench
- 216-T-6 Crib
- 216-T-7TF Crib and Tile Field
- 216-T-8 Crib
- 216-T-12 Trench
- 216-T-18 Crib
- 216-T-19TF Crib and Tile Field
- 216-T-22 Trench
- 216-T-23 Trench
- 216-T-24 Trench
- 216-T-25 Trench
- 216-T-26 Crib
- 216-T-27 Crib
- 216-T-28 Crib
- 216-T-32 Crib
- 216-T-33 Crib
- 216-T-34 Crib

- 216-T-35 Crib
- 216-W-LWC Laundry Crib.

Units that are estimated, based on the volume of waste and chemicals disposed of them, to have a low to moderate potential for impacts to groundwater based on the factors described above are as follows:

- 216-T-14 Trench
- 216-T-15 Trench
- 216-T-16 Trench
- 216-T-17 Trench
- 216-T-20 Trench
- 216-T-21 Trench
- 216-T-29 Crib
- 216-T-36 Crib.

In addition to the direct disposal of liquid wastes to the soil column, there is a potential that subsurface contaminant migration may be occurring as a result of liquid discharges to active waste management units affecting inactive waste management units. In the T Plant Aggregate Area, there are no known areas of vadose zone contamination within 50 m (160 ft) of any of the septic tanks or the 241-T-4-2 Ditch.

5.3 ADDITIONAL SCREENING CRITERIA

In addition to determining human health concerns for a worker at each of the waste management units, previously developed site ranking criteria were investigated for the purpose of setting priorities for waste management units and unplanned releases. These criteria are the CERCLA HRS scores assigned during preliminary assessment/site inspection (PA/SI) activities performed for the Hanford Site (DOE 1988), and the rankings assigned by the Westinghouse Hanford Environmental Protection Group to prioritize sites needing remedial actions for radiological control (Huckfeldt 1991b).

Both of these ranking systems take into account some measure of hazard and environmental mobility, and are thus appropriate to consider for waste unit prioritization. The HRS ranking system evaluates sites based on their relative risk, taking into account the population at risk, the hazard potential of the substances at the facility, the potential for contamination of the environment, the potential risk of fire and explosion, and the potential for injury associated with humans or animals that come into contact with the waste management unit inventory. The HRS is thus appropriate to consider for screening waste management units.

The PA/SI screening was performed using the EPA's HRS and mHRS. The HRS (40 CFR 300) is a site-ranking methodology that was designed to determine whether sites should

be placed on the CERCLA National Priority List (NPL) based on chemical contamination history. The EPA has established the criteria for placement on the NPL to be a score of 28.5 or greater. The mHRS is a ranking system developed by the Pacific Northwest Laboratory (PNL) for the U.S. Department of Energy (DOE) that uses the basic methodology of the HRS; however, it more accurately predicts the impacts from radionuclides. The mHRS takes into account concentration, half-life, and other chemical-specific parameters that are not considered by the HRS. The mHRS has not been accepted by EPA as a ranking system.

Many of the T Plant Aggregate Area waste management units were ranked in the PA/SI using both the HRS and mHRS. For those waste management units that were not ranked in the PA/SI, unit type and discharge history were evaluated in comparison with ranked units for the purpose of setting priorities. If a waste management unit that has been ranked exhibits similar characteristics (e.g., construction, waste type, and volume), the value for the ranked unit was applied to the unit without an HRS or mHRS score. If no ranked waste management units exhibit similar characteristics, then the unit was not ranked; however, a high or low score was determined qualitatively through evaluation of unit configuration and contamination history.

Table 5-1 lists the HRS and mHRS rankings, as well as scores that were assigned for unranked waste management units, based on their similarity to ranked units in terms of type, construction, and quantity of waste disposed of. If no similar waste management units were available for comparison, the units were not ranked but were assigned a qualitative indicator of migration potential.

Table 5-1 also lists the units scored by the Westinghouse Hanford Environmental Protection Group (Huckfeldt 1991b). The Environmental Protection Group's ranking system was developed to provide a remediation priority guide for managers of waste management units, based on environmental radiological concerns such as level of contamination, site accessibility, and environmental mobility. The highest ranking a site can receive is 15 (Huckfeldt 1991b, 1991c). A score of seven or greater results in the assignment of a "high" priority to the unit.

The Westinghouse Hanford Environmental Protection Group has issued rankings for a number of sites within the T Plant Aggregate Area (WHC 1992). The rankings of these sites range from 6 to 10.

Ten sites investigated in the PA/SI did not receive a ranking, because of insufficient data. These are denoted as "ENS" by the PA/SI to indicate sites not scored because of insufficient data. Other sites that did not receive a ranking were: (1) UPR-200-W-70, which discharged into an engineered facility, (2) UPR-200-W-147 through 153 and UPR-200-W-160, which were not listed due to lack of dose rates and mHRS or HRS ratings, and (3) the tanks, which will be closed under Resource Conservation and Recovery Act (RCRA).

5.4 SUMMARY OF SCREENING RESULTS

The screening process was used to sort sites as either high priority or low priority. Table 5-1 lists the T Plant Aggregate Area waste units that exceeded one or more of the screening criteria identified in the preceding Section 5.2. A discussion of the site prioritization and classification process is presented in Section 9.0 of this document.

Radiation survey results (dose rate and/or contamination) were available for 38 of the 120 non-single-shell tank waste management units. Twenty four were reported as having no detectable results. The remaining 14 units had survey results that exceeded one or more of the criteria (2 mrem/hr, 100 ct/min beta/gamma, and 20 ct/min alpha).

For both the mHRS and the HRS scores, six waste management units were given scores of 28.5 or greater. Eight units received a qualitative "high" score. Nine units received an Environmental Protection Group score of seven or greater. Because some sites were designated as high priority for more than one criterion, the total number of high priority sites, 29, is less than the sum of high priority ratings.

Table 5-1. Hazard Ranking Scores for T Plant Aggregate Area. (Sheet 1 of 5)

Site Name - Type	HRS Rating	mHRS Rating	Assigned Score /a/	Radiation Surveys			Environmental Protection Score /b/	Priority
				ct/min	dis/min	mrem/h		
Tanks and Vaults								
241-T-361 Settling Tank	--	--	High	--	--	--	--	Y
241-TX-302B Catch Tank	--	--	High	--	--	--	--	Y
241-TX-302C Catch Tank	--	--	High	--	--	--	--	Y
Cribs and French Drains								
216-T-6 Crib	2.5	2.83	--	--	--	--	6	N
216-T-7TF Crib and Tile Field	65.43	65.43	--	--	--	--	--	Y
216-T-8 Crib	47.81	47.82	--	--	--	--	--	Y
216-T-18 Crib	1.60	1.60	--	--	--	--	--	N
216-T-19TF Crib and Tile Field	57.88	45.19	--	--	3,000	--	9	Y
216-T-26 Crib	1.81	1.89	--	--	5,000	--	--	Y
216-T-27 Crib	1.72	2.36	--	--	50,000	25	--	Y
216-T-28 Crib	47.81	42.14	--	--	50,000	--	--	Y
216-T-29 Crib	1.03	0.71	--	--	--	--	--	N
216-T-31 French Drain /c/	0.00	0.00	--	--	--	--	--	N
216-T-32 Crib	1.42	1.42	--	--	--	--	--	N
216-T-33 Crib	1.03	0.82	--	--	3,000	--	6	Y
216-T-34 Crib	1.03	1.42	--	--	100,000	--	--	Y
216-T-35 Crib	1.38	1.52	--	--	--	--	--	Y
216-T-36 Crib	1.38	1.52	--	--	--	--	6	N
216-W-LWC Crib	--	--	High	--	--	--	--	Y

Table 5-1. Hazard Ranking Scores for T Plant Aggregate Area. (Sheet 2 of 5)

Site Name - Type	HRS Rating	mHRS Rating	Assigned Score /a/	Radiation Surveys			Environmental Protection Score /b/	Priority
				ct/min	dis/min	mrem/h		
Reverse Wells								
216-T-2 Reverse Well	50.33	50.33	--	--	--	--	--	Y
216-T-3 Reverse Well	60.40	60.40	--	--	--	--	8	Y
Ponds, Ditches, and Trenches								
216-T-4A Pond /c/	0.00	0.00	--	--	--	--	--	N
216-T-4B Pond /d/	0.00	0.00	--	--	--	--	--	N
216-T-1 Ditch	--	--	High	--	--	--	8	Y
216-T-4-1D Ditch /c/	0.00	0.00	--	--	--	--	--	N
216-T-4-2 Ditch /e/	0.00	0.00	High	--	--	--	--	N
200-W Powerhouse Pond	--	--	Low	--	--	--	--	N
216-T-5 Trench	1.25	1.25	--	--	--	--	--	N
216-T-9 Trench /c/	0.00	0.00	--	--	--	--	--	N
216-T-10 Trench /c/	0.00	0.00	--	--	--	--	--	N
216-T-11 Trench /c/	0.00	0.00	--	--	--	--	--	N
216-T-12 Trench	0.98	1.14	--	500	--	--	--	Y
216-T-13 Trench /c/	0.00	0.00	--	--	--	--	--	N
216-T-14 Trench	1.20	1.42	--	--	4,000	--	10	Y
216-T-15 Trench	1.20	1.42	--	--	4,000	--	10	Y
216-T-16 Trench	1.20	1.42	--	--	4,000	--	10	Y
216-T-17 Trench	1.20	1.42	--	--	4,000	--	10	Y
216-T-20 Trench	1.09	0.82	--	--	--	--	--	N

Table 5-1. Hazard Ranking Scores for T Plant Aggregate Area. (Sheet 3 of 5)

Site Name - Type	HRS Rating	mHRS Rating	Assigned Score /a/	Radiation Surveys			Environmental Protection Score /b/	Priority
				ct/min	dis/min	mrem/h		
216-T-21 Trench	1.52	1.52	--	--	--	--	--	Y
216-T-22 Trench	1.67	1.89	--	--	--	--	--	Y
216-T-23 Trench	1.25	1.42	--	--	--	--	--	Y
216-T-24 Trench	1.67	1.89	--	--	--	--	--	N
216-T-25 Trench	1.89	1.89	--	--	--	--	--	N
Septic Tanks								
2607-W1 Septic Tank	--	--	Low	--	--	--	--	N
2607-W2 Septic Tank	--	--	Low	--	--	--	--	N
2607-W3 Septic Tank	--	--	Low	--	--	--	--	N
2607-W4 Septic Tank	--	--	Low	--	--	--	--	N
Transfer Facilities, Diversion Boxes, and Pipelines								
241-TX-152 Diversion Box	--	--	High	--	--	--	--	N
241-TX-154 Diversion Box	--	--	High	--	--	--	--	Y
241-TX-155 Diversion Box	--	--	High	--	--	--	--	Y
Basins								
207-T Retention Basin	--	--	Low	--	--	--	9	Y
Burial Grounds								
200-W Ash Disposal Basin	--	--	Low	--	--	--	--	N
200-W Ash Pit Demolition Site	--	--	Low	--	--	--	--	N
200-W Burning Pit /c/	0.00	0.00	--	--	--	--	--	N
200-W Powerhouse Ash Pit	--	--	Low	--	--	--	--	N

Table 5-1. Hazard Ranking Scores for T Plant Aggregate Area. (Sheet 4 of 5)

Site Name - Type	HRS Rating	mHRS Rating	Assigned Score /a/	Radiation Surveys			Environmental Protection Score /b/	Priority
				ct/min	dis/min	mrem/h		
218-W-8 Burial Ground	0.70	0.50	--	--	--	--	--	N
Unplanned Releases								
UN-200-W-2	ENS	--	--	--	--	--	--	N
UN-200-W-3	ENS	--	--	--	--	--	--	N
UN-200-W-4	ENS	--	--	--	--	--	--	N
UN-200-W-7 /f/	ENS	--	--	--	--	--	--	N
UN-200-W-8	1.00	--	--	--	--	--	--	N
UN-200-W-14	ENS	--	--	--	--	--	--	N
UN-200-W-27	ENS	--	--	--	--	--	--	N
UN-200-W-29	1.00	--	--	--	--	--	--	N
UN-200-W-38 /f/	1.00	--	--	--	--	--	--	N
UN-200-W-58	ENS	--	--	--	--	--	--	N
UN-200-W-63	1.00	--	--	--	--	--	--	N
UN-200-W-65	0.60	--	--	--	--	--	--	N
UN-200-W-67	0.90	--	--	--	--	--	--	N
UN-200-W-73	0.70	--	--	--	--	--	--	N
UN-200-W-77	ENS	--	--	--	--	--	--	N
UN-200-W-85	--	--	Low	--	--	--	--	N
UN-200-W-88	--	--	Low	600	--	--	--	N
UN-200-W-98	1.10	--	--	300	--	--	10	Y
UN-200-W-99	0.70	--	--	4,000	--	.2	--	Y

Table 5-1. Hazard Ranking Scores for T Plant Aggregate Area. (Sheet 5 of 5)

Site Name - Type	HRS Rating	mHRS Rating	Assigned Score /a/	Radiation Surveys			Environmental Protection Score /b/	Priority
				ct/min	dis/min	mrem/h		
UN-200-W-102	1.00	--	--	--	--	--	--	N
UN-200-W-113 /f/	ENS	--	--	--	--	--	--	N
UN-200-W-135	1.20	--	--	--	--	--	--	N
UN-200-W-137	ENS	--	--	--	--	--	--	N

Sources: Waste Information Data System (WIDS), 1991; DOE 1988; Huckfeldt, 1991.

/a/ A low (high) value was given to those units for which no similarities to other ranked units exist and a qualitative investigation indicates a "low" ("high") score.
/b/ Relative to a maximum environmental protection score of 15.
/c/ Although the site was used for waste disposal, no inventory was available; therefore, the site did not score.
/d/ Value based on similarity to 216-T-4A.
/e/ Value based on similarity to 216-T-4-1D.
/f/ This unplanned release is associated with another waste management unit.

ENS = Classification given in PA/SI when sufficient information was not available for scoring.
-- = No information/data available.

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6.0 IDENTIFICATION OF POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE T PLANT AGGREGATE AREA

6.1 INTRODUCTION

The Superfund Amendments and Reauthorization Act (SARA) of 1986 amended Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to require that all applicable or relevant and appropriate requirements (ARARs) be employed during implementation of a hazardous waste site cleanup. "Applicable" requirements are defined by the Environmental Protection Agency (EPA) in "CERCLA Compliance with Other Laws Manual" (OSWER Directive 9234.1-01, August 8, 1988) as:

> cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

A separate set of "relevant and appropriate" requirements that must be evaluated include:

> cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

"To-be-Considered Materials" (TBCs) are nonpromulgated advisories or guidance issued by federal or state governments that are not legally binding and do not have the status of potential ARARs. However, in many circumstances, TBCs will be considered along with potential ARARs and may be used in determining the necessary level of cleanup for protection of health or the environment.

The following sections identify potential ARARs to be used in developing and assessing various remedial action alternatives at the T Plant Aggregate Area. Specific requirements pertaining to hazardous and radiological waste management, remediation of contaminated soils, surface water protection, and air quality will be discussed.

The potential ARARs focus on federal or state statutes, regulations, criteria, and guidelines. The specific types of potential ARARs evaluated include:

- Contaminant-specific
- Location-specific
- Action-specific.

Potential contaminant-specific ARARs are usually health or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical contaminant values that are generally recognized by the regulatory agencies as allowable to protect human health and the environment. In the case of the T Plant Aggregate Area, contaminant-specific potential ARARs address chemical constituents and/or radionuclides. The potential contaminant-specific ARARs that were evaluated for the T Plant Aggregate Area are discussed in Section 6.2.

Potential location-specific ARARs are restrictions placed on the concentration of hazardous substances, or the conduct of activities, solely because they occur in specific locations. The location-specific potential ARARs that were evaluated for the T Plant Aggregate Area are discussed in Section 6.3.

Potential action-specific ARARs apply to particular remediation methods and technologies, and are evaluated during the detailed screening and evaluation of remediation alternatives. The potential action-specific ARARs that were evaluated for the T Plant Aggregate Area are discussed in Section 6.4.

The TBC requirements are other federal and state criteria, advisories, and regulatory guidance that are not promulgated regulations, but are to be considered in evaluating alternatives. Potential TBCs include U.S. Department of Energy (DOE) Orders that carry out authority granted under the Atomic Energy Act. All DOE Orders are potentially applicable to operations at the T Plant Aggregate Area. Specific TBC requirements are discussed in Section 6.5.

Potential contaminant- and location-specific ARARs will be refined during the AAMS process. Potential action-specific ARARs are briefly discussed in this section, and will be further evaluated upon final selection of remedial alternatives. The points at which these potential ARARs must be achieved and the timing of the ARARs evaluations are discussed in Sections 6.6 and 6.7, respectively.

6.2 CONTAMINANT-SPECIFIC REQUIREMENTS

A contaminant-specific requirement sets concentration limits in various environmental media for specific hazardous substances, pollutants, or contaminants. Based on available information, some of the currently known or suspected contaminants that may be present in

the T Plant Aggregate Area are outlined in Table 4-23. The currently identified potential federal and state contaminant-specific ARARs are summarized below.

6.2.1 Federal Requirements

Federal contaminant-specific requirements are specified in several statutes, codified in the U.S. Code (USC), and promulgated in the Code of Federal Regulations (CFR), as follows:

6.2.1.1 Clean Water Act. Federal Water Quality Criteria (FWQC) are developed under the authority of the Clean Water Act to serve as guidelines to the states for determining receiving water quality standards. Different FWQC are derived for protection of human health and protection of aquatic life. The human health FWQC are further subdivided according to how people are expected to use the water (e.g., drinking the water versus consuming fish caught from the water). The SARA 121(d)(2) states that remedial actions shall attain FWQC where they are relevant and appropriate, taking into account the designated or potential use of the water, the media affected, the purpose of the criteria, and current information. Many more substances have FWQC than maximum contaminant levels (MCLs) issued under the Safe Drinking Water Act (see discussion below); consequently, EPA and other state agencies rely on these criteria more than MCLs, even though these criteria can only be considered relevant and appropriate and not applicable.

The FWQC would not be considered at T Plant Aggregate Area, as no natural bodies of water exist within the Aggregate Area. The only existing man-made surface water bodies at T Plant Aggregate Area are the 216-T-1 ditch, the 216-T-4-2 ditch, the 207-T retention basin, and the 200 West powerhouse pond. The 216-T-46 pond historically held water but is presently dry.

6.2.1.2 Safe Drinking Water Act. Under the authority of the Safe Drinking Water Act, MCLs apply when the water may be used for drinking. At present, EPA and the State of Washington apply MCLs as the standards for groundwater contaminants at CERCLA sites that could be used as drinking water sources. Groundwater contamination and application of MCLs as potential ARARs are addressed under a separate Aggregate Area Management Study (AAMS) specific to groundwater.

6.2.1.3 Resource Conservation and Recovery Act. The Resource Conservation and Recovery Act (RCRA) addresses the generation and transportation of hazardous waste, and waste management activities at facilities that treat, store, or dispose of hazardous wastes. Subtitle C (Hazardous Waste Management) mandates the creation of a cradle-to-grave management and permitting system for hazardous wastes. The RCRA defines hazardous wastes as "solid wastes" (even though the waste is often liquid in physical form) that may cause or significantly contribute to an increase in mortality or serious illness, or that poses a substantial hazard to human health or the environment when improperly managed. In

Washington State, RCRA is implemented by EPA and the authorized state agency, the Washington State Department of Ecology (Ecology).

The RCRA is potentially applicable or relevant and appropriate to the T Plant Aggregate Area. The extensive permitting requirements under RCRA would only apply to a waste management unit that is an identified hazardous waste treatment, storage or disposal (TSD) facility, and to hazardous waste management activities that occurred outside an area of contamination. If a waste management unit is not a RCRA TSD facility and if remediation occurs on site, then the RCRA permitting requirements would not have to be satisfied. However, other substantive requirements necessary to protect human health and the environment would constitute potential ARARs.

Two key potential contaminant-specific ARARs have been adopted under the federal hazardous waste regulations: the Toxicity Characteristic Leaching Procedure (TCLP) designation limits promulgated under 40 CFR Part 261; and the hazardous waste land disposal restrictions for constituent concentrations promulgated under 40 CFR Part 268.

The TCLP designation limits define when a waste is hazardous, and are used to determine when more stringent management standards apply than would be applied to typical solid wastes. Thus, the TCLP potential contaminant-specific ARARs can be used to determine when RCRA waste management standards may be required. The TCLP limits are presented in Table 6-1.

The land disposal restrictions (LDRs) are numerical limits derived by EPA by reviewing available technologies for treating hazardous wastes. Until a prohibited waste can meet the numerical limits, it can be prohibited from land disposal. Two sets of limits have been promulgated: limits for constituent concentrations in waste extract, which uses the TCLP test to obtain a leached sample of the waste; and limits for constituent concentrations in waste, which addresses the total contaminant concentration in the waste. The land disposal restrictions limits are presented in Table 6-1 (see Section 6.4.1.2 for a further discussion on applying the land disposal restriction limits).

6.2.1.4 Clean Air Act. The Clean Air Act establishes National Primary and Secondary Ambient Air Quality Standards (NAAQS) (40 CFR Part 50), National Emission Standards for Hazardous Air Pollutants (NESHAP)(40 CFR Part 61), and New Source Performance Standards (NSPS)(40 CFR Part 60).

In general, new and modified stationary sources of air emissions must undergo a pre-construction review to determine whether the construction or modification of any source, such as a CERCLA remedial program, will interfere with attainment or maintenance of NAAQS or fail to meet other new source review requirements including NESHAP and NSPS. However, the process applies only to "major" sources of air emissions (defined as emissions of 250 tons per year). The T Plant Aggregate Area would not constitute a major source.

Section 112 of the Clean Air Act directs EPA to establish standards at the level that provides an ample margin of safety to protect the public health from hazardous air pollutants. The NESHAP standards for radionuclides are directly applicable to DOE facilities under Subpart H of Section 112 that establishes a 10 mrem/year facility-wide standard for exposure to an offsite receptor. Further, if the maximum individual dose added by a new construction or modification during remediation exceeds 1 percent of the NESHAPs standard (0.1 mrem/yr), a report meeting the substantive requirements of an application for approval of construction must be prepared.

6.2.2 State of Washington Requirements

Potential state contaminant-specific requirements are specified in several statutes, codified in the Revised Code of Washington (RCW) and promulgated in the Washington Administrative Code (WAC).

6.2.2.1 Model Toxics Control Act. The Model Toxics Control Act (MTCA) (Ecology 1991) authorized Ecology to adopt cleanup standards for remedial actions at hazardous waste sites. These regulations are considered potential ARARs for soil, groundwater, and surface water cleanup actions. The processes for identifying, investigating, and cleaning up hazardous waste sites are defined and cleanup standards are set for groundwater, soil, surface water, and air in Chapter 173-340 WAC.

Under the MTCA regulations, cleanup standards may be established by one of three methods.

- Method A may be used if a routine cleanup action, as defined in WAC 173-340-200, is being conducted at the site or relatively few hazardous substances are involved for which cleanup standards have been specified by Tables 1, 2, or 3 of WAC 173-340-720 through -745.

- Under Method B, a risk level of 10^{-6} is established and a risk calculation based on contaminants present is determined.

- Method C cleanup standards represent concentrations that are protective of human health and the environment for specified site uses. Method C cleanup standards may be established where it can be demonstrated that such standards comply with applicable state and federal laws, that all practical methods of treatment are used, that institutional controls are implemented, and that one of the following conditions exist: (1) Method A or B standards are below background concentrations; (2) Method A or Method B results in a significantly greater threat to human health or the environment; (3) Method A or Method B standards are below technically possible concentrations, or (4) the site is defined as an industrial site for purposes of soil remediation.

Table 1 of Method A addresses groundwater, so it is not considered to be an ARAR for T Plant Aggregate Area (groundwater will be addressed in the 200 West Groundwater AAMS report). Table 2 of Method A is intended for non-industrial site soil cleanups, and Table 3 of Method A is intended for industrial site soil cleanups. Method A industrial soil cleanup standards for preliminary contaminants of concern are provided as potential ARARs in Table 6-1.

In addition to Method A, Method B and Method C cleanup standards may also be considered potential ARARs for the T Plant Aggregate Area. Method B and Method C cleanup standards can be calculated on a case-by-case basis in concert with Ecology. Method B and Method C should be used where Method A standards do not exist or cannot be met, or where routine cleanup actions cannot be implemented at a specific waste management unit.

6.2.2.2 State Hazardous Waste Management Act and Dangerous Waste Regulations. The State of Washington is a RCRA-authorized state for hazardous waste management, and has developed state-specific hazardous waste regulations under the authority of the State Hazardous Waste Management Act. Generally, state hazardous waste regulations parallel the federal regulations. The state definition of a hazardous waste incorporates the EPA designation of hazardous waste that is based on the compound being specifically listed as hazardous, or on the waste exhibiting the properties of reactivity, ignitability, corrosivity, or toxicity as determined by the TCLP.

In addition, Washington State identifies other waste as hazardous. Three unique criteria are established: toxic dangerous waste; persistent dangerous waste; and carcinogenic dangerous waste. These additional designation criteria may be imposed by Ecology as potential ARARs, for purposes of determining acceptable cleanup standards and appropriate waste management standards.

6.2.2.3 Ambient Air Quality Standards and Emission Limits for Radionuclides (Chapter 173-480 WAC). These Ecology ambient air quality standards specify maximum accumulated dose limits to members of the public.

6.2.2.4 Monitoring and Enforcement of Air Quality and Emission Standards for Radionuclides (WAC 246-247). These permitting requirements by the Washington State Department of Health adopt the Ecology standards for maximum accumulated dose limits to members of the public.

6.2.2.5 Controls for New Sources of Toxic Air Pollutants (Chapter 173-460 WAC). In accordance with regulations recently promulgated by Ecology in Chapter 173-460 WAC, any new emission source will be subject to Toxic Air Pollutant (TAP) emission standards. The regulations establish allowable ambient source impact levels (ASILs) for hundreds of organic and inorganic compounds. Ecology's ASILs may constitute potential ARARs for cleanup activities that have a potential to affect air. ASILs for preliminary contaminants of concern are provided in Table 6-1.

6.2.2.6 Water Quality Standards. Washington State has promulgated various numerical standards related to surface water and groundwater contaminants. These are included principally in the following regulations:

- **Public Water Supplies (Chapter 248-54 WAC).** This regulation establishes drinking water standards for public water supplies. The standards essentially parallel the federal drinking water standards (40 CFR Parts 141 and 143).

- **Water Quality Standards for Ground Waters of the State of Washington (Chapter 173-200 WAC).** This regulation establishes contaminant standards for protecting existing and future beneficial uses of groundwater through the reduction or elimination of the discharge of contaminants to the state's groundwater.

- **Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201 WAC and Proposed Chapter 173-203/173-201A WAC).** Ecology has adopted numerical ambient water quality criteria for six conventional pollutant parameters for various surface water classes (WAC 173-201-045): (1) fecal coliform bacteria; (2) dissolved oxygen; (3) total dissolved gas; (4) temperature; (5) pH; and (6) turbidity. In addition, toxic, radioactive, or deleterious material concentrations shall be below those of public health significance or which may cause acute or chronic toxic conditions to the aquatic environment or which may adversely affect any water use. Numerical criteria currently exist for a limited number of toxic substances (WAC 173-201-047). Ecology has initiated rulemaking to modify and incorporate additional numerical criteria for toxic substances and for radioactive substances, and to reclassify certain waters of the state.

  Under the state Water Quality Standards, the criteria and classifications do not apply inside an authorized mixing zone surrounding a wastewater discharge. In defining mixing zones, Ecology generally follows guidelines contained in "Criteria for Sewage Works Design." Although water quality standards can be exceeded inside the mixing zone, state regulations will not permit discharges that cause mortalities of fish or shellfish within the zone or that diminish aesthetic values.

These water quality standards do not constitute ARARs for purposes of establishing cleanup standards for the T Plant Aggregate Area. Because no natural surface water bodies exist within the T Plant Aggregate Area, there will be no need to achieve ambient water quality standards during remediation activities. Groundwater is being addressed under a separate study in which pertinent groundwater-related potential ARARs will be covered.

The numerical water quality standards cited above may become potential ARARs if selected remedial actions could result in discharges to groundwater or surface water (e.g., if

treated wastewaters are discharged to the soil column or the Columbia River). Determining appropriate standards for such discharges will depend on the type of remediation performed and will have to be established on a case-by-case basis as remedial actions are defined.

6.2.3 National Pollutant Discharge Elimination System (Chapter 173-220 WAC and 40 CFR Part 122) and Water Quality Standards.

National Pollutant Discharge Elimination System (NPDES) regulations govern point source discharges into navigable waters. Limits on the concentrations of contaminants and volumetric flowrates that may be discharged are determined on a case-by-case basis and permitted under this program. No point source discharges have been identified. The EPA implements this program in Washington State for federal facilities; however, assumption of the NPDES program by the state is likely within five years.

6.3 LOCATION-SPECIFIC REQUIREMENTS

Potential location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in specific locations. Some examples of special locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats.

Table 6-2 lists various location-specific standards and indicates which of these may be potential ARARs. Potential ARARs have been identified as follows:

- **Floodplains.** Requirements for protecting floodplains are not ARARs for activities conducted within the T Plant Aggregate Area because the aggregate area is not located within flood plain boundaries (See Section 3.1). However, remedial actions selected for cleanup may require projects in or near floodplains (e.g., construction of a treatment facility outfall at the Columbia River). In such cases, location-specific floodplain requirements may be potential ARARs.

- **Wetlands, Shorelines, and Rivers and Streams.** Requirements related to wetlands, shorelines, and rivers and streams are not ARARs for activities conducted within the T Plant Aggregate Area. However, remedial actions selected for cleanup may require projects on a shoreline or wetland, or discharges to wetlands (e.g., construction of a treatment facility outfall at the Columbia River). In such cases, location-specific shoreline and wetlands requirements may be potential ARARs.

- **Threatened and Endangered Species Habitats.** As discussed in Section 3.6, various threatened and endangered species inhabit portions of the Hanford Site and may occur in the T Plant Aggregate Area (American peregrine falcon, bald

eagle, white pelican, and sandhill crane). Therefore, critical habitat protection for these species would constitute a potential ARAR.

- **Wild and Scenic Rivers.** The Columbia River Hanford Reach is currently undergoing study pursuant to the federal Wild and Scenic Rivers Act. Pending results of this study, actions that may impact the Hanford Reach may be restricted. This requirement would not be an ARAR for remedial activities within the T Plant Aggregate Area. However, Wild and Scenic Rivers Act requirements may be potential ARARs for actions taken as a result of T Plant Aggregate Area cleanup efforts that could affect the Hanford Reach.

6.4 ACTION-SPECIFIC REQUIREMENTS

Potential action-specific ARARs are requirements that are triggered by specific remedial actions at the site. These remedial actions will not be fully defined until a remedial approach has been selected. However, the universe of action-specific ARARs defined by a preliminary screening of potential remedial action alternatives will help focus the selection process. Potential action-specific ARARs are outlined below. (Note that potential contaminant- and location-specific ARARs discussed above will also include provisions for potential action-specific ARARs to be applied once the remedial action is selected.)

6.4.1 Federal Requirements

6.4.1.1 Comprehensive Environmental Response, Compensation, and Liability Act. CERCLA, and regulations adopted pursuant to CERCLA contained in the National Contingency Plan (40 CFR Part 300), include selection criteria for remedial actions. Under the criteria, excavation and off-site land disposal options are least favored when on-site treatment options are available. Emphasis is placed on alternatives that permanently treat or immobilize contamination. Selected alternatives must be protective of human health and the environment, which implies that federal and state ARARs be met. However, a remedy may be selected that does not meet all potential ARARs if the requirement is technically impractical, if its implementation would produce a greater risk to human health or the environment, if an equivalent level of protection can otherwise be provided, if state standards are inconsistently applied, or if the remedy is only part of a complete remedial action which attains potential ARARs.

The CERCLA gives state cleanup standards essentially equal importance as federal standards in guiding cleanup measures in cases where state standards are more stringent. State standards pertain only if they are generally applicable, were passed through formal means, were adopted on the basis of hydrologic, geologic, or other pertinent considerations, and do not preclude the option of land disposal by a state-wide ban. Most importantly, CERCLA provides that cleanup of a site must ensure that public health and the environment

are protected. Selected remedies should meet all potential ARARs, but issues such as cost-effectiveness must be weighed in the selection process.

6.4.1.2 Resource Conservation and Recovery Act. The RCRA, and regulations adopted pursuant to RCRA, describe numerous action-specific requirements that may be potential ARARs for cleanup activities. The primary regulations are promulgated under 40 CFR Parts 262, 264, and 265, and include such action-specific requirements as follows:

- Packaging, labeling, placarding, and manifesting of off-site waste shipments
- Inspecting waste management areas to ensure proper performance and safe conditions
- Preparation of plans and procedures to train personnel and respond to emergencies
- Management standards for containers, tanks, incinerators, and treatment units
- Design and performance standards for land disposal facilities
- Groundwater monitoring system design and performance.

Many of these requirements will depend on the particular remediation activity undertaken, and will have to be identified as remediation proceeds.

One key potential area of action-specific RCRA ARARs are the 40 CFR Part 268 land disposal restrictions. In addition to the contaminant-specific constituent concentration limits established in the land disposal restrictions (as previously discussed in Section 6.2.1.3), EPA has identified best demonstrated available treatment technologies (BDATs) for various waste streams. The EPA could require the use of BDATs prior to allowing land disposal of wastes generated during remediation. The EPA's imposition of the land disposal restrictions and BDAT requirements will depend on various factors.

Applicability to CERCLA actions is based on determinations of waste "placement/disposal" during a remediation action. According to OSWER Directive 9347.3-05FS, EPA concludes that Congress did not intend in situ consolidation, remediations, or improvement of structural stability to constitute placement or disposal. Placement or disposal would be considered to occur if:

- Wastes from different units are consolidated into one unit (other than a land disposal unit within an area of contamination)
- Waste is removed and treated outside a unit and redeposited into the same or another unit (other than a land disposal unit within an area of contamination) or

- Waste is picked up from a unit and treated within the area of contamination in an incinerator, surface impoundment, or tank and then redeposited into the unit (except for in situ treatment).

Consequently, the requirement to use BDAT would not apply under the land disposal restrictions standards unless placement or disposal had occurred. However, remediation actions involving excavation and treatment could trigger the requirements to use BDAT for wastes subject to the land disposal restrictions standards. In addition, the agencies could consider BDAT technologies to be relevant and appropriate when developing and evaluating potential remediation technologies.

Two additional components of the land disposal restrictions program should be considered with regard to an excavate and treat remedial action. First, a national capacity variance was issued by EPA for contaminated soil and debris for a two-year period ending May 8, 1992 (54 FR 26640). Second, a series of variances and exemptions may be applied under an excavate and treat scenario. These include the following:

- A no-migration petition
- A case-by-case extension to an effective date
- A treatability variance
- Mixed waste provisions of a federal Facilities Compliance Act (when enacted).

The applicability and relevance of each of these options will vary based on the specific details of a T Plant Aggregate Area excavate and treat option. An analysis of these variances can be developed once engineering data on the option becomes available.

The effect of the land disposal restrictions program on mixed waste management is significant. Currently, limited technologies are available for effective treatment of these waste streams and no commercially available treatment facilities exist except for liquid scintillation counting fluids used for laboratory analysis and testing. The EPA recognized that inadequate capacity exists and issued a national capacity variance until May 8, 1992, to allow for the development of such treatment capacity.

Lack of treatment and disposal capacity also presents implications for storage of these materials. Under 40 CFR 268.50, mixed wastes subject to land disposal restrictions may be stored for up to one year. Beyond one year, the owner/operator has the burden of proving such storage is for accumulating sufficient quantities for treatment. On August 29, 1991, EPA issued a mixed waste storage enforcement policy providing some relief from this provision for generators of small volumes of mixed wastes. However, the policy was limited to facilities generating less than 28 m^3 (1,000 ft^3) of land disposal-prohibited waste per year.

Congress is considering amendments to RCRA postponing the storage prohibition for another five years; however, final action on these amendments has not occurred.

6.4.1.3 Clean Water Act. Regulations adopted pursuant to the Clean Water Act under the NPDES mandate use of best available treatment technologies prior to discharging contaminants to surface waters. The NPDES requirements would not be ARARs for actions conducted only within the T Plant Aggregate Area. However, NPDES requirements could constitute potential ARARs for cleanup actions which would result in discharge of treated wastewaters to the Columbia River, and associated treatment systems could be required to utilize best available treatment technologies.

6.4.2 State of Washington Requirements

6.4.2.1 Hazardous Waste Management. As discussed in Section 6.4.1.2, there are various requirements addressing the management of hazardous wastes that may be potential action-specific ARARs. Pertinent Washington regulations appear in Chapter 173-303 WAC and generally parallel federal management standards. Determination of potential ARARs will be on a case-by-case basis as cleanup actions proceed.

6.4.2.2 Solid Waste Management. Washington State regulations describe management standards for solid waste in Chapter 173-304 WAC. Some of these management standards may be potential ARARs for disposal of cleanup wastes within the T Plant Aggregate Area. Solid waste standards include such requirements as the following:

- Inspecting waste management areas to ensure proper performance and safe conditions
- Management standards for incinerators and treatment units
- Design and performance standards for landfills
- Groundwater monitoring system design and performance.

Many of these requirements will depend on the particular remediation activity undertaken, and will have to be identified as remediation proceeds.

6.4.2.3 Water Quality Management. Chapter 90.48 RCW, the Washington State Water Pollution Control Act, requires use of all known, available, and reasonable treatment technologies for treating contaminants prior to discharge to waters of the state. Implementing regulations appear principally at Chapters 173-216, 173-220, and 173-240 WAC.

The Water Pollution Control Act requirements for groundwater could be potential ARARs for actions conducted within the T Plant Aggregate Area if such actions would result in discharge of liquid contaminants to the soil column. In this event, Ecology may require use of all known, available, and reasonable treatment technologies to treat the liquid discharges prior to soil disposal.

The Water Pollution Control Act requirements for surface water would not be ARARs for actions conducted only within the T Plant Aggregate Area. However, these requirements could constitute potential ARARs for cleanup actions which would result in discharge of treated wastewaters to the Columbia River and associated treatment systems could be required to demonstrate they meet all known, available, and reasonable treatment technologies.

6.4.2.4 Air Quality Management. The Toxic Air Pollutant regulations for new air emission sources, promulgated in Chapter 173-460 WAC, require use of best available control technology for air toxics. The Toxic Air Pollutant regulations may be potential ARARs for cleanup actions at the T Plant Aggregate Area that could result in emissions of toxic contaminants to the air. Ecology may require the use of best available control technology for air toxics, to treat such air emissions.

6.5 OTHER CRITERIA AND GUIDANCE TO BE CONSIDERED

In addition to the potential ARARs presented, other federal and state criteria, advisories, guidance, and similar materials are TBC in determining the appropriate degree of remediation for the T Plant Aggregate Area. A myriad of resources may be potentially evaluated. The following represents an initial assessment of TBC provisions.

6.5.1 Health Advisories

The EPA Office of Drinking Water publishes advisories identifying contaminants for which health advisories have been issued.

6.5.2 International Commission of Radiation Protection/National Council on Radiation Protection

The International Commission of Radiation Protection and the National Council on Radiation Protection have a guidance standard of 100 mrem/yr whole body dose of gamma radiation. These organizations also issue recommendations on other areas of interest regarding radiation protection.

6.5.3 EPA Proposed Corrective Actions for Solid Waste Management Units

In the July 27, 1990, federal register (55 FR 30798), EPA published proposed regulations for performing corrective actions (cleanup activities) at solid waste management units associated with RCRA facilities. The proposed 40 CFR Part 264 Subpart S include requirements that would be TBCs for determining an appropriate level of cleanup at the T Plant Aggregate Area. In particular, EPA included an appendix, "Appendix A - Examples of Concentrations Meeting Criteria for Action Levels", which presented recommended contaminant concentrations warranting corrective action. These contaminant-specific TBCs are included in Table 6-1 for the preliminary contaminants of concern.

6.5.4 DOE Standards for Radiation Protection

A number of DOE Orders exist which could be TBCs. The DOE Orders that establish potential contaminant-specific or action-specific standards for the remediation of radioactive wastes and materials are discussed below.

6.5.4.1 DOE Order 5400.5 - DOE Standards for Radiation Protection of the Public and Environment. The DOE Order 5400.5 establishes the requirements for DOE facilities to protect the environment and human health from radiation including soil and air contamination. The purpose of the Order is to establish standards and requirements for operations of the DOE and DOE contractors with respect to protection of members of the public and the environment against undue risk from radiation.

The Order mandates that the exposure to members of the public from a radiation source as a consequence of routine activities shall not exceed 100 mrem from all exposure sources due to routine DOE activities. In accordance with the Clean Air Act, exposures resulting from airborne emissions shall not exceed 10 mrem to the maximally exposed individual at the facility boundary. The DOE Order 5400.5 provides Derived Concentration Guide (DCG) values for releases of radionuclides into the air or water. The DCG values are calculated so that, under conditions of continuous exposure, an individual would receive an effective dose equivalent of 100 mrem/year. Because dispersion in air or water is not accounted for in the DCG, actual exposures of maximally exposed individuals in unrestricted areas are considerably below the 100 mrem/year level.

The DOE Order 5400.5 also provides for establishment of soil cleanup levels through a site-specific pathway analysis such as the allowable residual contamination level method. The calculation of allowable residual contamination level values for radionuclides is dependent on the physical characteristics of the site, the radiation dose limit determined to be acceptable, and the scenarios of human exposure judged to be possible and to result in the upper-bound exposure.

6.5.4.2 DOE Order 5820.2A - Radioactive Waste Management. The DOE Order 5820.2A applies to all DOE contractors and subcontractors performing work that involves management of waste containing radioactivity. This Order requires that wastes be managed in a manner that assures protection of the health and safety of the public, operating personnel, and the environment. The DOE Order 5820.2A establishes requirements for management of high-level, transuranic, and low-level wastes as well as wastes containing naturally occurring or accelerator produced radioactive material, and for decommissioning of facilities. The requirements applicable to the T Plant Aggregate Area remediation activities include those related to transuranic waste and low-level radioactive waste. These are summarized below.

6.5.4.2.1 Management of Transuranic Waste. Transuranic waste resulting from the T Plant Aggregate Area remedial action must be managed to protect the public and worker health and safety, and the environment, and performed in compliance with applicable radiation protection standards and environmental regulations. Practical and cost-effective methods must be used to reduce the volume and toxicity of transuranic (TRU) waste.

Transuranic waste must be certified in compliance with the Waste Isolation Pilot Plant (WIPP) Acceptance Criteria, placed in interim storage, if required, and sent to the WIPP. Any transuranic waste that the DOE has determined, with the concurrence of the EPA Administrator, does not need the degree of isolation provided by a geologic repository or transuranic waste that cannot be certified or otherwise approved for acceptance at the WIPP must be disposed of by alternative methods. Alternative disposal methods must be approved by DOE Headquarters and comply with NEPA requirements and EPA/state regulations.

6.5.4.2.2 Management of Low-Level Radioactive Waste. The requirements for management of low-level radioactive waste presented in DOE Order 5820.2A are relevant to the remedial alternative of removal and disposal of T Plant Aggregate Area wastes. Performance objectives for this option shall ensure that external exposure to the radioactive material released into surface water, groundwater, soil, plants, and animals does not result in an effective dose greater than 25 mrem/yr to the public. Releases to the environment shall be at levels as low as reasonably achievable. An inadvertent intruder after the institutional control period of 100 years is not to exceed 100 mrem/yr for continuous exposure or 500 mrem for a single acute exposure. A performance assessment is to be prepared to demonstrate compliance with the above performance objectives.

Other requirements under DOE Order 5820.2A which may affect remediation of the T Plant Aggregate Area include waste volume minimization, waste characterization, waste acceptance criteria, waste treatment, and shipment. The low-level radioactive waste may be stored by appropriate methods prior to disposal to achieve the performance objectives discussed above. Disposal site selection, closure/post-closure, and monitoring requirements are also discussed in this Order.

6.6 POINT OF APPLICABILITY

A significant factor in the evaluation of remedial alternatives for the T Plant Aggregate Area will be the determination of the point at which compliance with identified ARARs must be achieved (i.e., the point of a specific ARAR's applicability). These points of applicability are the boundaries at which the effectiveness of a particular remedial alternative will be assessed.

For most individual radioactive species transported by either water or air, Ecology and Health standards generally require compliance at the boundaries of the Hanford Site (e.g. Clear Air Act, Section 6.2.1.4). The assumed point of compliance for radioactive species is the point where a member of the public would have unrestricted access to live and conduct business, and, consequently, to be maximally exposed. Although Health is responsible for monitoring and enforcing the air standards promulgated by Ecology, and generally recognizes the site boundary as the point of applicability, Ecology has recently indicated that compliance may be required at the point of emission.

The point at which compliance with identified ARARs must be achieved will be a significant factor in evaluating appropriate remedial alternatives in the T Plant Aggregate Area. Applicability of ARARs at the point of discharge, at the boundary of the disposal unit, at the boundary of the AAMS, at the boundary of the Hanford Site, and/or at the point of maximum exposure will need to be determined.

6.7 ARARs EVALUATION

Evaluation of ARARs is an iterative process that will be conducted at multiple points throughout the remedial process:

- When the public health evaluation is conducted to assess risks at the T Plant Aggregate Area, the contaminant-specific ARARs and advisories and location-specific ARARs will be identified more comprehensively and used to help determine the cleanup goals; and

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

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

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

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

- Compliance is technically impracticable.

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

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

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

Table 6-1. Potential Contaminant-Specific ARARs and TBCs for Preliminary Inorganic and Organic Contaminants of Concern.

	RCRA TCLP Designation Limits	RCRA Land Ban Limits Nonwastewater		MTCA Method A Cleanup Levels Industrial Soil	WCAA Toxic Air Pollutants ASIL	RCRA Corrective Action Levels (Proposed) (1)	
INORGANIC CHEMICALS	(mg/L)	CCWE (mg/L)	CCW (mg/kg)	(mg/kg)	($\mu g/m^3$)	Air ($\mu g/m^3$)	Soil (mg/kg)
Arsenic	5	5.0	—	200	—	.00007	.80
Barium	100	100	—	—	—	—	—
Boron	—	—	—	—	—	—	—
Cadmium	1.0	1.0	—	10	.00056	.0006	40
Chromium	5.0	5.0	—	500	.000083	.00009	40
Copper	—	—	—	—	3.3	—	—
Cyanide (total)	—	—	590	—	—	—	—
Fluoride	—	—	—	—	8.3	—	—
Lead	5	5.0	—	1,000	—	—	—
Manganese	—	—	—	—	—	—	—
Mercury	.2	.20 (low-level)	—	1	—	—	20
Nickel	—	134	—	—	—	—	2000
Nitrite	—	—	—	—	—	—	—
Vanadium	—	—	—	—	—	—	—
Zinc	—	—	—	—	—	—	—
ORGANIC CHEMICALS							
Acetone	—	160	.59	—	5927.4	—	8000
Carbon Tetrachloride	.5	5.6	.96	—	.12	.03	5
Chloroform	6	5.6	—	—	.043	.04	100
Methylene chloride	—	33	.96	.5	2.0	.3	90
MIBK ("Hexone")	—	33	.33	—	682.7	70	4000
Toluene	—	28	33	40	1248.8	—	20,000

ASIL = Acceptable Source Impact Level
CCWE = Constituent Concentration in Waste Extract
CCW = Constituent Concentration in Waste
MTCA = Washington State Model Toxics Control Act
RCRA = Federal Resource Conservation and Recovery Act
TCLP = Toxic Characteristic Leaching Procedure
WCAA = Washington State Clean Air Act

mg/L = milligrams per liter
mg/kg = milligrams per kilogram
$\mu g/m^3$ = micrograms per cubic meter

(1) RCRA Corrective Action Levels are only proposed at this time (40 CFR Part 264 Subpart S), so are not ARARs yet; they are "To Be Considered."

Table 6-2. Potential Location-Specific ARARs. (Sheet 1 of 7)

Location	Requirement	Prerequisite	Citation	ARAR
GEOLOGICAL:				
Within 200 feet of a fault displaced in Holocene time.	New treatment, storage or disposal of hazardous waste prohibited.	Hazardous waste management near Holocene fault.	40 CFR 264.18; WAC 173-303-420	Not ARAR. No Holocene fault.
Holocene faults and subsidence areas.	New solid waste disposal facilities prohibited over faults with displacement in Holocene time, and in subsidence areas.	New solid waste management activities near Holocene fault.	WAC 173-304-130	Not ARAR. No Holocene fault.
Unstable slopes.	New solid waste disposal areas prohibited from hills with unstable slopes.	New solid waste disposal on an unstable slope.	WAC 173-304-130	Not ARAR. No unstable slope.
100-year floodplains.	Solid and hazardous waste disposal facilities must be designed, built, operated, and maintained to prevent washout.	Solid or hazardous waste disposal in a 100-year floodplain.	40 CFR 264.18; WAC 173-303-420; WAC 173-304-460	Potential ARAR.
	Avoid adverse effects, minimize potential harm, restore/preserve natural and beneficial values in floodplains.	Actions occurring in a floodplain.	40 CFR Part 6 Subpart A; 16 USC 661 et seq; 40 CFR 6.302	Potential ARAR.
Salt dome and salt bed formations, underground mines, and caves.	Placement of non-containerized or bulk liquid hazardous wastes is prohibited.	Hazardous waste placement in salt dome, salt bed, mine, or cave.	40 CFR 264.18	Not ARAR. None of these units.

Table 6-2. Potential Location-Specific ARARs. (Sheet 2 of 7)

Location	Requirement	Prerequisite	Citation	ARAR
SURFACE WATER:				
Wetlands.	New hazardous waste disposal facilities prohibited in wetlands (including within 200 feet of shoreline).	Hazardous waste disposal within 200 feet of surface water.	WAC 173-303-420	Potential ARAR.
	New solid waste disposal facilities prohibited within 200 feet of surface water (stream, lake, pond, river, salt water body).	Solid waste disposal within 200 feet of surface water.	WAC 173-304-130	Potential ARAR.
	New solid waste disposal facilities prohibited in wetlands (swamps, marshes, bogs, estuaries, and similar areas).	Solid waste disposal in a wetland (swamp, marsh, bog, estuary, etc.).	WAC 173-304-130	Not ARAR. No wetlands present.
	Discharge of dredged or fill materials into wetlands prohibited without a permit.	Discharges to wetlands and navigable waters.	40 CFR Part 230; 33 CFR Parts 303, and 320 to 330	Potential ARAR.
	Minimize potential harm, avoid adverse effects, preserve and enhance wetlands.	Construction or management of property in wetlands.	40 CFR Part 6 Appendix A	Not ARAR. No wetlands present.
Shorelines.	Actions prohibited within 200 feet of shorelines of statewide significance unless permitted.	Actions near shorelines.	Chapter 90.58 RCW; Chapter 173-14 WAC.	Potential ARAR.
Rivers and streams.	Avoid diversion, channeling or other actions that modify streams or rivers, or adversely affect fish or wildlife habitats and water resources.	Actions modifying a stream or river and affecting fish or wildlife.	40 CFR 6.302	Potential ARAR.

Table 6-2. Potential Location-Specific ARARs. (Sheet 3 of 7)

Location	Requirement	Prerequisite	Citation	ARAR
GROUNDWATER:				
Sole source aquifer.	New solid and hazardous waste land disposal facilities prohibited over a sole source aquifer.	Disposal over a sole source aquifer.	WAC 173-303-402; WAC 173-304-130	Not ARAR. No sole source aquifer.
Uppermost aquifer.	Bottom of lowest liner of new solid waste disposal facility must be at least 10 feet above seasonal high water in uppermost aquifer (5 feet if hydraulic gradient controls installed).	New solid waste disposal.	WAC 173-304-130	Not ARAR. Groundwater is deeper than 10 feet.
Aquifer Protection Areas.	Activities restricted within designated Aquifer Protection Areas.	Activities within an Aquifer Protection Area.	Chapter 36.36 RCW.	Not ARAR. Not an Aquifer Protection Area.
Groundwater Management Areas.	Activities restricted within Ground Water Management Areas.	Activities within a Groundwater Management Area.	Chapter 90.44 RCW; Chapter 173-100 WAC	Not ARAR. Not a Groundwater Management Area.

Table 6-2. Potential Location-Specific ARARs. (Sheet 4 of 7)

Location	Requirement	Prerequisite	Citation	ARAR
DRINKING WATER SUPPLY:				
Drinking water supply well.	New solid waste disposal areas prohibited within 1,000 feet upgradient, or 90 days travel time, of drinking water supply well.	New solid waste disposal within 1,000 feet of drinking water supply well.	WAC 173-304-130	Not ARAR. No drinking water supply wells.
Watershed.	New solid waste disposal areas prohibited within a watershed used by a public water supply system for municipal drinking water.	New solid waste disposal in a public watershed.	WAC 173-304-130	Not ARAR. Not a public watershed.
AIR:				
Non-attainment areas.	Restrictions on air emissions in areas designated as non-attainment areas under state and federal air quality programs.	Activities in a designated non-attainment area.	Chapter 70.94 RCW; Chapters 173-400 and 173-403 WAC.	Not ARAR. Not a non-attainment area.
SENSITIVE ENVIRONMENTS:				
Endangered/threatened species habitats.	New solid waste disposal prohibited from areas designated by US Fish and Wildlife Service as critical habitats for endangered/ threatened species.	New solid waste disposal in critical habitats.	WAC 173-304-130	Not ARAR. Not a critical habitat.
	Actions within critical habitats must conserve endangered/threatened species.	Activities where endangered or threatened species exist.	50 CFR Parts 200 and 402.	Potential ARAR.

Table 6-2. Potential Location-Specific ARARs. (Sheet 5 of 7)

Location	Requirement	Prerequisite	Citation	ARAR
Parks.	No new solid waste disposal areas within 1,000 feet of state or national park.	New solid waste disposal near state/national park.	WAC 173-304-130	Not ARAR. No state/national park.
	Restrictions on activities in areas that are designated state parks, or recreation/ conservation areas.	Activities in state parks or recreation/conservation areas.	Chapter 43.51 RCW; Chapter 352.32 WAC	Not ARAR. None of these state areas.
Wilderness areas.	Actions within designated wilderness areas must ensure area is preserved and not impaired.	Activities within designated wilderness areas.	16 USC 1131 et seq; 50 CFR 35.1 et seq	Not ARAR. Not a wilderness area.
Wildlife refuge.	Restrictions on actions in areas that are part of the National Wildlife Refuge System.	Activities within designated wildlife refuges.	16 USC 668dd et seq; 50 CFR Part 27	Not ARAR. Not a wildlife refuge.
Natural areas preserves.	Activities restricted in areas designated as having special habitat value (Natural Heritage Resources).	Activities within identified Natural Area Preserves.	Chapter 79.70 RCW; Chapter 332-650 WAC	Not ARAR. Not a Natural Area Preserve.
Wild, scenic, or recreational rivers.	Avoid actions that would have adverse effects on designated wild, scenic, or recreational rivers.	Activities near wild, scenic, and recreational rivers.	16 USC 1271 et seq; 40 CFR 6.302; Chapter 79.72 RCW	Potential ARAR.
Columbia River Gorge	Restrictions on activities that could affect resources in the Columbia River Gorge.	Activities within the Columbia River Gorge.	Chapter 43.97 RCW	Not ARAR. Not in Columbia River Gorge.

Table 6-2. Potential Location-Specific ARARs. (Sheet 6 of 7)

Location	Requirement	Prerequisite	Citation	ARAR
UNIQUE LANDS AND PROPERTIES:				
Natural resource conservation areas.	Restrictions on activities within designated Conservation Areas.	Activities within designated Conservation Areas.	Chapter 79.71 RCW	Not ARAR. Not a Conservation Area.
Forest lands.	Activities restricted within state forest lands to minimize fire hazards and other adverse impacts.	Activities within state forest lands.	Chapter 76.04 RCW; Chapter 332-24 WAC	Not ARAR. Not a forest land.
	Restrictions on activities in state and federal forest lands.	Activities within state and federal forest lands.	16 USC 1601; Chapter 76.09 RCW	Not ARAR. Not a forest land.
Public lands.	Activities on public lands are restricted, regulated, or proscribed.	Activities on state-owned lands	Chapter 79.01 RCW	Not ARAR. Not a state land.
Scenic vistas.	Restrictions on activities that can occur in designated scenic areas.	Activities in designated scenic vista areas.	Chapter 47.42 RCW	Not ARAR. Not a scenic area.
Historic areas.	Actions must be taken to preserve and recover significant artifacts, preserve historic and archaeologic properties and resources, and minimize harm to national landmarks.	Activities that could affect historic or archaeologic sites or artifacts.	16 UST 469, 470 et seq; 36 CFR Parts 65 and 800; Chapters 27.34, 27.53, and 27.58 RCW.	Not ARAR. No historic or archaeologic sites.

Table 6-2. Potential Location-Specific ARARs. (Sheet 7 of 7)

Location	Requirement	Prerequisite	Citation	ARAR
LAND USE:				
Neighboring properties.	No new solid waste disposal areas within 100 feet of the facility's property line.	New solid waste disposal within 100 feet of facility property line.	WAC 173-304-130	Not ARAR. Not near facility boundary.
	No new solid waste disposal areas within 250 feet of property line of residential zone properties.	New solid waste disposal within 250 feet of property line of residential property.	WAC 173-304-130	Not ARAR. No residential property near.
Proximity to airports.	Disposal of garbage that could attract birds prohibited within 10,000 feet (turbojet aircraft)/5,000 feet (piston-type aircraft) of airport runways.	Garbage disposal near airport.	WAC 173-304-130	Not ARAR. No airports near.

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7.0 PRELIMINARY REMEDIAL ACTION TECHNOLOGIES

Previous sections identified contaminants of concern at the T Plant Aggregate Area, potential routes of exposure, and potentially applicable or relevant and appropriate requirements (ARARs). Section 7.0 identifies preliminary remedial action objectives (RAOs) and develops preliminary remedial action alternatives consistent with reducing the potential hazards of this contamination and satisfying ARARs. The overall objective of this section is to identify viable and innovative remedial action alternatives for media of concern at the T Plant Aggregate Area.

The process of identifying viable remedial action alternatives consists of several steps. In Section 7.1, RAOs are first identified. Next, in Section 7.2, general response actions are determined along with specific treatment, resource recovery, and containment technologies within the general response categories. Specific process options belonging to each technology type are identified, and these process options are subsequently screened based on their effectiveness, implementability, and cost (Section 7.3). The combining of process options into alternatives occurs in Section 7.4. Here the alternatives are described and diagrammed. Criteria are then identified in Section 7.5 for preliminary screening of alternatives that may be applicable to the waste management units and unplanned release sites identified in the T Plant Aggregate Area. Figure 7-1 is a matrix summarizing the development of the remedial action alternatives starting with media-specific RAOs.

Because of uncertainty regarding the nature and extent of contamination at the T Plant Aggregate Area waste sites, recommendations for remedial alternatives are general and cover a broad range of actions. Remedial action alternatives will be considered and more fully developed in future focused feasibility studies. The *Hanford Site Past-Practice Strategy* (DOE/RL 1992) is used to focus the range of remedial action alternatives that will be evaluated in focused studies. In general, the *Hanford Site Past-Practice Strategy* remedial investigation (RI)/feasibility study (FS) and the Resource Conservation and Recovery Act (RCRA)/Corrective Measures Studies are defined as the combination of interim remedial measures (IRMs), limited field investigations (LFIs) for final remedy selection where interim actions are not clearly justified, and focused or aggregate area feasibility/treatability studies for further evaluation of treatment alternatives. After completion of an IRM, data will be evaluated including concurrent characterization and monitoring data to determine if a final remedy can be selected.

A secondary purpose of the evaluation of preliminary remedial action alternatives is the identification of additional information needed to complete the evaluation. This information may include field data needs and treatability tests of selected technologies. Additional data will be developed for most sites or waste groups during future data gathering activities (e.g., LFIs, characterization supporting IRM, or treatability studies). These data may be used to refine and supplement the RAOs and proposed alternatives identified in this initial study. Data needs are defined in Section 8.0. Alternatives involving technologies that are not

well-demonstrated under the conditions of interest are identified in Sections 7.3 and 7.5. These technologies may require bench-scale and pilot-scale treatability studies. The intent is to conduct treatability studies for promising technologies early in the RI/FS process. Conclusions regarding the feasibility of some individual technologies may change after new data become available.

The bias-for-action philosophy of addressing contamination at the Hanford Site requires an expedited process for implementing remedial actions. Implementation of general response actions may be accomplished using an observational or approach in which the implementation is redirected as information is obtained. This observational approach is an iterative process of data acquisition and refinement of the conceptual model. Data needs are determined by the model, and data collected to fulfill these needs are used as additional input to the model. Use of the observational approach while conducting response actions in the 200 Areas will allow integrating these actions with longer range objectives of final remediation of similar areas and the entire 200 Areas. Site characterization and remediation data will be collected concurrently with the use of LFIs, IRMs, and treatability testing. The knowledge gained through these different activities will be applied to similar areas. The overall goal of this approach is convergence on an appropriate response action as early as possible while continuing to obtain valuable characterization information during remediation phases.

7.1 PRELIMINARY REMEDIAL ACTION OBJECTIVES

The RAOs are remediation goals for protection of human health and the environment that specify the contaminants and media of concern, exposure pathways, and allowable contaminant levels. The RAOs discussed in this section are considered to be preliminary and may change or be refined as new data are acquired and evaluated.

The fundamental objective of the corrective action process at the T Plant Aggregate Area is to protect environmental resources and/or human receptors from the potential threats that may exist because of known or suspected contamination. Specific interim and final RAOs will depend in part on current and reasonable potential future land use in the T Plant Aggregate Area and the 200 Areas. RAOs also taken into account the preference under CERCLA for isolation, permanent treatment or significant reduction of volume, toxicity or mobility of hazardous substances.

Potential future land use will affect the risk-based cleanup objectives, potential ARARs, and point of compliance. The RAOs for protecting human health would be based on risk assessment exposure scenarios. It is important that potential future land use and the RAOs be clearly defined and agreed upon by the U. S. Department of Energy (DOE), U. S. Environmental Protection Agency (EPA), and Washington State Department of Ecology (Ecology) before further and more detailed evaluation of remedial actions. The Hanford Site remedial Action Environmental Impact Statement is intended to resolve the land use issues. A Record of Decision for this environmental impact statement is expected in the spring of 1994.

To focus the corrective actions with a bias for action through implementing IRMs, preliminary RAOs are identified for the 200 Areas and T Plant Aggregate Area. The overall objective for the 200 Areas is as follows:

> Reduce the risk of harmful effects to the environment and human users of the area by isolating or permanently reducing the toxicity, mobility, or volume of contaminants from the source areas to meet ARARs or risk-based levels that will allow industrial use of the area (this is a potential final RAO, and an interim action objective based on current use of the 200 Area).

The RAOs are further developed in Table 7-1 for media of concern and applicable exposure pathways (see Sections 4.1 and 4.2) for the T Plant Aggregate Area. The media of concern for the T Plant Aggregate Area include the following:

- Radionuclide- and chemically-contaminated soils that could result in direct exposure or inhalation of soil particles
- Contaminated soils that are or could contribute to groundwater contamination
- Vadose zone vapors that could cause ambient air impacts or contribute to the lateral and vertical migration of contaminants in the soil and to the groundwater
- Biota that could mobilize radionuclides or chemical contaminants and could thereby degrade the integrity of other controls, such as caps.

Waste materials currently stored in single-shell tanks (SSTs) that contribute or may contribute contaminants to environmental media will not be addressed by this aggregate area management study (AAMS) program but rather by the SST program. In addition, groundwater as an exposure medium is not addressed in this source AAMS report but will be addressed in the 200 West Groundwater AAMS report.

7.2 PRELIMINARY GENERAL RESPONSE ACTIONS

General response actions represent broad classes of remedial measures that may be appropriate to achieve both interim and final RAOs at the T Plant Aggregate Area, and are presented in Table 7-2. The following are the general response actions followed by a brief description for the T Plant Aggregate Area:

- No action (applicable to specific facilities)
- Institutional controls

- Waste removal and treatment or disposal
- Waste containment
- In situ waste treatment
- Combinations of the above actions.

These general response actions are intended to cover the range of options from no action to complete remediation. Included are options that satisfy the CERCLA preference for isolation and permanent or significant reduction in volume, mobility, and toxicity of hazardous substances.

No action is included for evaluations as required by the National Environmental Policy Act and National Contingency Plan [40 CFR 300.68 (f)(l)(v)] to provide a baseline for comparison with other response actions. The no action alternative may be appropriate for some facilities and sources of contamination if risk assessments determine acceptable natural resource or human health risks posed by those sources or facilities and no exceedances of contaminant-specific ARARs occur.

Institutional controls involve the use of physical barriers or access restrictions to reduce or eliminate public exposure to contamination. Many access and land use restrictions are currently in place at the Hanford Site and will remain in place during implementation of remedial actions. Because the 200 Areas are already committed to waste management for long term, institutional controls will also be important for final remedial measures alternatives.

Waste removal and treatment or disposal involves excavation of contamination sources for eventual treatment and/or disposal either on a small- or large-scale basis. One approach being considered for large-scale waste removal is macro-engineering, which is based on high volume excavation using conventional surface mining technologies. Waste removal on a macro-engineering scale would be used over large areas such as groups of waste management units, operable units, or operational areas as a final remedial action. Waste removal on a small scale would be conducted for individual waste management units on a selective basis. Small-scale waste removal could be conducted as either an interim or final remedial action. One potential problem with off-site disposal is the lack of an alternate disposal location that will decrease the potential human exposure over the long time required for many of the contaminants. Waste removal actions may not be needed, or only be required on a small scale, to protect human health or the environment for industrial uses of the 200 Areas.

Waste treatment involves the use of biological, thermal, physical, or chemical technologies. Typical treatment options includes biological land farming, thermal processing, soil washing, and fixation/solidification/stabilization. Some treatment technologies may be pilot tested at the highest priority facilities. Waste treatment could be conducted either as an

interim or final action and may be appropriate in meeting RAOs for all potential future land uses.

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

In situ waste treatment includes thermal, chemical, physical, and biological technology types, of which there are several specific process options including in situ vitrification, in situ grouting or stabilization, soil flushing, and in situ biotreatment. The distinguishing feature of in situ treatment technologies is the ability to attain RAOs without removing the wastes. The final waste form generally remains in place. This feature is advantageous when exposure during excavation would be significant or when excavation is technically impractical. In situ treatment can be difficult because the process conditions may not be easily controlled.

In the next section, specific process options within these technology groups are evaluated.

7.3 TECHNOLOGY SCREENING

In this section, potentially applicable technology types and process options are identified. These process options are then screened using effectiveness, implementability, and relative cost as criteria to eliminate those process options that would not be feasible at the site. The remaining applicable processes are then grouped into remedial alternatives in Sections 7.4.

The effectiveness criterion focuses on: (1) the potential effectiveness of process options in handling the areas or volumes of media and meeting the remedial action objectives, (2) the potential impacts to human health and the environment during the construction and implementation phase, and (3) how proven and reliable the process is with respect to the contaminants and conditions at the site. This criteria also concentrates on the ability of a process option to treat a contaminant type (organics, inorganics, metals, radionuclides, etc.) rather than a specific contaminant (nitrate, cyanide, chromium, plutonium, etc.).

The implementability criterion places greater emphasis on the institutional aspects of implementability, such as the ability to obtain necessary permits for offsite actions, the availability of treatment, storage, and disposal services, and the availability of necessary equipment and skilled workers to implement the technology. It also focuses on the process option's developmental status, whether it is an experimental or established technology.

The relative cost criterion is an estimate of the overall cost of a process, including capital and operating costs. At this stage in the process, the cost analysis is made on the basis of engineering judgement, and each process is evaluated as to whether costs are high, medium, or low relative to other process options.

A process option is rated effective if it can handle the amount of area or media required, if it does not impact human health or the environment during the construction and implementation phases, and if it is a proven or reliable process with respect to the contaminants and conditions at the site. Also a process option is considered more effective if it treats a wide range of contaminants rather than a specific contaminant. An example of a very effective process option would be vitrification because it treats inorganics, metals, and radionuclides. On the other hand, chemical reduction may only treat chromium (VI), making it a less useful option.

An easily implemented process option is one that is an established technology, uses readily available equipment and skilled workers, uses treatment, storage, and disposal services that are readily available, and has few regulatory constraints. Preference is given to technologies that are easily implemented.

Preference is given to lower cost options, but cost is not an exclusionary criterion. A process option is not eliminated based on cost alone.

Results of the screening process are shown in Table 7-3. Brief descriptions are given of the process options, followed by comments regarding the evaluation criteria. The last column of the table indicates whether the process option is rejected or carried forward for possible alternative formation. The table first lists technologies that address soil RAOs. Next, technologies pertaining to biota RAOs are presented. All the biota-specific technologies happen to be technologies that were listed for soil RAOs. Air RAOs are dealt with as soil remediation issues because the air contamination is a result of the contaminants in the soil: addressing and remediating the air pathways would be unnecessary and ineffective as long as there is soil contamination. If the soil is remediated, the source of the air contamination would be removed.

The conclusions column of Table 7-3 indicates that besides no action, monitoring, 3 institutional process options, and 16 other process options are retained for further development of alternatives. These options are carried forward into the development of preliminary alternatives.

7.4 PRELIMINARY REMEDIAL ACTION ALTERNATIVES

This section develops and describes several remedial alternatives considered applicable to disposal sites that contain hazardous chemicals, radionuclides, and volatile organic compounds (VOCs). These alternatives are not intended as recommended actions for any

individual site, but are intended only to provide potential options applicable to most sites where multiple contaminants are present. Selection of actual remedial alternatives that should be applied to the individual sites would be partly based on future expedited or interim actions and LFIs, as recommended in Section 9.0 of this report. Selection of proper alternatives would be conducted within the framework of the *Hanford Site Past-Practice Strategy* (DOE/RL 1992) and the strategy outlined in Section 9.4. The selection process would also be based on a preference for isolation and permanent treatment.

The remedial alternatives are developed in Section 7.4.1. Then, in Section 7.4.2 through Section 7.4.7, the remedial action alternatives are described. Detailed evaluations and costs are not provided because site-specific conditions must be further investigated before meaningful evaluations could be conducted.

7.4.1 Development of Remedial Alternatives

Potentially feasible remedial technologies were described and evaluated in Section 7.3. Some of those technologies have been proven to be effective and constructible at industrial waste sites, while other technologies are in the developmental stages. EPA guidance on feasibility studies for uncontrolled waste management units recommends that a limited number of candidate technologies be grouped into "Remedial Alternatives." For this study, technologies were combined to develop remedial alternatives and provide at least one alternative for each of the following general strategies:

- No action
- Institutional controls
- Removal, aboveground treatment, and disposal
- Containment
- In situ treatment.

The alternatives are intended to treat all or a major component of the T Plant Aggregate Area contaminated waste management units or unplanned release. Consistent with the development of RAOs and technologies, alternatives were developed based on treating classes of compounds (radionuclides, heavy metals, inorganics, and organics) rather than specific contaminants. At a minimum, the alternative must be a complete package. For example, disposal of radionuclide-contaminated soil must be combined with excavation and backfilling of the excavated site.

One important factor in the development of the preliminary remedial action alternatives is the fact that radionuclides, heavy metals, and some inorganic compounds cannot be

destroyed. Rather, these compounds must be physically immobilized, contained, isolated, or chemically converted to less mobile forms to satisfy RAOs. Organic compounds can be destroyed, but may represent a small amount of the overall contamination at the T Plant Aggregate Area. Both no action and institutional controls are required as part of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) RI/FS guidance. The purpose of including both of these alternatives is to provide decision makers with information on the entire range of available remedial actions.

For the containment alternative, an engineered multimedia cover, with or without vertical barriers (depending on the specifics of the remediation) was selected. Two alternatives were selected to represent the excavation and treatment strategy. One of these deals with disposal of transuranic (TRU) contaminated soils. Finally, three in-situ alternatives were identified. One deals with vapor extraction for VOCs, one with stabilization of soils, and the other with vitrification of soils.

It is recognized that this does not represent an exhaustive list of all applicable alternatives. However, these do provide a reasonable range of remedial actions that are likely to be evaluated in future feasibility studies. The remedial action alternatives are summarized as follows:

- No action
- Institutional controls
- Engineered multimedia cover with or without vertical barriers (containment)
- In situ grouting or stabilization of soil (in situ treatment)
- Excavation, aboveground treatment, and disposal of soil (removal, treatment and disposal)
- In situ vitrification of soil (in situ treatment)
- Excavation, treatment, and geologic disposal of soil with TRU radionuclides (removal, treatment and disposal)
- In situ soil vapor extraction of VOCs (in situ treatment).

These alternatives, with the exception of no action and institutional controls, were developed because they satisfy a number of RAOs simultaneously and use technologies that are appropriate for a wide range of contaminant types. For example, constructing an engineered multimedia cover can effectively contain radionuclides, heavy metals, inorganic compounds, and organic compounds simultaneously. It satisfies the RAOs of protecting human health and the environment from exposures from contaminated soil, bio-mobilization,

and airborne contaminants. In situ soil vapor extraction is more contaminant-specific than the other alternatives, but it addresses a contaminant class (VOCs) that is not easily treated using the other options, such as in situ stabilization. It is possible that some waste management units may require a combination of the identified alternatives to completely address all contaminants.

The use of contaminant-specific remedial technologies was avoided because there appear to be few, if any, waste management units where a single contaminant has been identified. It is possible to construct alternatives that include several contaminant-specific technologies, but the number of combinations of technologies would result in an unmanageable number of alternatives. Moreover, the possible presence of unidentified contaminants may render specific alternatives unusable. Alternatives may be refined as more contamination data are acquired. For now, the alternatives will be directed at remediating the major classes of compounds (radionuclides, heavy metals, inorganics, and organics).

In all alternatives except the no-action alternative, it is assumed that monitoring and institutional controls are required, although they may be temporary. These features are not explicitly mentioned, and details are purposely omitted until a more detailed evaluation may be performed in subsequent studies. Also, treatability studies may accompany many of the alternatives during implementation.

In the next sections, the preliminary remedial action alternatives are described in more detail, with the exception of the no-action and institutional control options.

7.4.2 Alternative 1 - Engineered Multimedia Cover with or without Vertical Barriers

Alternative 1 consists of an engineered multimedia cover. Vertical barriers such as grout curtains or slurry walls may be used in conjunction with the cover. Figure 7-2 shows a schematic diagram of an engineered multimedia cover without the vertical barriers. If the affected area includes either a naturally-occurring or engineered depression, then imported backfill would be placed to control runoff and run-on water. The engineered cover itself may consist of clay, gravel, sand, asphalt, soil, and synthetic liners. A liquid collection layer could also be included. The specific design of the cover and vertical barriers would be the subject of a focused feasibility study that may be supported by treatability studies and performance testing. The barrier would be designed to minimize infiltration of surface water by enhancing evapotranspiration from plants. The covered area would be fenced, and warning signs posted.

Alternative 1 would provide a permanent cover over the affected area. The cover would accomplish the following: minimize or eliminate the migration of precipitation into the affected soil; reduce the migration of windblown dust that originated from contaminated surface soils; reduce the potential for direct exposure to contaminated soils; and reduce the

volatilization of VOCs and tritium to the atmosphere. If vertical barriers are included, they would limit the amount of lateral migration of contaminants.

7.4.3 Alternative 2 - In Situ Grouting or Stabilization of Soil

Radioactive and hazardous soil would be grouted in this alternative using in situ injection methods to significantly reduce the leachability of hazardous contaminants, radionuclides and/or VOCs from the affected soil. Grouting may also be used to fill voids, such as in cribs, thereby reducing subsidence. Another variation of this alternative would be to stabilize the soil using in situ mixing of soil with stabilizing compounds such as pozzolanics or fly ash.

Figure 7-3 shows a schematic diagram of the in situ grout injection process. Grouting wells would be installed and screened throughout the affected vertical zones. Specially formulated cement grout (determined by treatability studies) would be injected and allowed to cure. In situ stabilization would be conducted in a similar manner, except a cutting-head tool would be used to mix the contaminated soil with stabilizing compounds fed into the soil.

Alternative 2 would provide a combination of immobilization and containment of heavy metal, radionuclide, and inorganic contamination. Thus, this alternative would reduce migration of precipitation into the affected soil; reduce the migration of windblown dust that originated from contaminated surface soils; reduce the potential for direct exposure to contaminated soils; and reduce the volatilization of VOCs.

7.4.4 Alternative 3 - Excavation, Soil Treatment, and Disposal

Under Alternative 3, radioactive and hazardous soil would be excavated using conventional techniques, with special precautions to minimize fugitive dust generation. It was also assumed that sheet pile shoring would be installed to facilitate the excavation. The soil would be treated above ground. Several treatment options could be selected from the physical, chemical, and thermal treatment process options screened in Section 7.3. For example, thermal desorption with offgas treatment could be used if organic compounds are present; soil washing could be used to remove contaminated silts and sands or specific compounds; and stabilization could be used to immobilize radionuclides and heavy metals. The specific treatment method would depend on site-specific conditions. Treatability tests would be performed to determine the specific soil treatment protocols. The treated soil would be backfilled into the original excavation or landfilled. Soil treatment by-products may require additional processing or treatment. Figure 7-4 shows a schematic diagram of this alternative.

Alternative 3 would be effective in treating a full range of contamination, depending on the type of treatment processes selected. Attainment of soil RAOs would depend on the

depth to which the soil was excavated. If near surface soil was treated, airborne contamination, direct exposure to contaminated soil, and bio-mobilization of contamination would be minimized. Because of practical limits on deep excavation, deep contamination may not be removed and would be subject to migration into groundwater. Alternative 3 could be used in conjunction with Alternative 1 (multimedia cap) to reduce this possibility.

7.4.5 Alternative 4 - In Situ Vitrification of Soil

In this alternative, the contaminated soil in a subject site would be immobilized by in situ vitrification. Treatability tests would be performed initially to determine site-specific operating conditions. Figure 7-6 shows a schematic diagram of the alternative. Import fill would initially be placed over the affected area to reduce exposures to the remediation workers from surface contamination. High power electrodes would be used to vitrify the contaminated soil under the site, to a depth below where contamination is present. A large fume hood would be constructed over the site before the start of the vitrification process to collect and treat emissions. After completion of the vitrification, the site would be built back to original grade with imported backfill. Fences and warning signs may be placed around the vitrified monolith to minimize disturbance and potential exposure.

In situ vitrification would be effective in treating radionuclide, heavy metal, and inorganic contamination and may also destroy organic contaminants. This would reduce the potential for exposures by leaching to groundwater, windblown dust and direct dermal contact. However, this alternative would not reduce the mass or toxicity of the radionuclides present onsite. Also, in situ vitrification may be limited to depths of less than about 100 ft, which may not be adequate to immobilize deep contamination.

7.4.6 Alternative 5 - Excavation, Above-Ground Treatment, and Geologic Disposal of Soil with TRU Radionuclides

Figure 7-6 shows a schematic diagram of Alternative 5. Special excavation procedures would have to be used to minimize fugitive dust. Non-TRU "overburden" may have to be removed, temporarily stored, and returned to the excavation after the TRU soil was removed. Imported backfill would be used to restore the site to original grade. The excavated TRU soil would be vitrified or stabilized by an above-ground treatment plant. Treatability tests would be conducted to establish the treatment process. The vitrified or stabilized soil would then be shipped to a TRU waste repository. Long-term storage may be required until a suitable facility could be sited and constructed. An engineered multimedia cover (Alternative 1) could be installed over the completed site to reduce exposure to any remaining contaminated, non-TRU soils.

For Alternative 5, soil containing TRU radionuclides at concentrations exceeding 100 nCi/g would be excavated, treated, and disposed. Thus, potential exposure to and

migration of TRU-wastes would be minimized. Potential exposure to other contaminants would be determined by other remedial alternatives implemented. At sites containing TRU and non-TRU wastes, the use of Alternative 5 alone may not satisfy all RAOs.

7.4.7 Alternative 6 - In Situ Soil Vapor Extraction for VOCs

Figure 7-7 shows a schematic diagram of a representative soil vapor extraction system. The soil vapor extraction system would consist of venting wells, manifold piping, condensed water collectors, high efficiency particulate air (HEPA) filters, and a catalytic oxidizer. The condensed water might contain VOCs and radionuclides, so it may have to be disposed of as radioactive mixed waste. The vented air may contain radionuclide-containing dust particles, so HEPA filters would be installed to remove the particulate radionuclides. The vented vapors would be treated by the catalytic incinerator to provide at least 95% destruction. Because there are few sites in the T Plant Aggregate Area that contain VOCs, the potential use of soil vapor extraction in this Aggregate Area would limited.

In situ soil vapor extraction is a proven technology for removal of VOC from the vadose zone soils. Although some pilot scale testing may be needed at specific sites. Soil vapor extraction would reduce downward migration of the VOC vapors through the vadose zone, and thereby minimize potential cross-media migration into the groundwater. Soil vapor extraction would reduce upward migration of VOC through the soil column into the atmosphere, and thereby minimize inhalation exposures to the contaminants. In some cases the radionuclides were discharged to the disposal sites as aqueous wastewater that contained the radionuclides dissolved in carrier solutions consisting of surfactants and VOC (e.g., carbon tetrachloride). Removal of the VOC by implementing soil vapor extraction could reduce the mobility of the radionuclides, and thereby reduce the potential for downward migration of the radionuclides. Finally, soil vapor extraction would enhance partitioning of the VOC off of the soil and into the vented air stream, resulting in the permanent removal and destruction of the VOC. Alternative 6 may be used in conjunction with other alternatives if contaminants other than VOCs are present. However, because of the limited number of T Plant Sites that contain VOCs, the use of soil vapor extraction will not be extensive.

7.5 PRELIMINARY REMEDIAL ACTION ALTERNATIVES APPLICABLE TO WASTE MANAGEMENT UNITS AND UNPLANNED RELEASE SITES

The purpose of this section is to discuss which preliminary remedial action alternatives could be used to remediate each T Plant Aggregate Area waste management unit or unplanned release site. The criteria used for deciding this are as follows.

- Installing an engineered multimedia cover with or without vertical barriers (Alternative 1) could be used on any site where contaminants may be leached or

mobilized by surface water infiltration or if surface/near-surface contamination exists.

- In situ grouting or stabilization (Alternative 2) could be used on any waste management unit or unplanned release site that contain heavy metals, radionuclides, and/or other inorganic compounds. In situ grouting could also be effective in filling voids for subsidence control.

- Excavation and soil treatment (Alternative 3) could be used at most waste management units or unplanned release sites that contain radionuclides, heavy metals, other inorganics compounds, and/or semi-volatile organic compounds.

- In situ vitrification (Alternative 4) could be used at most waste management unit or unplanned release sites, although vapor extraction may be needed when VOCs are present. Waste management units or unplanned release sites where in situ vitrification may not be effective include reverse wells and other sites where the contamination is present in a very narrow geometry. In situ vitrification is also not considered for surface spills.

- Excavation, treatment, and geologic disposal of TRU-containing soils (Alternative 5) could be used only on those sites that contain TRU radionuclides. Since a geologic repository is likely to accept only TRU radioactive soils, the non-TRU radioactive soils will not be remediated using this alternative.

- In situ soil vapor extraction (Alternative 6) could be used on any waste management unit or unplanned release sites that contains volatile organic compounds. Such sites are not common in the T Plant Aggregate Area. Nonetheless the 5,300 L (1,400 gal) leak from 241-TY-104 Tank (UPR-200-W-151) in the T Plant Aggregate Area is an example of a site where soil vapor extraction may be an effective remedy. The waste types at this site include supernatant containing REDOX ion-exchange waste, PUREX organics wash waste, bismuth phosphate first cycle waste, tributylphosphate waste, and decontamination waste from 241-TX and -TY Tank Farms (WHC 1991a).

Using these criteria, Table 7-4 was created showing possible preliminary remedial action alternatives that could be used to remediate each of the waste management units and unplanned release sites. Each waste management unit or unplanned release site may require just one alternative or a combination of many alternatives. Furthermore, similar sites may be remediated simultaneously. Also, more specific waste treatment alternatives could be identified and evaluated as more information is obtained. Note that a single alternative may not be sufficient to remediate all contamination at a single site. For example, soil vapor extraction could precede in situ vitrification to remove organic contaminants. Also, different combinations of technologies are possible besides those presented in these preliminary

alternatives. Table 7-4 excludes sites that are covered by other programs. For example single-shell tanks are excluded because they are addressed by the single-shell tank program.

Technology development studies will be needed for the in situ vitrification process; and treatability studies will be needed for the in situ grouting or stabilization process and soil treatment processes to make sure that they will effectively remediate the contaminants. Specifically, organic waste mobility may be a problem for in situ vitrification; grouting agents and the resulting reduction of contaminant leachability will need to be determined before in situ grouting can be performed; and appropriate treatment protocols and systems will need to be identified before soil washing can be used. Capping, soil vapor extraction, and disposal options are all proven processes but may require site-specific performance assessment (treatability) studies.

Focused feasibility studies will be required to evaluate alternative designs for all of the alternatives evaluated, as they relate to the specific waste management unit being remediated. A site-by-site economic evaluation is also required before making a decision. This evaluation will require site-specific information obtained in LFIs and focused feasibility studies.

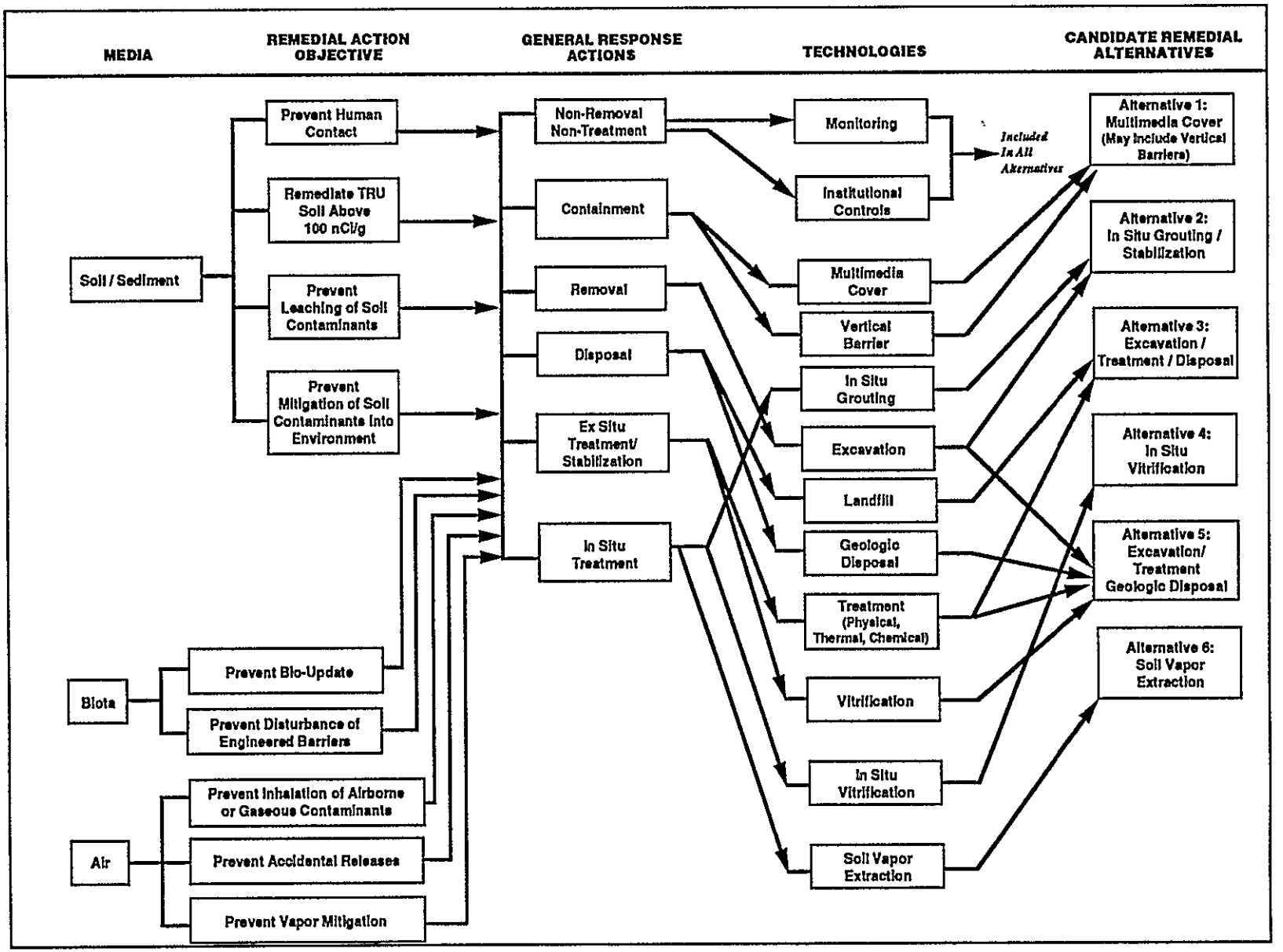

Figure 7-1. Development of Candidate Remedial Alternatives for T Plant Aggregate Area.

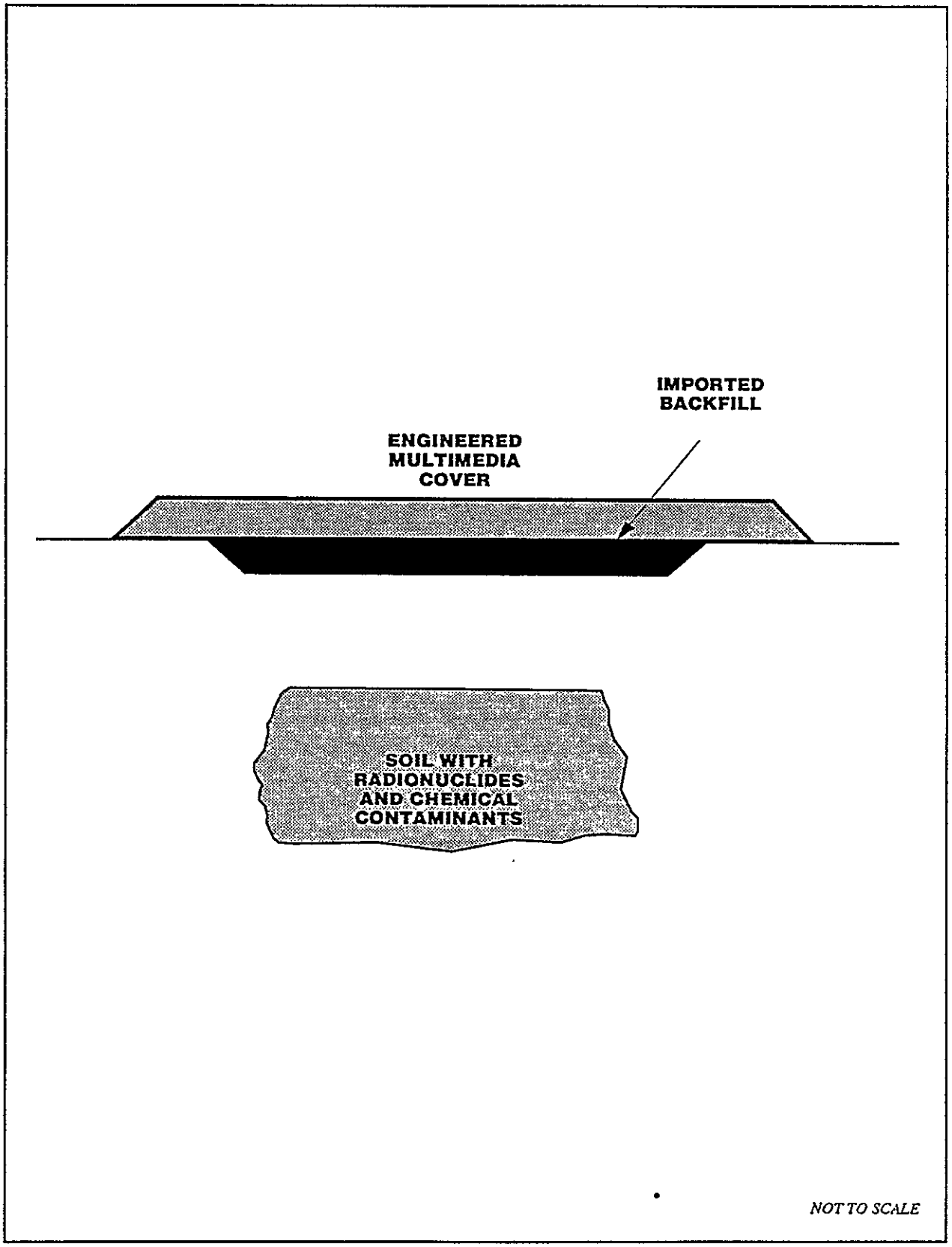

Figure 7-2. Alternative 1: Multi-Media Cover.

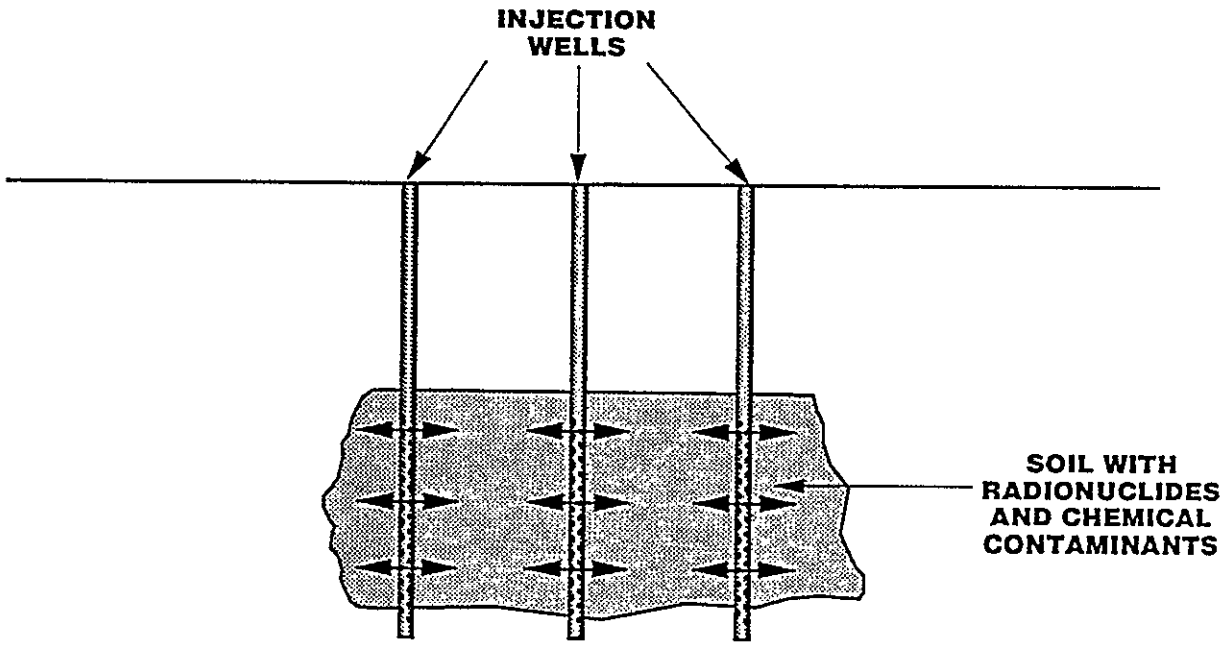

Figure 7-3. Alternative 2: In Situ Grouting of Soil.

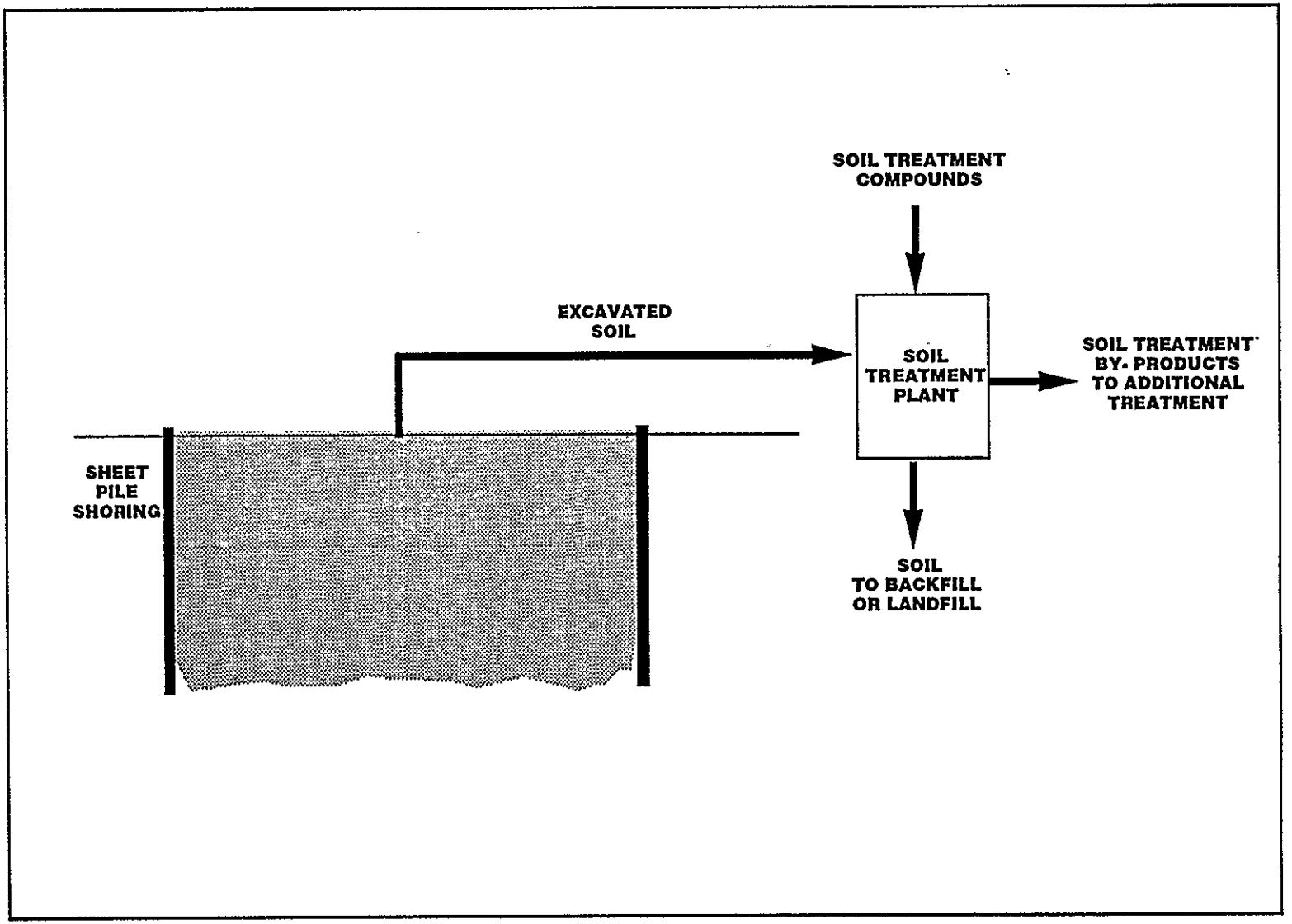

Figure 7-4. Alternative 3: Excavation, Treatment and Disposal.

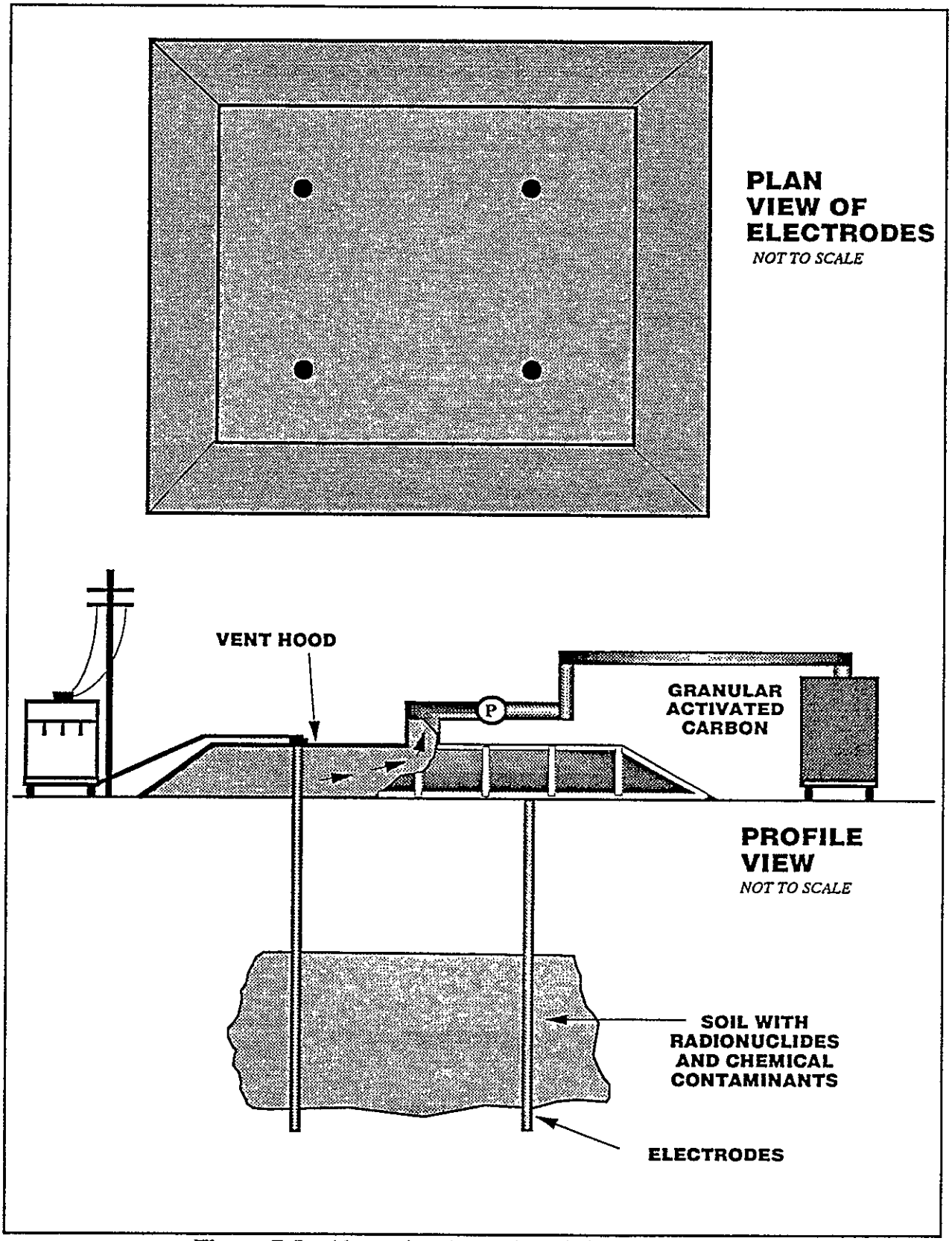

Figure 7-5. Alternative 4: In Situ Vitrification of Soil.

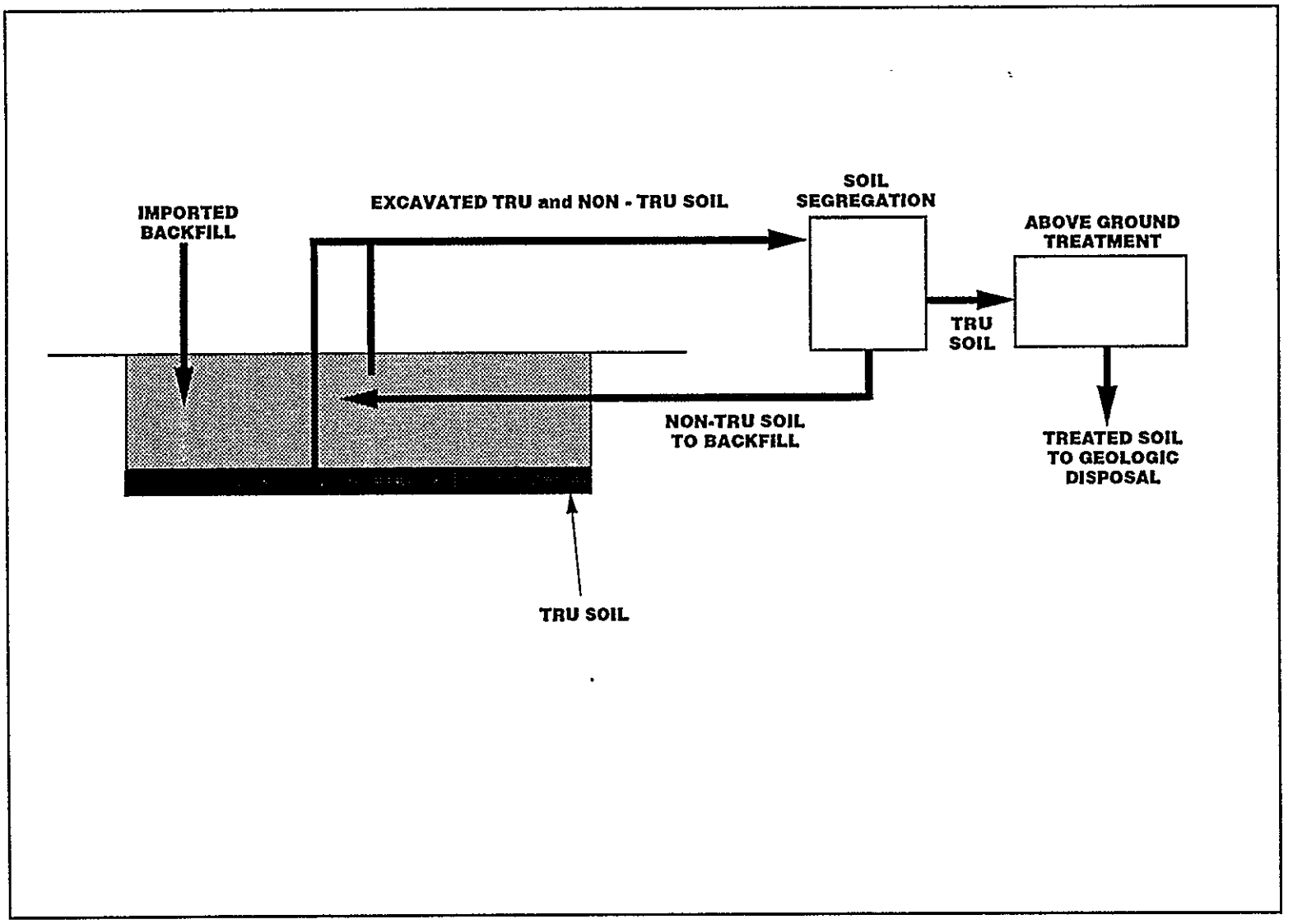

Figure 7-6. Alternative 5: Excavation, Vitrification, and Geologic Disposal of Soil with TRU Radionuclides.

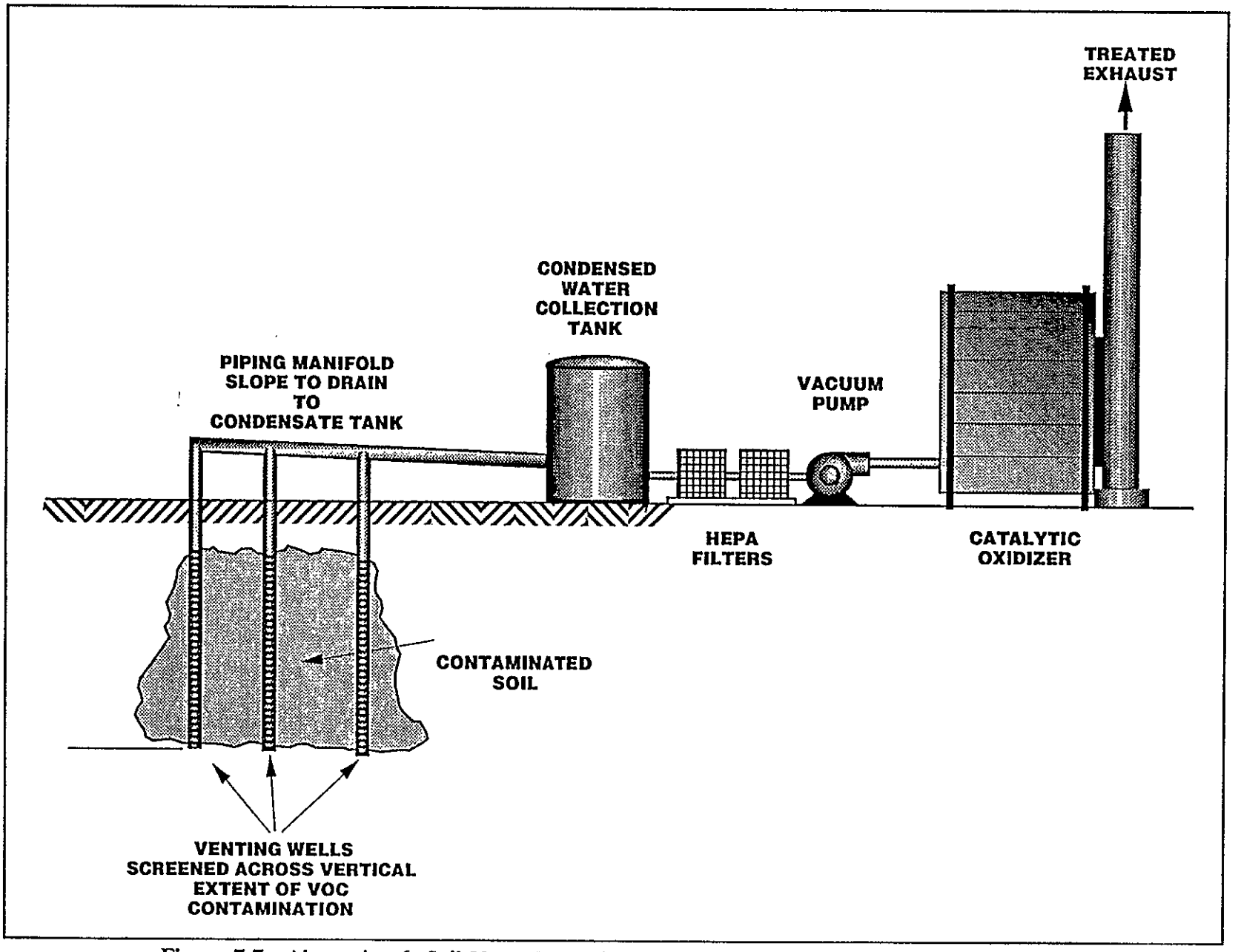

Figure 7-7. Alternative 6: Soil Vapor Extraction for Volatile Organic Compounds (VOCs).

Table 7-1. Preliminary Remedial Action Objectives and General Response Actions.

Environmental Media	Remedial Action Objectives: Human Health	Remedial Action Objectives: Environmental Protection	General Response Actions
Soils/ Sediments	• Prevent ingestion, inhalation, or direct contact with solids containing radioactive and/or hazardous constituents present at concentrations above MTCA and DOE standards for industrial sites (or subsequent risk-based standards). • Remediate soils containing TRU contamination above 100 nCi/g in accordance with 40 CFR 191 requirements. • Prevent leaching of contaminants from the soil into the groundwater that would cause groundwater concentrations to exceed MTCA and DOE standards at the compliance point location.	• Prevent migration of radionuclides and hazardous constituents that would result in groundwater, surface water, air, or biota contamination with constituents at concentrations exceeding ARARs.	• No Action • Institutional Controls/ Monitoring • Containment • Excavation • Treatment • Disposal • In Situ Treatment
Biota	• Prevent bio uptake by plants. • Prevent disturbance of engineered barriers by biota.	• Prevent bio-uptake of radioactive contaminants.	• No Action • Institutional Controls/ Monitoring • Excavation • Disposal • Containment
Air (1)	• Prevent inhalation of contaminated airborne particulates and/or volatile emissions exceeding MTCA and DOE limits from soils/sediments. • Prevent accidental release from collapse of containment structures.	• Prevent adverse environmental impacts on local biota.	

Note: (1) No General Response Actions are required for the air because soil remediation will eliminate the air contamination source.

Table 7-2. Preliminary Remedial Action Technologies. (Sheet 1 of 3)

Media	General Response Action	Technology Type	Process Option	Contaminants Treated
Soil	No Action	No Action	No Action	NA
	Institutional Controls	Land Use Restrictions	Deed Restrictions	NA
		Access Controls	Signs/Fences	NA
			Entry Control	NA
		Monitoring	Monitoring	NA
	Containment	Capping	Multimedia	I,M,R,O
		Vertical Barriers	Slurry Walls	I,M,R,O
			Grout Curtains	I,M,R,O
			Cryogenic Walls	I,M,R,O
		Dust & Vapor Suppression	Membranes/Sealants/Wind Breaks/Wetting Agents	I,M,R,O
	Excavation	Excavation	Standard Construction Equipment	I,M,R,O
	Treatment	Thermal Treatment	Vitrification	I,M,R,O
			Incineration	O
			Thermal Desorption	O
			Calcination	I,M,R,O
		Chemical Treatment	Chemical Reduction	M
			Hydrolysis	I,O

Table 7-2. Preliminary Remedial Action Technologies. (Sheet 2 of 3)

Media	General Response Action	Technology Type	Process Option	Contaminants Treated
		Physical Treatment	Soil Washing	I,M,R,O
			Solvent Extraction	O
			Physical Separation	I,M,R,O
			Fixation/Solidification/ Stabilization	I,M,R,O
			Containerization	I,M,R,O
		Biological Treatment	Aerobic	O
			Anaerobic	O
	Disposal	Landfill Disposal	Landfill Disposal	I,M,R,O
		Geologic Repository	Geologic Repository	R (I,M,O if mixed with R)
	In Situ Treatment	Thermal Treatment	Vitrification	I,M,R,O
			Thermal Desorption	O
		Chemical Treatment	Reduction	M,O
		Physical Treatment	Soil Flushing	I,M,R,O
			Vapor Extraction	O
			Grouting	I,M,R
			Fixation/Solidification/ Stabilization	I,M,R,O

Table 7-2. Preliminary Remedial Action Technologies. (Sheet 3 of 3)

Media	General Response Action	Technology Type	Process Option	Contaminants Treated
		Biological Treatment	Aerobic	O
			Anaerobic	O
Biota	No Action	No Action	No Action	NA
	Institutional Controls	Land Use Restrictions	Deed Restrictions	NA
		Access Controls	Signs/Fences	NA
			Entry Control	NA
		Monitoring	Monitoring	NA
	Excavation	Excavation	Standard Construction Equipment	I,M,R,O
	Disposal	Landfill Disposal	Landfill Disposal	I,M,R,O
	Containment	Capping	Multimedia	I,M,R,O

I = Other Inorganics contaminants applicability
M = Heavy Metals contaminants applicability
R = Radionuclide contaminants applicability
O = Organic contaminants applicability
NA = Not Applicable

Table 7-3. Screening of Process Options. (Sheet 1 of 9)

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
SOIL TECHNOLOGIES:						
No Action	No Action	Do nothing to cleanup the contamination or reduce the exposure pathways.	Not effective in reducing the contamination or exposure pathways.	Easily implemented, but might not be acceptable to regulatory agencies, local governments, and the public.	Low	Retained as a "baseline" case.
Land Use Restrictions	Deed Restrictions	Identify contaminated areas and prohibit certain land uses such as farming.	Depends on continued implementation. Does not reduce contamination.	Administrative decision is easily implemented.	Low	Retained to be used in conjunction with other process options.
Access Controls	Signs/Fences	Install a fence and signs around areas of soil contamination.	Effective if the fence and signs are maintained.	Easily implemented. Restrictions on future land use.	Low	Retained to be used in conjunction with other process options.
	Entry Control	Install a guard/monitoring system to prevent people from becoming exposed.	Very effective in keeping people out of the contaminated areas.	Equipment and personnel easily implemented and readily available.	Low	Retained to be used in conjunction with other process options.
Monitoring	Monitoring	Analyze soil and soil gas samples for contaminants and scan with radiation detectors.	Does not reduce the contamination, but is very effective in tracking the contaminant levels.	Easily implemented. Standard technology.	Low	Retained to be used in conjunction with other process options.
Capping	Multimedia	Fine soils over synthetic membrane or other layers and covered with soil; applied over contaminated areas.	Effective on all types of contaminants, not likely to crack. Likely to hold up over time.	Easily implemented. Restrictions on future land use will be necessary.	Medium	Retained because of potential effectiveness and implementability.
Vertical Barriers	Slurry Walls	Trench around areas of contamination is filled with a soil (or cement) bentonite slurry.	Effective in blocking lateral movement of all types of soil contamination. May not be effective for deep contamination.	Commonly used practice and easily implemented with standard earth moving equipment. May not be possible for deep contamination.	Medium	Retained for shallow contamination.

Table 7-3. Screening of Process Options. (Sheet 2 of 9)

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
	Grout Curtains	Pressure injection of grout in a regular pattern of drilled holes.	Effective in blocking lateral movement of all types of soil contamination.	Commonly used practice and easily implementable, but depends on soil type. May be difficult to ensure continuous wall.	Medium	Retained because of potential effectiveness and implementability.
	Cryogenic Walls	Circulate refrigerant in pipes surrounding the contaminated site to create a frozen curtain with the pore water.	Effective in blocking lateral movement of all types of soil contamination.	Specialized engineering design required. Requires ongoing freezing.	Medium	Rejected because it is difficult to implement.
Dust and Vapor Suppression	Membranes/ Sealants/ Wind Breaks/ Wetting Agents	Using membranes, sealants, wind breaks, or wetting agents on top of the contaminated soil to keep the contaminants from becoming airborne.	Effective in blocking the airborne pathways of all the soil contaminants, but may require regular upkeep.	Commonly used practice and very easy to implement, but land restrictions will be necessary.	Low	Rejected because of limited duration of integrity and protection.
Excavation	Standard Excavating Equipment	Moving soil around the site and loading soil onto process system equipment.	Effective in moving and transporting soil to vehicles for transportation, and for grading the surface.	Equipment and workers are readily available.	Low	Retained because of potential effectiveness and implementability.
Thermal Treatment	Above-ground Vitrification	Convert soil to glassy materials by application of electric current.	Effective in destroying organics and immobilizing the inorganics and radionuclides. Off-gas treatment for volatiles may be required.	Commercial units are available. Laboratory testing required to determine additives, operating conditions, and off gas treatment. Must pre-treat soil to reduce size of large materials.	High	Retained because of potential ability to immobilize radionuclides and destroy organics.

Table 7-3. Screening of Process Options. (Sheet 3 of 9)

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
	Incineration	Destroy organics by combustion in a fluidized bed, kiln, etc.	Effectively destroys the organic soil contaminants. Some heavy metals will volatilize. Radionuclides will not be treated.	Technology is well developed. Mobile units are currently available for relatively small soil quantities. Off-site treatment is available. Air emissions and wastewater generation should be addressed.	High	Rejected because of potential air emissions and wastewater generation.
	Thermal Desorption	Organic volatilization at 150 to 400°C (300 to 800°F) by heating contaminated soil followed by off gas treatment.	Effectively destroys the organic soil contaminants. Heavy metals less likely to volatilize than in high temperature treatments. Radionuclides will not be treated.	Successfully demonstrated on a pilot-scale level. Full-scale remediation yet to be demonstrated. Pilot testing essential.	Medium	Retained because of potential effectiveness and implementability.
	Calcination	High temperature decomposition of solids into separate solid and gaseous components without air contact.	Effective in the decomposition of inorganics such as hydroxides, carbonates, nitrates, sulfates, and sulfites. Removes organic components but does not combust them because of the absence of air. Radionuclides will not be treated.	Commercially available. Most often used for concentration and volume reduction of liquid or aqueous waste. Off-gas treatment is required.	High	Rejected because of limited effectiveness on non-liquid or aqueous wastes.
Chemical Treatment	Chemical Reduction	Treat soils with a reducing agent to convert contaminants to a more stable or less toxic form.	May be effective in treating heavy metal soil contaminants. Radioactivity will not be reduced.	Virtually untested on treating soils. Competing reactions may reduce efficiency.	Medium	Rejected because of limited applicability and implementation problems.

Table 7-3. Screening of Process Options. (Sheet 4 of 9)

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
	Hydrolysis	Acid- or base-catalyst reaction in water to break down contaminants to less toxic components.	Very effective on compounds generally classified as reactive. Limited effectiveness on stable compounds. Radioactivity will not be reduced.	Common industrial process. Use for treatment of soils not well demonstrated.	Medium	Rejected because of limited effectiveness and unproven on soils.
Physical Treatment	Soil Washing	Leaching of waste constituents from contaminated soil using a washing solution.	Effectiveness is contaminant specific. Generally more effective on contaminants that partition to the fine soil fraction. Radioactivity will not be reduced.	Treatability tests are necessary. Well developed technology and commercially available.	Medium	Retained because of potential effectiveness and implementability.
	Solvent Extraction	Contacting a solvent with contaminated soils to preferentially dissolve the contaminants into the solvent.	The selected solvent is often just as hazardous as the contaminants presented in the waste. May lead to further contamination. Radioactivity will not be reduced.	Laboratory testing necessary to determine appropriate solvent and operating conditions. Not fully demonstrated for hazardous waste applications.	Medium	Rejected because the solvent may lead to further contamination.
	Physical Separation	Separating soil into size fractions.	Effective as a concentration process for all contaminants that partition to a specific soil size fraction.	Most often used as a pretreatment to be combined with another technology. Equipment is readily available.	Low	Retained because of potential effectiveness and implementability.
	Fixation/ Solidification/ Stabilization	Form low permeability solid matrix by mixing soil with cement, asphalt, or polymeric materials.	Effective in reducing inorganic and radionuclide soil contaminant mobility. Effectiveness for organic stabilization is highly dependent on the binding agent.	Stabilization has been implemented for site remediations. Treatability studies are needed. Volume of waste is increased.	Medium	Retained because of potential effectiveness and implementability.

Table 7-3. Screening of Process Options. (Sheet 5 of 9)

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
	Containerization	Enclosing a volume of waste within an inert jacket or container.	Effective for difficult to stabilize, extremely hazardous, or reactive waste. Reduces the mobility of radionculides.	May be implemented for low concentration waste. Disposal or safe storage of containers required. Regulatory constraints may prevent disposal of containers of certain waste types.	Low	Retained because of potential effectiveness and implementability.
Biological Treatment	Aerobic	Microbial degradation in an oxygen-rich environment.	Effectiveness is very contaminant- and concentration-specific. Treatment has been demonstrated on a variety of organic compounds. Not effective on inorganics or radionuclides.	Various options are commercially available to produce contaminant degradation. Treatability tests are required to determine site-specific conditions.	Medium	Rejected because of limited applicability and difficult implementation.
	Anaerobic	Microbial degradation in an oxygen deficient environment.	Effectiveness is very contaminant and concentration specific. Treatment has been demonstrated on a variety of organic compounds. Not effective on inorganics or radionuclides.	Various options are commercially available to produce contaminant degradation. Treatability tests are required to determine site-specific conditions.	Medium	Rejected because of limited applicability and difficult implementation.
Disposal	Landfill Disposal	Place contaminated soil in an existing onsite landfill.	Does not reduce the soil contamination but moves all of the contamination to a more secure place.	Easily implemented if sufficient storage is available in an on-site landfill area.	Medium	Retained because of potential effectiveness and implementability.
	Geologic Repository	Put the contaminated soil in a safe geologic repository.	Does not reduce the soil contamination, but is a very effective and long-term way of storing radionuclides. Probably unnecessary for nonradioactive waste.	Not easy to implement because of limited site availability, and permits for transporting radioactive wastes are hard to get.	High	Retained because of effectiveness on TRU wastes.

Table 7-3. Screening of Process Options. (Sheet 6 of 9)

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
In Situ Thermal Treatment	Vitrification	Electrodes are inserted into the soil and a carbon/glass frit is placed between the electrodes to act as a starter path for initial melt to take place.	Effective in immobilizing radionuclides and most inorganics. Effectively destroys some organics through pyrolysis. Some volatilization of organics and inorganics may occur.	Potentially implementable. Implementability depends on site configuration, e.g., lateral and vertical extent of contamination. Treatability studies required.	High	Retained because of potential ability to immobilize radionuclides and destroy organics.
	Thermal Desorption	Soil is heated in situ by radio-frequency electrodes or other means of heating to temperatures in the 80 to 400°C (200 to 750°F) range thereby causing desorption of volatile and semi-volatile organics from the soil.	Effective for removal of volatile and semi-volatile organics from soil. Ineffective for most inorganics and radionuclides. Contaminants are transferred from soil to air.	Implementable for shallow organics contamination. Not implementable for radionuclides and inorganics. Emission treatment and treatability studies required.	Medium	Rejected because of limited applicability.
In Situ Chemical Treatment	Chemical Reduction	Reducing agent is added to the soil to change oxidation state of target contaminant.	Effective for certain inorganics, e.g., chromium. Ineffective for organics. Limited applicability.	Difficult to implement in situ because of distribution requirements for reducing agent.	Low	Rejected because of limited applicability and implementation problems.
In Situ Physical Treatment	Soil Flushing	Solutions are injected through injection system to flush and extract contaminants.	Potentially effective for all contaminants. Effectiveness depends on chemical additives and hydrology. Flushing solutions posing environmental threat likely to be needed. Difficult recovery of flushing solution.	Difficult to implement. Not implementable for complex solvents of contaminants. Flushing solution difficult to recover. Chemical additives likely to pose environmental threat.	Medium	Rejected because of implementation problem.

Table 7-3. Screening of Process Options. (Sheet 7 of 9)

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
	Vapor Extraction	Vacuum is applied by use of wells inducing a pressure gradient that causes volatiles to flow through air spaces between soil particles to the extraction wells.	Effective for volatile organics. Ineffective for inorganics and radionuclides. Emission treatment required.	Easily implementable for proper site conditions. Requires emission treatment for organics and capture system for radionculides and volatilized metals.	Medium	Retained for potential application to volatile organics.
	Grouting	Involves drilling and injection of grout to form barrier or injection to fill voids.	Effective in limiting migration of leachate, but difficult to maintain barrier integrity. Potentially effective in filling voids.	Implementable as barrier and for filling voids. Implementability depends on site conditions.	Medium	Retained because of ability to limit contaminant migration and potential use for filling void spaces.
	Fixation/ Solidification/ Stabilization	Solidification agent is applied to soil by mixing in place.	Effective for inorganics and radionuclides. Potentially effective for organics. Effectiveness depends on site conditions and additives used.	Implementable. Treatability studies required to select proper additives. Thorough characterization of subsurface conditions and continuous monitoring required.	Medium	Retained because of potential effectiveness and implementability.
In Situ Biological Treatment	Aerobic	Microbial growth utilizing organic contaminants as substrate is enhanced by injection of or spraying with oxygen source and nutrients.	Effective for most organics at proper conditions. Ineffective for inorganics and radionuclides.	Difficult to implement. Treatability studies and thorough subsurface characterization required.	Low	Rejected because of limited applicability and difficult implementation.
	Anaerobic	Microbial growth utilizing organic contaminants as substrate is enhanced by addition of nutrients.	Effective for volatile and complex organics. Not effective for inorganics and radionuclides.	Difficult to implement. Anoxic ground conditions required. Treatability studies and thorough subsurface characterization necessary.	Low	Rejected because of limited applicability and difficult implementation.

Table 7-3. Screening of Process Options. (Sheet 8 of 9)

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
BIOTA TECHNOLOGIES:						
No Action	No Action	Do nothing to clean-up the contamination or reduce the exposure pathways.	Not effective in reducing the contamination or exposure pathways.	Easily implemented, but might not be acceptable to regulatory agencies, local governments, and the public.	Low	Retained as a "baseline"case.
Land Use Restrictions	Deed Restrictions	Identify contaminated areas and prohibit certain land uses such as agriculture.	Effective if implementation is continued. Does not reduce contamination.	Administrative decision is easily implemented.	Low	Retained to be used in conjunction with other process options.
Access Controls	Signs/Fences	Install a fence and signs around areas of contamination to keep people out and the biota in.	Effective if fencing is maintained.	Easily implemented. Restrictions on future land use.	Low	Retained to be used in conjunction with other process options.
	Entry Control	Install a guard/monitoring system to eliminate people from coming in contact with the contamination.	Very effective in keeping people out of the contaminated areas.	Equipment and personnel are easily implemented and readily available.	Low	Retained to be used in conjunction with other process options.
Monitoring	Monitoring	Take biota samples and test them for contaminants.	Does not reduce the contamination, but is very effective tracking the contaminant levels.	Easily implemented. Standard Technology.	Low	Retained to be used in conjunction with other process options.
Capping	Multimedia	Fine soils over synthetic membrane or other layers and covered with soil; applied over contaminated areas.	Effective in reducing the uptake of contaminants, not likely to crack. Likely to hold up over time.	Easily implemented. Restrictions on future land use will also be necessary.	Medium	Retained because of potential effectiveness and implementability.
Excavation	Standard Excavating Equipment	Remove affected biota and load it onto process system equipment.	Effective in moving and transporting biota to vehicles for transportation.	Equipment and workers are readily available.	Low	Retained because of potential effectiveness and implementability.

Table 7-3. Screening of Process Options. (Sheet 9 of 9)

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
Disposal	Landfill Disposal	Place contaminated biota in an existing landfill.	Does not reduce the biota contamination but moves all of the contamination to a more secure place.	Easily implemented if sufficient storage is available in an offsite landfill area.	Medium	Retained because of potential effectiveness and implementability.

Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites. (Sheet 1 of 4)

Waste Management Unit or Unplanned Release	Alt 1. Multimedia Cover With or Without Vertical Barriers	Alt 2. In Situ Grouting	Alt 3. Excavation and Treatment	Alt 4. In Situ Vitrification	Alt 5. Excavation, Treatment, and Geologic Disp. of TRU Soil	Alt 6. In Situ Soil Vapor Extraction for VOCs
Tanks and Vaults						
241-T-361 Settling Tank (1)						
241-TX-302B Catch Tank	•	•	•	•		
241-TX-302C Catch Tank (2)	•	•	•	•		
Cribs and Drains						
216-T-6 Crib	•	•	•	•	•	
216-T-7TF Crib	•	•	•	•	•	
216-T-8 Crib	•	•	•	•	•	
216-T-18 Crib	•	•	•	•	•	
216-T-19TF Crib	•	•	•	•	•	
216-T-26 Crib	•	•	•	•	•	
216-T-27 Crib	•	•	•	•	•	
216-T-28 Crib	•	•	•	•		
216-T-29 Crib	•	•	•	•		
216-T-31 French Drain	•	•	•	•		
216-T-32 Crib	•	•	•	•	•	
216-T-33 Crib	•	•	•	•	•	
216-T-34 Crib	•	•	•	•	•	
216-T-35 Crib	•	•	•	•	•	
216-T-36 Crib	•	•	•	•	•	
216-W-LWC Crib (2)	•	•	•	•		
Reverse Wells						
216-T-2 Reverse Well	•	•				
216-T-3 Reverse Well	•	•			•	

Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites. (Sheet 2 of 4)

Waste Management Unit or Unplanned Release	Alt 1. Multimedia Cover With or Without Vertical Barriers	Alt 2. In Situ Grouting	Alt 3. Excavation and Treatment	Alt 4. In Situ Vitrification	Alt 5. Excavation, Treatment, and Geologic Disp. of TRU Soil	Alt 6. In Situ Soil Vapor Extraction for VOCs
Ponds, Ditches, and Trenches						
216-T-4A Pond	•	•	•	•	•	
216-T-4B Pond (2)	•	•	•	•	•	
216-T-1 Ditch (2)	•	•	•	•	•	
216-T-4-1D Ditch	•	•	•	•	•	
216-T-4-2 Ditch (2)	•	•	•	•	•	
200-W Powerhouse Pond (2)	•	•	•	•		
216-T-5 Trench	•	•	•	•	•	
216-T-9 Trench	•	•	•	•		
216-T-10 Trench	•	•	•	•		
216-T-11 Trench	•	•	•	•		
216-T-12 Trench	•	•	•	•	•	
216-T-13 Trench	•	•	•	•		
216-T-14 Trench	•	•	•	•	•	
216-T-15 Trench	•	•	•	•	•	
216-T-16 Trench	•	•	•	•	•	
216-T-17 Trench	•	•	•	•	•	
216-T-20 Trench	•	•	•	•	•	
216-T-21 Trench	•	•	•	•	•	
216-T-22 Trench	•	•	•	•	•	
216-T-23 Trench	•	•	•	•	•	
216-T-24 Trench	•	•	•	•	•	
216-T-25 Trench	•	•	•	•	•	

Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites. (Sheet 3 of 4)

Waste Management Unit or Unplanned Release	Alt 1. Multimedia Cover With or Without Vertical Barriers	Alt 2. In Situ Grouting	Alt 3. Excavation and Treatment	Alt 4. In Situ Vitrification	Alt 5. Excavation, Treatment, and Geologic Disp. of TRU Soil	Alt 6. In Situ Soil Vapor Extraction for VOCs
Septic Tanks and Associated Drain Fields						
2607-W1 Septic Tank (2)	•	•	•	•		
2607-W2 Septic Tank (2)	•	•	•	•		
2607-W3 Septic Tank (2)	•	•	•	•		
2607-W4 Septic Tank (2)	•	•	•	•		
Transfer Facilities, Diversion Boxes, and Pipelines						
241-TX-152 Diversion Box (1) (2)						
241-TX-154 Diversion Box (2)	•	•	•	•		
241-TX-155 Diversion Box	•	•	•	•		
Basins						
207-T Retention Basin (2)	•		•			
Burial Sites						
200-W Ash Disposal Basin (2)	•	•	•	•		
200-W Burning Pit	•	•	•	•		•
200-W Powerhouse Ash Pit (2)	•	•	•	•		
218-W-8 Burial Ground	•	•	•	•	•	•
Unplanned Releases						
UN-200-W-2	•	•	•	•		
UN-200-W-3	•	•	•	•		
UN-200-W-4	•	•	•	•		
UN-200-W-7 (4)						
UN-200-W-8	•	•	•	•		
UN-200-W-12	•	•	•	•		
UN-200-W-14	•	•	•	•		

Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites. (Sheet 4 of 4)

Waste Management Unit or Unplanned Release	Alt 1. Multimedia Cover With or Without Vertical Barriers	Alt 2. In Situ Grouting	Alt 3. Excavation and Treatment	Alt 4. In Situ Vitrification	Alt 5. Excavation, Treatment, and Geologic Disp. of TRU Soil	Alt 6. In Situ Soil Vapor Extraction for VOCs
UN-200-W-27	•	•	•	•		
UN-200-W-29	•	•	•	•		
UN-200-W-38 (4)						
UN-200-W-58	•	•	•	•		
UN-200-W-63	•	•	•	•		
UN-200-W-65	•	•	•	•		
UN-200-W-67	•	•	•	•		
UN-200-W-73 (3)						
UN-200-W-77	•	•	•	•		
UN-200-W-85 (3)						
UN-200-W-88 (3)						
UN-200-W-98	•	•	•	•		
UN-200-W-99	•	•	•	•		
UN-200-W-102	•	•	•	•		
UN-200-W-113 (4)						
UN-200-W-135	•	•	•	•		
UN-200-W-137	•	•	•	•		

Notes: (1) No record was found to indicate that any environmental contamination is associated with this structure. Therefore no applicable alternative(s) was identified.

(2) This is an active unit.

(3) Records indicate that all environmental contamination resulting from this unplanned release was removed and disposed. Therefore no applicable alternative(s) was identified.

(4) This unplanned release is associated with another waste management unit and therefore will not be remediated separately.

8.0 DATA QUALITY OBJECTIVES

As described in Section 1.2.2, this aggregate area management study (AAMS) process, as part of the *Hanford Site Past-Practice Strategy* (DOE/RL 1992), is designed to focus the remedial investigation (RI)/feasibility study (FS) process toward comprehensive cleanup or closure of all contaminated areas at the earliest possible date and in the most effective manner. The fundamental principle of the *Hanford Site Past-Practice Strategy* is a "bias for action" which emphasizes the maximum use of existing data to expedite the RI/FS process as well as allow decisions about work that can be done at the site early in the process, such as expedited response actions (ERAs), interim remedial measures (IRMs), limited field investigations (LFIs), and focused feasibility studies (FFS). The data have already been described in previous sections (2.0, 3.0, and 4.0). Remediation alternatives are described in Section 7.0. However, data, whether existing or newly acquired, can only be used for these purposes if it meets the requirements of data quality as defined by the data quality objective (DQO) process developed by the U.S. Environmental Protection Agency (EPA) for use at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites (EPA 1987a). This section implements the DQO process for this, the scoping phase in the T Plant Aggregate Area.

In the guidance document for DQO development (EPA 1987a), the process is described as involving three stages which have been used in the organization of the following sections:

- Stage 1--Identify decision types (Section 8.1)
- Stage 2--Identify data uses and needs (Section 8.2)
- Stage 3--Design a data collection program (Section 8.3).

8.1 DECISION TYPES (Stage 1)

Stage 1 of the DQO process is undertaken to identify:

- The decision makers (thus data users) relying on the data to be developed (Section 8.1.1)
- The data available to make these decisions (Section 8.1.2)
- The quality of these available data (Section 8.1.3)
- The conceptual model into which these data must be incorporated (Section 8.1.4)

- The objectives and decisions that must evolve from the data (Section 8.1.5).

These issues serve to define, from various sides, the types of decisions that will be made on the basis of the T Plant AAMS.

8.1.1 Data Users

The data users for the T Plant AAMS (and subsequent investigations such as LFIs, RI/FSs, and Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFIs)/Corrective Measures Studies (CMSs) are the following:

- The decision makers for policies and strategies on remedial action at the Hanford Site. These are the signatories of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1990) including the U.S. Department of Energy (DOE), EPA, and the Washington State Department of Ecology (Ecology).

Nominally these responsibilities are assigned to the heads of these agencies (the Secretary of Energy for DOE, the Administrator of EPA, and the Director of Ecology), although the political process requires that more local policy-makers (such as the Regional Administrator of EPA and the head of the U.S. Department of Energy, Richland Field Office (DOE-RL) and, to a great extent, technical and policy-assessment staff of these agencies will have a major say in the decisions to be evolved through this process.

- Unit managers of Westinghouse Hanford and potentially other Hanford Site contractors who will be tasked with implementing remedial activities at the T Plant Aggregate Area. Staff of these contractors will have to make the lower level (tactical) decisions about appropriate scheduling of activities and allocation of resources (funding, personnel, and equipment) to accomplish the recommendations of the AAMS.

- Concerned members of the wide community involved with the Hanford Site. These may include:

  - Other state (Washington, Oregon, and other states) and federal agencies,
  - Affected Indian tribes,
  - Special interest groups, and
  - The general public.

These groups will be involved in the decision process through the implementation of the Community Relations Plan (CRP) (Ecology et al. 1989), and will apply their

concerns through the "primary" data users, the signatories of the Tri-Party Agreement.

The needs of these users will have a pivotal role in issues of data quality. Some of this influence is already imposed by the guidance of the Tri-Party Agreement.

8.1.2 Available Information

The *Hanford Site Past-Practice Strategy* specifies a "bias for action" which intends to make the maximal use of existing data on an initial basis for decisions about remediation. This emphasis can only be implemented if the existing data are adequate for the purpose.

Available data for the T Plant Aggregate Area are presented in Sections 2.0, 3.0, and 4.0 and in topical reports prepared for this study. As described in Section 1.2.2, these data should address several issues:

- Issue 1: Facility and process descriptions and operational histories for waste sources (Sections 2.2, 2.3, and 2.4)

- Issue 2: Waste disposal records defining dates of disposal, waste types and waste quantities (Section 2.4)

- Issue 3: Sampling events of waste effluents and affected media (Section 4.1)

- Issue 4: Site conditions including the site physiography, topography, geology, hydrology, meteorology, ecology, demography, and archaeology (Section 3.0)

- Issue 5: Environmental monitoring data for affected media including air, surface water, sediment, soil, groundwater and biota (Section 4.1, except that groundwater data is presented in the separate 200 West Groundwater Aggregate Area Management Study Report (AAMSR).

A major requirement for adequate characterization of many of these issues is identification of chemical and radiological constituents associated with the sites, with a view to determine the contaminants of concern there and the extent of their distribution in the soils beneath each of the Waste Management Units in the T Plant Aggregate Area. There was found to be a limited amount of data in this regard. The data reported for the various waste management units in the T Plant Aggregate Area (Section 4.1 and Tables 4-1, 4-2, and 4-3) have been found to describe:

- Inventory--generally estimated from chemical process data and emphasizing radionuclides (Issues 1 and 2). These data are especially limited regarding reconstruction of early operations activities, and even the most recent data

are based on very few sampling events, possibly non-representative of the long-term activity of the waste management units. In some cases (e.g., for 216-T-4-2 and 216-T-4-ID Ditches) portions of the sites overlap and therefore should be considered jointly.

- Surface radiological surveys--undifferentiated radiation levels, without identification of radionuclides present, presented in terms of extent of radiation and maximal levels (Issue 5). These historical data are extremely difficult to relate to the present-day distribution and nature of the radioactive contamination they purport to measure because of the lack of radionuclide identification and the likelihood that changes have occurred (at least to surface soils) since the time of these surveys.

- External radiation monitoring--similar to the surface radiological surveys but provide even less information because with a fixed-point thermoluminescent dosimeter (TLD) no spatial distribution is provided. In addition, data are also available for some TLDs placed at points not associated with specific waste management units. TLD data again do not differentiate radionuclide species.

- Waste, soil, or sediment sampling--these include waste sampling in single-shell tanks (SSTs) (in the 241-T, TX, and TY Tank Farms) and soil sampling in the vadose zone around Tank 241-TY-104 as a result of a 5,300 L (1,400 gal) leak (UPR-200-W-153). The quality of these data is apparently good, but changes at the release sites (e.g., cleanup activities) since the time of the sampling makes the data again generally inapplicable to determination of the present-day distribution of contamination.

  There is also a set of data of soil sampling and analysis that was conducted for several years on a grid pattern, so cannot be assigned to a particular waste management unit. These data would indicate impacts of historical operations at the Hanford Site, and in the vicinity of the grid points, but the impacts cannot be ascribed to a particular unit and so do not assist in decision making on a unit-by-unit basis.

- Biota sampling--There are analytical data for grid-point samples of vegetation which again cannot be assigned to a specific waste management unit.

- Borehole geophysics--these data, for a number of units which discharged to the soil column (cribs, french drains, and ditches) and the SSTs, were designed to detect the presence of radionuclides (by their gamma-ray radiation) in the subsurface and to indicate whether these materials are migrating vertically (Issue 5). A list of these surveys that have been conducted in the T Plant Aggregate Area is included in the Data Package Topical Report prepared for this study (Chamness et al. 1991). These data

are limited by the method's inability to identify specific radionuclides and thus to differentiate naturally-occurring radioactive materials from possible releases. Variations in quality control further limit their comparability and possible use for estimation of concentrations.

Besides these historic data, additional borehole geophysical data will be available through the Radionuclide Logging System (RLS), being carried out at the time of this report and in support of the AAMS process. Like the previous (gross gamma) logging conducted at waste management units in the T Plant Aggregate Area, the RLS responds only to gamma rays and so cannot detect some species of radionuclides. However, unlike the gross gamma surveys, the RLS is designed to identify individual radionuclide species through their characteristic gamma ray photon energy levels. It should thus be able to differentiate naturally-occurring radionuclides from those resulting from releases. It will also (like gross gamma logging) determine the vertical extent of the presence of the radionuclides. It will be conducted in about 10 wells located in the T Plant Aggregate Area and will be available with completion of the AAMS process.

Based on the above summary, the data are considered to be a varying quality. These data have not been validated, a process generally required for risk assessment or final Record of Decision (ROD) purposes. Most of the data are based on field methods, which are generally applicable only for screening purposes and can be used to focus future activities (e.g., sampling and analysis plans).

They are considered to be deficient in one or more of the following ways:

- The methods are unable to differentiate the various radionuclides that may have been present at the time of the survey.

- The release locations have been changed (especially by remediation activities) since the time of the survey or sampling, and it is likely that containment distributions have changed.

- The survey or sampling has been done at a location different from the waste management unit or release, and so would not be representative of the concentrations in the zone of release. This deficiency applies to horizontal and vertical differences in location: the borehole geophysics data may be at the correct depths, but the distance of the borehole from the waste management unit can severely attenuate the gamma-radiation that is used to indicate contamination, surface sampling and surveys similarly cannot establish subsurface contaminant concentrations or even disprove the possible presence of some radioactive constituents (particularly alpha-emitting transuranic elements [TRUs]).

- There has been virtually no measurement of nonradioactive hazardous constituents in the sampling and analysis of media in the PUREX Plant Aggregate Area.

As a result of these deficiencies, the data are not considered to be usable for input to a quantitative risk assessment or for comparison to ARARs.

In addition to those data, there are also data regarding site conditions (Issue 4) which do no directly relate to the presence of environmental releases but which will assist in the assessment of their potential migration if present. These data are generally summarized in the Topical Reports prepared for this AAMS. Those reports include the following:

- *T Plant Geologic and Geophysics Data Package for the 200 AAMS* (Chamness et al. 1991), contains tables of wells in which borehole geophysics have been conducted, the types and dates of the tests, and a reference to indicate the physical location of the logs. The package also includes a list of the data available from the drilling of each well located in the T Plant Aggregate Area, such as the logs available (driller's or geologist's). Those logs contain information on well location, soil grain size, soil carbonate content, soil moisture, and chemical/radiological analyses. The boring logs also contain well completion (as-built) summaries for a selection of wells in the T Plant Aggregate Area.

- *Geologic Setting of the 200 West Area: An Update* (Lindsey et al. 1991) includes descriptions of regional stratigraphy, structural geology, and local (200 West Area) stratigraphy, with revised structure and isopach maps of the various suprabasalt strata found beneath the 200 West Area.

The data in these topical reports was obtained for the Aggregate Area study based on a review of driller's and geologist's logs for wells drilled in the T Plant Aggregate Area. A selection of 15 of those logs was made which best represented the geologic structures below the Aggregate Area and are presented in Chamness et al (1991). Lindsay et al (1991) then used these wells (and other from other Aggregate Areas in the 200 West Area) to develop cross-sections, structure maps, and isopach maps, which were in turn adapted to the specific needs of this report and presented in Section 3. Only existing logs were used; no new wells were drilled as part of this study. The quality of the data varies among the logs according to the time they were drilled and the scope of the study they were supporting, but generally these data are sufficient for the general geological characterization of the site. Issues involving the potential of contaminant migration at specific sites, based on stratigraphic concerns, may not be fully addressed through any existing borings or wells because appropriate borings may not be located in close proximity; these issues should be addressed during subsequent field investigations at locations where contaminant migration is considered likely.

Another class of data which was gathered in the general area of the 200 West Area, and thus potentially appropriate to the T Plant Aggregate Area, is the result of a studies which were performed for the Basalt Waste Isolation Project (BWIP) (DOE-RL 1988), in the attempt to site a high-level radioactive waste geologic repository in the basalt beneath and in the vicinity of the Hanford Site. The proposed Reference Repository Site included the 200 West Area and some distance beyond it, mainly to the west. For this siting project, a number of geologic techniques were used, and some of the data generated by the drilling program has been used for the stratigraphic interpretation presented in Section 3.4 (all the wells denoted with an alias "BH-.." were drilled for the BWIP project) and a number of the figures used in this and other sections of Section 3.0. The program also included a number of geophysical studies, using the following techniques:

- Gravity
- Magnetics
- Seismic reflection
- Seismic refraction
- Magnetotellurics.

These data, as presented in Section 1.3.2.2.3 of DOE-RL (1988), were reviewed for their relevance to the present T Plant (source area) AAMS. The limitations of these studies include the following aspects:

- Most of the studies covered a regional scale with lines or coverages that may have crossed the T Plant Aggregate Area (or even the 200 West Area) only in passing. Some of the surveys (e.g., the grid of gravity stations) specifically avoided the 200 West Area ("due to restricted access").

- Many of the techniques are more sensitive to the basalt than to the suprabasalt sediments of specific interest in the AAMS program, and even less sensitive to the features which are closer to the surface, as is applicable to the source area AAMS. Basalt is by nature much denser than the unconsolidated sediments (and thus also has a characteristic seismic signature) and has more consistent magnetic properties. In addition, the analysis of the data emphasized the basalt features which were apparent in the data. All this is appropriate to a study of the basalt, but does not make the studies applicable to the present study.

- Even when features potentially due to shallow sediments are identified, they are interpreted either very generally (e.g., "erosional features in the Hanford and (or) Ringold formations") or as complications (e.g., "shallow sediment

velocity variations causing stacking velocity correction errors"). There are only a very few features (and none in the T Plant Aggregate Area) which are interpreted as descriptive of the structure of the suprabasalt sediments.

- Lastly, some of the anomalies which are interpreted in terms of a sedimentary stratigraphic cause (e.g., "erosion of Middle Ringold") do not bear up under the more detailed stratigraphic interpretation carried out under the Topical Reports for the AAMS (Lindsey et al. 1991, Chamness et al. 1991).

However, these data will be reviewed in more detail for the purposes of the 200 West Groundwater AAMS, since deeper features (including in the basalt) are of more concern for that study.

Other data, presented in Sections 2.0, 3.0, and 4.0 are broader-scale rather than site-specific as the contaminant concentrations are. These include: topography, meterology, surface hydrology, environmental resources, human resources, and contaminant characteristics. These data are generally of acceptable quality for the purposes of planning remedial actions in the U Plant Aggregate Area.

8.1.3 Evaluation of Available Data

The EPA (1987) has specified indicators of data quality, the five "PARCC" parameters (precision, accuracy, representativeness, completeness, and comparability), which can be used to evaluate the existing data and to specify requirements for future data collection.

- Precision--the reproducibility of the data.

- Accuracy--the lack of a bias in the data.

  Much of the existing data are of limited precision and accuracy due to the analytical methods which have been used historically. The gross gamma borehole geophysical logging in particular is limited by methodological problems although reproducibility has been generally observed in the data. Conditions that have contributed to lack of precision and/or accuracy include: improvements in analytical instrumentation and methodology making older data incompatible, effects of background levels (particularly regarding radioactivity and inorganics), and lack of quality control on data acquisition.

  The limitations in precision and accuracy in existing data are due mainly to the progress of analytical methodologies and quality assurance (QA) procedures since the time they were collected. The *Hanford Site Past-Practice Investigation Strategy* (DOE/RL 1992) recommends that existing data be used to the maximum extent possible, at two levels: first to formulate the

conceptual model, conduct a qualitative risk assessment, and prepare work plans, but also as an initial data set which can be the basis for a fully-qualified data set through a process of review, evaluation, and confirmation.

- Representativeness--the degree to which the appropriate environmental parameters or media have been sampled.

This parameter highlights a shortcoming of most of the historical data. Limitations include the observation only of gross gamma radiation rather than differentiating it by radionuclide (e.g., through spectral surveying methods as are being used by the RLS program), the analysis of samples only for radionuclides rather than for chemicals and radionuclides, and the failure to sample (especially in the subsurface) for the full potential extent of contaminant migration.

The data are incomplete primarily because of the lack of subsurface sampling for extent of contamination. This is because no subsurface investigation has been initiated on the waste management units in the T Plant Aggregate Area yet. The lack of these data is also caused by concerns to limit the potential exposure to radioactivity of workers who would have to drill in contaminated areas and the possible release or spread of contamination through these intrusive procedures. The result of this data gap is that none of the sites can be demonstrated to have contamination either above or below levels of regulatory concern, and a full quantitative risk assessment cannot be conducted.

In addition, in many cases it has been necessary to use general data (i.e., from elsewhere in the 200 West Area or even from the vicinity of the 200 Areas) rather than data specific to a particular waste management unit. For most purposes of characterization for transport mechanisms, this procedure is acceptable given the screening level os the present study. For example, while it is appropriate to use a limited number of boring logs to characterize the stratigraphy in the Aggregate Area (Chamness et al. 1991, Lindsey et al. 1991), the later, waste management unit specific, field sampling plans will require detailed consideration of more of the logs of well drilled in the immediate vicinity, whatever their quality, as a starting point to conceptually model the geology specifically beneath that unit.

- Completeness--the fraction of samples which are considered "valid."

None of the data that have been previously gathered in the T Plant Aggregate Area has been "validated" in the EPA Contract Laboratory Program (CLP) sense, although varying levels of quality control have been applied to the sampling and analysis procedures. The best indication of the validity of the

data is the reproducibility of the results, and this indicates that validity (completeness) is one of the less significant problems with the data.

- Comparability -- the confidence that can be placed in the comparison to two data sets (e.g., separate samplings).

  With varying levels of quality control and varying procedures for sample acquisition and analysis, this parameter is also generally poorly met. Much of this is due to the more recent development of QA procedures.

While these limitations cannot in most cases be quantified (and some such as representativeness are specifically only qualitative), most of the data gathered in the T Plant Aggregate Area can be cited as failing one or more of the PARCC parameters. As discussed in Section 8.1.2, the data are considered to be deficient in completeness, (the appropriate media, constituents, or locations were generally not sampled or analyzed). These data should, however, be used to the maximum extent in the development of work plans for site field investigations, prioritization of the various units, and to determine, to the extent possible, where contamination is or is not present.

In addition to these site-specific data, there are also a limited number of non site-specific sampling events that are being developed to determine background levels of naturally occurring constituents (Hoover and LeGore 1991). These data can be used to differentiate the effect of the environmental releases from naturally occurring background levels.

8.1.4 Conceptual Models

The initial conceptual model of the sites in the T Plant Aggregate Area is presented and described in Section 4.2 (Figure 4-3). The model is based on best estimates of where contaminants were discharged and their potential for migration from release points. The conceptual model is designed to be conservatively inclusive in the face of a lack of data. This means that a migration pathway was included if there is any possibility of contamination travelling on it, historically or at present. In most cases there may not be a significant flux of such contamination migration for many of the pathways shown on the figure.

All pathways are possible; only a few are likely because of the conservatism inherent in including all conceivable pathways. More importantly, even if a pathway carries significant levels of a contaminant, it still may not have carried contamination to the ultimate receptors, human or ecological. This can only be assessed by sampling at the exposure point on this pathway, or sampling at some other point and extrapolation to the exposure point, to indicate the dosage to the receptors.

There are thus significant uncertainties in the contaminant levels in the contaminant migration pathways shown on the conceptual model, yet almost none of these pathways has been sampled to determine whether any contamination still exists in any of the locations implicated from the conceptual model, and if so which constituents, how much, and to what extent.

8.1.5 Aggregate Area Management Study Objectives and Decisions

The specific objectives of the T Plant AAMS are listed in Section 1.3. They include (in part) the following:

- Assemble site data (as described in Section 8.1.2)
- Develop a preliminary site conceptual model (see Section 8.1.3)
- Identify potential contaminants of concern and their distribution (Sections 4.0 and 5.0)
- Identify preliminary ARARs (Section 6.0)
- Define preliminary remedial action objectives and screen potential remedial technologies to prepare preliminary remedial action alternatives (Section 7.0)
- Recommend ERA, IRM, LFI, or other actions (Section 9.0)
- Redefine and prioritize, as data allow, workplan activities with emphasis on supporting early cleanup actions and records of decision.

The decisions that will have to be made on the basis of this AAMS can best be described according to the *Hanford Site Past-Practice Strategy* (DOE/RL 1992) flow chart (Figure 1-2 in Section 1.0) that must be conducted on a site-by-site basis. Decisions are shown on the flow chart as diamond-shaped boxes, and include the following:

- Is an ERA justified?
- Is less than six months' response needed (is the ERA time critical)?
- Are data from field investigations sufficient to formulate the conceptual model and perform a qualitative risk assessment?
- Is an IRM justified?
- Can the remedy be selected?

- Can additional required data be obtained by LFI?
- Are data (from field investigations) sufficient to perform risk assessment?
- Can an Operable Unit/Aggregate Area ROD be issued?

(The last two questions will only be asked after additional data are obtained through field investigations, and so are DQO issues only in assessing scoping for those investigations.)

Most of these decisions are actually a complicated mixture of many smaller questions, and will be addressed in Section 9.0 in a more detailed flowchart for assessing the need for remediation or investigation.

Similarly, the tasks that will need to be performed after the AAMS that drive the data needs for the study are found in the rectangular boxes on the flow chart. These include the following:

- ERA (if justified)
- Definition of threshold contamination levels, and formulation of conceptual model, performance of qualitative risk assessment and FS screening (IRM preliminaries)
- FFS for IRM selection
- Determination of minimum data requirements for IRM path
- Negotiation of Scope of Work, relative priority, and incorporation into integrated schedule, performance of LFI
- Determination of minimum data needs for risk assessment and final Remedy Selection (preparation of RI/FS pathway).

These stages of the investigation must be considered in assessing data needs (Section 8.2.1).

8.2 DATA USES AND NEEDS (Stage 2 of the DQO Process)

Stage 2 of the DQO development process (EPA 1987a) defines data uses and specifies the types of data needed to meet the project objectives. These data uses and needs are based on the Stage 1 results, but must be more specific. The elements of this stage of the DQO process include:

- Identifying data uses (Section 8.2.1)
- Identifying data types (Section 8.2.2.1)
- Identifying data quality needs (Section 8.2.2.2)
- Identifying data quantity needs (Section 8.2.2.3)
- Evaluating sampling/analysis options (Section 8.2.2.4)
- Reviewing data quality parameters (Section 8.2.2.5)
- Summarizing data gaps (Section 8.2.3).

Stage 2 is developed on the basis of the conceptual model and the project objectives. These following sections discuss these issues in greater detail.

8.2.1 Data Uses

For the purposes of the remediation in the T Plant Aggregate Area, most data uses fall into one or more of four general categories:

- Site characterization
- Public health evaluation and human health and ecological risk assessments
- Evaluation of remedial action alternatives
- Worker health and safety.

Site characterization refers to a process that includes determination and evaluation of the physical and chemical properties of any wastes and contaminated media present at a site, and an evaluation of the nature and extent of contamination. This process normally involves the collection of basic geologic, hydrologic, and meteorologic data but more importantly for the T Plant Aggregate Area waste management units, data on specific contaminants and sources that can be incorporated into the conceptual model to indicate the relative significance of the various pathways. Site characterization is not an end in itself, as stressed in the *Hanford Site Past-Practice Strategy* (DOE/RL 1992), but rather the data must work toward the ultimate objectives of assessing the need for remediation (according to risk assessment methods, either qualitative or quantitative, or compliance with ARARs) and providing appropriate means of remediation (through an FFS, FS, or CMS). The understanding of the site characterization, based on existing

data, is presented in Sections 2.0, 3.0, and 4.0, and summarized in the conceptual model (Section 4.2).

Data required to conduct a public health evaluation, and human health and ecological risk assessments at the sites in the T Plant Aggregate Area include the following: input parameters for various performance assessment models (e.g., the Multimedia Environmental Pollutant Assessment System), site characteristics, and contaminant data required to evaluate the threat to public and environmental health and welfare through exposure to the various media. These needs usually overlap with site characterization needs. An extensive discussion of risk assessment data uses and needs, both for human and ecological evaluations, is presented in the *Risk Assessment Guidance for Superfund* Volumes 1 and 2 (EPA 1989b,c). EPA Region 10 has also developed its preferred methodology for these risk assessment activities (EPA-10 1991, 1989). The ecological and human health risk assessments will follow the guidance outlined in the M-29-03 milestone document, *Hanford Site Baseline Risk Assessment Methodology* (DOE/RL 1991c). The data requirements for an ecological risk assessment include (1) identification of critical species, (2) identification of habitat within and surrounding the Hanford Site, (3) feeding relationships among species of concern, and (4) contaminant concentrations in environmental media and species of concern. The main deficiency in the data available for waste management units in the T Plant Aggregate Area is that a quantitative assessment of contaminant concentrations for the purposes of Risk Assessment cannot be performed. The present understanding of site risks is presented in the selection of constituents of concern (Section 5.0). Quantitative risk assessments will be conducted at the Hanford Site with a methodology under development, and the data needs for this methodology will be considered in developing site specific sampling and analysis plans.

Data collected to support evaluation of remedial action alternatives for ERAs, IRMs, FFSs, or the full RI/FS, include site screening of alternatives, feasibility-level design, and preliminary cost estimates. Once an alternative is selected for implementation, much of the data collected during site investigations (LFI or RI) can also be used for the final engineering design. Generally, collection of information during the investigations specifically for use in the final design is not cost effective because many issues must be decided about appropriate technologies before effective data gathering can be undertaken. It is preferable to gather such specific information during a separate predesign investigation or at the time of remediation (i.e., the "observational approach" of the *Hanford Site Past-Practice Strategy* [DOE/RL 1992]). Based on the existing data, broad remedial action technologies and objectives have been identified in Section 7.0.

The worker health and safety category includes data collected to establish the required level of protection for workers during various investigation activities. These data are used to determine if there is concern for the personnel working in the vicinity of the aggregate area. The results of these assessments are also used in the development of

the various safety documents required for field work (see Health and Safety Plan, Appendix B).

It should be noted that each of these data use categories (site characterization, risk assessment needs, remedial actions, and health and safety) will be required at each decision point on the *Hanford Site Past-Practice Strategy* (DOE/RL 1992) flow chart, as discussed at the end of Section 8.1.5. To the extent possible, however, not all sites will be investigated to the same degree but only those with the highest priority. These results will then be extended to the other, analogous sites which have similar geology and disposal histories (see Section 9.2.3).

The existing data can presently be used for two main purposes:

- Development of site-specific sampling plans (site characterization use)
- Screening for health and safety (worker health and safety use).

Table 8-1 presents a summary of the availability of existing data for these two uses.

For the purposes of developing sampling plans, existing information is available for:

- The location of sites -- many of the sites have surface expressions, markers, or have been surveyed in the past. The unplanned releases in particular are lacking in this information, as well as for the 216-T-20 Trench.
- Possible contamination found at the sites -- these data are derivable from the inventories for the sites (mainly for the cribs and other disposal facilities).
- The depth of gamma-ray emitting radionuclides -- this information is obtained from the gross gamma borehole logging for many of the sites.

Two types of information are available for the purposes of worker health and safety, and will be used for the development of health and safety documents:

- Levels of surface contamination -- derived from the ongoing periodic radiological surveys done under the Environmental Surveillance program (Schmidt et al. 1991). Table 8-1 shows where surveys have indicated detectible levels of surface radiation.
- Potential groundwater contamination -- this determination is based on a comparison of waste volume discharged and the available soil pore volume. All sites for which waste volume exceeds the soil pore volume are identified in Table 8-1.

Table 8-1 also presents a first expression of the data needs for the individual waste management units in the T Plant Aggregate Area, which must be addressed for remediation approaches to be developed.

8.2.2 Data Needs

The data needs for the T Plant Aggregate Area are discussed in the following sections according to the categories of types of data (Section 8.2.2.1), quality (8.2.2.2), quantity (8.2.2.3), options for acquiring the data (8.2.2.4), and appropriate DQO (PARCC) parameters (8.2.2.5). These considerations are summarized for each category of waste management unit site in the T Plant Aggregate Area (Section 8.2.3).

8.2.2.1 Data Types. Data use categories described in Section 8.2.1 define the general purpose of collecting additional data. Based on the intended uses, a concise statement regarding the data types needed can be developed. Data types specified at this stage should not be limited to chemical parameters, but should also include necessary physical parameters such as bulk density and moisture. Since environmental media and source materials are interrelated, data types used to evaluate one media may also be useful to characterize another media.

Identifying data types by media indicates that there are overlapping data needs. Data objectives proposed for collection in the site investigations at sites in the T Plant Aggregate Area are discussed in Section 8.3 to provide focus to investigatory methods that may be employed. The data type requirements for the preliminary remedial action alternatives developed in Section 7.4 are summarized in Table 8-2.

8.2.2.2 Data Quality Needs. The various tasks and phases of a CERCLA investigation may require different levels of data quality. Important factors in defining data quality include selecting appropriate analytical levels and validation and identifying contaminant levels of concern as described below. The Westinghouse Hanford document, *A Proposed Data Quality Strategy for Hanford Site Characterization,* will be used to help define these levels (McCain and Johnson 1990). Data Quality Objectives will also be developed and defined on an operable unit basis in the work plans and, specifically, in the Quality Assurance Project Plan (QAPjPs) which will guide investigation activities.

Chemical and radionuclide laboratory analysis will be one of the most important data types, and is required at virtually all the sites in the T Plant Aggregate Area. In general, increasing accuracy, precision, and lower detection limits are obtained with increasing cost and time. Therefore, the analytical level used to obtain data should be commensurate with the intended use. Table 8-3 defines five analytical levels associated with different types of characterization efforts. While the bulk of the analysis during LFIs/RIs will be screening level (DQO Level I or II), these data will require confirmation sampling and analysis to allow final remedial decisions through quantitative risk assessment methods. Individual DQO analytical PARCC parameters for Level III or IV analytical data associated with each contaminant anticipated in the T Plant Aggregate Area (as developed in Section 4) are given in Table 8-4. These parameters will be used for the development of site-specific sampling and analysis plans and quality assurance plans for investigations and remediations in the aggregate area.

Before laboratory or even field data can be used in the selection of the final remedial action, they must first be validated. Exceptions are made for initial evaluations of the sites using existing data, which may not be appropriate for validation but will be used on a screening basis based on the *Hanford Site Past-Practice Strategy* (DOE/RL 1992). Other screening data (e.g., estimates of contaminant concentration inferred from field analyses) may also be excepted. Validation involves determining the usability and quality of the data. Once data are validated, they can be used to

successfully complete the remedial action selection process. Activities involved in the data validation process include the following:

- Verification of chain-of-custody and sample holding times
- Confirmation that laboratory data meet QA/Quality Control (QC) criteria
- Confirmation of the usability and quality of field data, which includes geological logs, hydrologic data, and geophysical surveys
- Proper documentation and management of data so that they are usable.

Validation may be performed by qualified Westinghouse Hanford personnel from the Office of Sample Management (OSM), other Westinghouse Hanford organizations, or a qualified independent participant subcontractor. Data validation of laboratory analyses will be performed in accordance with *A Proposed Data Quality Strategy for Hanford Site Characterization* (McCain and Johnson 1990) and standards set forth by Westinghouse Hanford.

To accomplish the second point, all laboratory data must meet the requirements of the specific QA/QC parameters as set up in the Quality Assurance Project Plan (QAPP) for the project before it can be considered usable. The QA/QC parameters address laboratory precision and accuracy, method blanks, instrument calibration, and holding times.

The usability of field data must be assessed by a trained and qualified person. The project geohydrologist/geophysicists will review the geologic logs, hydrologic data, geophysical surveys, and results of physical testing, on a daily basis, and senior technical reviews will be conducted periodically throughout the project.

Data management procedures are also necessary for the validation. Data management includes proper documentation of field activities, sample management and tracking, and document and inventory control. Specific consistent procedures are discussed in the Information Management Overview (Appendix D).

8.2.2.3 Data Quantity Needs. The number of samples that need to be collected during an investigation can be determined by using several approaches. In instances where data are lacking or are limited (such as for contamination in the vadose zone soils), a phased sampling approach will be appropriate. In the absence of any available data, an approach or rationale will need to be developed to justify the sampling locations and the numbers of samples selected. This will be accomplished and documented by Westinghouse Hanford in the production of work plans and field sampling plans for each aggregate area, under the guidance and review of the Tri-Party Agreement participants. Specific locations and numbers of samples will be determined based on data collected during screening activities. For example, the number and location of beta/gamma

spectrometer probe locations can be based on results of surface geophysical and radiation surveys. These may help locate some subsurface features (such as the 216-T-20 Trench), which may not be adequately documented. Details of any higher DQO level subsurface soil sampling scheme will depend on results of screening investigations such as geophysics surveys, surface radiation surveys, and beta/gamma spectrometer probe surveys. In situations where and when available data are more complete, statistical techniques may be useful in determining the additional data required.

8.2.2.4 Sampling and Analysis Options. Data collection activities are structured to obtain the needed data in a cost-effective manner. Developing a sampling and analysis approach that ensures that appropriate data quality and quantity are obtained with the resources available may be accomplished by using field screening techniques and focusing the higher DQO level analyses on a limited set of samples at each site. The investigations on sites in the T Plant Aggregate Area should take advantage of this approach for a comprehensive characterization of the site in a cost-effective manner.

A combination of lower level (Levels I, II, and III) and higher level analytical data (Levels IV and V) should be collected. For instance, at least one of the samples collected from each source (including contaminated surface soil at unplanned release locations) should be analyzed at DQO Level IV or V and validated to provide high quality data to confirm the less expensive but more extensive lower level analyses. This approach would provide the certainty necessary to determine contaminants present near the sources. Samples collected from the other media (i.e., subsurface soils, sediments) will be analyzed by *Test Methods for Evaluating Solid Wastes*, (EPA 1986), CLP (EPA 1988b, EPA 1989b), *Methods for Chemical Analysis of Water and Wastes* (EPA 1983), or *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980b).

8.2.2.5 Data Quality Parameters. The PARCC parameters are indicators of data quality. Ideally, the end use of the data collected should define the necessary PARCC parameters. Once the PARCC requirements have been identified, then appropriate analytical methods can be chosen to meet established goals and requirements. Definitions of the PARCC parameters are presented in Section 8.1.2.

In general the precision and accuracy objectives are governed by the capabilities of the available methodologies and in most cases these are more than adequate for the needs of the investigations. Chemical analyses can usually attain parts per billion detection range in soils and water, and this level is adequate to the needs of the risk assessment for most analytes. Radiological analyses reach similar levels. Some constituents (e.g., arsenic) would require analysis to much lower levels, but this is impossible because of the limitations of analytical methods and the effects of natural background levels. For example, EPA Method 200.62-C-CLP can analyze to detection levels of 500 μg/kg in soils, while the Model Toxics Control Act (MTCA) Method C Industrial soils cleanup level is 50 μg/kg. In addition, risk assessment is conventionally computed only to a single digit of precision and uses conservative assumptions, which reduce the impact of measurements with lower accuracy.

For other measurements, such as physical parameters, the precision and accuracy capabilities of existing measurement technologies are sufficient for the evaluation methods used to produce characterization data, so the objectives are based on the limitations of the analysis methodologies.

Representativeness is maintained by fitting the sampling program to the governing aspects of the sources and transport processes of the site, as demonstrated in the site conceptual model (Section 4.2). Initial sampling should concentrate on sources, which are fairly well-understood, and on representative locations of anticipated transport mechanisms. If necessary, following activities can focus on aspects or locations that were not anticipated but were demonstrated by the more general results.

Completeness is generally attained by specifying redundancy on critical samples and maintaining quality control on their acquisition and analysis. As with representativeness, the initial sampling program may lead to modifications of which samples should be considered critical during subsequent sampling activities.

Comparability will be met through the use of Westinghouse Hanford standard procedures generally incorporated into the *Environmental Investigation and Site Characterization Manual* (WHC 1988c).

8.2.3 Data Gaps

Considering the data needs developed in the subsections of Section 8.2.2, and the data available to meet these needs as presented in Section 8.1.2, it is apparent that a number of data gaps can be identified. These are summarized, on a waste management unit category basis, in Table 8-5, and should be the focus of LFIs on a waste management unit category basis, using the analogue sites approach. These contaminant concentration data are the highest priority because of the need to assess the need for remediation (through quantitative risk assessment and evaluation of compliance with ARARs) and appropriate remedial actions for each site.

In addition to these data needs specifically addressing contamination problems at sites included for consideration in this aggregate area, there are general data needs which will be required for characterization of the possible transport pathways, as presented in the conceptual model, at locations away from the individual units. These general, non-site specific needs include characterization of the following:

- Geologic stratigraphy, particularly for possible perched water zones
- Air transport of contamination
- Ecological impacts and transport mechanisms (bio-uptake, bio-concentration, secondary receptors through predation)

- Potential releases from process effluent lines between facilities and to waste disposal sites.

All of these needs will have to be addressed in the data collection program (Section 8.3).

8.3 DATA COLLECTION PROGRAM (Stage 3 of the DQO Process)

The data collection program is Stage 3 of the process to develop DQOs. Conducting an investigation with a mixture of screening and higher-level data is a common method for optimizing the quantity and quality of the data collected. It would be very inefficient and overly expensive to specify beforehand all the types of samples and analyses that will yield the most complete and accurate understanding of the contamination and physical behavior of the site. Data adequate to achieve all the goals and objectives for remedial action decisions are obtained at a lower cost by using the information obtained in the field to focus the ongoing investigation and remediation process.

Initial sampling should collect new data believed most necessary to confirm and refine the conceptual model particularly at priority sites. Sampling may then be extended to further reduce uncertainty, to fill in remaining data gaps, to collect more detailed information for certain points where such information is required, or to conduct any needed treatability studies or otherwise support the data needs of the remedial action selection process. An alternative of extrapolating the data from a limited number of sites to other analogous ones will also be used. The need for subsequent investigation phases will be assessed throughout the investigation and remediation activities as data become available. Assessing completeness of the investigation data through a formal statistical procedure is not possible, given the complexity and uncertainty of the parameters required to describe the site and the time to make decisions. Rather, the use of engineering judgement is considered sufficient to the decision process.

8.3.1 General Rationale

The general rationale for the investigation of sites in the T Plant Aggregate Area is to collect needed data that are not available. Because of the size of the aggregate area, the complexity of past operations, and the number of unplanned releases and waste management units, a large amount of new information will be required such as the specific radionuclides and chemicals present, their spatial distribution and form, and the presence of special migration pathways (such as perched groundwater systems).

The following work plan approach will be used for LFIs and RI/FS in the T Plant Aggregate Area. The results are described in Sections 8.3.2 and 8.3.3 in a general form.

- Existing data as described in Sections 2.0, 3.0, and 4.0 should be used to the maximum extent possible. Although existing data are not validated fully, the data are still useful in developing a preliminary conceptual model (Section 4.2) and in helping to focus and guide the planning of investigations, expedited actions, and interim measures.

- Additional data at validated and screening levels should be collected to obtain the maximum amount of useful information for the amount of time and resources invested in the investigation.

- Data should be collected to support the intended data uses identified in Section 8.2.1.

- Nonintrusive sampling (e.g., geophysical surveys, surface radiation surveys, soil gas, and spectral gamma probe surveys), and surficial and source sampling should be conducted early in any investigation effort to identify necessary interim response actions (i.e., additional ERAs or IRMs).

- Data collected from initial investigation activities should be used to confirm and refine the conceptual model (Section 4.2), refine the analyte constituents of concern, and provide information to conduct interim response actions or risk assessment activities.

- Additional investigation activities are proposed to support (if needed) quantitative baseline risk assessments for final cleanup actions and further refine the conceptual model.

- Field investigation techniques should be used to minimize the amount of hazardous or mixed waste generated. Any waste generated will be in accordance with EII 4.2, "Interim Control of Unknown Suspected Hazardous and Mixed Waste " (WHC 1988c).

8.3.2 General Strategy

The overall objective of any field investigation (LFI, IRM, or RI) of the sites in the T Plant Aggregate Area will be to gather additional information to support risk assessment and remedial action selection according to the *Hanford Site Past Practice Strategy* (DOE/RL 1992) flow chart discussed in Section 8.1.5. The general approach or strategy for obtaining this additional information is presented below.

- Analytical parameter selection should be based on verifying overall conditions and then narrowed to specific constituents of concern, in consideration with regulatory requirements and site conditions. Periodic analyses of the long list of parameters should be conducted to verify that the list of constituents of

concern has not changed, either because new constituents are identified or some of those considered as a potential concern do not appear to be significant.

- Similarly, investigations should work from a screening level (DQO Levels I or II, e.g., surface radiation surveys) to successively more specific sampling and analysis methodologies (e.g., beta/gamma spectral probes, then DQO Level III or IV soil sampling and analysis), without time consuming remobilizations.

- Dangerous and radioactive wastes may be generated during the field investigation. While efforts should be made to minimize these wastes, any waste generated will be handled in accordance with EII 4.2, "Interim Control of Unknown Suspected Hazardous and Mixed Waste" (WHC 1988c). The analyses of samples for constituents of concern analytes will allow wastes generated to be adequately designated.

8.3.3 Investigation Methodology

Initial field investigations (mainly LFIs, but also associated with IRMs at appropriate sites and possibly some RIs) may include some or all of the following integrated methodologies:

- Source Investigation (Section 8.3.3.1)
- Geological Investigation (Section 8.3.3.2)
- Surface Water Sediment Investigation (Section 8.3.3.3)
- Soil Investigation (Section 8.3.3.4)
- Air Investigation (Section 8.3.3.5)
- Ecological Investigation (Section 8.3.3.6)
- Geophysical Stratigraphic Survey (Section 8.3.3.7)
- Process Effluent Pipeline Integrity Assessment (Section 8.3.3.8)
- Geodetic Survey (Section 8.3.3.9).

Each investigation methodology is briefly outlined in the following sections. Specific survey methods (such as electromagnetics or ground-penetrating radar) have not been recommended to allow flexibility in the development of field sampling plans which can be sensitive to very local conditions. A summary of the applicable methods for each

waste management unit is presented in Table 8-6. In addition, some of the data needs must be addressed on an area-wide basis (e.g., stratigraphy interpretation). More detailed descriptions and specific methods and instrumentation will be included in site-specific work plans, sampling and analysis plans, and field sampling plans for LFIs/IRMs at waste management units that require these investigations.

These investigations are presented in the approximate priority of their need, with the source investigation first because of its importance to the decisions about remedial action on a site-by-site basis. The other investigations are of lower priority, and will be conducted according to the need to determine whether contamination has been transported beyond the immediate vicinity of the waste management units. To some extent, this need will depend on the results of the source investigation.

8.3.3.1 Source Investigation. The purpose of source investigation activities in the T Plant Aggregate Area is to characterize the known waste management units and unplanned releases that exist in the area and that may contribute to contamination of surface soil, vadose zone, surface water, sediment, air, and biota. The completeness of the characterization effort will be assessed according to the needs of risk assessment and remedial action selection, which will also determine what levels of the various constituents of concern comprise "contamination."

Source sampling should be conducted at waste management units or unplanned release locations where the available data indicate that dangerous, mixed, or radioactive wastes may be present. Activities which are proposed to be performed during the source investigations include the following.

- Compile and evaluate additional existing data for the purpose of: verifying locations, specifications of engineered facilities, and pipelines, and waste stream characteristics; assessing the construction and condition of boreholes/wells that exist in the operable unit and their suitability for use for investigation activities, QA/QC information, and raw data regarding radiological and hazardous substances monitoring; and integrating any additional environmental modeling data into the conceptual model. This has been done (on an aggregate area basis) in this report; the process will be extended to site-specific planning and on-going assessments of the investigation/remediation as it is carried out.

- Conduct surface radiological survey of suspected or known source areas to verify locations and nature of surface and subsurface radiological contamination. Conditions at specific sources within a waste management unit should also be noted in order to plan sampling/remediation activities and worker health and safety.

- Conduct nonintrusive geophysical surveys at unplanned release locations to verify locations and physical characteristics of source locations. Data generated from these activities can be used in planning intrusive source sampling activities. It is recommended that sites with structures which could not be field located, as identified in Table 8-1, and all unplanned releases associated with pipelines be investigated with surface geophysics.

- Conduct beta/gamma spectrometer probe survey to screen for near-surface contamination and to confirm the absence or presence of some specific radionuclides, which may be of particular concern. Existing boreholes will be used to the maximum extent, but new boreholes may be needed at many locations (to be decided based on screening results). Logging will be done both by NaI detectors or μR meters for rapid screening as well as the RLS high purity germanium logging system. Westinghouse Hanford will develop an EII Procedure for the beta/gamma spectrometer probe survey. The beta/gamma spectrometer probe survey serves two purposes depending on the source conditions: to confirm absence of contamination in the near-surface soils, and to serve as a screening tool to choose locations and quantities of vadose zone soil borings. The RLS procedure could demonstrate "assay quality" data for radionuclide concentrations, but will probably continue to require supporting Level IV soil analysis data to allow a risk assessment before final remedial decisions. The need to conduct this survey will be based (at least in part) on the screening results of the surface survey and on information about site burial.

- Soil gas surveys should be conducted at waste management units (such as cribs or the Construction Surface Laydown Area) where volatile organic chemicals are suspected, as a screening method to identify compounds such as solvents and degreasers that may have been used in separate processes or during construction activities. The soil gas survey should not be considered conclusive that volatile organic compounds at lower concentrations may not be present. Data from the soil gas survey can be used to help locate surface and near-surface samples and vadose zone borings.

- Collect surface and near-surface samples of contaminated soils and/or waste materials at selected locations. Specific sampling sites will be chosen to assess particular facilities or releases. Additional sampling sites may be specified based on results from nonintrusive investigations.

- Wipe samples should be collected as part of the investigations of surface contamination or building (piping or pavement) surfaces. The wipe sample locations can be chosen based on visual observations and a surface radiation survey conducted during a site walkthrough. The methodology may be limited by the presence of soil, rough concrete, or paving and so may not be heavily used except as confirmation following removal of loose contamination.

8.3.3.2 Geologic Investigation. A geologic investigation should be performed to better characterize the vadose zone and the nature of unsaturated soils that make up this system. The geologic investigation will include the following tasks:

- Borings may be advanced into zones where an accurate interpolation of the subsurface stratigraphy is important to understanding migration pathways in the vadose zone. An investigation of the Plio-Pleistocene layer, which may be causing perched water zones, may be especially valuable.

- Geologic data collected during the ongoing vadose zone soil (Section 8.3.3.4) and other (deeper) investigations (e.g., geologic and geophysical logs from groundwater well installations for groundwater AAMSs) will be compared, compiled, and evaluated.

8.3.3.3 Surface Water Sediment Investigation. A surface water sediment investigation should be conducted. The investigation will include the following.

- Radiation surveys along ditches, trenches, and ponds for health and safety purposes and to locate areas of elevated radiation for selection of specific sediment sampling locations.

- Sampling of sediment in any ditches, ponds, and trenches that still contain water. This will probably be limited to the 207-T Retention Basin, and the 216-T-1 and 216-T-4-2 Ditches.

8.3.3.4 Soil Investigation. The purpose of soil investigations is to determine physical and chemical properties of the soil and to determine the nature, type, and extent of soil contamination associated with waste management units and unplanned releases to allow initiation of interim remedial actions and to assess the quantitative risk at other sites. Sampling will include the following.

- Samples of vadose zone soil will be collected and analyzed for constituents of concern when wells are drilled for other studies (i.e., groundwater investigations) in the vicinity of a waste management unit or unplanned release with reported liquid disposals or spills. Organic vapor (at sites with suspected volatiles) and radiation sampling should also be performed with samples selected by onsite screening.

- Data collected during this investigation will be evaluated to further understand the contribution of contaminants to the vadose zone from specific waste management units and/or unplanned releases and to better define the hydrology and water quality in the vadose zone system through moisture content profiles and tracking of specific contaminants.

8.3.3.5 Air Investigation. Air investigations (on an aggregate area scale) should consist of onsite particle sampling as part of the health and safety program. In addition, high-volume air samplers should be placed in appropriate locations on-site based on evaluation of existing meteorological data. The purpose of these samplers will be to determine if any migration of airborne contaminants occurs.

8.3.3.6 Ecological Investigation. Ecological investigation activities, on a site-wide scale, should include a literature search and data review, and a site walkthrough. These activities are intended to identify potential biota concerns which need to be addressed in the site investigation. Particular emphasis should be given to identifying potential exposure pathways to biota that migrate offsite or that introduce contaminants into the food web. Data obtained in this survey will be used to both refine the conceptual model as well as to conduct the ecological risk assessment.

8.3.3.7 Geophysical Stratigraphic Survey. Additional information needs to be gathered to better define the depth and lateral extent of the perched water zones and the caliche layer (an important aquitard) in the Plio-Pleistocene unit. This information may be obtained using a number of subsurface characterization techniques such as: magnetic and seismic surveys and well hole logging.

8.3.3.8 Process Effluent Pipeline Integrity Assessment. An assessment of process effluent pipeline integrity should be conducted early in site investigation activities to look for potential leaks and therefore possible areas of contamination. Initially, as part of this effort, drawings of the process lines and encasements within the aggregate area (Section 2.3.7) should be reviewed and their construction, installation, and operation evaluated. Specific lines will then be selected for integrity assessment with emphasis on lines serving the waste management units that have received large volumes of liquid (e.g., cribs). Investigation of operating high level waste transfer lines will be deferred to their respective programs. Results of the integrity assessments will be evaluated and additional sampling activities may be recommended for subsequent studies.

8.3.3.9 Geodetic Survey. Geodetic surveys will be conducted after the installation and completion of each investigation activity. The survey will be to locate the horizontal locations of surface and near-surface soil samples; corners of geophysics, soil gas, and beta/gamma probe surveys; and surface water and sediment sample locations. Horizontal and vertical locations of all vadose zone soil borings and perched zone wells will be surveyed. The geodetic survey should be conducted by a professional surveyor licensed in the state of Washington and should be referenced to both historic (e.g., Hanford coordinates) and current coordinate datums (e.g., North American Datum of 1983 - NAD-83), both vertical and horizontal.

8.3.4 Data Evaluation and Decision Making

Data will be evaluated as soon as results (e.g., soil gas, radiation screening, drilling results) become available for use in restructuring and focusing the investigation activities. Data reports will be developed that summarize and interpret new data. This includes groundwater sampling and RLS borehole logging as part of the AAMS. Data will be used to refine the conceptual model, further assess potential contaminant-specific ARARs, develop the quantitative risk assessment, and assess remedial action alternatives.

The objectives of data evaluation follow:

- To reduce and integrate data to ensure that data gaps are identified and that the goals and objectives of the T Plant AAMS are met

- To confirm that data are representative of the media sampled and that QA/QC criteria have been met.

Table 8-1. Uses of Existing Data for T Plant Aggregate Area Waste Management Units. (Sheet 1 of 5)

Waste Management Unit or Unplanned Release	Development of Sampling Plans				Health and Safety
	Field Located[1] (Y or N)	Possible Contamination[2]	Depth of Contamination[3]	Potential Groundwater Contamination[4] (Y or N)	Surface Contamination[5]
Tanks and Vaults					
241-T-361 Settling Tank	Y				
241-TX-302B Catch Tank	Y				
241-TX-302C Catch Tank	Y				
Cribs and Drains					
216-T-6 Crib	Y	R,C	R	Y	
216-T-7TF Crib	Y	R,C	R	Y	
216-T-8 Crib	Y	R,C		N	
216-T-18 Crib	Y	R,C	R	Y	
216-T-19TF Crib	Y	R,C	R	Y	R
216-T-26 Crib	Y	R,C	R	Y	R
216-T-27 Crib	Y	R,C	R	Y	R
216-T-28 Crib	Y	R,C	R	Y	R
216-T-29 Crib	Y	C		N	
216-T-31 French Drain	Y				
216-T-32 Crib	Y	R,C	R	Y	
216-T-33 Crib	Y	R,C		Y	R
216-T-34 Crib	Y	R,C		Y	R
216-T-35 Crib	Y	R,C	R	N	
216-T-36 Crib	Y	R,C		N	
216-W-LWC Crib	Y	R,C		Y	

Table 8-1. Uses of Existing Data for T Plant Aggregate Area Waste Management Units. (Sheet 2 of 5)

Waste Management Unit or Unplanned Release	Development of Sampling Plans				Health and Safety
	Field Located[1] (Y or N)	Possible Contamination[2]	Depth of Contamination[3]	Potential Groundwater Contamination[4] (Y or N)	Surface Contamination[5]
Reverse Wells					
216-T-2 Reverse Well	Y	R,C		Y	
216-T-3 Reverse Well	Y	R,C	R	Y	
Ponds, Ditches, and Trenches					
216-T-4A Pond	Y	R		Y	
216-T-4B Pond	Y	R			
216-T-1 Ditch	Y	R,C		Y	
216-T-4-1D Ditch	Y	R			
216-T-4-2 Ditch	Y	R		Y	
200-W Powerhouse Pond[6]	Y				
216-T-5 Trench	Y	R,C			
216-T-9 Trench	N				
216-T-10 Trench	N				
216-T-11 Trench	N				
216-T-12 Trench	Y	R,C		Y	R
216-T-13 Trench	N				
216-T-14 Trench	Y	R,C		N	R
216-T-15 Trench	Y	R,C		N	R
216-T-16 Trench	Y	R,C		N	R
216-T-17 Trench	Y	R,C		N	R
216-T-20 Trench	N	R,C		N	

Table 8-1. Uses of Existing Data for T Plant Aggregate Area Waste Management Units. (Sheet 3 of 5)

Waste Management Unit or Unplanned Release	Development of Sampling Plans				Health and Safety
	Field Located[1] (Y or N)	Possible Contamination[2]	Depth of Contamination[3]	Potential Groundwater Contamination[4] (Y or N)	Surface Contamination[5]
216-T-21 Trench	Y	R,C	R		
216-T-22 Trench	Y	R,C	R	N	
216-T-23 Trench	Y	R,C		N	
216-T-24 Trench	Y	R,C	R	N	
216-T-25 Trench	Y	R,C			
Septic Tanks and Associated Drain Fields					
2607-W1 Septic Tank	Y				
2607-W2 Septic Tank	Y				
2607-W3 Septic Tank	Y	R			
2607-W4 Septic Tank	Y				
Transfer Facilities, Diversion Boxes, and Pipelines					
241-TX-152 Diversion Box	Y				
241-TX-154 Diversion Box	Y	R,C			
241-TX-155 Diversion Box	Y	R,C			
Basins					
207-T Retention Basin	Y	R			
Burial Sites					
200-W Ash Disposal Basin	Y	C			
200-W Ash Pit Demolition Site	Y	C			
200-W Burning Pit	Y	R,C			
200-W Powerhouse Ash Pit	Y				

Table 8-1. Uses of Existing Data for T Plant Aggregate Area Waste Management Units. (Sheet 4 of 5)

Waste Management Unit or Unplanned Release	Development of Sampling Plans				Health and Safety
	Field Located[1] (Y or N)	Possible Contamination[2]	Depth of Contamination[3]	Potential Groundwater Contamination[4] (Y or N)	Surface Contamination[5]
218-W-8 Burial Ground	Y	R			
Unplanned Releases					
UN-200-W-2	N	R,C			
UN-200-W-3	N	R,C			
UN-200-W-4	N	R,C			
UN-200-W-7[6]	Y	R,C			
UN-200-W-8	N	R,C			
UN-200-W-12	Y	R,C			
UN-200-W-14	N	R,C			
UN-200-W-27	Y	R,C			
UN-200-W-29	N	R,C			
UN-200-W-38[6]	Y	R,C			
UN-200-W-58	N	R,C			
UN-200-W-63	N	R			
UN-200-W-65	Y	R			
UN-200-W-67	Y	R,C			
UN-200-W-73	N	R,C			
UN-200-W-77	N	R,C			
UN-200-W-85	Y	R			
UN-200-W-88	N	R,C			
UN-200-W-98	N	R,C			R

Table 8-1. Uses of Existing Data for T Plant Aggregate Area Waste Management Units. (Sheet 5 of 5)

Waste Management Unit or Unplanned Release	Development of Sampling Plans				Health and Safety
	Field Located[1] (Y or N)	Possible Contamination[2]	Depth of Contamination[3]	Potential Groundwater Contamination[4] (Y or N)	Surface Contamination[5]
UN-200-W-99	N	R,C			R
UN-200-W-102	N	R			
UN-200-W-113[6]	Y	R,C			
UN-200-W-135	Y	R,C			
UN-200-W-137	Y	R,C			

C: Chemical Contamination
R: Radiological Contamination

1) Based on site visit information contained in Appendix A-2.5.
2) Based on information contained in Table 4-20.
3) Based on information contained in Table 4-11.
4) Based on results from Table 4-17.
5) Based on information contained in Table 4-8.
6) This unplanned release is associated with another waste management unit.

Table 8-2. Data Needs for Preliminary Remedial Action Alternatives T Plant Aggregate Area.

Alternative	Physical Attribute	Chemical/Radiochemical Attribute
1. Multimedia Cover (plus possible vertical barriers)	• areal extent • depth of contamination • structural integrity (collapse potential) • run-off/run-on potential • cover properties (permeability)	• surface radiation • biologic transport potential
2. In Situ Grouting/ Stabilization	• areal extent • depth • particle size • hydraulic properties (permeability/porosity) • stratigraphy • borehole spacing • grout/additive mix parameters	• solubility • reactivity • leachability from grout medium
3. Excavation, Soil Treatment, and Disposal	• areal extent[a] • depth[a] • particle size • silt-size (dust) content • excavation stability	• toxicity/radioactivity • levels of contaminants • solubility/reactivity • soil chemistry (relative affinity) • concentrations in PM-10 fraction • spent solvent treatment/disposal options
4. In Situ Vitrification	• areal extent • depth • soil/waste conductivity • thermal properties • moisture contact • voids	• volatility • reactivity • leachability/integrity • off-gas treatment waste disposal options
5. Excavation, Above Ground Treatment,and Geologic Disposal	• areal extent[a] • depth[a] • mineralogy of soil/waste • particle size • silt-size (dust) content • excavation stability • treatment parameters	• concentrations of TRU • toxicity/radioactivity • levels of contaminants • concentrations in PM-10 fraction • reactivity • leachability/integrity of final waste form
6. In Situ Soil Vapor Extraction	• areal extent • depth • locations/depth of highest concentrations (vapors, adsorbed) • stratigraphy • soil permeability/porosity • voids	• volatility of constituents (Henry's Law Constant) • non-volatile organics • levels • volatile radionuclides (Radon) • treatability (catalytic oxidization)

[a] May be obtained during remediation using the observational approach recommended by the *Hanford Site Past-Practice Investigation Strategy* (Thompson 1991)

Table 8-3. Analytical Levels for the T Plant Aggregate Area.

Level	Description
LEVEL I	Field screening. This level is characterized by the use of portable instruments which can provide real-time data to assist in the optimization of sampling point locations and for health and safety support. Data can be generated regarding the presence or absence of certain contaminants (especially volatiles) at sampling locations.
LEVEL II	Field analysis. This level is characterized by the use of portable analytical instruments which can be used onsite, or in mobile laboratories stationed near a site (close-support laboratories). Depending on the types of contaminants, sample matrix, and personnel skill, qualitative and quantitative data can be obtained.
LEVEL III	Laboratory analysis using methods other than the Contract Laboratory Program (CLP) Routine Analytical Services (RAS). This level is used primarily in support of engineering studies using standard EPA-approved procedures. Some procedures may be equivalent to CLP RAS without the CLP requirements for documentation.
LEVEL IV	Contract Laboratory Program (CLP) Routine Analytical Services (RAS). This level is characterized by rigorous QA/QC protocols and documentation and provides qualitative and quantitative analytical data. Some regions have obtained similar support via their own regional laboratories, university laboratories, or other commercial laboratories.
LEVEL V	Nonstandard methods. Analyses which may require method modification and/or development are considered Level V by CLP Special Analytical Services (SAS).

Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses. (Sheet 1 of 5)

Analyte	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)
RADIONUCLIDES								
Gross Alpha	900.0 M	TBD	±30	±25	900.0	10	±25	±25
Gross Beta	900.0 M	TBD	±30	±25	900.0	5	±25	±25
Gamma Scan	D3699 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Actinium-225	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Actinium-227	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Americium-241	Am-01	TBD	±30	±25	Am-03	TBD	±25	±25
Americium-242	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Americium-242m	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Americium-243	Am-01	TBD	±30	±25	Am-03	TBD	±25	±25
Antinomy-126	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Antimony-126m	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Barium-137m	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Bismuth-210	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Bismuth-211	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Bismuth-213	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Bismuth-214	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Carbon-14	C-01 M	TBD	±30	±25	TBD	TBD	±25	±25
Cesium-134	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Cesium-135	901.0 M	TBD	±30	±25	901.0	TBD	±25	±25
Cesium-137	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Cobalt-60	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Curium-242	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Curium-244	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Curium-245	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Europium-152	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Europium-154	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25

Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses. (Sheet 2 of 5)

Analyte	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)
RADIONUCLIDES (cont.)								
Europium-155	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Francium-221	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Francium-223	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Iodine-129	902.0 M	TBD	±30	±25	902.0	TBD	±25	±25
Lead-209	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Lead-210	Pb-01 M	TBD	±30	±25	Pb-01	TBD	±25	±25
Lead-211	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Lead-212	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Lead-214	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Neptunium-237	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Neptunium-239	D35649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Nickel-59	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Nickel-63	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Niobium-93m	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Plutonium	Pu-02	TBD	±30	±25	Pu-10	TBD	±25	±25
Plutonium-238	Pu-02	TBD	±30	±25	Pu-10	TBD	±25	±25
Plutonium-239/240	Pu-02	TBD	±30	±25	Pu-10	TBD	±25	±25
Plutonium-241	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Polonium-210	Po-02	TBD	±30	±25	Po-02	TBD	±25	±25
Polonium-214	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Polonium-215	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Polonium-218	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Potassium-40	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Protactinium-231	TBD	TBD	±30	±25	TBD	TBD	±25	±25

Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses. (Sheet 3 of 5)

Analyte	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)
RADIONUCLIDES (cont.)								
Protactinium-234m	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Radium	Ra-04	TBD	±30	±25	Ra-05	TBD	±25	±25
Radium-223	Ra-04	TBD	±30	±25	Ra-05	TBD	±25	±25
Radium-225	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Radium-226	Ra-04	TBD	±30	±25	Ra-05	TBD	±25	±25
Ruthenium-106	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Samarium-151	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Selenium-79	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Sodium-22	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Strontium-90	Sr-02	TBD	±30	±25	Sr-02	TBD	±25	±25
Technetium-99	Tc-01 M	TBD	±30	±25	Tc-01	TBD	±25	±25
Thallium-207	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Thorium-227	00-06	TBD	±30	±25	00-07	TBD	±25	±25
Thorium-229	00-06	TBD	±30	±25	00-07	TBD	±25	±25
Thorium-230	00-06	TBD	±30	±25	00-07	TBD	±25	±25
Thorium-231	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Thorium-234	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Tritium	906.0 M	TBD	±30	±25	906.0	300	±25	±25
Uranium	U-04	TBD	±30	±25	U-04	TBD	±25	±25
Uranium-233	U	TBD	±30	±25	908.0	TBD	±25	±25
Uranium-234	U	TBD	±30	±25	908.0	TBD	±25	±25
Uranium-235	U	TBD	±30	±25	908.0	TBD	±25	±25
Uranium-238	U	TBD	±30	±25	908.0	TBD	±25	±25
Yttrium-90	Sr-02	TBD	±30	±25	Sr-02	TBD	±25	±25
Zirconium-93	TBD	TBD	±30	±25	TBD	TBD	±25	±25

Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses. (Sheet 4 of 5)

Analyte	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)
INORGANICS								
Arsenic	7061	0.02	±25	±30	7061	10	±20	±25
Barium	6010	0.02	±25	±30	6010	20	±20	±25
Boron	6010	TBD	±25	±30	6010	TBD	±20	±25
Cadmium	6010	0.09	±25	±30	6010	1	±20	±25
Chromium	6010	0.07	±25	±30	6010	10	±20	±25
Copper	6010	0.06	±25	±30	220.2	10	±20	±25
Cyanide	9010	TBD	±25	±30	335.3	50	±20	±25
Fluoride	300 M	TBD	±25	±30	300	50	±20	±25
Iron	6010	20	±25	±30	6010	70	±20	±25
Lead	6010	0.45	±25	±30	6010	450	±20	±25
Manganese	6010	0.02	±25	±30	6010	20	±20	±25
Mercury	7471	0.02	±25	±30	245.2	2	±20	±25
Nickel	6010	1.5	±25	±30	6010	50	±20	±25
Nitrate	300 M	TBD	±25	±30	300	130	±20	±25
Nitrite	300 M	TBD	±25	±30	300	40	±20	±25
Selenium	6010	0.75	±25	±30	270.2	20	±20	±25
Silver	6010	2	±25	±30	272.2	10	±20	±25
Titanium	6010	TBD	±25	±30	6010	TBD	±20	±25
Vanadium	6010	0.08	±25	±30	286.2	40	±20	±25
Zinc	6010	0.02	±25	±30	6010	20	±20	±25

Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses. (Sheet 5 of 5)

Analyte	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)
ORGANICS								
Acetone	8240	0.1	±25	±30	8240	100	±20	±25
Carbon tetrachloride	8240	0.005	±25	±30	8240	1	±20	±25
Chloroform	8240	0.005	±25	±30	8240	5	±20	±25
Kerosene	8015	20	±35	±30	8015	500	±35	±25
Methylene chloride	8240	0.005	±25	±30	8240	5	±20	±25
MIBK	8240	0.5	±25	±30	8240	5	±20	±25
1,1,1-Trichloroethane	8240	0.005	±25	±30	8240	5	±20	±25
Toluene	8240	0.005	±25	±30	8240	5	±20	±25
Tributyl phosphate	TBD	TBD	±25	±30	TBD	TBD	±30	±25

TBD = To Be Determined
M = method modified to include extraction from the solid medium, extraction method is matrix and laboratory-specific
RPD = Relative Percent Difference
Prescribed Procedures for Measurement of Radioactivity in Drinking Water (EPA 1980b)
Test Methods for Evaluation Solid Waste (SW 846) Third Edition (EPA 1986)
Methods for Chemical Analysis of Water and Waste (EPA 1983)
Prescribed Procedures for the Determination of Uranium in Soil and Air (EPA 1980a)
EML Procedures Manual (DOE/EML 1990)
Eastern Environmental Radiation Facility RadioChemistry Procedures Manual (EPA 1984)
High-Resolution Gamma-Ray Spectrometry of Water (ASTM 1985)
Precision and accuracy are goals. Since these parameters are highly matrix dependent they could vary greatly from the goals listed.

Table 8-5. Data Gaps by Site Category.

Site Category	Identified Data Gaps
Tanks and Vaults	• Contaminant concentrations in waste management units other than single-shell tanks • Distribution of contaminants in subsurface soils released in leaks • Constituents concentrations in related surface contamination
Cribs and Drains	• Containment concentrations in cribs • Containment concentrations in soils beneath cribs • Specific constituents (especially organic chemicals) • Distribution and vertical/lateral extent of contamination
Reverse Wells	• Containment concentrations in subsurface soils impacted by discharges • Specific constituents (especially organics) • Extent of contamination
Ponds, Ditches, and Trenches	• Distribution/extent of subsurface contamination • Buried contaminant concentrations in stabilized portions/units
Septic Tanks and Associated Drain Fields	• Actual discharge levels • Possible discharge and presence/level of non-sanitary wastes (e.g., laboratory drains)
Transfer Facilities, Diversion Boxes, and Pipelines	• Contamination constituents and concentrations • Direct radiation levels in facilities • Constituents/concentrations in related surface contamination • Integrity of transfer lines
Basins (207-U)	• Constituents and concentrations in sediments • Distribution/extent of subsurface contamination
Unplanned Releases	• Surface soil constituents and concentrations • Buried contamination constituents and concentrations

Table 8-6. Recommended Characterization Investigation Methods at T Plant Aggregate Area Waste Management Units. (Sheet 1 of 5)

Waste Management Unit or Unplanned Release	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics (EM/GPR)	Soil Gas Survey	Surface Soil Sampling	Wipe Samples	Surface Water Sampling	Subsurface Soil Sampling	Perched Zone Monitoring Wells	Remarks
Tanks and Vaults										
241-T-361 Settling Tank	X	X								
241-TX-302B Catch Tank	X					X				
241-TX-302C Catch Tank	X					X				
Cribs and Drains										
216-T-6 Crib				X				X	X	
216-T-7TF Crib				X				X	X	
216-T-8 Crib		X						X		
216-T-18 Crib		X		X				X	X	
216-T-19TF Crib				X	X			X	X	
216-T-26 Crib		X		X	X			X	X	
216-T-27 Crib		X			X			X	X	
216-T-28 Crib					X			X	X	
216-T-29 Crib								X		
216-T-31 French Drain										
216-T-32 Crib				X				X	X	
216-T-33 Crib		X			X			X	X	
216-T-34 Crib		X			X			X	X	
216-T-35 Crib		X						X		
216-T-36 Crib		X						X		

Table 8-6. Recommended Characterization Investigation Methods at T Plant Aggregate Area Waste Management Units. (Sheet 2 of 5)

Waste Management Unit or Unplanned Release	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics (EM/GPR)	Soil Gas Survey	Surface Soil Sampling	Wipe Samples	Surface Water Sampling	Subsurface Soil Sampling	Perched Zone Monitoring Wells	Remarks
216-W-LWC Crib		X						X	X	
Reverse Wells										
216-T-2 Reverse Well		X								
216-T-3 Reverse Well		X								
Ponds, Ditches, and Trenches										
216-T-4A Pond	X	X					X	X	X	
216-T-4B Pond	X	X					X	X		
216-T-1 Ditch		X		X			X	X	X	
216-T-4-1D Ditch		X						X		
216-T-4-2 Ditch		X					X	X	X	
200-W Powerhouse Pond	X						X	X		
216-T-5 Trench		X		X				X		
216-T-9 Trench										
216-T-10 Trench										
216-T-11 Trench										
216-T-12 Trench		X		X	X			X	X	
216-T-13 Trench										
216-T-14 Trench		X		X	X			X		
216-T-15 Trench		X		X	X			X		
216-T-16 Trench		X		X	X			X		

Table 8-6. Recommended Characterization Investigation Methods at T Plant Aggregate Area Waste Management Units. (Sheet 3 of 5)

Waste Management Unit or Unplanned Release	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics (EM/GPR)	Soil Gas Survey	Surface Soil Sampling	Wipe Samples	Surface Water Sampling	Subsurface Soil Sampling	Perched Zone Monitoring Wells	Remarks
216-T-17 Trench		X		X	X			X		
216-T-20 Trench		X						X		
216-T-21 Trench		X		X				X		
216-T-22 Trench		X		X				X		
216-T-23 Trench		X		X				X		
216-T-24 Trench		X		X				X		
216-T-25 Trench		X		X				X		
Septic Tanks and Associated Drain Fields										
2607-W1 Septic Tank								X		
2607-W2 Septic Tank								X		
2607-W3 Septic Tank	X				X			X		
2607-W4 Septic Tank								X		
Transfer Facilities, Diversion Boxes, and Pipelines										
241-TX-152 Diversion Box	X					X				
241-TX-154 Diversion Box	X			X		X				
241-TX-155 Diversion Box	X			X		X				
Basins										
207-T Retention Basin	X						X	X		
Burial Sites										
200-W Ash Disposal Basin				X				X		

Table 8-6. Recommended Characterization Investigation Methods at T Plant Aggregate Area Waste Management Units. (Sheet 4 of 5)

Waste Management Unit or Unplanned Release	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics (EM/GPR)	Soil Gas Survey	Surface Soil Sampling	Wipe Samples	Surface Water Sampling	Subsurface Soil Sampling	Perched Zone Monitoring Wells	Remarks
200-W Ash Pit Demolition Site	X			X	X			X		
200-W Burning Pit	X			X	X			X		
200-W Powerhouse Ash Pit								X		
218-W-8 Burial Ground								X		
Unplanned Releases										
UN-200-W-2	X	X		X	X			X		
UN-200-W-3	X	X		X	X			X		
UN-200-W-4	X			X	X			X		
UN-200-W-7 (1)										
UN-200-W-8	X	X			X			X		
UN-200-W-12	X			X				X		
UN-200-W-14	X		X	X	X			X		
UN-200-W-27	X			X	X			X		
UN-200-W-29	X		X	X	X			X		
UN-200-W-38(1)										
UN-200-W-58	X				X			X		
UN-200-W-63										
UN-200-W-65	X				X			X		
UN-200-W-67	X				X			X		
UN-200-W-73	X				X			X		

Table 8-6. Recommended Characterization Investigation Methods at T Plant Aggregate Area Waste Management Units. (Sheet 5 of 5)

Waste Management Unit or Unplanned Release	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics (EM/GPR)	Soil Gas Survey	Surface Soil Sampling	Wipe Samples	Surface Water Sampling	Subsurface Soil Sampling	Perched Zone Monitoring Wells	Remarks
UN-200-W-77										
UN-200-W-85										
UN-200-W-88										
UN-200-W-98				X	X			X		
UN-200-W-99					X			X		
UN-200-W-102								X		
UN-200-W-113[1]										
UN-200-W-135	X			X	X			X		
UN-200-W-137	X			X	X			X		

[1] This unplanned release is associated with another waste management unit and therefore will not be investigated separately.

9.0 RECOMMENDATIONS

The purpose of the aggregate area management study (AAMS) is to compile and evaluate the existing body of knowledge to support the *Hanford Site Past-Practice Strategy* (DOE/RL 1992) decision making process. A primary task in achieving this purpose is to assess each waste management unit and unplanned release within the aggregate area to determine the most expeditious path for remediation within the statutory requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA). The existing body of pertinent knowledge regarding T Plant Aggregate Area waste management units and unplanned releases has been summarized and evaluated in the previous sections of this study. A data evaluation process has been established that uses the existing data to develop preliminary recommendations on the appropriate remediation path for each site. This data evaluation process is a refinement of the *Hanford Site Past-Practice Strategy* (Figure 1-2) and establishes criteria for selecting appropriate *Hanford Site Past-Practice Strategy* path (expedited response action, ERA; interim remedial measures, IRM; limited field investigation, LFI; and final remedy selection) for individual waste management units and unplanned releases within the 200 Areas. A discussion of the criteria for path selection and the results of the data evaluation process are provided in Section 9.1 and 9.2, respectively. Figure 9-1 provides a flowchart of the data evaluation process that will be discussed. Table 9-1 provides a summary of the results of the data evaluation assessment of each unit. Table 9-2 provides the decisional matrix patterns each unit followed.

This section presents recommended assessment paths for the waste management units and unplanned releases at the T Plant Aggregate Area. These recommendations are only proposed at this time and are subject to adjustment and change. Factors that may affect development of final recommendations include, but are not limited to, comments and advice from the U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), or U.S. Department of Energy (DOE); identification and development of new information; and modification of the criteria used in the assessment path decision-making process. The data evaluation process depicted in Figure 9-1 and discussed in Section 9.1 was developed to facilitate only the technical data evaluation step shown on the *Hanford Site Past-Practice Strategy* (Figure 1-2). Procedural and administrative requirements for implementation of the recommendations provided in this AAMS will be performed in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1990) and the *Hanford Site Past-Practice Strategy*. Changes in recommendations will be addressed, and more detail on recommended assessment paths for waste management units and unplanned releases will be included in work plans as they are developed for the actual investigation and remediation activities.

A majority of waste management units and unplanned releases do not have information regarding the nature and extent of contamination necessary for quantitative or qualitative risk assessment, especially with regard to hazardous constituents, and were recommended for additional investigation (e.g., LFI). Several units and releases assessed within the ERA path were recommended for actions that fall within the scope of existing operational programs.

Sites with elevated levels of radionuclide contamination at the surface were recommended for inclusion in the Radiation Area Remedial Action (RARA) program.

Waste management units and unplanned releases that are addressed entirely by other programs were not subjected to the data evaluation process. This includes units and unplanned that are within the scope of the Single-Shell Tank Program, Surplus Facilities Program, and Defense Waste Management Program. The units associated with the 241-T, -TX, and -TY Tank Farms that were not evaluated include single-shell tanks and associated diversion boxes, catch tanks, and high-level waste transfer lines (Table 9-3).

A majority of facilities not addressed in the data evaluation fall within the scope of the Single-Shell Tank Program. The activities associated with closure of the 200-TP-5 and TP-6 Operable Unit single-shell tank sites have separate Tri-Party Agreement milestones and any recommendations for disposition of these units and associated unplanned releases will be developed as part of the ongoing program addressing the single-shell tanks. The units associated with these operable units include single-shell tanks and associated diversion boxes, vaults, catch tanks, and high-level waste transfer lines.

A discussion of the four decision-making paths shown on Figure 9-1: ERA, IRM, LFI, and FRS, is provided in Section 9.1. Section 9.2 provides a discussion of the waste management units grouped under each of these path. A discussion of regrouping and prioritization of the waste management units is provided in Section 9.3. Recommendations for redefining operable unit boundaries and prioritizing operable units for work plan development are also provided in Section 9.3. No additional aggregate area-based field characterization activities are recommended to be undertaken as a continuation of the AAMS. All recommendations for future characterization needs (see Section 8.0) will be more fully developed and implemented through work plans.. For the purposes of this discussion, RI/FS and the RFI/CMS processes are synonymous; therefore, the terms RI/FS will be used to represent both processes. Sections 9.4 and 9.5 provide recommendations for focused feasibility and treatability studies, respectively.

9.1 DECISION-MAKING CRITERIA

The criteria used to assess the most expeditious remediation process are based primarily on urgency for action and whether site data are adequate to proceed along a given path (Figure 9-1). All units and unplanned releases that are not completely addressed under other Hanford Site programs are assessed in the data evaluation process. All of the units and unplanned releases that are addressed in the data evaluation process are initially evaluated as candidates for an ERA. Sites where a release has occurred or is imminent are considered candidates for ERAs. Conditions that might trigger an ERA are the determination of an unacceptable health or environmental risk or a short time frame available to mitigate the problem (DOE/RL 1992). As a result, candidate ERA units were evaluated against a set of criteria to determine whether potential for exposure to unacceptable health or environmental risks exists. Units and unplanned releases that are recommended for ERAs will undergo a formal evaluation following the selection process outlined in WHC (1991b) and Gustafson (1991).

Waste management units and unplanned releases that are not recommended for consideration as an ERA continue through the data evaluation process. Sites continuing through the process that potentially pose a high risk (refer to Section 5.0), become candidates for consideration as an IRM. The criteria used to determine a potential for high risk, thereby indicating a high priority site, were the Hazard Ranking System (HRS) score used for nominating waste management units for CERCLA cleanup (40 CFR 300), the modified Hazard Ranking System (mHRS) scores, surface radiation survey data, and rankings by the Environmental Protection Program (Huckfeldt 1991b). Units and unplanned releases with HRS or mHRS scores greater than 28.5 (the CERCLA cleanup criterion) were designated as candidate sites for IRM consideration. Units and unplanned releases that did not have an HRS score were compared to similar sites to establish an estimated HRS score. Sites with surface contamination greater than 2 mR/h exposure rate, 100 ct/min beta/gamma above background or alpha greater than 20 ct/min were also designated as candidate IRM sites. In addition, surface contamination sites which had an Environmental Protection Program ranking of greater than 7 were also designated as candidate IRM sites. The candidate IRM sites are listed in Table 5-1, which summarizes the high priority sites. The four risk indicators are based on limited data (refer to Section 8.0) and therefore may not adequately represent the actual risk posed by the site. Technical judgment, including assessment of similarities in site operational histories, was used to include sites not ranked as high priority in the list of sites under consideration for an IRM. Candidate IRM sites were then further evaluated to determine if an IRM is appropriate for the site. Candidate IRM sites that did not meet the IRM criteria were placed into the final remedy selection path. As future data become available the list of units recommended for consideration as IRM sites may be altered.

For certain waste management units and unplanned releases, it was recognized that remedial actions could be undertaken under an existing operational or other Hanford Site program (e.g., SST, RARA, or surplus facility programs). As a result, recommendations were made that remedial actions be undertaken (partially or completely) outside the 200 AAMS past practice program. Waste management units or unplanned releases that could be addressed only in part by another program (e.g., surface contamination cleanup under the RARA program) remained in the 200 AAMS data evaluation process for further consideration. If it cannot be demonstrated that these sites will be addressed under the operational program within a time frame compatible with the past practice program, they will be readdressed by the 200 AAMS process.

Units and unplanned releases recommended for complete disposition under another program (e.g., closure under the RCRA program) were not considered in the 200 AAMS data evaluation process. If potentially new sites were identified during the AAMS, they were also not considered. It is recommended that a formal determination be made regarding the regulatory status of all new sites following established procedures before they are considered further under the 200 AAMS data evaluation process.

Specific criteria used to develop initial recommendation for ERA, LFI, and IRM for waste management units and unplanned releases within the aggregate area are provided in Section 9.1.1 and 9.1.2. Units and unplanned releases not initially addressed as an ERA,

LFI, or IRM will be evaluated under the final remedy selection path discussed in Section 9.1.3.

9.1.1 Expedited Response Action Path

Candidate ERA sites are evaluated to determine if they pose an unacceptable health or environmental risk and a short time-frame available to mitigate the problem exists. All units and unplanned releases other than those recommended for complete disposition under another Hanford program are assessed against the ERA criteria. The *Hanford Site Past-Practice Strategy* describes conditions that might trigger abatement of a candidate waste management unit or unplanned release under an ERA. Generally, these conditions would rely on a determination of, or suspected, existing or future unacceptable health or environmental risk, and a short time-frame available to mitigate the problem. Conditions include, but are not limited to the following:

- Actual or potential exposure to nearby human populations, biota, or the food chain from hazardous substances and radioactive or mixed waste contaminants
- Actual or potential contamination of drinking water supplies or sensitive ecosystems
- Threats of release of hazardous substances and radioactive or mixed waste contaminants
- High levels of hazardous substances and radioactive or mixed waste contaminants in soils that pose or may pose a threat to human health or the environment, or have the potential for migration
- Weather conditions that may increase the potential for release or migration of hazardous substances and radioactive or mixed waste contaminants
- The availability of other appropriate federal or state response mechanisms to respond to the release
- Time required to develop and implement a final remedy
- Further degradation of the medium which may occur if a response action is not expeditiously initiated
- Risks of fire or explosion or potential for exposure as a result of an accident or failure of a container or handling system
- Other situations or factors that may pose threats to human health or welfare or the environment.

These conditions were used as the initial screening criteria to identify candidate waste management units and unplanned releases for ERAs. Candidate waste management units and releases that did not meet these conditions were not assessed through the ERA evaluation path. Additional criteria for further, detailed screening of ERA candidates were developed based on the conditions outlined in the *Hanford Site Past-Practice Strategy*. Quantification of these criteria for further screening were developed. These screening criteria are shown in Figure 9-1 and are described below.

The next decision point on Figure 9-1 used to assess each ERA candidate is whether a driving force to an exposure pathway exists or is likely to exist. Units or unplanned releases with contamination that is migrating or is likely to significantly migrate to a medium that can result in exposure and harm to humans required additional assessment under the ERA process. Units or unplanned releases where contamination could migrate and, therefore, potentially require significantly more extensive remedial action if left unabated were also assessed in the ERA path.

Waste management units and unplanned releases with a driving force were assessed to determine if unacceptable health or environmental risk and a short time-frame available to mitigate the problem exists from the release. The criteria used to determine unacceptable risks are based on the quantity and concentration of the release. If the release or imminent release is greater than 100 times the CERCLA reportable quantity for any constituent, the unit or unplanned release remain in consideration for an ERA. If the release or imminent release contains hazardous constituents at concentrations that are 100 times the most applicable standard, the unit or unplanned release continues to be considered for an ERA. Application of the criterion of 100 times applicable standards is for quantification of the strategy criteria which addresses "high levels of hazardous substances and radioactive or mixed waste contaminants...." The factor of 100 is based on engineering judgment of what constitutes a high level of contamination warranting expedited action. In some cases, engineering judgment was used to estimate the quantity and concentration of a postulated release. Standards applied include Model Toxics Control Act (MTCA) standards for industrial sites and U.S. Department of Energy and Westinghouse Hanford Company radiation criteria (refer to Section 6.0). The application of these standards does not signify they are recognized as ARARs.

The ERA screening criteria, in addition to those presented in the *Hanford Site Past-Practice Strategy,* were applied to provide a consistent quantitative basis for making recommendations in the AAMS. The decision to implement the recommendations developed in AAMS will be made collectively between DOE, EPA and Ecology based only on the criteria established in the *Hanford Site Past-Practice Strategy*.

If a release is unacceptable with respect to health or environmental risk, a technology must be readily available to control the release for a unit or unplanned release to be considered for an ERA. An example that would require substantial technology development before implementation of cleanup would be a tritium release since no established treatment technology is available to separate low concentrations of tritium from water.

The next step in the ERA evaluation path involves determining whether implementation of the available technology would have adverse consequences that would offset the benefits of an ERA. Examples of adverse consequences include: (1) use of technologies that result in risks to cleanup personnel that are much greater than the risks of the release; (2) the ERA would foreclose future remedial actions; and (3) the ERA would prevent or greatly hinder future data collection activities. If adverse consequences are not expected, the site remains in consideration for an ERA.

The final criterion is to determine if the candidate ERA is within the scope of an operational program. Maintenance and operation of active waste management facilities are within the scope of activities administered by the Defense Waste Management Program. Active facilities include certain transfer lines, diversion boxes, the 241-TX-302C Catch Tank, the 244-TX Receiver Tank, the 216-W-LWC Crib, the 216-T-1 and 216-T-4-2 Ditches. Generally, active facilities will not be included in past practice investigations unless operation is discontinued prior to initiation of the investigation. The Surplus Facilities and RCRA Closures program is responsible for safe and cost-effective surveillance, maintenance, and decommissioning of surplus facilities and RCRA closures at the Hanford Site. The Surplus Facilities program is also responsible for RARA activities that include surveillance, maintenance, decontamination, and/or stabilization of inactive burial grounds, cribs, ponds, trenches, and unplanned release sites.

If the proposed ERA will not address all the contamination present, the unit or unplanned release continues through the process to be evaluated under a second path. For example, surface contamination cleanup under the RARA program may not address subsurface contamination and, therefore, additional investigation may be needed.

Final decision regarding the conduct of ERAs in the aggregate area will be made among DOE, EPA, and Ecology based, at least in part, on the recommendations provided in this section, and results of the final selection process outlined in WHC (1991b).

9.1.2 Limited Field Investigation and Interim Remedial Measure Paths

High priority waste management units and unplanned release sites were evaluated to determine if sufficient need and information exists such that an IRM could be pursued. An IRM is desired for high priority units and unplanned releases where extensive characterization is not necessary to reach defensible cleanup decisions. Implementation of IRMs at waste management units and unplanned releases with minimal characterization is expected to rely on observational data acquired during remedial activities. Successful execution of this strategy is expected to reduce both time and cost for cleanup of units and unplanned releases without impacting the effectiveness of the implemented action.

The initial step in the IRM evaluation path is to categorize the units. The exposure pathways of interest are similar for each site in a category; therefore, it is effective to evaluate candidate units as a group. The groupings used in Section 2.3 (e.g., cribs; tanks and vaults; etc.) will continue to be used to group the units for IRM assessment. This

grouping approach is especially effective in reducing characterization requirements. As is being done in the 100 Areas using the observational approach, the LFIs can be used to characterize a representative unit or units in detail to develop a remedial alternative for the group of units. Observational data obtained during implementation of the remedial alternative could be used to meet unit specific needs. Similarities of waste management units may make it possible to remediate them using the observational approach after first characterizing only a few units. It is expected, therefore, that a LFI would provide sufficient information to proceed with an IRM for groups of similar high priority waste management units.

Data adequacy is assessed in the next step. The existing data are evaluated to determine if: (1) existing data were sufficient to develop a conceptual model and qualitative risk assessment; (2) the IRM will work for this pathway; (3) implementing the IRM will have adverse impacts on the environment, future remediation activities or data collection efforts; (4) the benefits of implementing the IRM are greater than the costs. If data are not adequate an assessment was made to determine if an LFI might provide enough data to perform an IRM. If an LFI would not collect sufficient data to perform an IRM, the unit was addressed in the final remedy selection path.

The final step in the IRM evaluation process is to assess if the IRM will work without significant adverse consequences. This includes: will the IRM be successful? will it create significant adverse environmental impacts (e.g., environmental releases)? will the costs outweigh the benefits? will it preclude future cleanup or data collection efforts? and will the risks of the cleanup be greater than the risks of no action? Units where remediation is considered to be possible without adverse consequences outweighing benefits of the remediation are recommended for IRMs.

Final decisions will be made among DOE, EPA, and Ecology on regarding the conduct of IRMs in the T Plant Aggregate Area, at least in part, on the recommendation provided in this AAMS, and the results of a supporting LFI.

9.1.3 Final Remedy Selection Path

Sites recommended for initial consideration in the FRS path are those not recommended for IRMs, LFIs, or ERAs and those considered to be low-priority sites. It is recognized that all waste management units and unplanned releases within the operable unit or aggregate area will eventually be addressed collectively under the final remedy selection path to support a final Record of Decision (ROD).

The initial step in the final remedy selection path is to assess whether the combined data from the AAMS, and any completed ERAs, IRMs, and LFIs, are adequate for performing a risk assessment (RA) and selecting a final remedy. Whereas the scope of an ERA, IRM, and LFI is limited to individual sites or groups of similar sites, the final remedy selection path will likely address an entire operable unit or aggregate area.

If the data are collectively sufficient, an operable unit or aggregate area RA will be performed. If sufficient data are not available, additional data needs will be identified and the data collected.

9.2 PATH RECOMMENDATIONS

Initial recommendations for ERAs, IRMs, and LFIs are discussed in Section 9.2.1 through 9.2.3, respectively. Waste management units and unplanned releases proposed for initial consideration under the final remedy selection path are discussed in Section 9.2.4. Table 9-1 provides a summary of the data evaluation process path assessment. A summary of the responses to the decision points on the flowchart that led to the recommendations is provided in Table 9-2. A listing of sites that will be addressed by other operational programs is presented in Table 9-3. Following approval by DOE, EPA, and Ecology, these recommendations will be further developed and implemented in work plans.

9.2.1 Proposed Sites for Expedited Response Actions

Twelve waste management units were evaluated along the ERA path but no ERAs were recommended because the candidate units are proposed for disposition under existing operational programs. The candidate units consist of 5 cribs with collapse potential, 1 crib and 1 ditch which are potentially mobilizing contaminants into the groundwater, 4 sites with surface contamination and 1 tank that could be potentially leaking.

This section will provide a discussion of the perceived threats of these waste managements units and the proposed recommendations. It is anticipated that the proposed response actions will not fully remediate the candidate units, therefore all units will be included for further data evaluation in the assessment paths.

9.2.1.1 Sites Potentially Causing Subsurface Contaminant Migration. One active waste management unit may be causing the migration of contaminants to the groundwater. The 216-T-4 Ditch is recommended for disposition under an ongoing Defence Waste Management Program to discontinue effluent discharge to the soil column by June of 1995. Following the implementation of this program, these units will be included in the data evaluation path for investigation as an IRM.

The 216-T-4 Ditch receives an average of 71,000 L (19,000 gal) per day from the T Plant Facilities (WHC, 1992). This effluent is totally adsorbed into the soil within the first 15 m (50 ft) of the ditch. This is a significant flux of water to be discharged into the vadose zone and may be remobilizing contaminants from the adjacent 216-T-4-1D which is reported to overlap with the 216-T-4 Ditch in this area (Section 2.3.5.1.5).

The 216-T4-1D Ditch is reported to have received large volumes of contaminated effluents and is reported to have surface contamination levels of 20,000 ct/min. Additional data to support this conclusion can be found in water samples taken from the 216-T4-1D

data to support this conclusion can be found in water samples taken from the 216-T4-1D Ditch for the 1990 Hanford Environmental Surveillance Annual Report (WHC, 1992) which report the highest measured alpha levels in the 200 Areas. It is unknown if this high alpha measurement can be attributed to discharges from the T Plant Buildings or from remobilized contaminants in the 216-T-4 Ditches but regardless of its source it is still potentially contributing contamination to the underlying aquifers.

9.2.1.2 Cribs with Collapse Potential. Five of the older cribs are open wooden structures that could fail catastrophically. A sudden collapse could bring contaminated dust from the buried crib to the surface. Based on crib inventory data, dust derived from the bottom of the cribs would be expected to contain radionuclides at several orders of magnitude above reportable quantities and concentration standards. Cribs with potential collapse problems include:

- 216-T-6
- 216-T-7TF
- 216-T-8
- 216-T-19TF
- 216-T-32

It should be noted the 216-T-7TF and 216-T-32 cribs are located within the boundary of the 241-T Tank Farms and will require interaction with the Single Shell Tank program.

Maintenance and contamination control measures for cribs with collapse potential are implemented under the RARA program. Therefore, actions to mitigate environmental releases from these facilities will be maintained under the RARA program. An engineering study is planned under the RARA program for 1993 for the 200 Areas to evaluate the potential for crib collapse.

Response actions such as the addition of clean fill material over the cribs or pressure grouting void areas within the crib to prevent collapse may be considered for these waste management units. Evaluation and recommendation of response actions for these facilities will be performed under the RARA program.

9.2.1.3 Active Waste Management Units. One active waste management unit within the T Plant Aggregate Area is thought to be potentially discharging contaminated effluent to the soil column. Operation of this unit provides a potential migration pathway for movement of radioactive contaminants into the groundwater.

The 216-W-LWC Crib is reported to receive an average of 275,000 L (73,000 gal) per day from the 200 West Laundry Facility (WHC, 1992). Approximately two thirds of this volume is from the regulated laundry facility which is responsible for the cleaning of radioactively

contaminated clothing and contains a number of contaminants 100 times above the reportable quantities (4% Derived Concentration Guide, DOE Order 5400.5).

Efforts are currently underway to evaluate an alternative that could be implemented that would result in deactivation of this facility by June 1995. In the interim, hazardous constituents may be discharged to these units. Evaluation and deactivation of these facilities will remain with the ongoing program and will not be included as part of the past practices investigation. In addition, investigation of contamination associated with this crib will be deferred until after deactivation of the facility.

9.2.1.4 Sites with Significant Surface Contamination. Five waste management units have levels of surface contamination that are high enough to be of immediate concern. A sixth unit, UN-200-W-98, is reported to have high levels of surface contamination but has recently been stabilized and therefore was eliminated from ERA consideration. However, it is discussed here for completeness.

Surface contamination is immediately accessible to humans (i.e., workers) and biota. The potential for transport by the wind or biota is also significant and so surface migration is also a problem. It is expected that the releases of radionuclides and potential radiation exposure levels at these sites would be grater than 100 times reportable quantities and quality standards. The corrective action for surface contamination sites is addressed within the scope of the RARA program.

The 216-T-14, -15, -16 and -17 Trenches are reported to have surface contamination readings of 400 c/s of beta/gamma radiation which is two times the action level set for ERA sites, it has also been assigned an environmental protection score of 10 (Winship, 1991). Actions for control of surface contamination at this site are currently planned for implementation under the RARA program.

The 216-T-19TF Crib is reported to have surface contamination readings of 3,000 dis/min and has been assigned an environmental protection score of 9 (Winship, 1991). This crib is of wood construction and is also an ERA candidate for stabilization as discussed in Section 9.2.1.2.

The UN-200-W-98 located southeast of the Building 221-T was reported in 1990 to have an area of direct smearable beta contamination of 250,000 dis/min. The site has also been assigned an environmental protection score of 10 (Winship, 1991). A site visit in September 1991 found the site to have been stabilized along with other areas located on the east side of Building 221-T.

9.2.1.5 Tanks with Leak Potential. Excluding the tanks listed in Table 9-3, the 241-T-361 Settling Tank is the only tank in the T Plant Aggregate Area that may contain drainable liquids. This tank is estimated to be over 35 years old and have the potential to leak radioactive and hazardous liquid to the soil. The 241-T-361 Settling Tank is an inactive facility that is reported to contain 28,000 gal of sludge containing an estimated 2 kg (4.4 lbs) of plutonium (WHC 1991a). It is recommended that the settling tank be sampled to verify

that it contains no drainable liquids. If drainable liquids exist action should be taken to stabilize and isolate the tanks under existing operational programs. Following remediation activities this unit will be included in the data evaluation path investigation as an IRM.

9.2.2 Proposed Sites for Interim Remedial Measures

Thirty four waste management units and unplanned releases addressed in the T Plant Aggregate Area data evaluation process were identified as high priority units (refer to Section 5.0) and were assessed as candidates for IRMs. Eight of the units and unplanned releases were so designated because of high HRS and mHRS scores or assigned scores. Eleven units and unplanned releases were designated as high priority because of surface radiation measurements. The Environmental Protection rankings did not add to the high priority sites. Fifteen additional low priority sites were included in the IRM path because they are sufficiently similar not to warrant separate evaluation under the RI path priority sites that they warrant evaluation under an IRM path rather than the RI path. It was determined that an LFI could gather sufficient data for an IRM, therefore, all 34 sites remain IRM candidates. Septic tanks and drain fields were not considered in the IRM path. A discussion of the LFIs is provided in Section 9.2.3.

9.2.3 Proposed Sites for Limited Field Investigation Activities

Thirty four waste management units are recommended to undergo LFIs. The rationale for IRM and LFI will be more completely developed in work plans, however, the following addresses possible considerations during work plan development.

Possible LFI objectives would be to:

- Evaluate the potential for releases from the waste management unit to impact underlying groundwater quality.
- Determine if contamination exists in the soil beneath the waste management unit, and if so, assess the extent.
- Assess the nature and extent of contaminant migration from the waste management unit in support of focused feasibility studies.

Candidate IRM units have been identified for five of the nine group categories listed in Section 2.0. Sites falling under these categories are discussed below.

9.2.3.1 Cribs. Fourteen cribs were recommended for LFIs because they lack sufficient information to conduct an IRM. The data available for cribs are screening level data and estimated inventories which do not provide information on the nature and extent of contamination. Several of the cribs such as the 216-T-8 which received laboratory waste may have contained organic wastes for which no inventory data is available.

Nine of the cribs are considered high priority sites; four based on HRS scores and five due to high surface radiation. Another five cribs are low priority sites that are sufficiently similar to warrant inclusion with the LFI units.

Of the nine high priority cribs, three of the cribs were recommended for actions under the RARA program (Section 9.2.1). The actions implemented under the RARA program will precede the LFI activities. Cribs dispositioned under the RARA program include:

- 216-T-7TF Crib and Tile Field (Located in 241-T Tank Farm)
- 216-T-8 Crib
- 216-T-19TF Crib and Tile Field

Cribs to be included in LFI activities that do not require actions under the RARA program include:

- 216-T-26 Crib
- 216-T-27 Crib
- 216-T-28 Crib
- 216-T-33 Crib
- 216-T-34 Crib
- 216-W-LWC Crib (Following Deactivation in 6/95)

The cribs with surface contamination were addressed in the IRM path after first being assessed in the ERA path. The actions recommended for the units will not address the subsurface contaminations in the facilities; therefore, they were included for assessment under the remaining criteria.

The following five cribs are all low priority sites but are considered sufficiently similar to the high priority sites because they are like structures and received similar contaminants and volumes. As with the high priority cribs they too have only screening level data and estimate inventory which is insufficient to conduct an IRM. Therefore, it is recommended that they be evaluated under the IRM/LFI Path along with the high priority cribs above:

- 216-T-6 Crib
- 216-T-18 Crib
- 216-T-32 Crib (Located in the 241-T Tank Farm)

- 216-T-35 Crib
- 216-T-36 Crib

9.2.3.2 Reverse Wells. The two reverse wells located in the T Plant Aggregate Area have been recommended for LFIs. These wells were considered high priority sites due to HRS scores but lacked sufficient information to conduct IRMs.

The reverse wells recommended for LFIs are the following:

- 216-T-2 Reverse Well
- 216-T-3 Reverse Well

The reverse wells were recommended for LFIs based on HRS scores.

9.2.3.3 Ponds, Ditches, and Trenches. Three ditches and thirteen trenches have been recommended for LFIs. The following ditches and trenches were recommended for LFIs based on surface radiation:

- 216-T-1 Ditch (Following Deactivation in 6/95)
- 216-T-12 Trench
- 216-T-14 Trench
- 216-T-15 Trench
- 216-T-16 Trench
- 216-T-17 Trench

Trenches 216-T-14, -15, -16, and -17 contain high levels of surface contamination which will be assessed under RARA as discussed in Section 9.2.1.4.

The following ditches and trenches were considered to be low priority sites but are considered sufficiently similar to the above sites because they are like structures and received similar contaminants and waste volumes. Therefore, it is recommended that they be evaluated that they have been recommended for inclusion in the IRM/LFI path along with the high priority ditches and trenches. These sites are:

- 216-T-4-1D Ditch
- 216-T-4-2 Ditch (Following Deactivation in 6/95)

- 216-T-5 Trench
- 216-T-9 Trench
- 216-T-20 Trench
- 216-T-21 Trench
- 216-T-22 Trench
- 216-T-23 Trench
- 216-T-24 Trench
- 216-T-25 Trench

9.2.3.4 Unplanned Releases. LFIs are recommended for the following two unplanned releases due to surface radiation:

- UN-200-W-98
- UN-200-W-99

9.2.4 Proposed Sites for Final Remedy Selection

A number of unplanned releases, along with several diverse waste management units which are unique because of design, contaminants received, or operational history, have been proposed for the final remedy selection path. It was determined that sufficient information may exist to perform a RA and select a final remedy for one french drain, three trenches, and four unplanned releases; these are discussed in Section 9.2.4.2. RIs are recommended for the remainder of the waste management units and unplanned releases due to the lack of information to perform RAs and select final remedies. These waste management units and unplanned releases are discussed in Section 9.2.4.1.

9.2.4.1 Proposed Sites for Remedial Investigation Activities. A RI has been recommended for the T Plant Aggregate Area which includes several groups of waste management units and unplanned releases. The first group generally contains a mix of unique units which were assessed in the IRM path but had insufficient data to conduct an IRM. The second group consists of low priority trenches (dry trenches) which generally received one time transfers of waste. The third group contains septic tanks and drain fields which require confirmatory sampling to show that the sites do not contain hazardous or radioactive substances. The fourth group contains burial sites which require confirmatory sampling to show no contamination exists. The fifth group contains low priority unplanned releases which have unique contamination histories.

9.2.4.1.1 Ponds, Ditches, and Trenches. A RI is recommended to include the three T Plant Aggregate Area ponds, and three trenches:

- 216-T-4A Pond
- 216-T-4B Pond
- 200-W Powerhouse Pond (Following Deactivation)
- 216-T-10 Trench
- 216-T-11 Trench
- 216-T-13 Trench

These six waste management units all are low priority sites and they are not sufficiently similar to high priority units to warrant evaluation under the IRM path, so they could not be recommended for LFIs. The 200-W Powerhouse Pond is an active unit and will be included in past practice investigation of the U-14 ditch, located in Operable Unit UP-1 of the U Plant Aggregate Area. Deactivation of the pond will remain with the on going program which is the evaluation alternative to replace this unit by June 1995.

Insufficient data exist at these units to conduct a RA. A RI is recommended which would include each of these units to provide nature and extent of contamination information to perform a RA for final remedy selection.

9.2.4.1.2 Septic Tanks and Sanitary Drain Fields. A RI is recommended to include each of the septic tanks and sanitary drain fields:

- 2607-W1
- 2607-W2
- 2607-W3
- 2607-W4

These four waste management units all have been assigned low HRS scores by comparison with other waste management units and they are not sufficiently similar to high priority units to warrant evaluation under the IRM path, so they could not be recommended for LFIs.

There are no sampling or inventory data for any of these units and so a RA cannot be performed. The purpose of a limited sampling program under a RI would be to confirm that

no contamination exists in the septic tanks and sanitary drain fields. If no contamination is found, then no further action would likely be recommended.

9.2.4.1.3 Retention Basin and Settling Tank. It is recommended that the aggregate area RI include the 207-T Retention Basin and the 241-T-361 Settling Tank.

The retention basin is a low priority unit and is not sufficiently similar to high priority units to warrant evaluation under RARA, so it could not be recommended for LFI.

The 241-T-361 Settling Tank contains a large volume of plutonium contaminated sludge which is recommended for investigation under the ERA path. Following this investigation, additional site information is needed to determine if a release has occurred from this tank.

Only surface radiation data and inventory data is available for these units. This information is not sufficient to conduct an RA. Therefore, a RI is recommended which would provide nature and extent of contamination information to perform a RA for final remedy selection.

9.2.4.1.4 Burial Sites. An aggregate area RI is recommended to include each of four burial sites:

- 200-W Ash Disposal Basin (Active)
- 200-W Powerhouse Ash Pit (Active)
- 200-W Burning Pit
- 218-W-8 Burial Ground

The active waste management units will only be included in the RI if they are closed prior to initiation of RI activities, otherwise they will be investigated.

The burial sites in this group are low priority units and they are not sufficiently similar to high priority units to warrant evaluation under the IRM path, so they could not be recommended for LFIs. The existing information (i.e., inventory and surface sampling data) on these units is not adequate to conduct a RA. Therefore, a RI is recommended which would include each of these units to provide nature and extent of contamination information to perform a RA for final remedy selection.

9.2.4.1.5 Unplanned Releases. Fifteen unplanned releases are recommended as candidates for inclusion in an aggregate area or operable unit RI. These unplanned releases are:

- UN-200-W-2
- UN-200-W-3

- UN-200-W-4
- UN-200-W-8
- UN-200-W-12
- UN-200-W-14
- UN-200-W-27
- UN-200-W-29
- UN-200-W-58
- UN-200-W-63
- UN-200-W-65
- UN-200-W-67
- UN-200-W-73
- UN-200-W-102
- UN-200-W-135
- UN-200-W-137

Unplanned releases UN-200-W-8, UN-200-W-29, UN-200-W-63, UN-200-W-65, UN-200-W-67, UN-200-W-73, UN-200-W-102, and UN-200-W-135 all have HRS scores below 28.5, and do not have sufficient data to conduct a risk assessment. Unplanned releases UN-200-W-2, UN-200-W-3, UN-200-W-4, UN-200-W-12, UN-200-W-14, UN-200-W-27, UN-200-W-58, and UN-200-W-137 all have insufficient information available for HRS scoring.

A lack of soil sample data and inconsistent survey data prevent RA completion for these sixteen unplanned releases. RI has been recommended to provide enough data for a RA to be performed.

9.2.4.2 Proposed Sites for Risk Assessment. Five candidates have sufficient information for direct inclusion in the final RA under the final remedy selection path, including one french drain, and three unplanned releases:

- 216-T-31 French Drain
- UN-200-W-77

- UN-200-W-85
- UN-200-W-88

The 216-T-31 French Drain was exhumed in 1959 and was assigned HRS and mHRS scores of 0.0. No organic material was found to have been discharged to this trench.

Unplanned releases UN-200-W-85, and UN-200-W-88 resulted from contamination spread during transportation of contaminated materials. All detectable contamination associated with UN-200-W-85 and UN-200-W-88 was removed and these releases were assigned "low" HRS scores (less than 28.5) by comparison to other unplanned releases. Unplanned release UN-200-W-77 resulted from the discovery of radioactive coyote feces. The feces were removed and no further contamination was identified.

It is recommended that a RA be performed encompassing each of these waste management units using available information. If the RA confirms that no contamination warranting remediation remains, it is likely that no further action will be required at these sites.

9.3 SOURCE OPERABLE UNIT REDEFINITION AND PRIORITIZATION

The investigation process can be made more efficient if units with similar histories and waste constituents are studied together. The data needs and remedial actions required for similar waste management units are generally the same. It is much easier to ensure a consistent level of effort and investigation methodology if like units are grouped together. Economies of scale also make the investigation process more cost effective if similar units are studied together.

9.3.1 Units Addressed by Other Aggregate Areas or Programs

One T Plant Aggregate Area waste management unit was recommended for inclusion in the U Plant Aggregate Area. The 200-W Powerhouse Pond, has been mistakenly located in the T Plant Aggregate Area based on incorrect coordinates in WIDS database. The appropriate paper work needs to be initiated to have this mistake corrected in the WIDS and the TPA. The 216-T-7 and 216-T-32 Cribs are located within the boundary of the 241-T-Tank Farm and may be more effectively addressed under the Single Shell Tank Closure Program. Integration of these cribs into the tank farm closure will require additional study.

A number of waste management units are associated with the operation of the Single- and Double-Shell Tank Program should remain within the scope of the Defense Waste Management Program. This includes all sites listed in Table 9-3, which includes units located within the 241 -T, -TX and -TY Tank Farms in addition to three units located outside the Tank Farms:

- 241-TX-302C Catch Tank
- 241-TX-152 Diversion Box
- 241-TX-154 Diversion Box.

9.3.2 T Plant Operable Unit Redefinition

Redefinition of the 200-TP-1, -2, -3, -4, -5, -6, and SS-1 Operable Units is suggested based on the data evaluation in this report. In general, it is recommended that:

Groundwater beneath the T Plant Aggregate Area interacts with all surrounding operable units since it is not confined by the geographic boundaries. The carbon tetrachloride plume from nearby Z Plant has migrated beneath the T Plant Aggregate Area. Similarly, the contamination originating from the operable units has migrated outside the boundaries of the operable unit. These interactions with other operable units will necessitate the integration of groundwater response actions throughout the 200 West Area. This integration would likely be best handled in a single 200 West Area-wide groundwater operable unit, rather than in individual source operable units.

High-level waste transfer facilities and pipelines should remain within the scope of the Defense Waste Management Program and the Surplus Facilities Programs. The facilities are also structures with no unplanned releases and can be dealt with more efficiently in these existing Hanford programs. The Tri-Party Agreement does not include these lines within the scope of the past-practices investigations.

It is recommended that the 200-TP-3 Operable Unit boundary be redefined to exclude the 218-W-3AE and 218-W-1A Burial Grounds. A small portion of the burial grounds fall within the boundary of this operable unit.

9.3.3 Investigation Prioritization

Very little if any data exist to rank the waste management units and unplanned releases within the T Plant Aggregate Area on a risk-related basis. The HRS and surface contamination data which were used to sort the waste management units and unplanned releases into either high or low priority are indicators of potential risk but are not suitable to develop a risk-related ranking. The most useful data for indicating potential risk are probably the waste inventories and facility construction or operation information.

Based on available information about inventories of wastes and contaminants, facility construction, and operational history, it is recommended that investigations be prioritized as follows:

- Based on inventories of contaminants, the cribs and a french drain received the largest quantities of contamination and should be investigated first. The majority of the cribs and the french drain are located in operable units 200-TP-1, -2 and 4. Operable Units 200-TP-3 and 200-SS-2 each contain four cribs. This prioritization is consistent with that developed in the Tri-Party Agreement.

- The 241-T-TX and -TY Tank Farms located in operable unit 200-TP-5 and -6 are tied to separate milestones in the Tri-Party Agreement and therefore are not subject to prioritization.

- Other facilities which discharged liquid wastes that are not suspected of containing radionuclides and hazardous constituents, such as the septic tanks and associated sanitary drain fields, should be evaluated third.

Specific priorities for each waste management unit will be developed in subsequent work plans.

9.3.4 RCRA Facility Interface

A total of 45 RCRA facilities are located in the T Plant Aggregate Area as discussed in Section 2.6.1. Forty of these units are associated with the SST Closure Program at the 241-T, -TX and -TY Tank Farm as listed in Table 9-3. Of the remaining five RCRA units, three are associated with buildings (CSTF, T Plant Treatment Tank and TRUSAF) and have not resulted in any environmental releases as discussed in Section 2.6.

The remaining two TSD units are the 244-TX-RT Receiving Tank and the 200-W Ash Demolition Basin. The active 244-TX-RT Receiving Tank is located within the boundary of the 241-TX Tank Farm and has been recommended to be addressed by the Defense Waste Management Program. The 200-W Ash Demolition Basin is a TSD facility that is scheduled to submit a RCRA closure plan to Ecology and EPA by November 1992. The Ash Demolition Basin is located inside the 200-W Ash Disposal Basin which is an active facility. Closure of the Ash Demolition Basin is recommended to be performed under RCRA as tentatively planned but its cleanup levels should exceed the background levels of the Ash Disposal Basin which will be closed at a later date. No unplanned releases are associated with any of the TSD units.

9.4 FEASIBILITY STUDY

Two types of the FS will be conducted to support remediation in the 200 Area including focused and the final FS. Focused feasibility studies (FFSs) are studies in which a limited number of units or remedial alternatives are considered. Final FS will be prepared to provide the data necessary to support the preparation of final ROD. Insufficient data exists to prepare either a focused or final FS for any units or group of units within the T Plant

Aggregate Area. Sufficient data are considered available to prepare a FFS on selected remedial alternatives.

9.4.1 Focused Feasibility Study

Both LFIs and IRMs are planned for the T Plant Aggregate Area for individual waste management units or waste management unit groups. The IRMs will be implemented as they are approved, and the FFS will be prepared to support their implementation. The FFS applied in this manner is intended to examine a limited number of alternatives for a specific site or groups of sites. The FFS supporting IRMs will be based on the technology screening process applied in Section 7.0, engineering judgement, and/or new characterization data such as that generated by an LFI.

Recommendations for the FFS in support of IRMs are not provided in this report because of the limited data availability. In most cases, LFIs will be conducted at sites initially identified for IRMs. The information gathered is considered necessary prior to making a final determination whether an IRM is actually necessary or whether a remedy can be selected.

Rather than being driven by an IRM, the FFS will also be prepared to evaluate select remedial alternatives. In this case the FS focuses on technologies or alternatives that are considered to be viable based on their implementability, cost, and effectiveness and have broad application to a variety of sites. The following recommendations are made for FS that focus on a particular technology or alternative:

- capping
- ex situ treatment of contaminated soils
- in situ stabilization

These recommendations reflect select technologies developed in Section 7.0 of this report.

The FFS is intended to provide a detailed analysis of select remedial alternatives. The results of the detailed analysis provide the basis for identifying preferred alternatives. The detailed analysis for alternatives consists of the following components:

- Further definition of each alternative, if appropriate, with respect to the volumes or areas of contaminated environmental media to be addressed, the technologies to be used, and any performance requirements associated with those technologies. Remedial investigations and treatability studies, if conducted, will also be used to further define applicable alternatives.

- An assessment and summary of each alternative against evaluation criteria specified in EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988a).

- A comparative analysis of the alternatives that will facilitate the selection of a remedial action.

9.4.2 Final Feasibility Study

To complete the remediation process for an aggregate area, a final or summary FS will be prepared. This study will address those sites not previously evaluated and will summarize the results of preceding evaluations. The overall study and evaluation process for an aggregate area will consist of a number of FFSs, field investigations, and interim RODs. All of this study information will be summarized in one final FS to provide the data necessary for the final ROD. The summary FS will likely be conducted on an aggregate area basis; however, future considerations may indicate that a larger scope is appropriate.

9.5 TREATABILITY STUDIES

A range of technologies which are likely to be considered for remediation of sites within the T Plant Aggregate Area were discussed in Section 7.3. The range of technologies included:

- Engineered multimedia cover
- In situ grouting
- Excavation and soil treatment
- In situ vitrification
- Excavation, treatment, and disposal of transuranic (TRU) radionuclides
- In situ soil vapor extraction of volatile organic compounds (VOCs)

Treatability testing will be required to conduct a detailed analysis for most of the technologies. Relevant EPA guidance will be relied upon to conduct these future treatability studies. A summary of treatability testing needs outlined in Section 7.3 is as follows:

- Engineered multimedia cover - performance testing (pilot-scale testing) of conceptual designs is needed.
- In situ grouting - testing required to optimize injection properties of grout and verify effectiveness in stabilizing contaminants.
- Excavation and soil treatment - testing of dust control measures, soil treatment reagents, and contacting methods will be required. Some limited soil washing bench scale studies have been initiated.

- In situ vitrification - testing required to verify contaminant stabilization effectiveness and to establish operating parameters. Some vitrification pilot testing is ongoing.

- Excavation, treatment, and disposal of TRU radionuclides - testing to evaluate dust control measures and stabilization or vitrification effectiveness and to establish operating parameters is required.

- In situ soil vapor extraction of VOCs - extraction effectiveness needs to be verified and operating parameters require development. A program is currently under way for field testing of vapor extraction techniques.

As treatability testing of the various alternatives progresses, other parameters are likely to be identified which require further development.

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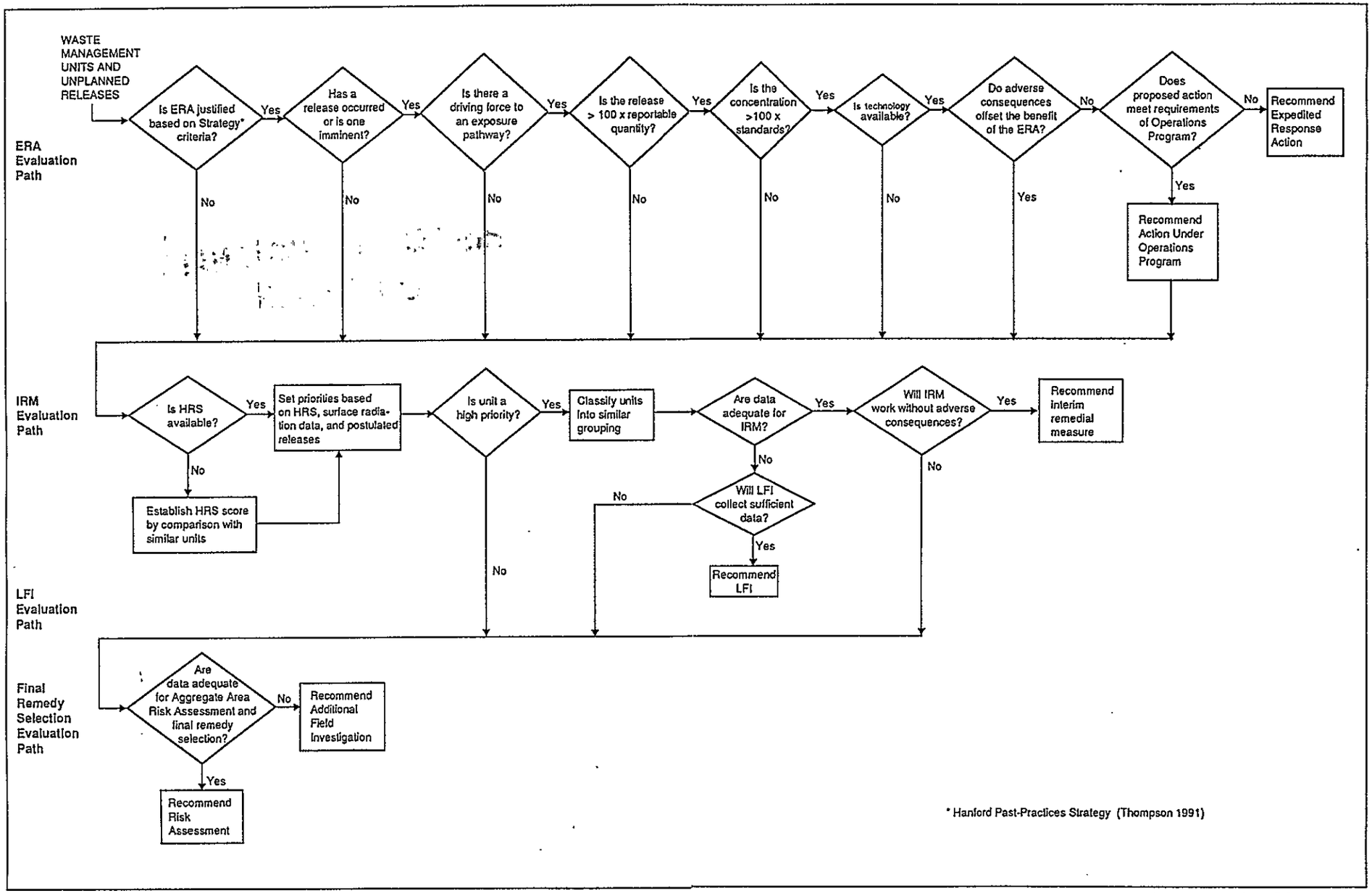

Figure 9-1. 200 Aggregate Area Management Study Data Evaluation Process.

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Table 9-1. Summary of the Results of Remediation Process Pathway Assessment. (Sheet 1 of 5)

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
Tanks and Vaults							
241-T-361 Settling Tank					X	X	HSFP
Cribs and Drains							
216-T-6 Crib		X	X			X	RARA - cave-in potential
216-T-7TF Crib and Tile Field		X	X			X	RARA - cave-in potential
216-T-8 Crib		X	X			X	RARA - cave-in potential
216-T-18 Crib		X	X				
216-T-19TF Crib and Tile Field		X	X			X	RARA - cave-in potential
216-T-26 Crib		X	X				
216-T-27 Crib		X	X				
216-T-28 Crib		X	X				
219-T-29 Crib					X		
216-T-31 French Drain				X			Exhumed
216-T-32 Crib		X	X			X	RARA - cave-in potential
216-T-33 Crib		X	X				
216-T-34 Crib		X	X				
216-T-35 Crib		X	X				
216-T-36 Crib		X	X				
216-W-LWC Crib		X	X				Groundwater Contamination

Table 9-1. Summary of the Results of Remediation Process Pathway Assessment. (Sheet 2 of 5)

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
Reverse Wells							
216-T-2 Reverse Well		X	X				
216-T-3 Reverse Well		X	X				
Ponds, Ditches, and Trenches							
216-T-4A Pond					X		
216-T-4B Pond					X		Active - close by 6/95
216-T-1 Ditch		X	X				Active - close by 6/95
216-T-4-1D Ditch		X	X				
216-T-4-2 Ditch		X	X			X	Groundwater Contamination
200-W Powerhouse Pond					X		Active - close by 6/95
216-T-5 Trench		X	X				
216-T-9 Trench		X	X				
216-T-10 Trench					X		Exhumed
216-T-11 Trench					X		Exhumed
216-T-12 Trench		X	X				
216-T-13 Trench					X		Exhumed
216-T-14 Trench		X	X			X	Surface Contamination
216-T-15 Trench		X	X			X	Surface Contamination
216-T-16 Trench		X	X			X	Surface Contamination
216-T-17 Trench		X	X			X	Surface Contamination

Table 9-1. Summary of the Results of Remediation Process Pathway Assessment. (Sheet 3 of 5)

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
216-T-20 Trench		X	X				
216-T-21 Trench		X	X				
216-T-22 Trench		X	X				
216-T-23 Trench		X	X				
216-T-24 Trench		X	X				
216-T-25 Trench		X	X				
Septic Tanks and Associated Drain Fields							
2607-W1 Septic Tank					X		Active - HSSP
2607-W2 Septic Tank					X		Active - HSSP
2607-W3 Septic Tank					X		Active - HSSP
2607-W4 Septic Tank					X		Active - HSSP
Basins							
207-T Retention Basin					X		
Burial Sites							
200-W Ash Disposal Basin					X		Active - DWMP
200-W Ash Pit Demolition Site							
200-W Burning Pit					X		
200-W Powerhouse Ash Pit					X		Active - DWMP
218-W-8 Burial Ground					X		

Table 9-1. Summary of the Results of Remediation Process Pathway Assessment. (Sheet 4 of 5)

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
Unplanned Releases							
UN-200-W-2					X		
UN-200-W-3					X		
UN-200-W-4					X		
UN-200-W-7 (1)							
UN-200-W-8					X		
UN-200-W-12					X		
UN-200-W-14					X		
UN-200-W-27					X		
UN-200-W-29					X		
UN-200-W-38 (1)							
UN-200-W-58					X		
UN-200-W-63					X		Exhumed/covered
UN-200-W-65					X		
UN-200-W-67					X		
UN-200-W-73					X		
UN-200-W-77				X			Exhumed
UN-200-W-85				X			Exhumed
UN-200-W-88				X			Exhumed
UN-200-W-98		X	X				

Table 9-1. Summary of the Results of Remediation Process Pathway Assessment. (Sheet 5 of 5)

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
UN-200-W-99		X	X				
UN-200-W-102					X		
UN-200-W-113 (1)							
UN-200-W-135					X		
UN-200-W-137					X		

Notes:

ERA - Expediated Response Action
DWM - Defense Waste Management
HSFP - Hanford Surplus Facilities Program
HSSP - Hanford Site Services Program
IRM - Interim Remedial Measure
LFI - Limited Field Investigation
NFA - No Further Action
OPS - Operational Programs
RA - Risk Assessment
RARA - Radiation Area Remedial Action Program
RI - Remedial Investigation

(1) This unplanned release is associated with another waste management unit and therefore will not be remediated separately.

Table 9-2. T Plant Aggregate Area Data Evaluation Decision Matrix. (Sheet 1 of 5)

Waste Management Unit	ERA EVALUATION PATHWAY								IRM EVALUATION PATHWAY			LFI PATH	FINAL REMEDY
	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Technology Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data?	Data Adequate?
Tanks and Vaults													
241-T-361 Settling Tank	Y	Y	Y	Y	Y	Y	N	Y	N	-	-	-	N
Cribs and Drains													
216-T-6 Crib	Y	Y	Y	Y	Y	Y	N	Y	N	-	-	-	N
216-T-7TF Crib and Tile Field	Y	Y	Y	Y	Y	Y	N	Y	Y	N	-	Y	-
216-T-8 Crib	Y	Y	Y	Y	Y	Y	N	Y	Y	N	-	Y	-
216-T-18 Crib	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-19TF Crib and Tile Field	Y	Y	Y	Y	Y	Y	N	Y	Y	N	-	Y	-
216-T-26 Crib	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-27 Crib	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-28 Crib	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
219-T-29 Crib	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-31 French Drain	N	N	-	-	-	-	-	-	N	-	-	-	Y
216-T-32 Crib	Y	Y	Y	Y	Y	Y	N	Y	N	-	-	-	N
216-T-33 Crib	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-34 Crib	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-35 Crib	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-36 Crib	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-W-LWC Crib	Y	Y	Y	Y	N	-	-		Y	N	-	Y	-

Table 9-2. T Plant Aggregate Area Data Evaluation Decision Matrix. (Sheet 2 of 5)

Waste Management Unit	ERA EVALUATION PATHWAY								IRM EVALUATION PATHWAY			LH PATH	FINAL REMEDY
	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Technology Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data?	Data Adequate?
Reverse Wells													
216-T-2 Reverse Well	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-3 Reverse Well	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
Ponds, Ditches, and Trenches													
216-T-4A Pond	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-4B Pond	Y	Y	Y	Y	N	-	-	Y	N	-	-	-	N
216-T-1 Ditch	Y	Y	Y	Y	N	-	-	Y	Y	N	-	Y	-
216-T-4-1D Ditch	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-4-2 Ditch	Y	Y	Y	Y	N	-	-	Y	N	-	-	-	N
200-W Powerhouse Pond	N	N	-	-	-	-	-	Y	N	-	-	-	N
216-T-5 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-9 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-10 Trench	N	N	-	-	-	-	-	-	N	-	-	-	N
216-T-11 Trench	N	N	-	-	-	-	-	-	N	-	-	-	N
216-T-12 Trench	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-13 Trench	N	N	-	-	-	-	-	-	N	-	-	-	N
216-T-14 Trench	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-15 Trench	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-16 Trench	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
216-T-17 Trench	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-

Table 9-2. T Plant Aggregate Area Data Evaluation Decision Matrix. (Sheet 3 of 5)

Waste Management Unit	ERA EVALUATION PATHWAY								IRM EVALUATION PATHWAY			LH PATH	FINAL REMEDY
	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Technology Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data?	Data Adequate?
216-T-20 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-21 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-22 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-23 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-24 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
216-T-25 Trench	Y	Y	N	-	-	-	-	-	N	-	-	-	N
Septic Tanks and Associated Drain Fields													
2607-W1 Septic Tank	N	N	-	-	-	-	-	-	N	-	-	-	N
2607-W2 Septic Tank	N	N	-	-	-	-	-	-	N	-	-	-	N
2607-W3 Septic Tank	N	N	-	-	-	-	-	-	N	-	-	-	N
2607-W4 Septic Tank	N	N	-	-	-	-	-	-	N	-	-	-	N
Basins													
207-T Retention Basin	N	Y	Y	Y	N	-	-	-	N	-	-	-	N
Burial Sites													
200-W Ash Disposal Basin	N	N	-	-	-	-	-	-	N	-	-	-	N
200-W Ash Pit Demolition Site													
200-W Burning Pit	N	N	-	-	-	-	-	-	N	-	-	-	N
200-W Powerhouse Ash Pit	N	N	-	-	-	-	-	-	N	-	-	-	N
218-W-8 Burial Ground	N	N	-	-	-	-	-	-	N	-	-	-	N

Table 9-2. T Plant Aggregate Area Data Evaluation Decision Matrix. (Sheet 4 of 5)

Waste Management Unit	ERA EVALUATION PATHWAY								IRM EVALUATION PATHWAY			LFI PATH	FINAL REMEDY
	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Technology Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data?	Data Adequate?
Unplanned Releases													
UN-200-W-2	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-3	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-4	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-7[1]	-	-	-	-	-	-	-	-	-	-	-	-	-
UN-200-W-8	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-12	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-14	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-27	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-29	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-38[1]	-	-	-	-	-	-	-	-	-	-	-	-	-
UN-200-W-58	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-63	N	N	-	-	-	-	-	-	N	-	-	-	Y
UN-200-W-65	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-67	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-73	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-77	N	N	-	-	-	-	-	-	N	-	-	-	Y
UN-200-W-85	N	N	-	-	-	-	-	-	N	-	-	-	Y
UN-200-W-88	N	N	-	-	-	-	-	-	N	-	-	-	Y
UN-200-W-98	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-
UN-200-W-99	Y	Y	N	-	-	-	-	-	Y	N	-	Y	-

Table 9-2. T Plant Aggregate Area Data Evaluation Decision Matrix. (Sheet 5 of 5)

Waste Management Unit	ERA EVALUATION PATHWAY								IRM EVALUATION PATHWAY			LFI PATH	FINAL REMEDY
	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Technology Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data?	Data Adequate?
UN-200-W-102	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-113[1]	-	-	-	-	-	-	-	-	-	-	-	-	-
UN-200-W-135	Y	Y	N	-	-	-	-	-	N	-	-	-	N
UN-200-W-137	Y	Y	N	-	-	-	-	-	N	-	-	-	N

[1] This unplanned release is associated with another waste management unit and therefore will not be remediated separately.

Table 9-3. Waste Management Units and Unplanned Releases to be Addressed by Other Programs. (Sheet 1 of 2)

Site Name	Site Type	Program	Active/Inactive	Operable Units
Tanks and Vaults				
241-T-101	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-102	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-103	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-104	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-105	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-106	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-107	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-108	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-109	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-110	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-111	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-112	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-201	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-202	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-203	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-T-204	Single-Shell Tank	HSSTP	Inactive	200-TP-6
241-TX-101	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-102	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-103	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-104	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-105	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-106	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-107	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-108	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-109	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-110	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-111	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-112	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-113	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-114	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-115	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-116	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-117	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TX-118	Single-Shell Tank	HSSTP	Inactive	200-TP-5
141-TY-101	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TY-102	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TY-103	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TY-104	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-TY-105	Single-Shell Tank	HSSTP	Inactive	200-TP-5

Table 9-3. Waste Management Units and Unplanned Releases to be Addressed by Other Programs. (Sheet 2 of 2)

Site Name	Site Type	Program	Active/Inactive	Operable Units
241-TY-106	Single-Shell Tank	HSSTP	Inactive	200-TP-5
241-T-301	Catch Tank	HSSTP	Inactive	200-TP-6
241-T-302	Catch Tank	HSSTP	Inactive	200-TP-6
241-TX-302A	Catch Tank	HSSTP	Inactive	200-TP-5
241-TX-302B	Catch Tank	HSSTP	Inactive	200-TP-2
241-TX-302C	Catch Tank	HDSTP	Active	200-TP-4
241-TY-302A	Catch Tank	HSSTP	Inactive	200-TP-5
241-TY-302B	Catch Tank	HSSTP	Inactive	200-TP-5
244-TX-RT	Receiver Tank	HDSTP	Active	200-TP-5
Septic Tanks and Associated Drain Fields				
2607-WT	Septic Tank	HSSTP	Active	200-TP-5
2607-WTX	Septic Tank	HSSTP	Active	200-TP-5
Transfer Facilities, Diversion Boxes, and Pipelines				
241-T-151	Diversion Box	HSSTP	Inactive	200-TP-6
241-T-152	Diversion Box	HSSTP	Inactive	200-TP-6
241-T-153	Diversion Box	HSSTP	Inactive	200-TP-6
241-T-252	Diversion Box	HSSTP	Inactive	200-TP-6
241-TR-152	Diversion Box	HSSTP	Inactive	200-TP-6
241-TR-153	Diversion Box	HSSTP	Inactive	200-TP-6
241-TX-152	Diversion Box	DWMP	Active	200-TP-2
241-TX-153	Diversion Box	HSSTP	Inactive	200-TP-5
241-TX-154	Diversion Box	DWMP	Active	200-TP-4
241-TX-155	Diversion Box	HSSTP	Inactive	200-TP-2
241-TXR-152	Diversion Box	HSSTP	Inactive	200-TP-5
241-TXR-153	Diversion Box	HSSTP	Inactive	200-TP-5
241-TY-153	Diversion Box	HSSTP	Inactive	200-TP-5
242-T-151	Diversion Box	HSSTP	Inactive	200-TP-6
Burial Site				
200-W	Ash Pit Demolition	RCRA	Active	200-SS-2
Unplanned Releases				
UN-200-W-17	Unplanned Release	HSSTP	Inactive	200-TP-5
UN-200-W-62	Unplanned Release	HSSTP	Inactive	200-TP-6
UN-200-W-64	Unplanned Release	HSSTP	Inactive	200-TP-6
UN-200-W-76	Unplanned Release	HSSTP	Inactive	200-TP-5
UN-200-W-97	Unplanned Release	HSSTP	Inactive	200-TP-6
UN-200-W-100	Unplanned Release	HSSTP	Inactive	200-TP-5

DWMP - Defense Waste Management Program
HDSTP - RCRA Hanford Site Double-Shell Tank Program
HSSTP - RCRA Hanford Site Single-Shell Tank Program
RCRA - RCRA TSD Facility

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APPENDIX A

SUPPLEMENTAL DATA

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A.1.0 SUBSURFACE GEOPHYSICAL LOGS

Geophysical well logging has been conducted at the T Plant Aggregate Area since at least as early as 1954, as a surveillance technique to evaluate radionuclide migration in the unsaturated zone underlying or adjacent to waste disposal or storage areas. Vadose-zone monitoring wells ("drywells") and groundwater monitoring wells have been constructed at many of the T Plant Aggregate Area waste management units. Geophysical well logs have been acquired from monitoring wells at the following 24 waste management units, the remaining waste management units did not have monitoring structures in the immediate vicinity:

- 216-T-21 Trench
- 216-T-22 Trench
- 216-T-23 Trench
- 216-T-24 Trench
- 216-T-25 Trench
- 216-T-36 Crib
- 216-T-5 Trench
- 216-T-7 Crib
- 216-T-19 Crib
- 216-T-26 Crib
- 216-T-27 Crib
- 216-T-28 Crib
- 216-T-3 Reverse well
- 216-T-32 Crib
- 216-T-18 Crib
- 216-T-33 Crib
- 216-T-34 Crib
- 216-T-35 Crib
- 216-T-6 Crib
- 216-T-14 Trench
- 216-T-15 Trench
- 216-T-16 Trench
- 216-T-17 Trench
- 216-W-LC Laundry crib.

As part of this Aggregate Area Management Study, select geophysical well logs from these 24 waste management units were examined to provide a preliminary appraisal of migration of radionuclides in the unsaturated zone. The objectives of the geophysical well log study were to qualitatively evaluate the extent and rate of vertical and lateral migration of radionuclides. Several previously conducted studies provide important background information. Most notable is a three-volume document by Fecht et al. (1977), in which gross gamma-ray logs were reviewed and evaluated for potential contamination. Several additional published and unpublished documents exist such as gross-gamma logs acquired

from the 241-T Tank Farm area (Jensen 1976), periodic reports (Hanlon 1991), and miscellaneous and archived reports in the Tank Farm Surveillance Group files. Pertinent results of previously conducted studies or observations are discussed along with results of this study in sections describing individual waste management units.

The following vadose zone fluid migration pathways have been recognized in the 200 West Area: (1) vertical downward migration, (2) lateral migration at the interface of an underlying coarser-grained zone or low permeability zone, (3) a combination of vertical and lateral migration that may be manifested in adjacent wells as digitate clean and contaminated zones, and (4) vertical downward migration along the well casings in poorly constructed wells. Additional complications in interpreting the migration of contaminants include the natural decay of radionuclides and the different migration rates of various radionuclides.

A.1.1 AVAILABLE GEOPHYSICAL WELL LOGS

The array of geophysical logs acquired from the T Plant Aggregate Area includes gross gamma-ray logs, gamma-gamma logs, neutron-epithermal-neutron logs, density logs, sonic logs, and temperature logs. To date, no spectral gamma-ray logs have been acquired from T Plant wells. The gross gamma-ray log was by far the most common log acquired, and, with the exception of the spectral gamma-ray log, is the most useful for evaluating migration of anthropogenic radionuclides in the unsaturated zone. Ancillary logs, such as the neutron and density logs, may also provide useful information. The interpretation of those logs, however, is complicated by several factors, including: the presence of multiple casing strings, the complications of logging in unsaturated zones, uncertainties in well construction and modifications, and questionable tool geometry and response characteristics. Consequently, the ancillary logs were not evaluated as part of this study.

Nearly all of the available gross gamma-ray logs have been acquired from T Plant monitoring wells by the Westinghouse Hanford Company (Westinghouse Hanford) Tank Farm Surveillance Group or the Pacific Northwest Laboratory (PNL) under contract by the primary U.S. Department of Defense (DOD) Westinghouse Hanford contractor.

The PNL began recording gross gamma-ray logs from T Plant monitoring wells in 1958. On the basis of log presentation, three generations of logging equipment have been used in the T Plant Aggregate Area since 1958. However, based on conversations with long-term Westinghouse Hanford and PNL employees, several more subtle equipment modifications were made within generations of logging equipment. In fact, judging from the normalization factors used by Fecht et al. (1977), procedural, or equipment modifications may even have been made annually. Beginning in 1982, procedures were implemented to improve log quality and consistency. Further improvements in logging procedures were implemented in 1989. Since 1976, two probes with similar response characteristics have been used by PNL. Beginning in 1982, the serial number of the probe used has been recorded on the log header. Detailed logging procedures are described in WHC (1991).

The gross gamma-ray logs utilized for this study are listed in Table 1. The logs listed in Table 1 constitute a comprehensive list of all logs acquired in the T Plant Aggregate Area through 1990.

A.1.2 LOG QUALITY

An assessment of gross gamma-ray log quality is difficult, particularly for the very early logs, because of a lack of accessible documentation of procedures and results. Evaluation of log quality ultimately encompasses a large number of factors including documentation of design specifications, modifications, and repairs; detailed performance tests of probes and instrumentation; evaluation of the precision and accuracy of the depth measurement system; and probe response; and periodic calibration. Of equal importance to equipment considerations is documentation of monitoring well construction and modifications ("as-built" diagrams) and reference elevations. The PNL has vastly improved their quality control procedures over the last decade. Beginning in 1979, a designated test well (399-5-2) was logged on a quarterly basis, and probe serial numbers were recorded along with basic logging information. "Calibration" logs acquired between 1979 and 1988, when more sophisticated procedures were implemented, are fairly uniform with respect to log intensity and bed resolution. No known quality control information exists for logs acquired by PNL prior to 1979. Since 1988, a significant campaign has been mounted to improve PNL log quality.

Without documentation, the only means to evaluate log quality is to compare logs collected from the same well. There is substantial variability in probe sensitivity both between and within the three generations of equipment, although reproducibility increases significantly after 1980. There also appears to be variability in the linearity of probe response, because peak to background ratios are not consistent. Resolution of marker beds seems to be consistent between generations, but depths typically vary by $\pm$ 0.6 m (2 ft). Both intensity and depth measurements are very difficult to assess on major peaks from the 1958-1959 logs (Esterline-Angus recorder).

A.1.3 TECHNICAL APPROACH

To facilitate differentiation of peaks resulting from natural and anthropogenic radionuclides, geologic cross-sections of the waste management units were constructed (Figures 1 through 6) using representative gross gamma-ray logs acquired from the main waste management units. Logs showing obvious or suspected anthropogenic peaks were avoided. Correlations shown on the cross-sections are based on geologic descriptions by Last et al. (1989) and typical gamma-ray log characteristics (Schlumberger 1972, 1979, Dresser Atlas 1982).

In the T Plant Aggregate Area, the upper 12 m to 27 m (40 to 90 ft) consist of coarse sand, gravelly sand, and sandy gravel identified as the Pasco gravel member of the Hanford formation. This horizon typically has a fairly low and uniform natural gamma response.

The low gamma response frequently observed in the upper 6 m (20 ft) is probably due to attenuation by conductor casing. Underlying the Pasco gravels member is the basal slack-water sequence of the Hanford formation. The fine-grained nature of this unit produces a slightly higher, but still uniform, gamma-ray response.

One of the most striking features of many logs is the relatively high gamma-ray response resulting from the fine-grained eolian sand and silt (loess) comprising the Early Palouse soil. That unit is typically 6 to 9 m (20 to 30 ft) thick and has one or two peaks yielding the greatest gamma-ray response of the natural radionuclides. The underlying Pliocene-Pleistocene basaltic gravels and caliche-rich paleosal (calcrete) units are not easily recognizable on the logs, although they often display a relatively low gamma-ray response (as low as the Pasco gravels). Zones of especially low response are probably gravel and rich, whereas zones of especially high response may result from the calcrete layers. Underlying the Plio-Pleistocene horizons, is the middle Ringold formation, consisting of sand and gravels and occasional lenses of sand and clay. In the southern portion of the site the upper Ringold formation is present. The discontinuous fine sands and muds of the Upper Ringold produce a fairly high gamma-ray response comparable to the Early Palouse soils.

The "regional" stratigraphic framework described above provides a baseline for more detailed evaluation of logs from an individual waste management unit. For each waste management unit (excluding the 241-T Tank Farm), logs from nearby wells were correlated and compared to the cross-section of the waste management unit to identify log-profile anomalies that might represent anthropogenic radionuclides.

Results of the log interpretations for each of the waste management units are presented in the following sections.

A.1.3.1 216-T-3 Reverse Well

Description of Waste: All drainage from Tank 5-6; waste from 224-T via overflow from the 241-T-361 settling tank.

Service Dates: 1945-1946

Waste Volume: 1.1.3 E+07 L

Waste Inventory:

	Total	Decayed Thru 6/76
Pu (gm)	3.35 E+03	3.35 E+03
Beta (Ci)	2.80 E+03	1.10 E+02
Sr90 (Ci)	5.57 E+01	2.64 E+01
Ru106 (Ci)	1.20 E+02	9.73 E-08
Cs137 (Ci)	5.95 E+01	2.95 E+01

Evaluation of Scintillation Probe Profiles:

Monitoring well W11-07 is located about 4 m (13 ft) north of the 216-T-3 Reverse Well, in operational unit 200-TP-4 (Figure 1). Well W11-07 was completed in September 1951. It is 20 cm (8 in.) in diameter, has a total depth of 93 m (306 ft) and is perforated from 75 to 88 m (245 to 290 ft). The top of casing for W11-07 is at an elevation of 216 m (709 ft) above sea level. These statistics differ from those used in Price and Fecht, 1976. However, the differences still support many of those conclusions.

Profiles of natural gamma radiation measured by scintillation probes plotted against depth were produced on June 8, 1959, February 24, 1970, February 23, 1976, July 2, 1986, and August 12, 1987 (Figure 1). These profiles reveal that there are three zones of probable anthropogenic radionuclide contamination between 3 and 37 m (10 and 123 ft) depth. The amplitude and depth of the anomalous gamma readings do not change significantly in time. This implies that there is little or no vertical migration of contaminants and the radionuclides present have long half-lives. The data are inadequate to define any lateral migration trends, although wells W11-67, W11-1, and W11-64 (in the 216-T-6 area), the closest wells to W11-07 (Figure 1), reveal no significant radionuclide contamination. There is no evidence of significant radioactive contamination of the aquifer in W11-07, which is downgradient from T-3, in the gamma scintillation profiles. However, it is known that radioactive wastes were pumped into the groundwater at this site (Price and Fecht 1976).

Fecht et al. concluded that the radionuclide contamination could not enter the ground above the perforated interval and that the probable source of contamination was either the 216-T-6 Cribs or the 216-T-361 Settling Tank. They discounted the possibility of casing failure because the gamma activity measured is too high.

The contamination in the vadose zone may be correlated with lithologic boundaries mapped and described by Last et al. 1989. The lithologies used for correlation purposes are from well W11-26, located 240 m (800 ft) southeast of W11-07 (Table 1). The contaminated interval from 30 to 38 m (98 to 123 ft) depth corresponds to the Early Palouse soil. The contaminated interval from 13 to 22 m (43 to 71 ft) is above the Basal Slackwater Sequence (fine-grained facies) in the Hanford Formation. The interval from 3 to 7 m (10 to 23 ft) corresponds to an interval of poorly sorted cobbly, silty sandstone in well W11-26. Since the contaminated regions occur in the vadose zone, contaminant migration will be controlled by the southwesterly dipping beds rather than the northward groundwater flow. Therefore it is unlikely that the 216-T-6 Cribs or the 216-T-361 Settling Tank were the source of this contamination. Nor is it likely that gross surface spills are the source since the entire interval would be contaminated. It seems most probable that the T-3 Reverse Well was not properly grouted, and when waste was pumped into it, the radioactive waste backed up the well bore and contaminated more permeable horizons above the perforated interval. Possibility is that the source of the contamination is the T Plant.

A.1.3.2 216-T-6 Cribs 1 & 2

Description of Waste: All drainage from Tank 5-6 in 221-T and waste from 224-T via overflow from the 241-T-361 Settling Tank.

Service Dates: 1946 to 1947

Waste Volume: 4.50 E+07 L

Waste Inventory:

	Total	Decayed Thru June 1976
Pu (gm)	3.90 E+02	3.90 E+02
Beta (Ci)	1.80 E+04	6.50 E+02
Sr90 (Ci)	3.60 E+02	1.76 E+02
Ru106 (Ci)	6.00 E+02	1.13 E-06
Cs137 (Ci)	3.00 E+02	1.53 E+02
Co60 (Ci)	5.00 E+00	1.07 E-01
U (kg)	2.27 E+01	2.27 E+01

Evaluation of Scintillation Probe Profiles:

The 216-T-6 Cribs are monitored by Wells W11-01 and W11-54 through W11-67 (Table 1). These wells, with the exception of W11-60, are located in or near Crib #1. W11-60 is located in Crib #2. Cross sections were compiled from natural gamma radiation logs (scintillation probe profiles) from these wells (Figure 1). A map of the thickness and extent of probable anthropogenic radionuclides in the subsurface was constructed from these cross sections. Lithologic correlations were based upon the stratigraphy of Well W11-26, located about 160 m (525 ft) southwest of Crib #1 (Price and Fecht 1976).

Analysis of the gamma logs collected from the wells used for monitoring the 216-T-6 Cribs reveals a significant plume of probable anthropogenic radionuclides beneath Crib #1 (Figure 2). This plume is lenticular in shape and elongate towards the south-southeast, the dip direction of the alluvium. It extends from a depth of about 3 m (10 ft) to a depth of about 117 m (54 ft). Elevated gamma activity at the surface was also found in wells W11-54, W11-56, and W11-58; all are located within Crib #1. The amplitude and thickness of the interval of high gamma activity decreases near the edge of the plume. Wells W11-01, W11-60 and W11-65 each have thin, relatively low amplitude peaks approaching background levels. It is uncertain whether the plume beneath Crib #1 continues beneath Crib #2 or if there are separate plumes beneath each crib.

The interpretation of the logs from the T-6 Wells are consistent with the lithologic descriptions from W11-26 and the mapping of Last et al. (1989). The Early Palouse soil has a distinct gamma signature and could be correlated over the entire area. The top of the Basal Slackwater Sequence in the Hanford formation could be correlated across most the area with

less certainty. The radionuclide plume occurs in the coarse-grained sequence of the Hanford Formation, well above the water table. The plume appears to coincide with an interval of poorly sorted alluvium found in W11-26 (Table 2). This layer may be represented by an increase in the gamma response at a depth of about 9 m (30 ft) in wells with background radiation levels (W11-57, 64, 66 and 67). This "step" could be due to increased clay content in the poorly sorted alluvium or it may be due to attenuation of the gamma radiation by concrete or conductor pipe around the well casing at shallow depths.

A.1.3.3 216-T-14, 15, 16, and 17 Cribs

Description of Waste:

216-T-14 and 15 - First cycle supernatant waste from 221-T via the 241-T-104, 105 and 106 Tanks.

216-T-16 and 17 - Unknown, assumed to be similar to above.

Service Dates:

216-T-14 and 15 - 1954
216-T-16 and 17 - Unknown, assumed to be similar to above.

Waste Volume:

216-T-14 and 15 - 1.00 abbe liters each.
216-T-16 and 17 - Unknown, assumed to be similar to above.

Waste Inventory:

	216-T-14		216-T-15	
	Total	Decayed Thru 6/76	Total	Decayed Thru 6/76
Pu (gm)	8.80 E-01	8.80 E-01	9.40 E-01	9.40 E-01
Beta (Ci)	9.85 E+02	5.50 E+02	2.07 E+03	1.22 E+03
Sr90 (Ci)	6.00 E+00	3.49 E+00	2.10 E+01	1.22 E+01
Ru106 (Ci)	1.50 E+01	3.86 E-06	1.20 E+01	3.09 E-06
Cs137 (Ci)	4.69 E+02	2.83 E+02	1.04 E+03	6.24 E+02
Co60 (Ci)	1.50 E+00	8.28 E-02	1.20 E+00	6.60 E-02
U (kg)	3.03 E+01	3.03 E+01	2.72 E+01	2.72 E+01

The inventory of wastes placed in the 216-T-16 and 17 Cribs was unavailable at the time of this writing. It is assumed that the composition of the wastes placed in these cribs is similar to those placed in the 216-T-14 and 15 Cribs. The volume of waste disposed of in the 216-T-16 and 17 Cribs is assumed to be approximately the same as those placed in the 216-T-14 and 15 Cribs.

Evaluation of Scintillation Probe Profiles:

The 216-T-14, 15, 16 and 17 cribs are monitored by Wells W11-68, 69, 80 and 81 respectively (Figure 3, Table 3). These wells are 61 to 91 m (200 to 300 ft) apart and are located in a manner which precludes the construction of cross sections using the scintillation probe profiles. Due to the sparseness of data points, it is not possible to evaluate the potential for lateral migration of contaminants. Zones of elevated gamma radiation detected by the scintillation probe profiles from these wells were correlated with lithologic columns constructed for wells W10-1 and W11-26 (Figure 3). Well W10-1 is located about 320 m (1050 ft) east of this area and Well W11-26 is located about 290 m (940 ft) southwest of this area.

Currently, the gamma radiation levels in Wells W11-68, 69 and 80 are at or near background levels. There is no evidence of elevated gamma radiation in wells W11-69 and 80 at any time in the past. Scintillation probe profiles collected between 1963 and 1987 from well W11-68 show that there were once elevated gamma radiation levels in that well. The scintillation probe profiles from well W11-81 indicate that there is currently significant probable anthropogenic radionuclide contamination in the area of that well. There is an appreciable increase in gamma radiation levels at the bottom of W11-81, suggesting that his well does not fully penetrate the zone of potential contamination.

Previous qualitative evaluations of the scintillation probe profiles from these wells by Chamness (1986) and by Brodeur (1988) are consistent with these conclusions. However, Brodeur noted an interval of increased gamma activity at 90 to 100 ft. This interval correlates with the Early Palouse Soil of Last et al. (1989). The amplitude of the scintillation probe profiles in this interval are consistent with normal background levels for that unit.

In both Wells W11-68 and 81, there is evidence of historical or current contamination respectively at a depth of 9 m (30 ft). This interval is located within the coarse-grained sequence of the Hanford formation (Last et al. 1989). In Well W10-1, there is a thin layer of black sand between gravels at 9 m (30 ft). In Well W11-26, the top of a poorly sorted interval is found at 9 m (30 ft) (Table 4b). These observations suggest that although the stratigraphy of the coarse-grained sequence of the Hanford formation is discontinuous, there are significant changes in the permeability of the formation at about 9 m (30 ft) in depth which has caused contaminants to be concentrated at that level.

Scintillation probe profiles collected from 1963 through 1987 in Well W11-68 (which monitors the 216-T-14 Crib) show that although the gamma radiation levels are currently at or near background levels.

The logs collected after 1976 were not normalized (as per Fecht et al., 1977). The computation of normalization factors for post-1976 scintillation profiles is outside the scope of this project.

A.1.3.4 216-T-26, 27, and 28 Cribs

Description of Waste:

216-T-26 - Scavenged first-cycle waste from 221-T.
216-T-27 - 300 Area laboratory waste from 340 Building.
216-T-28 - Steam condensate, decontamination waste and miscellaneous effluents from 221-T; 300 Area laboratory waste from 340 Building.

Service Dates:

216-T-26 - 1955 to 1956.
216-T-27 - 1965.
216-T-28 - 1960 to 1966.

Waste Volume:

216-T-26 - 1.20 E+07 L
216-T-27 - 7.19 E+06 L
216-T-28 - 4.23 E+07 L

Waste Inventory:

	216-T-26		216-T-27		216-T-28	
	Total	Dec. to 6/76	Total	Dec. to 7/76	Total	Dec. to 7/76
Pu (gm)	5.90 E+01	5.90 E+01	1.30 E+01	1.30 E+01	7.00 E+01	7.00 E+01
Beta (Ci)	2.90 E+04	1.02 E+03	3.60 E+03	3.65 E+02	5.85 E+04	1.07 E+03
Sr90 (Ci)	6.70 E+02	4.00 E+02	1.40 E+02	1.07 E+02	2.00 E+02	1.50 E+02
Ru106 (Ci)	2.60 E+03	1.49 E-03	1.50 E+03	7.62 E-01	1.00 E+03	3.64 E-01
Cs137 (Ci)	1.70 E+02	1.05 E+02	1.00 E+02	7.76 E+01	3.50 E+02	2.68 E+02
Co60 (Ci)	1.00 E+00	6.63 E-02	1.00 E+00	2.35 E-01	5.00 E+00	1.12 E+00
U (kg)	1.50 E+02	1.50 E+02	7.26 E+00	7.26 E+00	3.91 E+02	3.91 E+02

Evaluation of Scintillation Probe Profiles:

Crib 216-T-26 is monitored by Wells W11-70 and 82, crib 216-T-27 is monitored by wells W11-53 and 62 and crib 216-T-28 is monitored by wells W14-1, 2, 3 and 4. Scintillation probe profiles collected between 1959 and 1987 (Table 4) were used to construct cross sections of the subsurface beneath these cribs (Figure 4). These cross sections were correlated with the geological units beneath this area as mapped by Last et al. (1989). The stratigraphy of well W11-26 (Last et al. 1989), located 244 m (800 ft) north-northwest of these cribs, was used in the correlation of the cross sections. Maps showing the approximate locations of regions in the subsurface contaminated by probable anthropogenic radionuclides were constructed from the interpreted cross sections (Figure 4).

Most of the lithologic units described by Last et al. (1989) were correlated across the area of the 216-T-26, 27 and 28 Cribs. The maps of the lithologic boundaries and the isopach maps of Last et al. (1989) did not agree within this area. This is probably because an excess thickness was assigned to the coarse-grained sequence of the Hanford formation. It was not possible to correlate the Upper Ringold unit here because it does not have a distinctive natural gamma radiation signature in the area of the 216-T-26, 27, and 28 Cribs.

Scintillation probe profiles collected after 1976 were not normalized to values consistent with the 1976 profiles (Fecht et al. 1977). It is outside the scope of this project to normalize the newer profiles to the 1976 profiles.

The cross sections constructed from the scintillation probe profiles show that there is insufficient data to fully characterize the extent of elevated gamma radiation levels in the subsurface of the T-26, 27 and 28 Cribs.

There are two main zones in the subsurface in the area of Cribs 216-T-26, 27, and 28 which are or have been potentially contaminated by radionuclides. The shallower of these zones extends from the surface to a depth of 30 to 33.5 m (100 to 110 ft), the top of the Middle Ringold unit (Figure 4). This shallow zone has been significantly contaminated with probable anthropogenic radionuclides. The deeper zone of potential contamination corresponds to the unconfined aquifer beneath these cribs. The water table is approximately 46 m (150 ft) below the surface and dips to the northwest (Last et al. 1989). Although currently there is no evidence of gamma emitters in the groundwater (Figure 4).

It is apparent from the cross sections in Figure 4 that the vertical distribution of elevated gamma radiation in the shallow contamination zone is roughly controlled by the lithology. Gamma radiation levels are generally higher in the sandy Coarse-Grained Sequence of the Hanford formation and the Early Palouse Soil, lower in the silty Basal Slackwater Sequence and the carbonate-cemented sand of the Plio-Pleistocene unit. The gamma radiation levels in the silty interval at the top of the Middle Ringold unit are presently at or near background. This effect is probably due to higher rates of flow (discounting chemical interactions) in the more permeable zones. One of the consequences of this mechanism would be higher levels of activity in more permeable intervals at locations laterally removed from the source of the contamination (Figure 4).

The data are insufficient to accurately evaluate the lateral distribution of radionuclide contaminants in the shallow zone. Preliminary maps of the thickness and the base of the region of elevated gamma radiation were constructed (Figure 5, 6, and 7). From these maps it is apparent that the plume of contaminants is elongate to the south, in the dip direction of the layering (Last et al. 1989).

Based upon the low levels (though significant) of gamma radiation found in Well W14-01 and the profiles in Wells W11-82, W14-4 and W14-62 (Figure 4), the plume probably does not extend much further than shown. This suggests that the plume is relatively thick, with roughly vertical sides and a rounded bottom. These maps also indicate that crib T-28 was the major source of contaminants, followed by Crib T-26 and T-27

respectively. This observation is consistent with the waste volumes and inventories for these cribs.

Although Cribs 216-T-26, 27 and 28 are not presently a source of contamination to the groundwater, there is evidence that between 1963 and 1976 the T-28 Crib was a source of groundwater contamination. The scintillation probe profiles from Wells W14-01, 02, 03 and 04 indicate (assuming they were properly normalized) that probable anthropogenic radionuclides migrated from Crib T-28, through the Middle Ringold unit, to the water table during the span of time including 1967 through 1970 (Figures 2, 3, 4 and 5). The profiles from these wells suggest that the migration of radionuclides may have started as early as 1963. By 1976, the radiation levels in the Middle Ringold had returned to near background levels. The unusual mobility (compared with other T Plant areas) of the wastes from the T-28 may be due to their diverse sources and probable diverse chemistry. Another possibility is that the wastes may have traveled to the water table along the pathway provided by a poorly grouted monitoring well. The data are inadequate to evaluate the possibility that cribs T-26 and 27 were (or are) sources of contamination to the groundwater.

A map of the approximate water table was constructed from the 1976 scintillation probe profiles. This map shows that the direction of groundwater flow was to the northwest, consistent with the current flow direction (Last et al., 1989). (Indications are that although contaminants from the surface impoundments generally migrated downward in a southerly direction, down the dip of the bedding, in the vadose zone, upon reaching the water table, the resulting contaminant plume doubled back and migrated to the northwest. This is supported by the 1976 scintillation probe profiles showing background gamma radiation levels below the water table in Well W14-01, and elevated readings in Wells 14-02, 03 and 04 (Figure 4). Currently, background gamma radiation levels are found in Wells W14-01, 03 and 04.)

A.1.3.5 216-T-34 & 35 Cribs

Description of Waste: 300 Area laboratory waste from 340 Building.

Service Dates:	216-T-34:	1966-1967
	216-T-35:	1967-1968
Waste Volume:	216-T-34:	1.73 E+07 L
	216-T-35:	5.72 E+06 L

Waste Inventory:

	216-T-34		216-T-35	
	Total	Decayed Thru 6/76	Total	Decayed Thru 6/76
Pu (gm)	1.07 E+02	1.07 E+02	6.62 E+01	6.62 E+01
Beta (Ci)	2.62 E+04	1.10 E+03	9.29 E+02	7.05 E+01
Sr90 (Ci)	3.23 E+02	2.53 E+02	<2.0 E+01	<1.62 E+01
Ru106 (Ci)	1.05 E+02	1.11 E-01	1.31 E+02	2.68 E-01
Cs137 (Ci)	2.75 E+02	2.19 E+02	1.99 E+01	1.62 E+01
Co60 (Ci)	7.33 E+00	2.05 E+00	3.41 E+00	1.04 E+00
U (kg)	4.12 E+00	4.12 E+00	4.89 E+00	4.89 E+00

Evaluation of Scintillation Probe Profiles:

Wells W11-15 and 16 monitor the 216-T-34 Crib and Wells W11-17, 18, 19, 20 and 21 monitor the 216-T-35 Crib. Details of the construction of these wells is provided in Table 2. Cross sections were constructed with available natural gamma radiation logs from these wells (Figure 8). Lithologic correlations were made using the stratigraphic column and natural gamma radiation log from well W6-2, located 427 m (1,400 ft) north of this area (Last et al. 1989). These sections are consistent with the mapping of Last et al. (1989).

The scintillation profiles from the wells in the area of the 216-T-34 and 35 Cribs indicate that there are two zones of probable anthropogenic radionuclide contamination. The shallower zone of contamination is located in the immediate vicinity of 216-T-35, between 6 and 17 m (20 and 55 ft) below the ground surface. There have been no changes in the conditions within this zone, so the conclusions of Price and Fecht (1976) and Brodeur (1988) remain valid and will be summarized here. The deeper zone of potential contamination by anthropogenic radionuclides is located over the entire area below a depth of 76 m (250 ft), at or near the water table. The contamination in the deeper zone was detected between 1967 and 1970 in all the wells in this area, except W11-21. (Reviews of the most recent scintillation profiles indicate there is no evidence of elevated gamma radiation in this zone.)

Monitoring Wells W11-15 and 16 are updip from the 216-T-34 Crib (Last et al. 1989) and their usefulness for monitoring the migration of wastes from that crib has been questioned (Price and Fecht 1976). No contamination has ever been detected above the water table with natural gamma radiation measurements in these wells. Even if the waste inventory for the crib is inaccurate, radioactive waste was dumped there and should be detectable with an effective monitoring system.

Significant levels of gamma radiation from probable anthropogenic radionuclides have been detected between 6 and 17 m (20 and 55 ft) below the surface in Wells W11-18, 20 and 21. Wells W11-17 and 19 have not detected any elevated readings in this shallow zone. An isopach map of the thickness of this plume was constructed using the scintillation profiles from these wells (Figure 9). The plume is lenticular in section and is located in the immediate vicinity of the 216-T-35 Crib. There is no evidence of significant migration of the contaminants. It appears that in Wells W11-20 and 21 the levels of radiation has

declined to near background levels over time. However, the radiation levels measured in Well W11-18, near the "head" of the crib, has not changed significantly over the years.

The deeper zone of potential anthropogenic radionuclide contamination extends from near the water table (approximately 76 m [250 ft] below the ground surface) past the bottom of the monitoring wells. Radiation levels in this zone are currently at or near background levels and have been since 1976. However, scintillation profiles run between 1967 and 1970 detected elevated levels of activity in this zone. Assuming that the scintillation probe(s) used in this period were working properly, this suggests that a plume of radioactive material carried by the groundwater passed under the area of the 216-T-34 and 35 Cribs. The earliest profiles available imply that the radioactive contaminants originated from a source northeast of this area because the profiles from wells W11-15, 17 and 18 detected elevated gamma radiation and the profile from W11-16 detected background levels. In 1970, all of the profiles from the wells in this area detected elevated gamma radiation levels in the deep zone. The top of the contaminant plume was mapped using the 1970 data (Figure 10). This map shows that the top of the plume, and presumably the water table, was dipping to the southwest, conflicting with the current northerly dip of the water table (Last et al. 1989). If the groundwater flow was toward the southwest prior to 1976, than a potential source of the radioactive material was northeast of the 216-T-35 Crib. By 1976 the gamma radiation levels had returned to background levels, suggesting that the radioactive material was both very mobile and had a short half-life. The available data from this area is inadequate to determine the present location and level of activity of the contaminant plume.

A.1.4.6 216-T-21, 22, 23, 24, and 25 Cribs

Description of Wastes: Unknown

Service Dates: Unknown

Waste Volume: Unknown

Waste Inventory: Unknown

Evaluation of Scintillation Probe Profiles:

Wells W15-81, 209, 210, 211, and 212 monitor Cribs 216-T-22, 21, 23, 24 and 25 respectively. The scintillation probe profiles from these wells were previously evaluated in a qualitative sense by Chamness (1986). Otherwise, no other evaluations of these wells has been done. No information was available as to the composition, and amount of waste disposed of in these cribs or their service dates at the time of this evaluation. A cross section was constructed using the scintillation probe profiles from Wells W15-209, 210 and 211 (Figure 11). This cross section shows that there is significant contamination of the vadose zone by probable anthropogenic radionuclides. There is no evidence that the contaminants reached the water table in this area. Although these wells are relatively shallow, it was possible to roughly correlate the lithology on this cross section with the

mapping of Last et al. (1989) and with the stratigraphy of Wells W15-16 and W11-26. These wells are located about 490 m (1,600 ft) southwest and 610 m (2,000 ft) northeast of these cribs respectively. Profiles for wells W15-81 and 212 were not available at the time of this evaluation.

Chamness (1986) qualitatively evaluated the scintillation probe profiles from wells W15-209, 210, 211 and 212 and found that the radiation levels were declining slowly in these wells. Since these wells were completed in late 1982, only 1984 and 1986 vintage geophysical logs were available for Chamness' evaluation and for the present evaluation (Table 6). Different scintillation probes were used for logging these wells in 1984 than in 1986. The response of these tools is different and the profiles collected have not been normalized to a common datum (such as that used by Fecht et al., 1977). Comparisons between 1984 and 1986 vintage logs collected in other areas indicate that the 1986 profiles are consistently higher than those collected in 1976 and the 1984 profiles are slightly lower. With these qualitative relationships in mind, it is not possible to determine if the levels of radiation measured in these wells declined between 1984 and 1986.

A very rough map of the thickness of the region of elevated gamma radiation in the vadose zone was constructed from the information contained in the cross section and from the mapping of Last et al. (1989) (Figure 12). There is insufficient information available to determine the lateral extent of radionuclide contamination. However, it appears that the plume is thickening toward the south, controlled by the south dipping beds (Last et al. 1989). The base of the plume is interpreted to correspond to the top of the Basal Slackwater sequence in the Hanford formation. The Basal Slackwater sequence pinches out toward the south and east within the area of the 216-T-21, 22, 23, 24 and 25 cribs (Last et al. 1989). It appears that the base of the plume reaches the Early Palouse soil where the Basal Slackwater sequence is absent. The available data are inadequate to determine if the plume has migrated through the Early Palouse soil.

A.1.3.7 216-T-5, 7, 32, and 36 Cribs

Description of Waste:

216-T-5 Specific Retention Trench: Second cycle supernatant waste from 221-T via the 241-T-112 Tank.
216-T-7 Crib and Tile Field: Second cycle supernatant from 221-T via the 241-T-112 Tank; 221-T effluent and cell drainage from Tank 5-6 in 221-T; effluent from 221-T and waste from 224-T.
216-T-32 Crib: Waste from 224-T via the 241-T-201 Tank.
216-T-36 Crib: 221-T and 221-U decontamination facility wastes; steam condensate; decontamination and miscellaneous waste.

Service Dates:

216-T-5 Specific Retention Trench: 1955
216-T-7 Crib and Tile Field: 1948 to 1955
216-T-32 Crib: 1946 to 1952
216-T-36 Crib: 1967 to 1969

Waste Volume:

216-T-5 Specific Retention Trench: 2.60 E+06 L
216-T-7 Crib and Tile Field: 1.10 E+08 L
216-T-32 Crib: 2.90 E+07 L
216-T-36 Crib: 5.22 E+05 L

Waste Inventory:

216-T-5 Specific Retention Trench

	Total	Decayed Thru 6/76
Pu (gm)	1.80 E+02	1.80 E+02
Beta (Ci)	2.08 E+02	8.44 E+01
Sr90 (Ci)	1.00 E+00	5.97 E-01
Ru106 (Ci)	3.00 E+01	1.54 E-05
Cs137 (Ci)	7.00 E+01	4.32 E+01
Co60 (Ci)	5.00 E+00	3.14 E-01
U (kg)	4.54 E+00	4.54 E+00

216-T-7 Crib and Tile Field

	Total	Decayed Thru 6/76
Pu (gm)	1.30 E+02	1.30 E+02
Beta (Ci)	3.10 E+03	1.26 E+02
Sr90 (Ci)	6.00 E+01	3.40 E+01
Ru106 (Ci)	1.00 E+02	1.91 E-05
Cs137 (Ci)	5.00 E+01	2.94 E+01
Co60 (Ci)	1.00 E+00	4.98 E-02
U (kg)	9.10 E+00	9.10 E+00

216-T-32 Crib

	Total	Decayed Thru 6/76
Pu (gm)	3.20 E+03	3.20 E+03
Beta (Ci)	1.50 E+03	5.73 E+01
Sr90 (Ci)	3.00 E+01	1.55 E+01
Ru106 (Ci)	5.00 E+01	8.27 E-07
Cs137 (Ci)	2.50 E+01	1.35 E+01
Co60 (Ci)	1.00 E+00	2.89 E-02
U (kg)	2.27 E+01	2.27 E+01

216-T-36 Crib

	Total	Decayed Thru 6/76
Pu (gm)	2.48 E+00	2.48 E+00
Beta (Ci)	7.11 E+02	2.81 E+01
Sr90 (Ci)	7.71 E+00	6.18 E+00
Ru106 (Ci)	4.61 E+01	9.76 E-02
Cs137	6.42 E+00	5.26 E+00
Co60 (Ci)	5.14 E-01	<1.70 E-01
U (kg)	1.18 E+00	1.18 E+00

Evaluation of Scintillation Probe Profiles:

There are a total of 31 monitoring wells in the area of the 216-T-5 Specific Retention Trench, 216-T-7 Crib and Tile Field, 216-T-32 and 36 Cribs (Table 6). The T-5 Specific Retention Trench is monitored by well W10-1. The T-7 Crib is monitored by wells W10-3, 59, 60, 61, 62, 66, 67, 68 and 74. Scintillation probe profiles were not used for wells W10-60, 62, 66 and 74. Since these wells are in close proximity to the other wells in the T-7 crib area and they are of similar depths, it is not expected that the scintillation profiles would add to this evaluation. The T-7 Tile Field is monitored by Wells W10-2, 69, 70, 71, 77, 78, 80 and 81. Profiles for Wells W10-78 and 79 were not available at the time of this writing. Wells W10-77 and 81 are too shallow 7.3 and 5.8 m ([24 and 19 ft] respectively) to yield information useful to this evaluation. More current logs for many of the wells monitoring the T-7 Crib and Tile Fields (W10-59, 60, 61, 62, 63, 66, 67, 68, 69, 70, 71, 72, 74, 77, 78, 79, 80 and 81) are not available due to hazardous conditions over the aging wooden structure of the T-7 Crib (Chamness, 1986). The T-32 Crib is monitored by Wells W10-56, 57, 58, 64, 65, 73, 75 and 76.

Cross sections were constructed from the scintillation probe profiles from the monitoring wells used in this evaluation (Figures 13 and 14). These cross sections were correlated with the lithologies found in W10-1 and W11-26 (located about 365 m [1200 ft]

east-southeast of this area) and with the mapping of Last et al. (1989). An isopach map of the zone of elevated gamma radiation in the subsurface (Figure 15).

The isopach map constructed from the information contained in the correlated cross sections roughly delineates the extent of contamination by probable anthropogenic radionuclides (Figure 15). This map shows that there is a thin 3 m ([10 ft] or less thick) region of elevated gamma radiation beneath the T-32 Crib. The top of this region is 9 to 12 m (30 to 40) ft below the surface. This plume merges with a thick region of contamination beneath the T-7 Crib (more than 30 m [100 ft] thick) and tile field (30 m [100 ft] thick). The top of the plume in the area of the T-7 Crib is 2.4 to 3 m (8 to 10 ft) below the surface beneath the crib and 11 to 12 m (35 to 40 ft) below the surface beyond the crib boundaries. The top of the plume beneath the T-7 Tile Field ranges from 12 to 14 m (40 to 45 ft) below the surface. It is possible that the base of this plume reaches (or reached) the water table (Fecht et al. 1977), but the wells monitoring the T-7 Crib and Tile Field are too shallow to fully penetrate the region of contamination. There is evidence of vertical migration of the plume in the T-7 Crib area (Fecht et al. 1977). Between 1963 and 1987, there has been a 2 m (7 ft) increase in the depth of the top of the contamination measured on the profiles from Well W10-3. The vertical migration of contaminants in the vicinity of this well appears to be confined to the Basal Slackwater Sequence. Changes in the character of the profiles from Wells W10-61 and 80 provide further evidence of vertical migration of contaminants within the Basal Slackwater. There is no evidence of vertical migration of contaminants within deeper lithological units. Scintillation probe profiles from the wells monitoring the T-5 and 36 Cribs currently register background levels of gamma radiation. However, the 1963 and 1976 profiles from the W10-4, which monitors Crib T-36, show low to moderate levels of contamination in the Early Palouse soil and the Plio-Pleistocene unit. The source of these elevated readings was probably effluent from the T-7 Crib and Tile Field (Fecht et al. 1977).

The region of elevated gamma radiation beneath the T-32 Crib is manifested by a sharp peak on the scintillation probe profiles from the monitoring wells (Figure 13). This peak corresponds to a poorly sorted zone at the base of the Coarse Grained Sequence of the Hanford formation (Last et al., 1989) and represents low to near background gamma radiation levels.

A.1.4 SUMMARY OF GAMMA LOG EVALUATIONS IN THE T PLANT AREA

1.0 Introduction

Scintillation probe profiles collected in monitoring wells in the vicinity of 23 waste disposal units were analyzed. These waste disposal units were divided into 10 areas located in the eastern half of the T Plant area.

Summary of Findings in Each Area

Area of 216-T-5, 7, 32, and 36 Waste Disposal Units

A thick region of high levels of gamma radiation were detected beneath the 216-T-7 Crib and Tile Field. This region is found within the Coarse Grained sequence of the Hanford formation, down to the top of the Middle Ringold unit or deeper. There is no evidence that radionuclides reached the groundwater in this area; however, most of the monitoring wells do not penetrate the zone of elevated gamma radiation. There is evidence of downward migration of radionuclides within the Basal Slackwater sequence of the Hanford formation but not in deeper units. There is evidence that radionuclides may have migrated laterally, within the Early Palouse soil and the Plio-Pleistiocene unit, as far south as the 216-T-36 Crib. Current conditions around the crib and tile field are uncertain since no scintillation probe profiles were collected after 1963 due to hazardous conditions over the aging wooden structure.

A thin interval of low gamma radiation levels was found beneath the 216-T-32 Crib. These elevated levels are found at the base of the Coarse Grained Sequence of the Hanford formation. There is no evidence of vertical or lateral radionuclide migration. This region of probable anthropogenic radionuclide contamination merges with that found beneath the 216-T-7 Crib and tile field to the south.

No elevated gamma radiation levels were detected in the subsurface near the 216-T-5 Specific Retention Trench. Mapping of the top of the Basal Slackwater sequence in this area suggests that the monitoring well for this crib may not be located optimally.

No evidence of elevated gamma radiation in the subsurface from radionuclides placed in the 216-T-36 Crib was found. The low to moderate gamma radiation levels detected within the Early Palouse soil and the Plio-Pleistocene unit during the early 1960's is attributed to lateral migration of contaminants from the 216-T-7 Crib and Tile Field.

Area of 216-T-6 Cribs 1 and 2

High levels of gamma radiation were found beneath Crib 1. It appears this plume is elongate to the south and extends to the east, under Crib 2. The elevated region of gamma radiation is confined to the Coarse Grained sequence of the Hanford formation. Data are inadequate to define the lateral extent of the radionuclides. There is no evidence of vertical migration of radionuclide. There is no evidence that radionuclides reached the groundwater in this area.

Area of 216-T-3 Reverse Well

Although the T-3 Reverse Well is in close proximity to the T-6 Cribs, it is updip and the nature of waste disposal activities was different. High levels of gamma radiation is found in the Coarse Grained sequence of the Hanford formation and in the Early Palouse soil. Based upon the nature of waste disposal activities in this area, it appears that the gamma emitting contaminants migrated outwards from the T-3 Reverse Well bore into these units. Since the purpose of this well was to pump wastes into the groundwater, it is certain that wastes reached the ground water. Data are inadequate to determine the lateral extent of contamination.

Area of 216-T-14, 15, 16 and 17 Cribs

The scintillation probe profiles from the well monitoring the 216-T-17 Cribs indicate that currently high levels of gamma radiation are found within the Coarse Grained sequence of the Hanford formation. There is no evidence that radionuclides have penetrated to the groundwater. Data are inadequate to delineate the extent of contamination.

The scintillation probe profiles from the well monitoring the 216-T-14 Crib indicate that in the past moderate to low levels of gamma radiation was present in the Coarse Grained sequence of the Hanford formation. Currently levels are at or near background. Based upon regional mapping by Last et al. (1989), this well may not be in an optimal position to monitor the crib.

The scintillation probe profiles from the wells monitoring the 216-T-15 and 16 Cribs have never showed any evidence of gamma emitting radionuclides in the subsurface. However, based upon the regional mapping by Last et al. these wells may not be located in optimal positions for monitoring waste migration from these cribs.

Area of 216-T-34 and 35 Cribs

Moderate to high levels of gamma radiation are currently found at the north end of the T-35 Crib. These levels fall off rapidly to the south, along the crib, reaching background levels in the central portion of the crib. The region of elevated gamma radiation once extended from the Coarse Grained sequence of the Hanford formation into the Plio-Pleistocene unit. Currently levels above background are only found in the Coarse Grained sequence. There is no evidence that radionuclides from this crib reached the groundwater. Scintillation probe profiles from wells monitoring the T-34 crib have never showed any evidence of elevated gamma radiation from that crib. However, regional mapping by Last et al. (1989) suggests these wells may not be located optimally.

In the late 1960's and early 1970's, low to moderate levels of gamma radiation were detected beneath the water table. The temporal and spacial pattern of the contamination suggests that the source was east to northeast of this area.

Area of 216-T-21, 22, 23, 24 and 25 Cribs

Although scintillation probe profiles from the wells monitoring Cribs T-22 and 25 were not available, those from Cribs T-21, 23 and 24 indicate that high levels of gamma radiation are found in the Coarse Grained sequence of the Hanford formation. The Basal Slackwater sequence pinches out to the south in this area (Last et al. 1989) and the Coarse Grained sequence thickens. Since the well monitoring the T-21 crib does not fully penetrate the region of contamination, it cannot be determined if the radionuclides from these cribs have penetrated the Early Palouse soil. The data are inadequate to define the vertical and lateral extent of the plume. However, there is no evidence that radionuclides from these cribs reached the groundwater.

Area of 216-T-26, 27 and 28 Cribs

High levels of gamma radiation extending from within the Coarse Grained Sequence of the Hanford formation to the top of the Middle Ringold unit are detected beneath all three of these cribs. Many of the wells in this area do not fully penetrate the plume, but scintillation probe profiles from those that do suggest that this area was a source of groundwater contamination during the late 1960's.

There is evidence from the scintillation probe profiles collected from the monitoring wells in this area that the lateral migration of radionuclides is lithologically controlled. The profiles from wells in close proximity or within the crib boundaries have a "blocky" character, while those further from the cribs have a more "spiky" character. These "spikes" correspond to the Early Palouse soil and Coarse Grained sequence lithologic intervals in this area. This implies that radionuclides traveled further in these intervals than in others. Currently, there is no evidence of vertical migration of radionuclides.

Area of 216-T-18 Specific Retention Crib

No additional data was available to add to that used by Fecht et al (1977). Moderate to high levels of gamma radiation were detected in the Coarse Grained sequence of the Hanford formation and moderate to low levels in the Early Palouse soil. There was a large decrease in the amplitude of the gamma radiation levels between 1954 and 1976. Current conditions in this area are unknown.

Area of 216-T-219 Crib and Tile Field

No additional data was available to add to that used by Fecht et al (1977). The four wells monitoring the tile field are of insufficient depth. That monitoring the crib was last logged in 1970 and may not be located optimally per the regional mapping of Last et al (1989). High levels of gamma radiation were detected in the Coarse Grained sequence of the

Hanford formation. Radiation levels declined with depth to the water table. This suggests that this crib was a source of groundwater contamination in the past.

Area of 216-T-33 Crib

No evidence of elevated gamma radiation levels has ever been found in this well. Possible regions of elevated gamma radiation referred to by Brodeur (1988) correspond to the Early Palouse soil and Upper Ringold unit intervals. Since the monitoring well for this crib is located to the north, it is probably updip and therefore in a non-optimum position for detecting contaminants from the crib based on the regional mapping by Last et al (1989).

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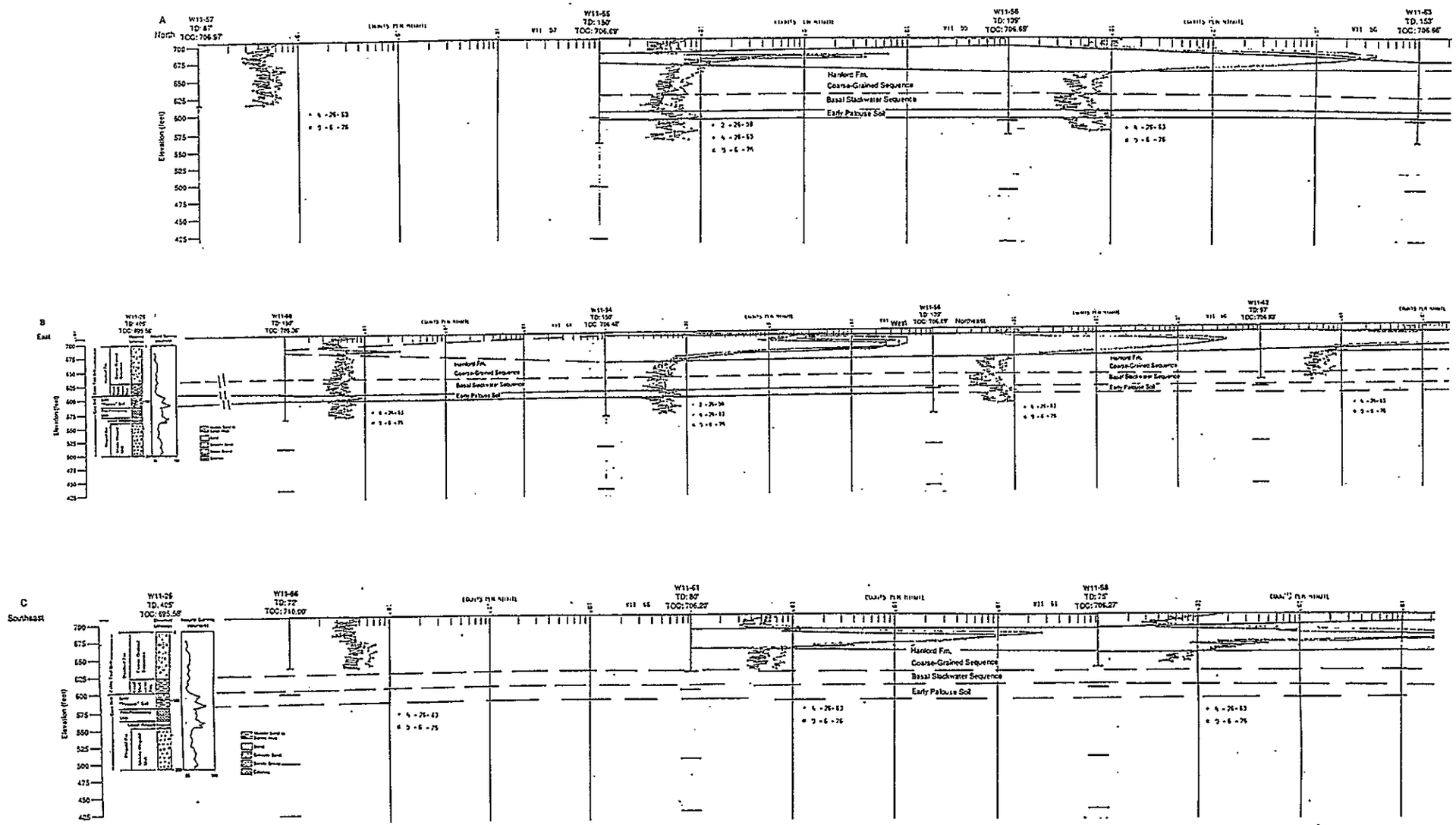

Figure A-1. 216-T-6 Cribs 1 and 2 - Scintillation Probe Profile Cross Sections A-A', B-B', and C-C'. (sheet 1 of 2)

9 3 1 2 8 1 5 7 6 2 2

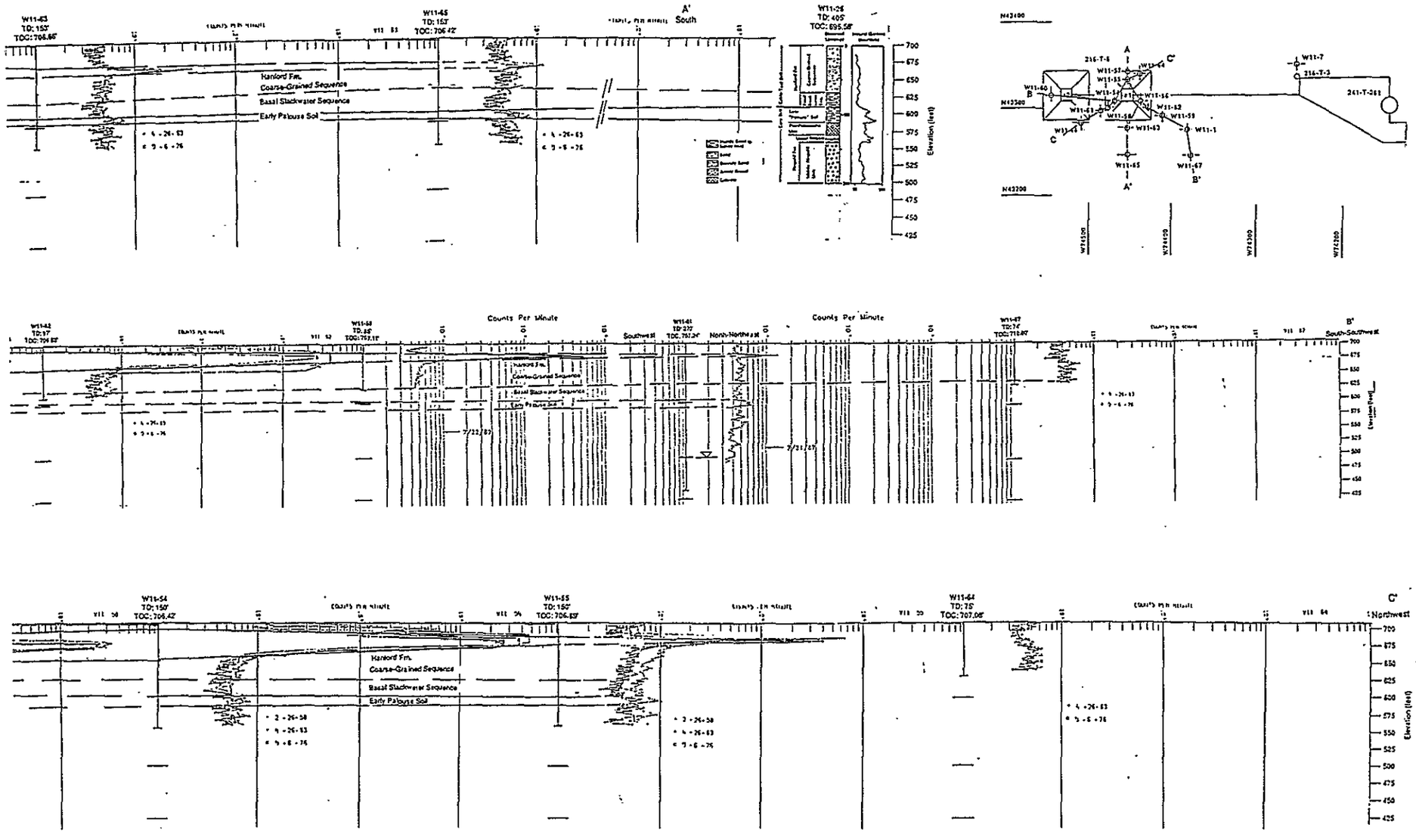

Figure A-1. 216-T-6 Cribs 1 and 2 - Scintillation Probe Profile Cross Sections A-A', B-B', and C-C'. (sheet 2 of 2)

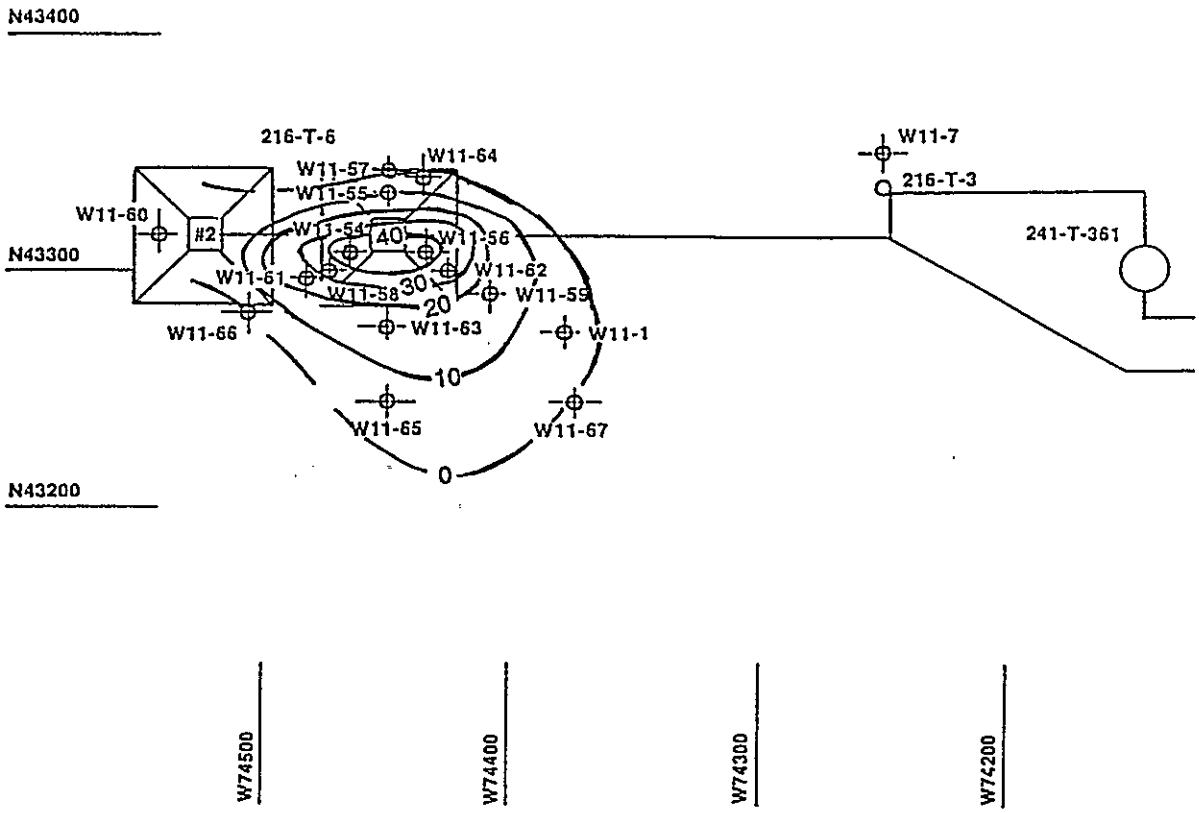

Figure A-2. 216-T-6 Cribs 1 & 2 -
Elevated Gamma Radiation Isopach Map

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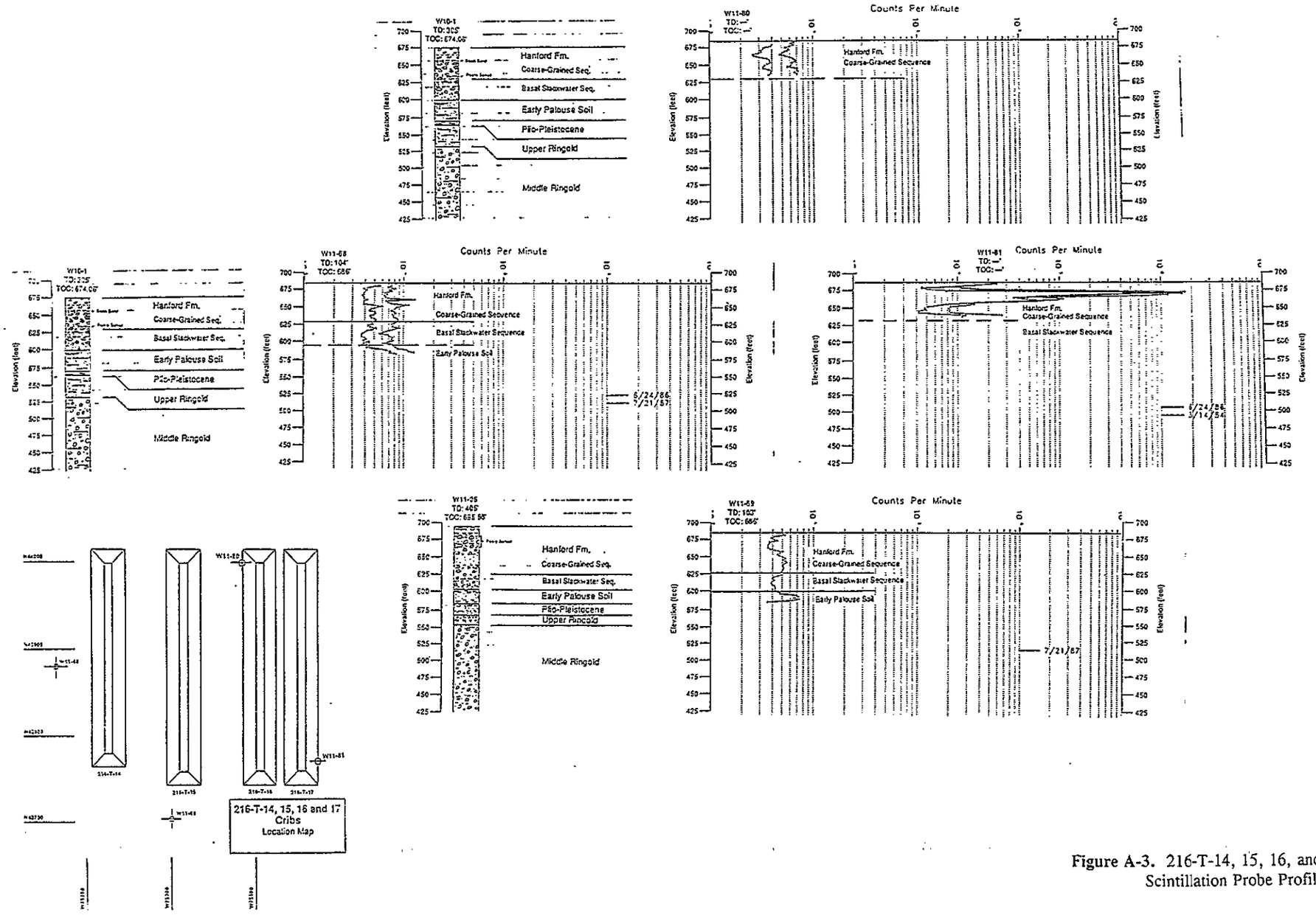

Figure A-3. 216-T-14, 15, 16, and 17 Cribs - Scintillation Probe Profile.

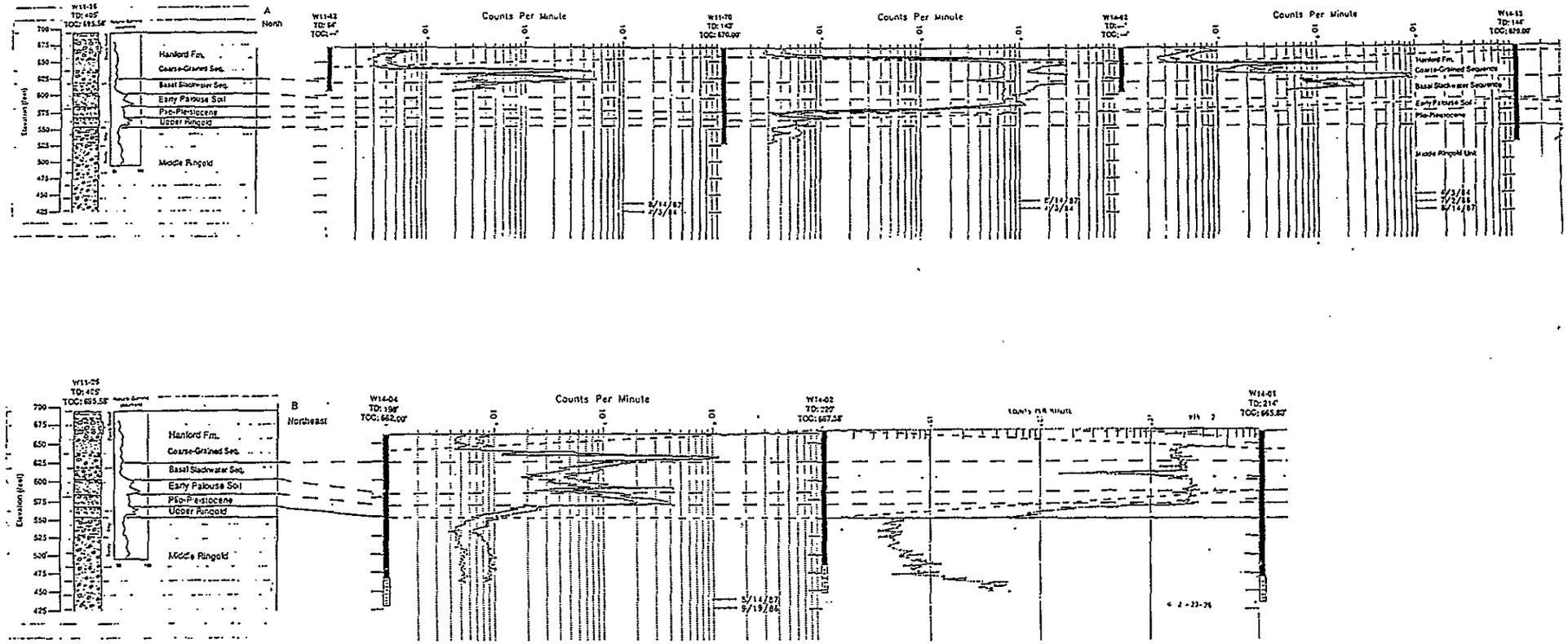

Figure A-4. 216-T-26, 27, and 28 Cribs - Scintillation Probe Profile Cross Sections A-A' and B-B'. (sheet 1 of 2)

9 3 1 2 8 5 6 7 5 2 6

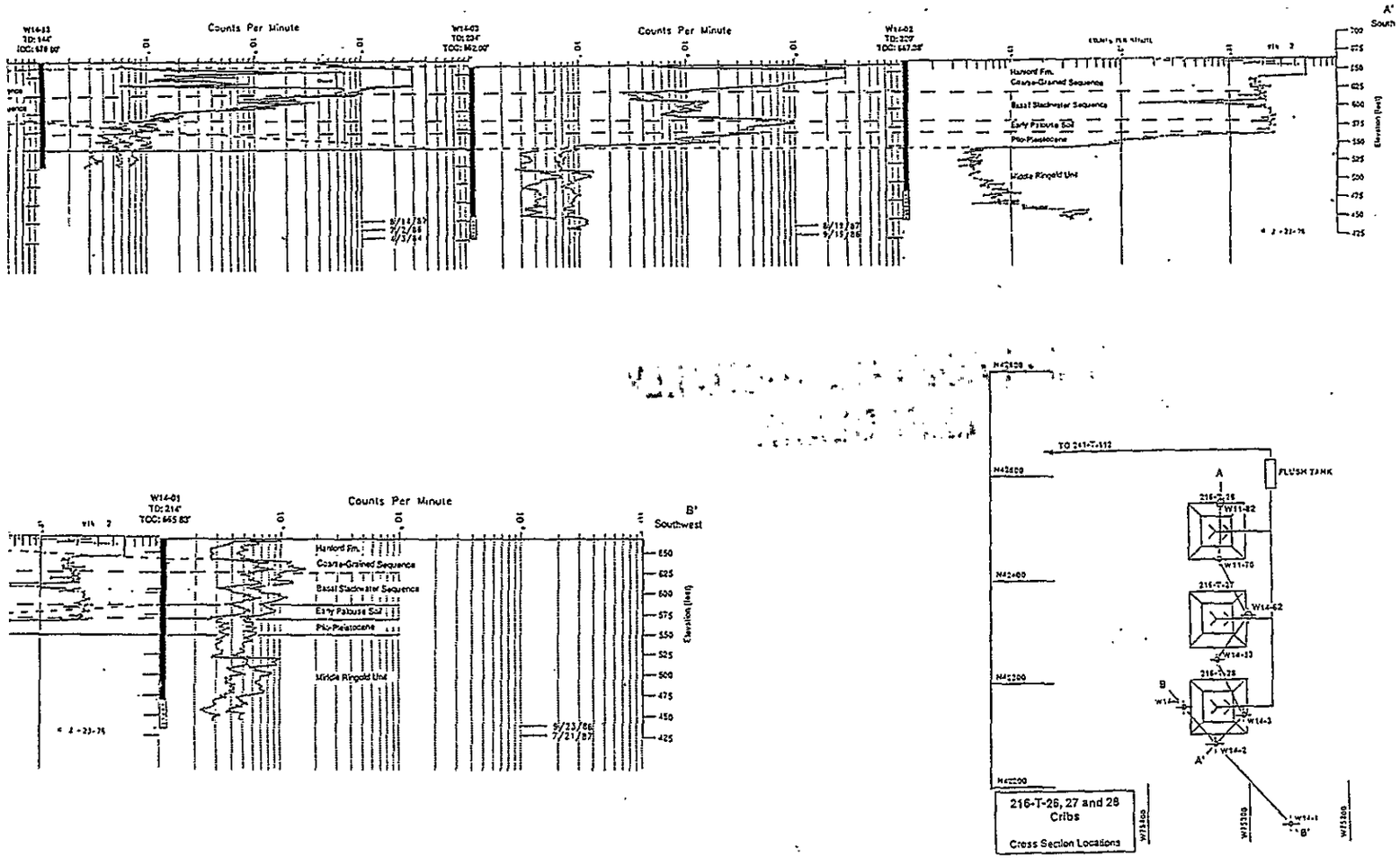

Figure A-4. 216-T-26, 27, and 28 Cribs - Scintillation Probe Profile Cross Sections A-A' and B-B'. (sheet 2 of 2)

9 3 1 2 8 1 6 7 6 2 7

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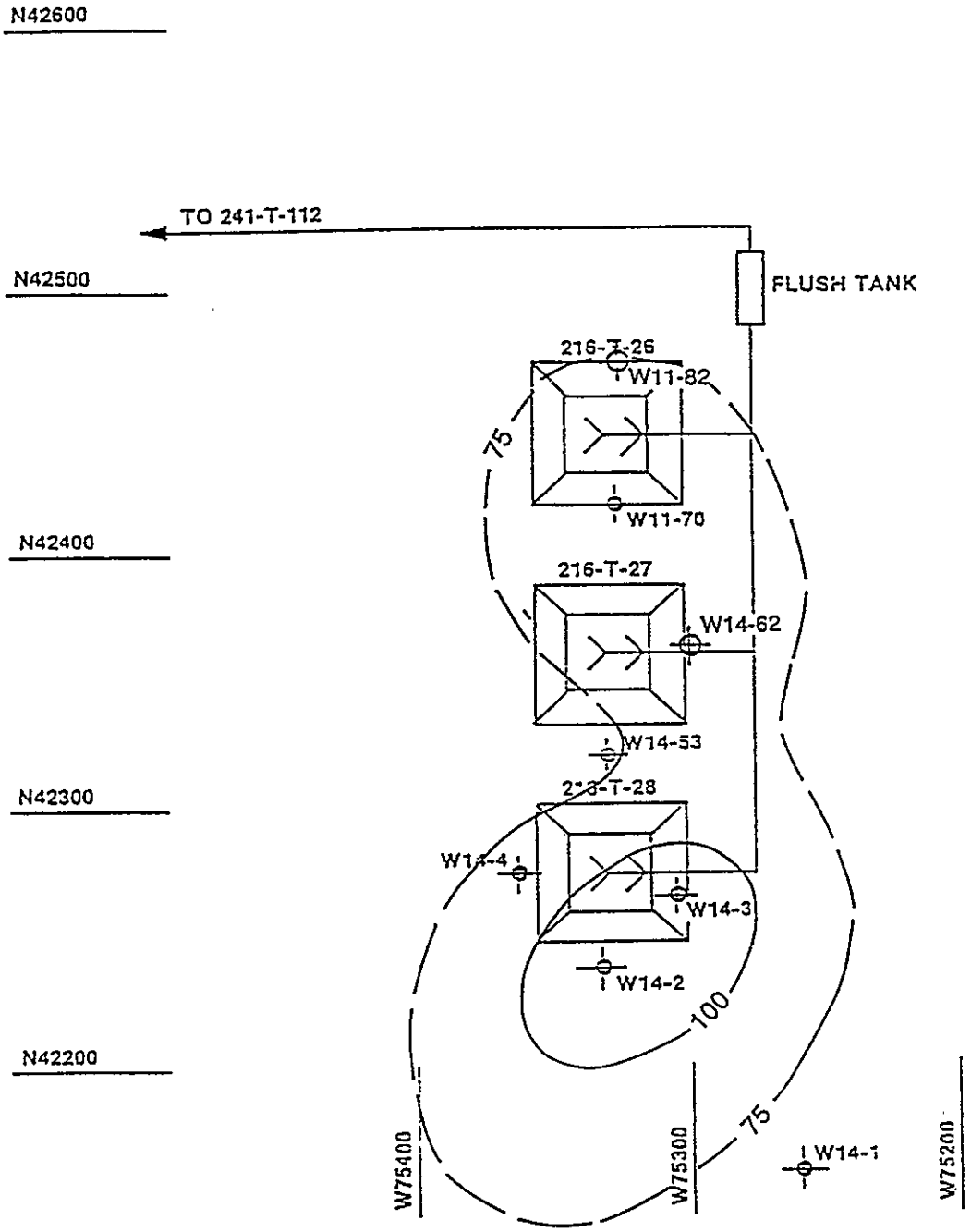

Figure A-5. 216-T-26, 27, and 28 Cribs - Elevated Gamma Radiation Isopach Map

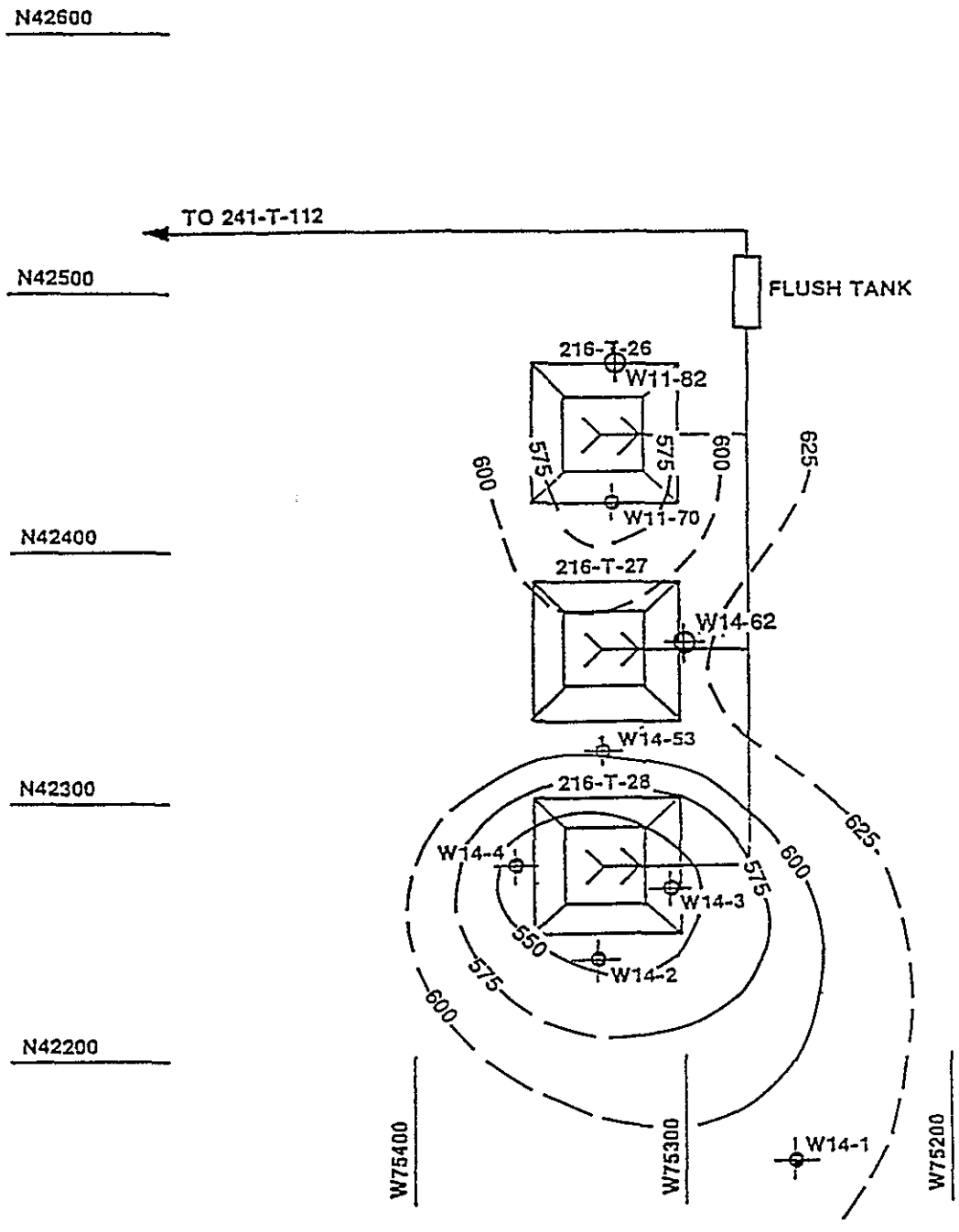

Figure A-6. 216-T-26, 27 and 28 Cribs - Base Contaminated Zone Elevation (ft).

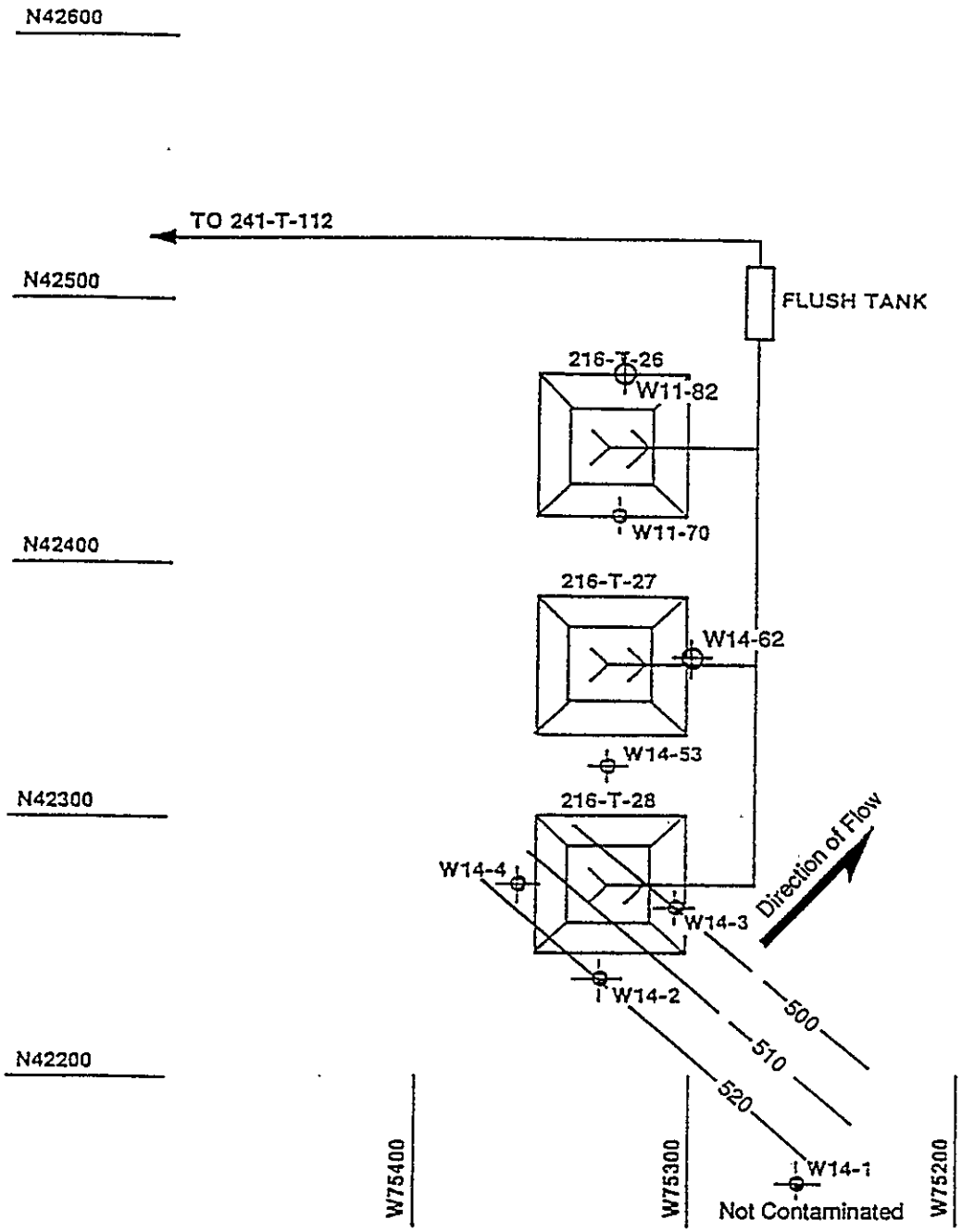

Figure A-7. 216-T-26, 27 and 28 Cribs - Approximate Water Table Elevation (1976)

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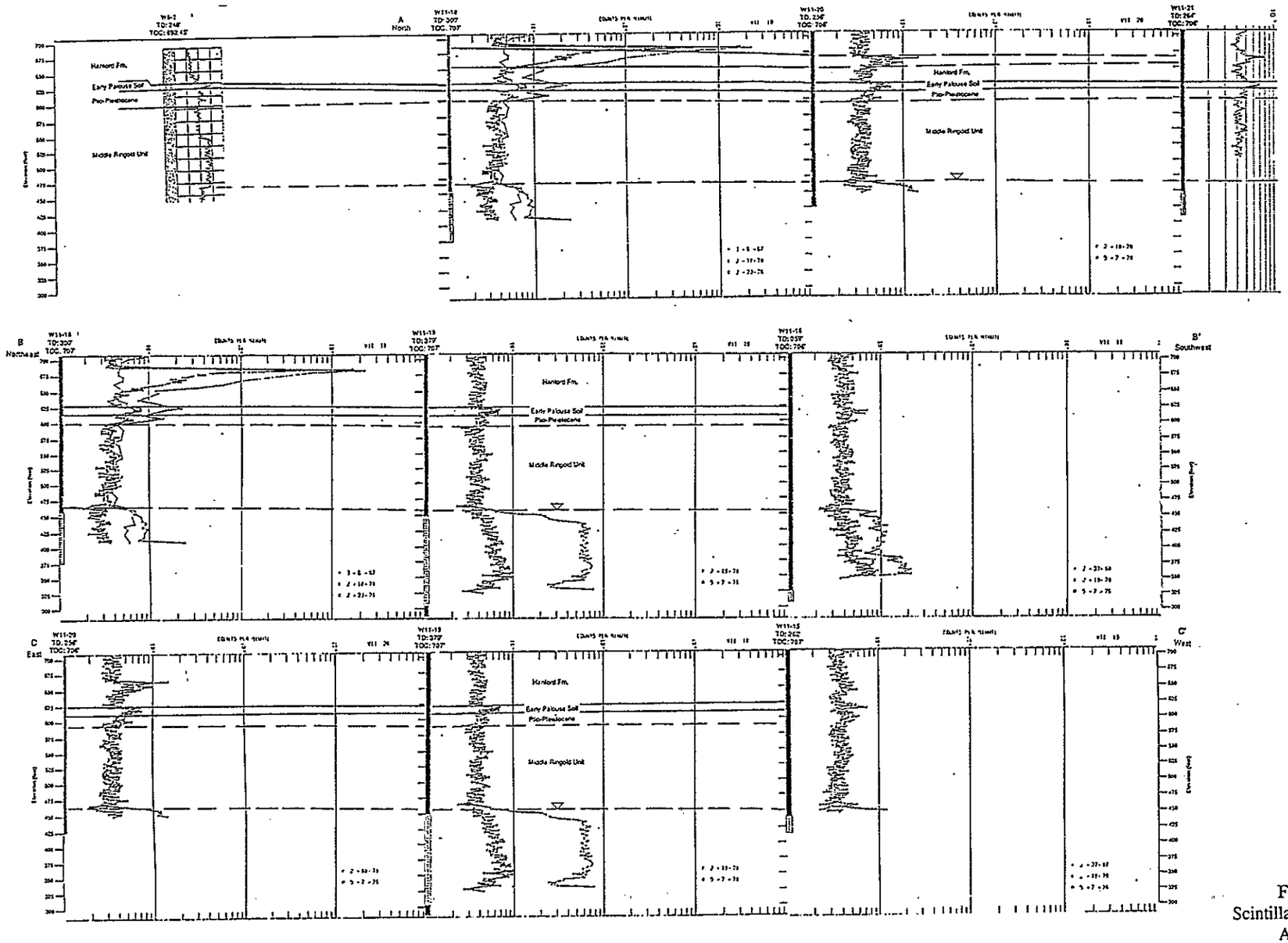
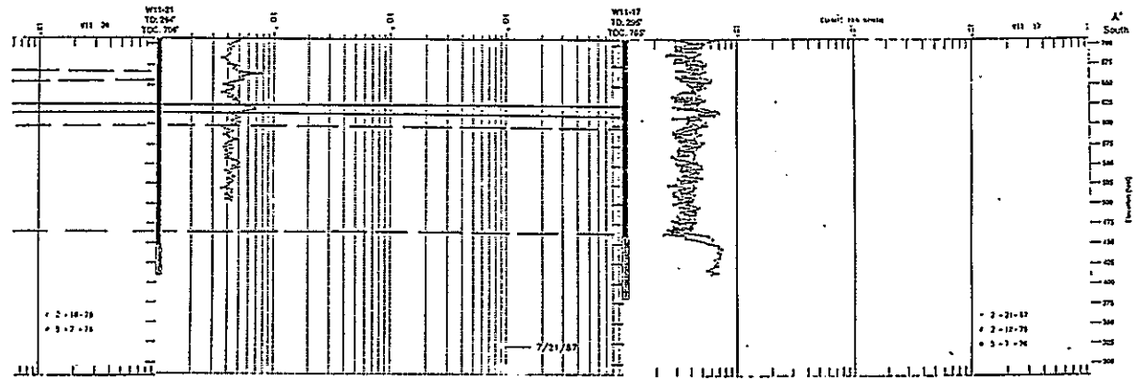


Figure A-8. 216-T-34 and 35 Cribs - Scintillation Probe Profile Cross Sections A-A', B-B', and C-C'. (sheet 1 of 2)



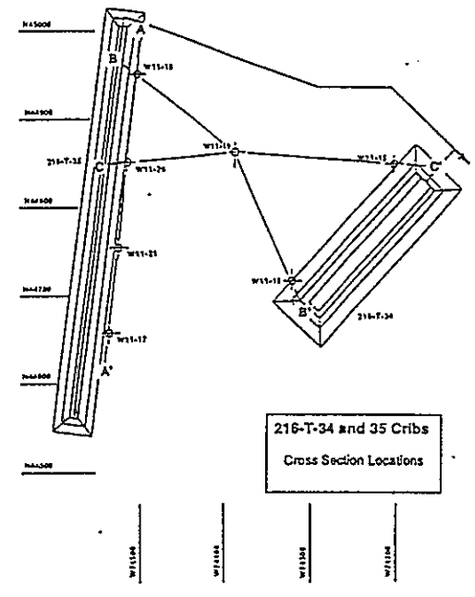


Figure A-8. 216-T-34 and 35 Cribs - Scintillation Probe Profile Cross Sections A-A', B-B', and C-C'. (sheet 2 of 2)

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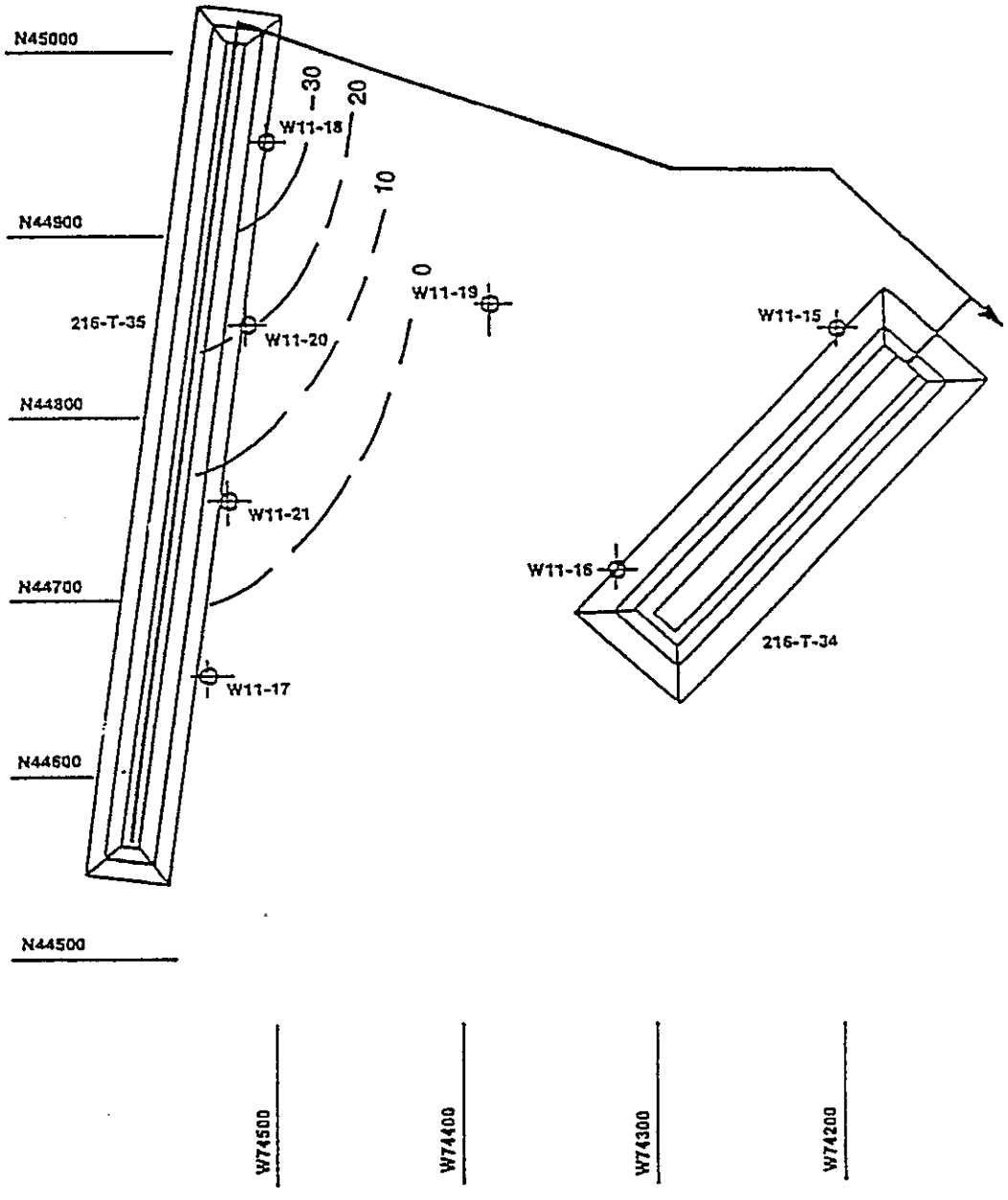

Figure A-9. 216-T-34 and 35 Cribs -
Shallow Zone Elevated Gamma Radiation Isopach Map

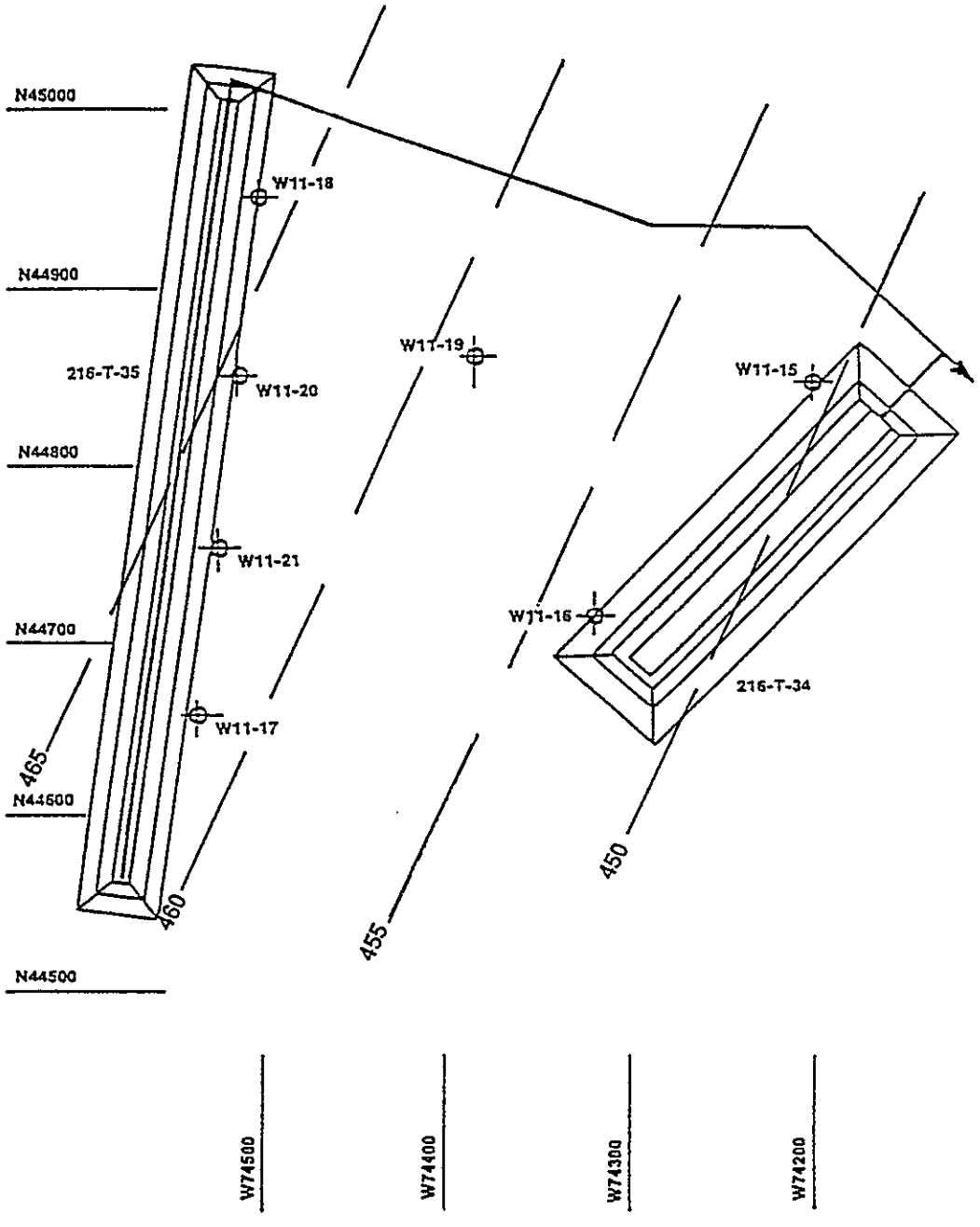

Figure A-10. 216-T-34 and 35 Cribs - Deep Zone Top Elevated Gamma Radiation

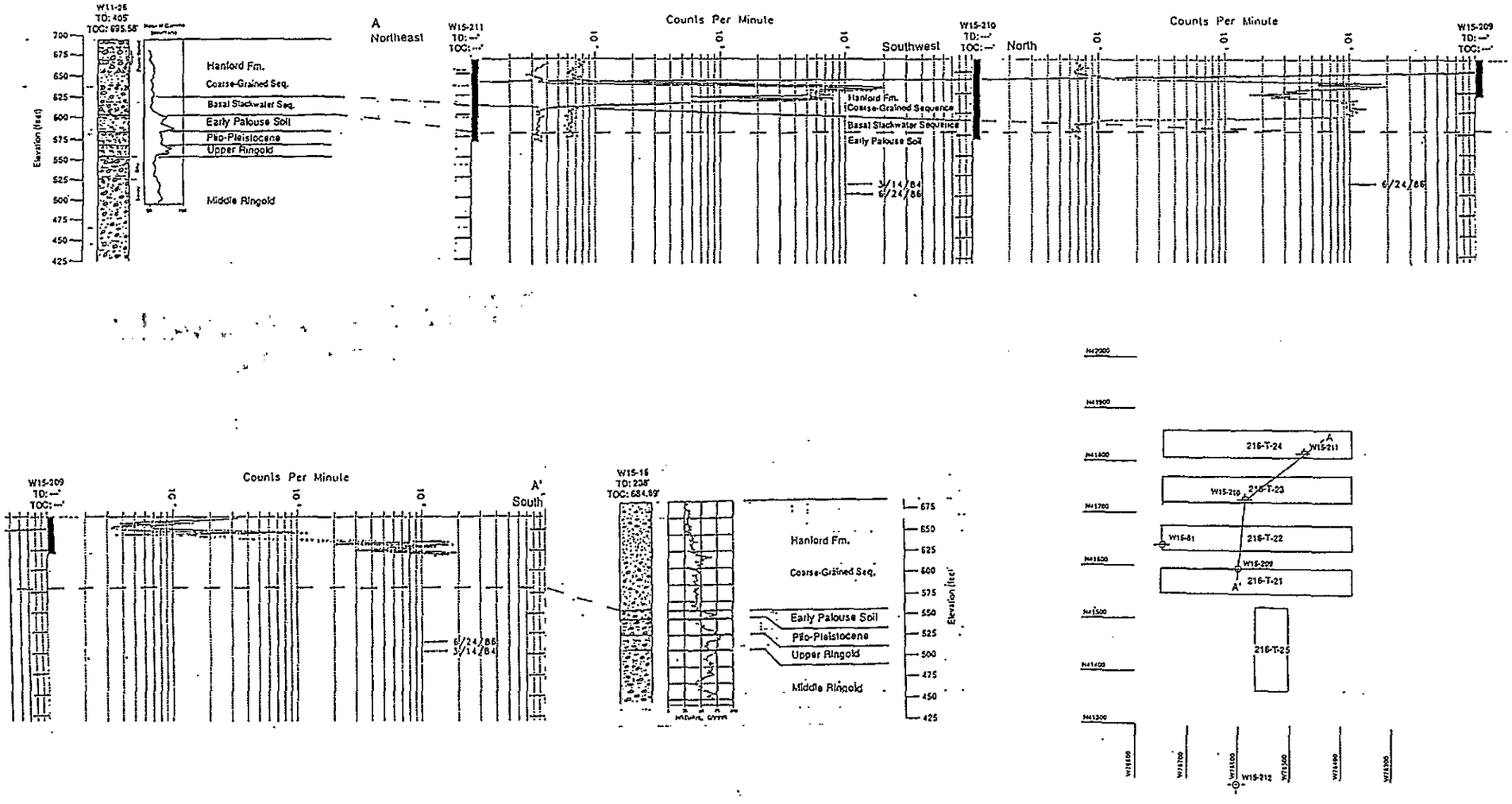

Figure A-11. 216-T-21, 22, 23, 24, and 25 Cribs - Scintillation Probe Profile Cross Section A-A'.

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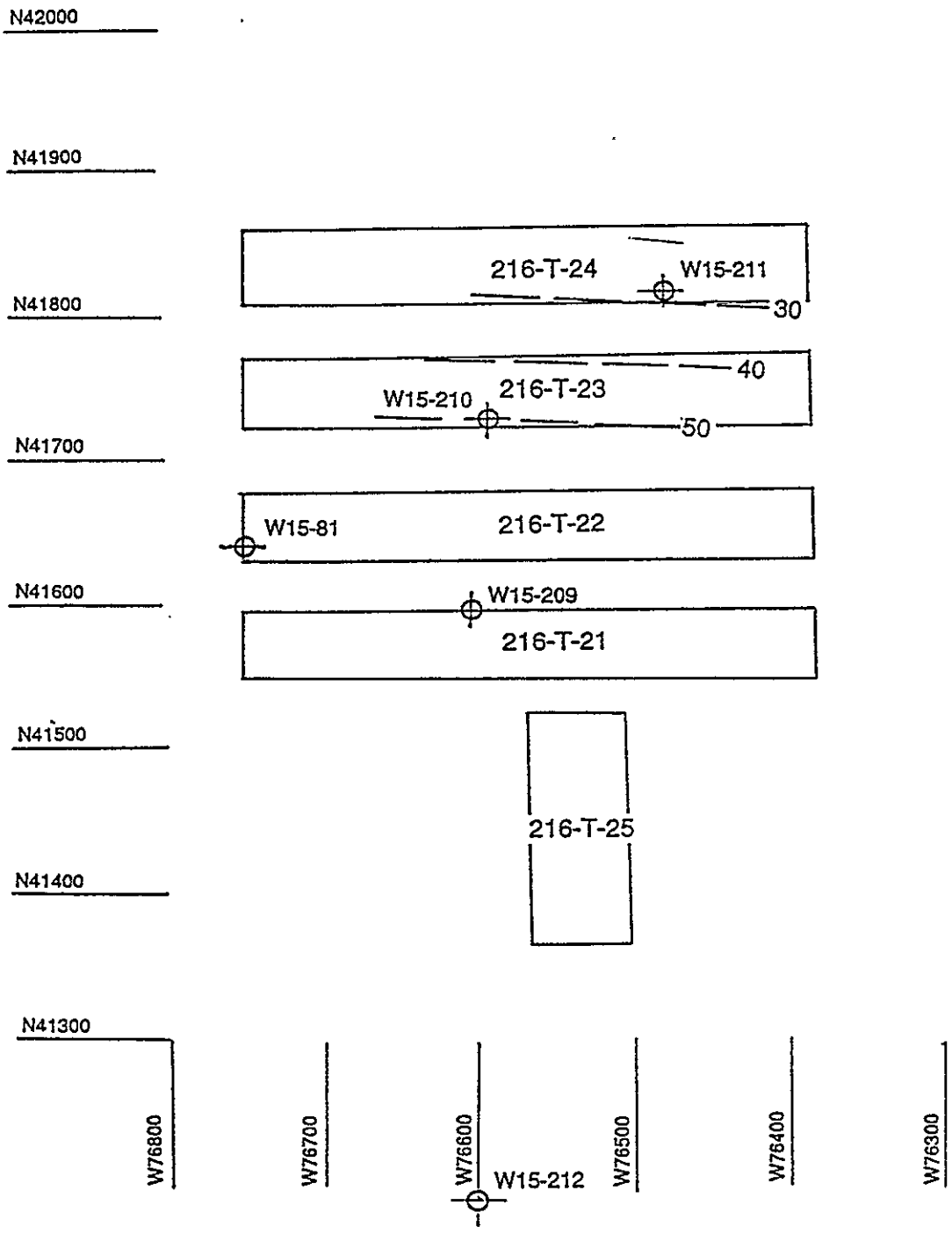

Figure A-12. 216-T-21, 22, 23, 24 and 25 Cribs - Elevated Gamma Radiation Isopach Map

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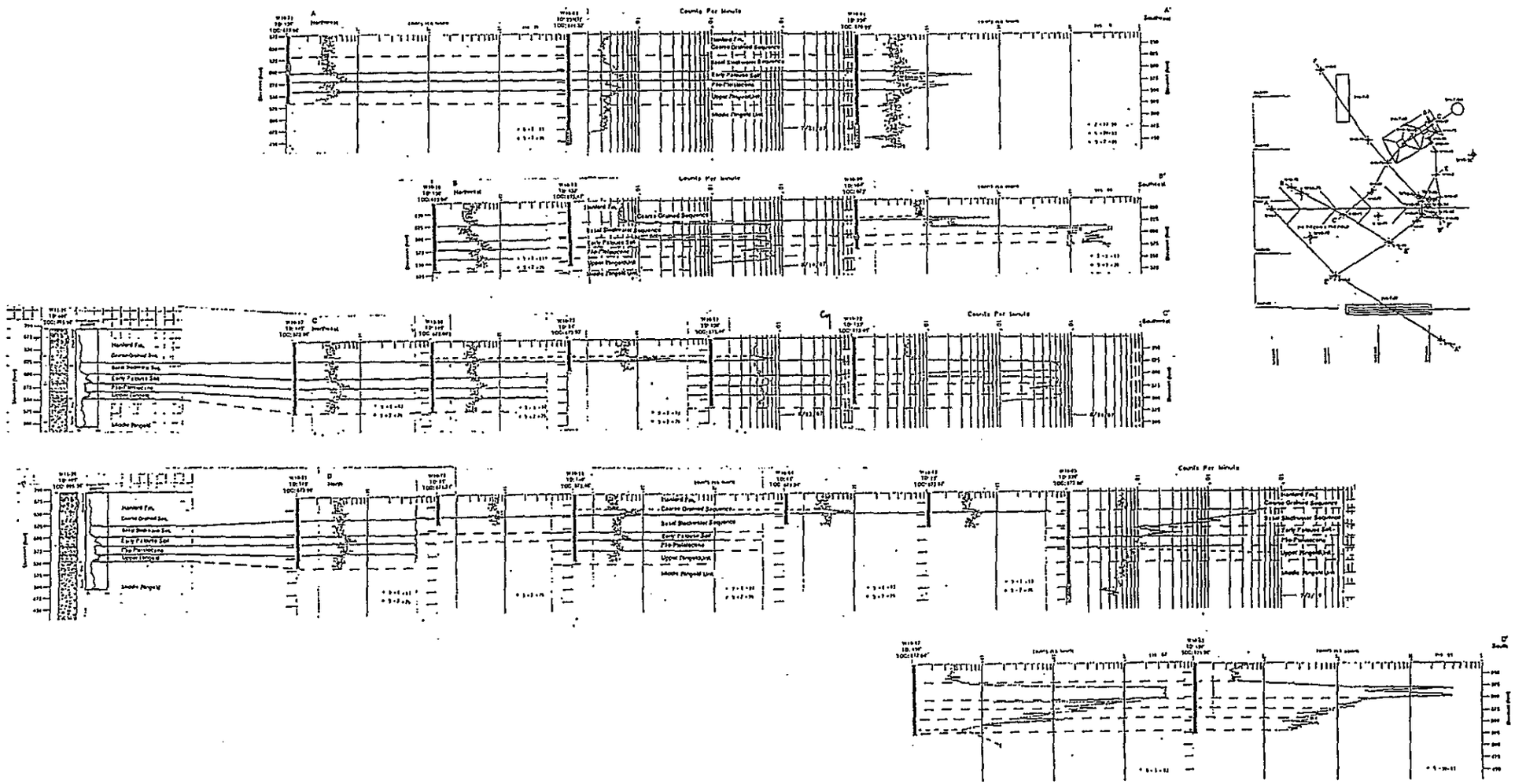

Figure A-13. 216-T-5, 7, 32, and 36 Cribs - Scintillation Probe Profile Cross Sections A-A', B-B', C-C', and D-D'.

9 3 1 2 3 5 6 9 6 3 7

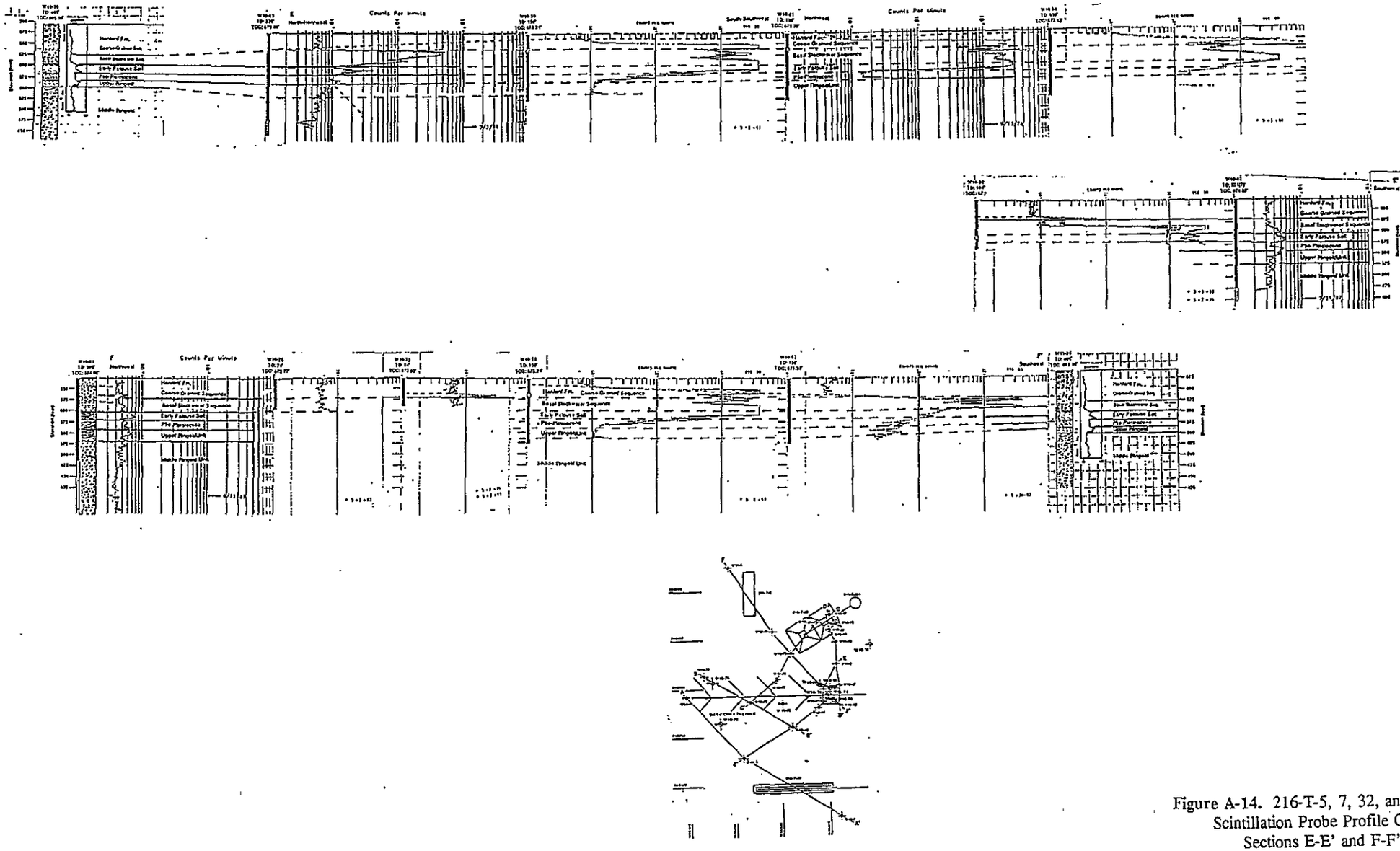

Figure A-14. 216-T-5, 7, 32, and 36 Cribs - Scintillation Probe Profile Cross Sections E-E' and F-F'.

9 3 1 2 5 5 6 1 6 3 8

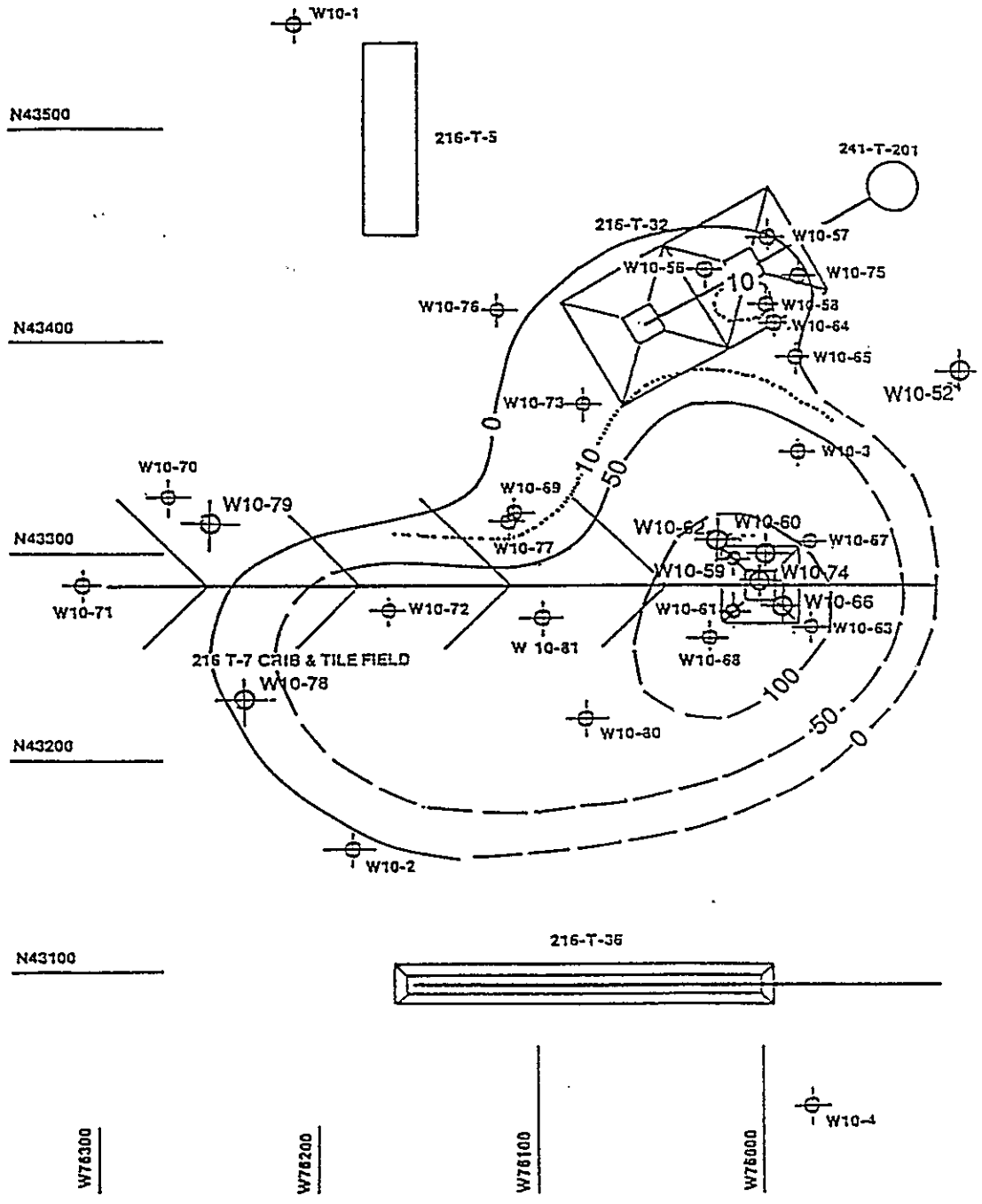

Figure A-15. 216-T-5, 7, 32 and 36 Cribs - Elevated Gamma Radiation Isopach Map

Table A-1. Details of Monitoring Wells for 216-T-6 Cribs.

Well Name	O.U.	Completed	T.D.	T.O.C.	Diameter	Gamma Logs	
W11-1	200-TP-4	3/50	270	707.24	8	2/20/58	*
						6/8/59	*
						4/26/63	*
						2/27/68	
						5/6/76	
						7/21/87	
W11-54	200-TP-3	5/47	150	706.42	8	2/26/58	
						4/26/63	
						5/6/76	
W11-55	200-TP-3	6/47	150	706.69	8	9/23/53	*
						2/26/58	
						4/26/63	
						5/6/76	
W11-56	200-TP-3	6/47	139	706.69	8	2/26/58	*
						4/26/63	
						5/6/76	
W11-57	200-TP-3	3/51	87	706.97	8	2/26/58	*
						4/26/63	
						5/6/76	
						7/22/87	*
W11-58	200-TP-3	7/47	75	706.27	8	2/26/58	*
						4/26/63	
						5/6/76	
W11-59	200-TP-4	7/47	85	707.11	8	2/26/58	*
						4/26/63	
						5/6/76	
						7/22/87	
W11-60	200-TP-3	7/47	150	705.36	8	2/26/58	*
						4/26/63	
						5/6/76	
W11-61	200-TP-3	7/47	80	706.20	8	2/26/58	*
						4/26/63	
						5/6/76	
W11-62	200-TP-3	8/47	97	706.83	8	2/26/58	*
						4/26/63	
						5/6/76	
W11-63	200-TP-3	9/47	153	706.66	8	2/26/58	*
						4/26/63	
						5/6/76	
						7/22/87	*
W11-64	200-TP-4	9/47	75	707.08	8	2/26/58	*
						4/26/63	
						5/6/76	
W11-65	200-TP-3	10/47	153	706.42	8	2/26/58	*
						4/26/63	
						5/6/76	
						7/22/87	*
W11-66	200-TP-3	8/51	72	710.00	8	2/26/58	*
						4/26/63	
						5/6/76	
						7/22/87	*
W11-67	200-TP-4	8/51	74	710.00	8	2/26/58	*
						4/26/63	
						5/6/76	
						7/22/87	*

* Log Not Used in Interpretation

Table A-2. Details of Monitoring Wells for 216-T-34 and 216-T-35 Cribs.

Well Name	O.U.	Completed	T.D.	Perf.	T.O.C.	Diameter	Gamma Logs
W11-15	200-TP-4	12/65	262	240-263	707	6	2/27/68
							2/19/70
							5/6/76
W11-16	200-TP-4	12/65	359	343-357	706	6	2/27/68
							2/19/70
							5/7/76
							7/21/87 *
W11-17	200-TP-4	2/67	295	223-295	705	6	2/21/67
							2/27/68 *
							2/18/70
							5/7/76
							7/21/87 *
W11-18	200-TP-4	3/67	300	227-295	707	6	3/6/67
							2/27/68 *
							2/18/70
							2/23/76
W11-19	200-TP-4	4/69	379	234-365	707	6	2/19/70
							5/7/76
							7/21/87 *
W11-20	200-TP-4	6/69	256	—	706	6	2/18/70
							5/7/76
							7/21/87 *
W11-21	200-TP-4	3/69	264	235-267	706	6	2/18/70 *
							5/7/76
							7/21/87

* Log Not Used in Interpretation

Table A-3. Details of Monitoring Wells for 216-T-14, 15, 16, and 17 Cribs.

Well Name	O.U.	Completed	T.D.	T.O.C.	Diameter	Gamma Logs
W11-83	200-TP-6	10/53	104	686	8	5/2/58 *
						4/29/63
						5/7/76
						6/24/86
						7/21/87
W11-69	200-TP-3	9/53	103	686	8	5/2/58 *
						4/29/63
						5/7/76
						7/21/87
W11-80	200-TP-3	10/82	—	—	8	3/14/84
						6/24/86
W11-81	200-TP-3	10/82	—	—	8	3/14/84
						6/24/86

* Log Not Used in Interpretation

Table A-4. Details of Monitoring Wells for 216-T-26, 27, and 28 Cribs.

Well Name	O.U.	Completed	T.D.	Perf.	T.O.C.	Diameter	Gamma Logs	
W11-70	200-TP-2	5/55	143	—	670	8	7/15/59	*
							8/29/60	*
							4/29/63	
							9/2/65	
							5/7/76	
							4/3/84	
							7/3/86	*
							8/14/87	
W11-82	200-TP-2	1/83	64	—	—	8	4/3/84	
							7/3/86	*
							8/14/87	
W14-1	200-TP-2	1/54	214	195-230	665.83	8	4/15/58	*
							6/9/59	*
							8/29/60	*
							4/29/63	
							2/23/68	
							5/7/76	
							9/23/86	
							7/21/87	
W14-2	200-TP-2	5/55	220	181-222	667.38	8	4/15/58	*
							6/9/59	
							8/29/60	*
							4/29/63	
							2/23/68	*
							4/9/70	
							2/23/76	
W14-3	200-TP-2	12/61	234	234-208	662	8	4/29/63	
							5/7/76	
							9/19/86	
							8/19/87	
W14-4	200-TP-2	7/86	198	—	662	8	2/7/87	
							5/7/76	
							9/19/86	
							8/14/87	
W14-53	200-TP-2	5/55	144	208-268	670	8	7/15/59	*
							8/29/60	*
							4/29/63	
							9/2/65	*
							4/9/70	
							5/7/76	
							4/3/84	
							7/2/86	
							8/14/87	
W14-62	200-TP-2	2/83	—	—	—	8	4/3/84	
							7/2/86	
							8/14/87	

* Log Not Used in Interpretation

Table A-5. Details of Monitoring Wells for 216-T-21, 22, 23, 24, and 25 Cribs.

Well Name	O.U.	Completed	T.D.	Perf.	T.O.C.	Diameter	Gamma Logs
W15-81	200-TP-1	10/53	115	—	670	8	5/2/63 *
							12/2/76 *
W15-209	200-TP-1	11/82	—	—	—	8	3/14/84
							6/24/86
W15-210	200-TP-1	10/82	—	—	—	8	3/14/84 *
							6/24/86
W15-211	200-TP-1	10/82	—	—	—	8	3/14/84
							6/24/86
W15-212	200-TP-1	10/82	—	—	—	8	Unknown

* Log Not Used in Interpretation

Table A-6. Details of Monitoring Wells for 216-T-5, 7, 32, and 36 Cribs. (Sheet 1 of 2)

Well Name	O.U.	Completed	T.D.	Perf.	T.O.C.	Diameter	Gamma Logs
W10-1	200-TP-1	8/47	305	190-270	674.08	8	6/9/59
							5/1/63
							4/12/68 *
							4/9/70 *
							2/23/76
							8/13/87
W10-2	200-TP-1	12/51	213	201-229	674.33	4	5/7/76
							7/21/87
W10-3	200-TP-6	11/51	228	194-230	672.66	8	6/9/59
							5/1/63 *
							4/9/70
							2/23/76
							7/3/86
W10-4	200-TP-2	11/52	238	190-245	670.95	8	4/15/58 *
							7/23/59
							4/29/63
							2/24/70 *
							5/7/76
W10-52	200-TP-6	10/44	149	50-150	672.11	6	4/30/63 *
W10-56	200-TP-6	6/47	145	—	672.86	8	5/1/63
							5/7/76
W10-57	200-TP-6	6/47	145	—	673.99	8	5/1/63
							5/7/76
W10-58	200-TP-6	7/47	140	—	672.46	8	5/1/63
							5/7/76
W10-59	200-TP-6	7/47	150	33-38	672.24	8	5/1/63
							12/6/76 *
W10-60	200-TP-6	7/47	150	31-36	671.74	8	5/1/63 *
							12/6/76 *
W10-61	200-TP-6	7/47	150	32-37	672.29	8	5/1/63
							9/15/76
W10-62	200-TP-6	7/47	150	—	672.37	8	5/1/63 *
							12/6/76 *
W10-63	200-TP-6	7/47	150	—	671.92	8	4/30/63
							12/6/76 *
W10-64	200-TP-6	7/47	66	—	672.34	8	5/1/63
							5/7/76
W10-65	200-TP-6	8/47	75	—	673.07	8	5/1/63
							5/7/76
W10-66	200-TP-6	9/47	125	31-36	671.80	8	4/30/63 *
							12/6/76 *
W10-67	200-TP-6	8/47	150	—	672.04	8	5/1/63
							12/6/76 *
W10-68	200-TP-6	8/47	150	—	672.13	8	5/1/63
							12/6/76 *
W10-69	200-TP-6	8/47	138	—	673.44	8	5/1/63
							5/7/76
							8/13/87
W10-70	200-TP-1	8/47	138	—	673.84	8	5/2/63
							5/7/76
							8/13/87 *
W10-71	200-TP-1	8/47	138	60-80	673.98	8	5/2/63
							5/7/76
							8/13/87 *

*Log Not Used in Interpretation

Table A-6. Details of Monitoring Wells for 216-T-5, 7, 32, and 36 Cribs. (Sheet 2 of 2)

Well Name	O.U.	Completed	T.D.	Perf.	T.O.C.	Diameter	Gamma Logs
W10-72	200-TP-1	8/47	133	—	673.41	8	5/2/63
							5/7/76
							8/14/87
W10-73	200-TP-6	9/47	64	—	673.03	8	5/2/63
							5/7/76
W10-74	200-TP-6	10/47	49	—	672.01	8	4/30/63 *
							12/6/76 *
W10-75	200-TP-6	10/47	65	—	674.71	8	5/1/63 *
							5/7/76
W10-76	200-TP-1	10/47	71	—	673.77	8	5/2/63
							8/13/87 *
W10-77	200-TP-6	12/48	24	—	672	8	5/1/63 *
							5/7/76 *
							8/13/87 *
W10-78	200-TP-1	12/48	20	—	672	8	5/2/63 *
							5/7/76 *
							8/14/87 *
W10-79	200-TP-1	12/48	22	—	672	8	5/2/63 *
							5/7/76 *
							8/13/87 *
W10-80	200-TP-6	9/51	104	77-83	672	8	5/1/63
							5/7/76
W10-81	200-TP-6	11/51	19	—	672	8	5/2/63 *
							5/7/76 *

* Log Not Used in Interpretation

APPENDIX B

HEALTH AND SAFETY PLAN

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ACRONYMS AND ABBREVIATIONS

AAMS	aggregate area management study
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EII	Environmental Investigations Instructions
HEHF	Hanford Environmental Health Foundation
HSP	health and safety plan
HWOP	Hazardous Waste Operations Permit
JSA	Job Safety Analysis
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
RCRA	Resource Conservation Recovery Act
RWP	Radiation Work Permit
SCBA	self-contained breathing apparatus
Westinghouse Hanford	Westinghouse Hanford Company
WISHA	Washington Industrial Safety and Health Act

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1.0 GENERAL CONSIDERATIONS AND REQUIREMENTS

1.1 INTRODUCTION

The purpose of this Health and Safety Plan (HSP) is to outline standard health and safety procedures for Westinghouse Hanford Company (Westinghouse Hanford) employees and contractors engaged in investigation activities in the T Plant Aggregate Area Management Study (AAMS). These activities will include surface investigation, drilling and sampling boreholes, and environmental sampling in areas of known chemical and radiological contamination. Appropriate site-specific safety documents (e.g., Hazardous Waste Operations Permit [HWOP] or Job Safety Analysis [JSA]) will be written for each task or group of tasks. A more complete discussion of Westinghouse Hanford environmental safety procedures is presented in the Westinghouse Hanford manual *Health and Safety for Hazardous Waste Field Operations*, WHC-CM-4-3 vol. 4 (WHC 1992).

All employees of Westinghouse Hanford or any other contractors who are participating in onsite activities in the T Plant AAMS shall read the site-specific safety document and attend a pre-job safety or tailgate meeting to review and discuss the task.

1.2 DESIGNATED SAFETY PERSONNEL

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

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

- Allocating and administering resources to successfully comply with all technical and health and safety requirements
- Verifying that all permits, supporting documentation, and clearances are in place (e.g., electrical outage requests, welding permits, excavation permits, HWOP or JSA, sampling plan, radiation work permits [RWP], and onsite/offsite radiation shipping records)
- Providing technical advice during routine operations and emergencies
- Informing the appropriate site management and safety personnel of the activities to be performed each day
- Coordinating resolution of any conflicts that may arise between RWPs and the implementation of the HWOP or JSA with health physics

- Handling emergency response situations as may be required

- Conducting pre-job and daily tailgate safety meetings

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

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

- Monitor chemical, physical, and (in conjunction with the health physics technician) radiation hazards to assess the degree of hazard present; monitoring shall specifically include organic vapor detection, radiation screening, and confined space evaluation where appropriate.

- Determine protection levels, clothing, and equipment needed to ensure the safety of personnel in conjunction with the health physics department.

- Monitor the performance of all personnel to ensure that the required safety procedures are followed.

- Halt operations immediately, if necessary, due to safety or health concerns.

- Conduct safety briefings as necessary.

- Assist the field team leader in conducting safety briefings as necessary.

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

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

1.3 MEDICAL SURVEILLANCE

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

Medical examinations will be designed to identify any pre-existing conditions that may place an employee at high risk, and will verify that each worker is physically able to perform the work required by this plan without undue risk to personal health. The physician shall determine the existence of conditions that may reduce the effectiveness or prevent the employee's use of respiratory protection. The physician shall also determine the presence of conditions that may pose undue risk to the employee while performing the physical tasks of this work plan using level B personal protection equipment. This would include any condition that increases the employee's susceptibility to heat stress.

The examining physician's report will not include any nonoccupational diagnoses unless directly applicable to the employee's fitness for the work required.

1.4 TRAINING

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

The field team leader and the site safety officer shall receive an additional 8 hours of training (in addition to the refresher training previously discussed).

1.5 TRAINING FOR VISITORS

For the purposes of this plan, a visitor is defined as any person visiting the Hanford Site, who is not a Westinghouse Hanford employee or a Westinghouse Hanford contractor directly involved in the Resource Conservation and Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) facility investigation activities, including but not limited to those engaged in surveillance, inspection, or observation activities.

Visitors who must, for whatever reason, enter a controlled (either contamination reduction or exclusion) zone, shall be subject to all of the applicable training, respirator fit testing, and medical surveillance requirements discussed in Westinghouse Hanford Environmental Investigations Instructions (EII) 1.1 and Appendix B to EII 1.1 (WHC 1991).

All visitors shall be informed of potential hazards and emergency procedures by their escorts and shall conform to EII 1.1 (WHC 1991).

1.6 RADIATION DOSIMETRY

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

1.7 REQUIREMENTS FOR THE USE OF RESPIRATORY PROTECTION

All employees of Westinghouse Hanford and subcontractors who may be required to use air-purifying or air-supplied respirators must be included in the medical surveillance program and be approved for the use of respiratory protection by the Hanford Environmental Health Foundation (HEHF) or other licensed physician. Each team member must be trained in the selection, limitations, and proper use and maintenance of respiratory protection (existing respiratory protection training may be applicable towards the 40-hour training requirement).

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

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

2.0 GENERAL PROCEDURES

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

2.1 GENERAL WORK SAFETY PRACTICES

2.1.1 Work Practices

The following work practices must be observed.

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

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

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

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

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

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

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

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

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

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

- Do not enter any test pit or trench deeper than 1.2 m (4 ft) unless in accordance with procedures specified in the HWOP.

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

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

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

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

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

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

- Follow all provisions of each site-specific RWP.

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

2.1.2 Personal Protective Equipment

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

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

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

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

- Personnel should maintain a high level of awareness of the limitations in mobility, dexterity, and visual impairment inherent in the use of level B and level C personal protective equipment.

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

- Rescue equipment as required by Occupational Safety and Health Administration (OSHA), Washington Industrial Safety and Health Act (WISHA), or standards for working over water will be available and used.

2.1.3 Personal Decontamination

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

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

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

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

2.1.4 Emergency Preparation

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

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

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

2.2 CONFINED SPACE/TEST PIT ENTRY PROCEDURES

The following procedures apply to the entry of any confined space, which for the purpose of this document shall be defined as any space having limited egress (access to an exit) and the potential for the presence or accumulation of a toxic or explosive atmosphere. This includes manholes, certain trenches (particularly those through waste disposal areas), and all test pits greater than 1 m (4 ft) deep. If confined spaces are to be entered as part of the work operations, a hazardous work permit (filled out for confined space entry) must be obtained from Industrial Safety and Fire Protection.

The identified remedial investigation activities on the T Plant AAMS should not require confined space entry. Nevertheless, the hazards associated with confined spaces are of such severity that all employees should be familiar with the safe work discussed in the following paragraphs.

No employee shall enter any test pit or trench deeper than 1 m (4 ft) unless the sides are shored or laid back to a stable slope as specified in OSHA 29 CFR 1926.652 or equivalent state occupational health and safety regulations.

When an employee is required to enter a pit or trench 1 m (4 ft) deep or more, an adequate means of access and egress, such as a slope of at least 2:1 to the bottom of the pit or a secure ladder or steps shall be provided.

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

An employee entering a confined or partially confined space must be equipped with an appropriate level of respiratory protection in keeping with the monitoring procedures discussed previously and the action levels for airborne contaminants (see "Warnings and Action Levels" in HWOP).

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

3.0 SITE BACKGROUND

Specific details on the T Plant AAMS background and known and suspected contamination are described in Chapters 2.0 through 10.0 of the plan. The T Plant Aggregate Area is situated within the 200 West Area of the U.S. Department of Energy's (DOE) Hanford Site, in the south-central portion of the state of Washington. The 200 West Area is located in Benton County in the central portion of the Hanford Site. It is adjacent to the 200 East Area, located roughly 5 km to the west.

The T Plant Area at the Hanford Site was used by the U.S. Government as a chemical separations area in the process to produce plutonium for nuclear weapons. These operations resulted in the release of chemical and radioactive wastes into the soil, air, and water of the area. Each waste site in the aggregate area is described separately in this document. Close relationships between waste units, such as overflow from one to another, are also discussed.

4.0 SCOPE OF WORK AND POTENTIAL HAZARDS

While the information presented in Chapters 2.0 through 10.0 of the plan are believed to be representative of the constituents and quantities of wastes at the time of discharge, the present chemical nature, location, extent, and ultimate fate of these wastes in and around the liquid disposal facilities are largely unknown. The emphasis of the investigation in the T Plant AAMS will be to characterize the nature and extent of contamination in the vadose (unsaturated subsurface soil) zone.

4.1 WORK TASKS

Work tasks are described in Chapter 5.0 of the plan.

4.2 POTENTIAL HAZARDS

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

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

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

Potential hazards include the following:

- External radiation (gamma and to a lesser extract, beta) from radioactive materials in the soil
- Internal radiation resulting from radionuclides present in contaminated soil entering the body by ingestion or through open cuts and scratches
- Internal radiation resulting from inhalation of particulate (dust) contaminated with radioactive materials
- Inhalation of toxic vapors or gases such as volatile organics or ammonia
- Inhalation or ingestion of particulate (dust) contaminated with inorganic or organic chemicals, and toxic metals
- Dermal exposure to soil or groundwater contaminated with radionuclides
- Dermal exposure to soil or groundwater contaminated with inorganic or organic chemicals, and toxic metals
- Physical hazards such as noise, heat stress, and cold stress
- Slips, trips, falls, bumps, cuts, pinch points, falling objects, other overhead hazards, crushing injuries, and other hazards typical of a construction-related job site
- Unknown or unexpected underground utilities
- Biological hazards; snakes, spiders, etc.

4.3 ASSESSMENT AND MITIGATION OF POTENTIAL HAZARDS

The likelihood of significant exposure (100 mR/h or greater) to external radiation is remote and can be readily monitored and controlled by limiting exposure time, increasing distance, and employing shielding as required.

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

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

5.0 ENVIRONMENTAL AND PERSONAL MONITORING

The site safety officer or authorized delegate shall be present at all times during work activities which require an HWOP, and shall be in charge of all environmental/personal monitoring equipment. Industrial Hygiene and Safety shall review all activities involving or potentially involving radiological exposure or contamination control and shall prescribe the appropriate level of technical support and/or monitoring requirements. Other equipment deemed necessary by the site safety officer or Industrial Hygiene and Safety shall be obtained at their direction; work will be initiated or continued until such equipment is in place. These instruments are to be used only by persons who are trained in their usage and who understand their limitations. No work shall be done unless instrumentation is available and in proper working order.

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

- "Radionuclide Concentrations in Air," in Chapter XI, DOE Order 5480.1B (DOE 1986)

- "Air Contaminants - Permissible Exposure Limits," in 29 CFR 1910.1000

- *Threshold Limit Values and Biological Exposure Indices for 1990-1991* (ACGIH 1991)

- *Occupational Safety and Health Standards*, 29 CFR 1910.1000

- *Pocket Guide to Chemical Hazards* (NIOSH 1991), which provides National Institute for Occupational Safety and Health (NIOSH)-recommended exposure limits for substances that do not have either a threshold limit value or a permissible exposure limit.

5.1 AIRBORNE RADIOACTIVE AND RADIATION MONITORING

An onsite health physics technician will monitor airborne radioactive contamination levels and external radiation levels. Action levels will be consistent with derived air concentrations and applicable guidelines as specified in the radiation protection manual WHC-CM-4-10 (WHC 1988).

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

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

6.0 PERSONAL PROTECTIVE EQUIPMENT

The level of personal protective equipment required initially at a site will be specified in the site-specific safety document for each task or group of tasks. Personal protective clothing and respiratory protection shall be selected to limit exposure to anticipated chemical and radiological hazards. Work practices and engineering controls may be used to control exposure.

7.0 SITE CONTROL

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

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

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

8.0 DECONTAMINATION PROCEDURES

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

During site activities, potential sources of contamination may include airborne vapors, gases, dust, mists, and aerosols; splashes and spills; walking through contaminated areas; and handling contaminated equipment. Personnel who enter the exclusion zone will be required to go through the appropriate decontamination procedures on leaving the zone. Decontamination procedures shall be consistent with EII 5.4, "Field Decontamination of Drilling, Well Development, and Sampling Equipment," and EII 5.5, "Decontamination of Equipment for RCRA/CERCLA Sampling" (WHC 1991), or other approved decontamination procedures.

9.0 CONTINGENCY AND EMERGENCY RESPONSE PLANS

As a general rule, in the event of an unanticipated, potentially hazardous situation indicated by instrument readings, visible contamination, unusual or excessive odors, or other

indications, team members shall temporarily cease operations and move upwind to a predesignated safe area as specified in the site-specific safety documentation.

10.0 REFERENCES

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

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

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

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WHC, 1991, *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

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APPENDIX C

PROJECT MANAGEMENT PLAN

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ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	feasibility study
MCS	Management Control System
PMP	Project Management Plan
QAPP	quality assurance project plan
RCRA	Resource Conservation Recovery Act
RI	remedial investigation
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
Westinghouse Hanford	Westinghouse Hanford Company

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1.0 INTRODUCTION

This Project Management Plan (PMP) defines the administrative and institutional tasks necessary to support the T Plant Aggregate Area investigations at the Hanford Site. Also, this PMP defines the responsibilities of the various participants, the organizational structure, and the project tracking and reporting procedures. This PMP is in accordance with the provisions of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) Action Plan dated August 1990. Any revisions to the Tri-Party Agreement Action Plan that would result in changes to the project management requirements would supersede the provisions of this chapter.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 INTERFACE OF REGULATORY AUTHORITIES AND THE U.S. DEPARTMENT OF ENERGY

The T Plant Aggregate Area consists of active and inactive waste management units to be remedied under either Resource Conservation Recovery Act (RCRA) or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The U.S. Department of Ecology (Ecology) has been designated as the lead regulatory agency, as defined in the Tri-Party Agreement. Accordingly, Ecology is responsible for overseeing remedial action activity at this aggregate area and ensuring that the applicable authorities of both the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE) are applied. The specific responsibilities of EPA, Ecology, and DOE are detailed in the Tri-Party Agreement Action Plan.

2.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project organization for implementing remedial activities at the T Plant Aggregate Area is shown in Figure C-1. The following sections describe the responsibilities of the individuals shown in Figure C-1.

2.2.1 Project Managers

The EPA, DOE, and Ecology have each designated one individual as project manager for remedial activities at the Hanford Site. These project managers will serve as the primary point of contact for all activities to be carried out under the Tri-Party Agreement Action Plan. The responsibilities of the project managers are given in Section 4.1 of the Tri-Party Agreement Action Plan.

2.2.2 Unit Managers

As shown in Figure C-1, EPA, DOE, and Ecology will each designate an individual as a unit manager for the T Plant Aggregate Area.

The unit manager from Ecology will serve as the lead unit manager. The Ecology unit manager will be responsible for regulatory oversight of all activities required for the T Plant Aggregate Area.

The unit manager from EPA 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 made by the Ecology unit manager.

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 the activities at the T Plant Aggregate Area, particularly the status of agreements and commitments.

2.2.3 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.

2.2.4 Quality Coordinator

The quality coordinator is responsible for coordinating and monitoring performance of the Quality Assurance Project Plan (QAPP) requirements by means of internal surveillance techniques and by auditing, as directed by the quality assurance officer. The quality coordinator retains the necessary organizational independence and authority to identify conditions adverse to quality, and to inform the technical lead of needed corrective action.

2.2.5 Health and Safety Officer (Environmental Division/Environmental Field Services)

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.

2.2.6 Technical Lead

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

2.2.7 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 and FS coordinators will be responsible for keeping the technical lead informed as to the RI and FS work status and any problems that may arise.

2.2.8 Resource Conservation Recovery Act Facility Investigation/Corrective Measures Study Contractor

Figure C-1 shows the organizational relationship of an offsite contractor. Assuming a contractor is used to perform the RI/FS for the T Plant Aggregate Area, the contractor would assume responsibilities of the RI and FS coordinators, as described above. In this instance, the contractor will be directly responsible for planning data collection activities and for analyzing and reporting the results of the data-gathering in the RI and FS reports. However, the Westinghouse Hanford coordinator would retain the responsibility for securing and managing the field sampling efforts of the Hanford Site technical resource teams, described below. Figure C-2 shows a sample organizational structure for an RI/FS contractor team.

2.2.9 Hanford Site Technical Resources

The various technical resources available on the Hanford Site for performing the field studies are shown in Table C-1. These resources will be responsible for performing data collection activities and analyses, and for reporting the results of specific technical activities. Figures C-3 through C-6 show the detailed organizational structure of specific technical teams. Internal and external work orders and subcontractor task orders will be written by the Westinghouse Hanford technical lead to use these technical resources, which are under the control of the technical lead. Statements of work will be provided to the technical teams and will include a discussion of authority and responsibility, a schedule with clearly defined milestones, and a task description including specific requirements. Each technical team will keep the coordinator informed of the work status performed by that group and any problems that may arise.

3.0 DOCUMENTATION AND RECORDS

All plans and reports will be categorized as either primary or secondary documents as described by Section 9.1 of the Tri-Party Agreement Action Plan. The process for document review and comment will be as described in Section 9.2 of the Tri-Party Agreement Action Plan. Revisions, should they become necessary after finalization of any document, will be in accordance with Section 9.3 of the Tri-Party Agreement Action Plan. Changes in the work schedule, as well as minor field changes, can be made without having to process a formal revision. The process for making these changes will be as stated in Section 12.0 of the Tri-Party Agreement Action Plan. Administrative records, which must be maintained to support the Hanford Site activities, will be in accordance with Section 9.4 of the Tri-Party Agreement Action Plan.

4.0 FINANCIAL AND PROJECT TRACKING REQUIREMENTS

4.1 MANAGEMENT CONTROL

Westinghouse Hanford will have the overall responsibility for planning and controlling the investigation activities, and providing effective technical, cost, and schedule baseline management. If a contractor is used, the contractor will assume the direct day-to-day responsibilities for these management functions. The management control system used for this project must meet the requirements of DOE Order 4700.1, Project Management System and DOE Order 2250.1C, Cost and Schedule Control Systems Criteria. The Westinghouse Hanford Management Control System (MCS) meets these requirements. The primary goals of the Westinghouse Hanford MCS are to provide methods for planning, authorizing, and controlling work so that it can be completed on schedule and within budget, and to ensure that all planning and work performance activities are technically sound and in conformance with management and quality requirements.

The schedule developed for the T Plant Aggregate Area will be updated at least annually, to expand the new current fiscal year and the follow-on year. In addition, any approved schedule changes (see Section 12.0 of the Tri-Party Agreement Action Plan for the formal change control system) would be incorporated at this time, if not previously incorporated. This update will be performed in the fourth quarter of the previous fiscal year (e.g., July to September) for the upcoming current fiscal year. The work schedule can be revised at any time during the year if the need arises, but the changes would be restricted to major changes that would not be suitable for the change control process.

4.2 MEETINGS AND PROGRESS REPORTS

Both project and unit managers must meet periodically to discuss progress, review plans, and address any issues that have arisen. The project managers' meeting will take place at least quarterly, and is discussed in Section 8.1 of the Tri-Party Agreement Action Plan.

Unit managers shall meet monthly to discuss progress, address issues, and review near-term plans pertaining to their respective operable units and/or treatment, storage, and disposal groups/units. The meetings shall be technical in nature, with emphasis on technical issues and work progress. The assigned DOE unit manager for the T Plant Aggregate Area will be responsible for preparing revisions to the aggregate area schedule prior to the meeting. The schedule shall address all ongoing activities associated with the T Plant Aggregate Area, including actions on specific source units (e.g., sampling). This schedule will be provided to all parties and reviewed at the meeting. Any agreements and commitments (within the unit manager's level of authority) resulting from the meeting will be prepared and signed by all parties as soon as possible after the meeting. Meeting minutes will be issued by the DOE unit manager and will summarize the discussion at the meeting, with information copies given to the project managers. The minutes will be issued within five working days following the meeting. The minutes will include, at a minimum, the following information:

- Status of previous agreements and commitments
- Any new agreements and commitments
- Schedules (with current status noted)
- Any approved changes signed off at the meeting in accordance with Section 12.1 of the Tri-Party Agreement Action Plan.

Project coordinators for each operable unit also will meet on a monthly basis to share information and to discuss progress and problems.

The DOE shall issue a quarterly progress report for the Hanford Site within 45 days following the end of each quarter. Quarters end on March 31, June 30, September 30, and December 31. The quarterly progress reports will be placed in the public information repositories as discussed in Section 10.2 of the Tri-Party Agreement Action Plan. The report shall include the following:

- Highlights of significant progress and problems
- Technical progress with supporting information, as appropriate

- Problem areas with recommended solutions. This will include any anticipated delays in meeting schedules, the reason(s) for the potential delay, and actions to prevent or minimize the delay

- Significant activities planned for the next quarter

- Work schedules (with current status noted).

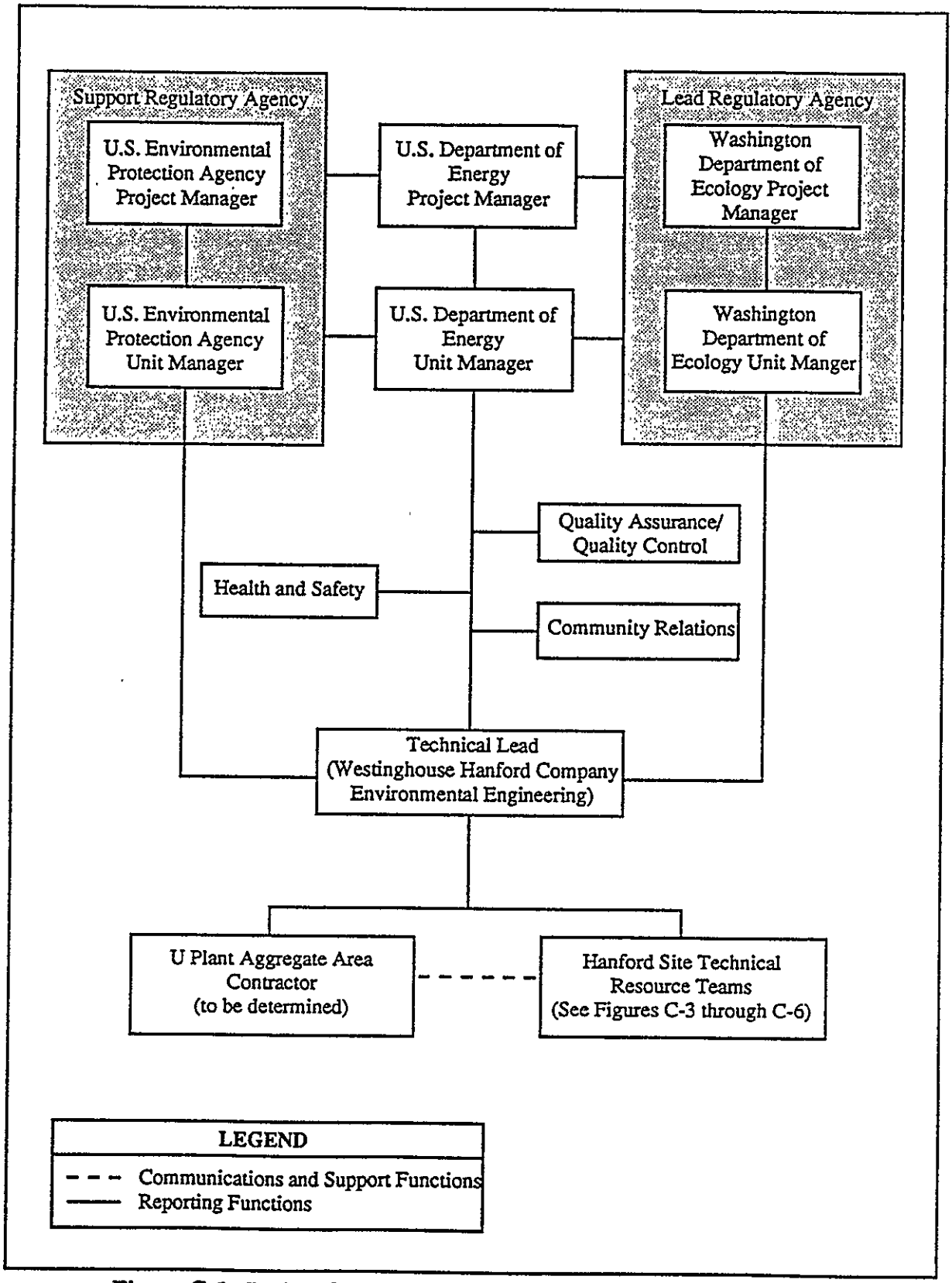

Figure C-1. Project Organization for the T Plant Aggregate Area Project.

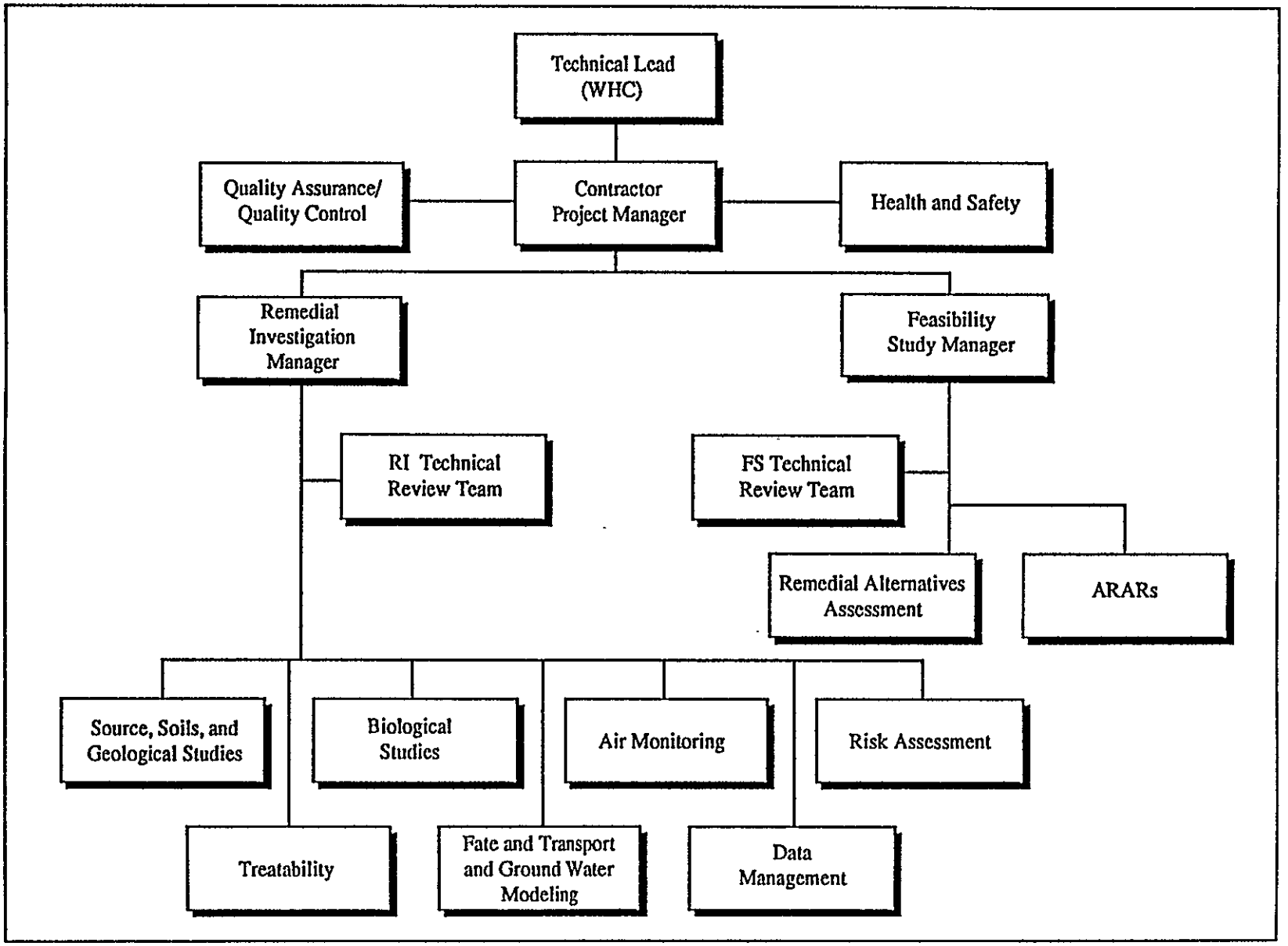

Figure C-2. Example Project Organization for the T Plant Aggregate Area

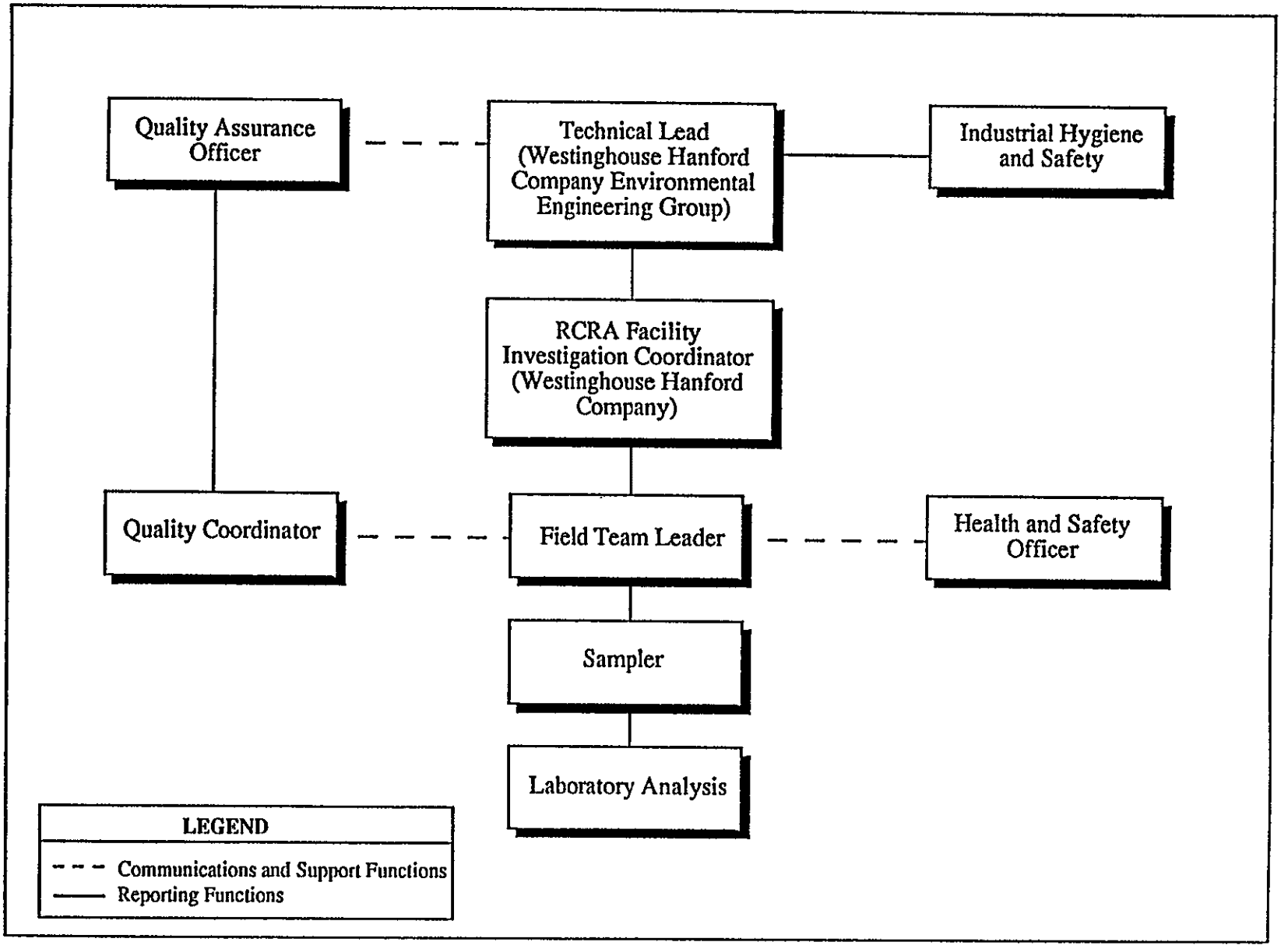

Figure C-3. The Hanford Site Soil Sampling Team.

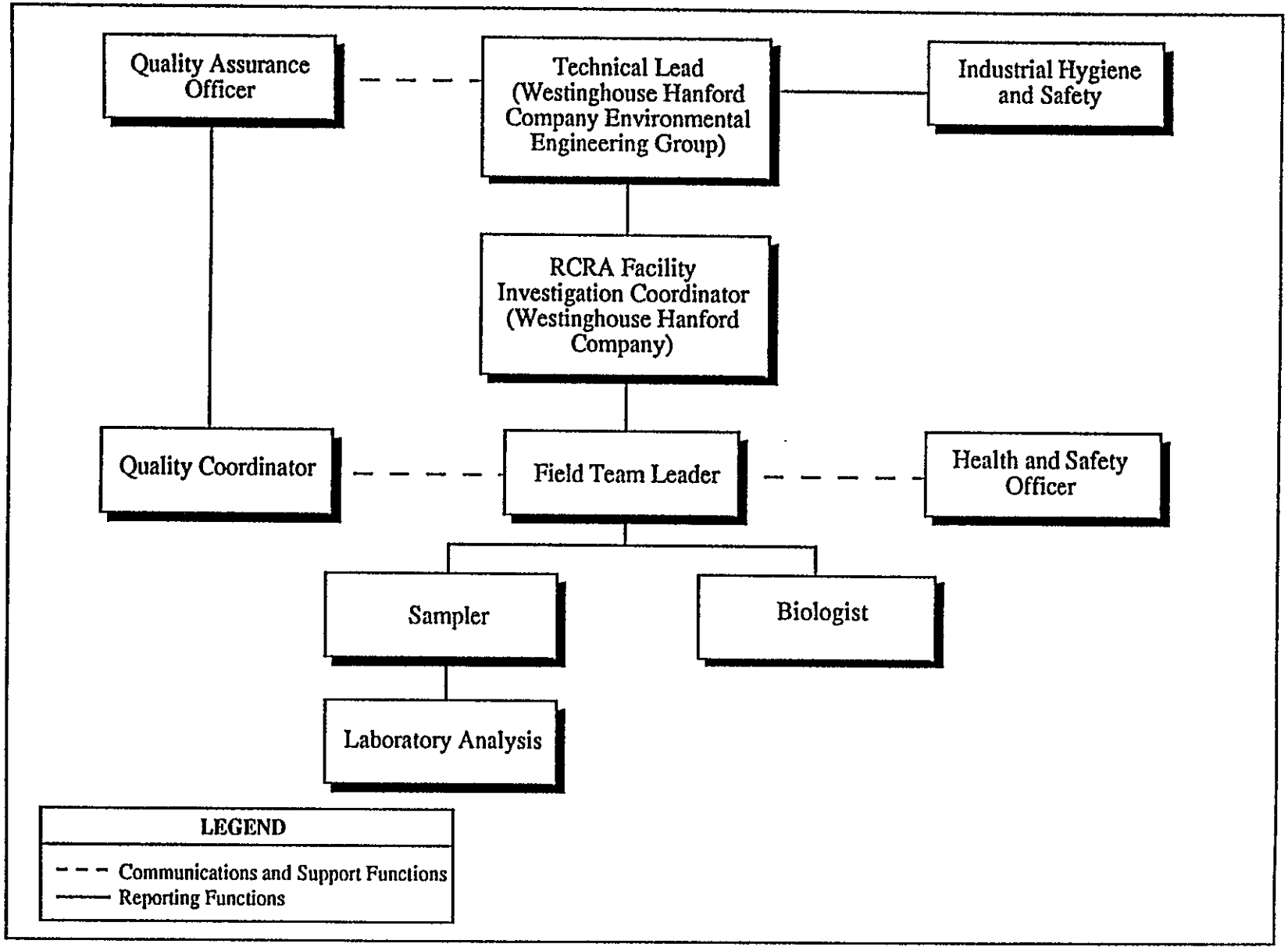

Figure C-4. The Hanford Site Biological Sampling Team.

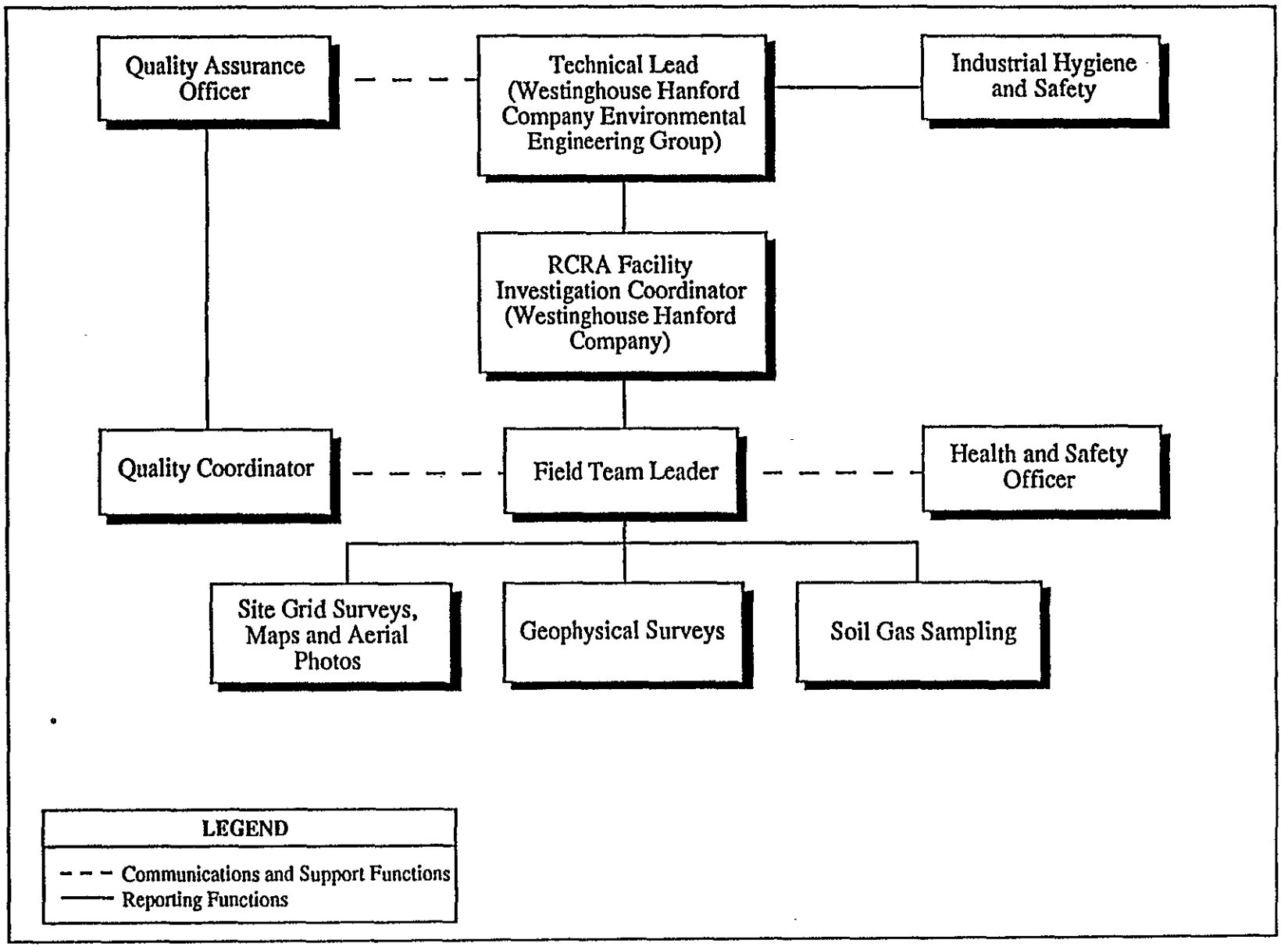

Figure C-5. The Hanford Site Physical and Geophysical Survey Team.

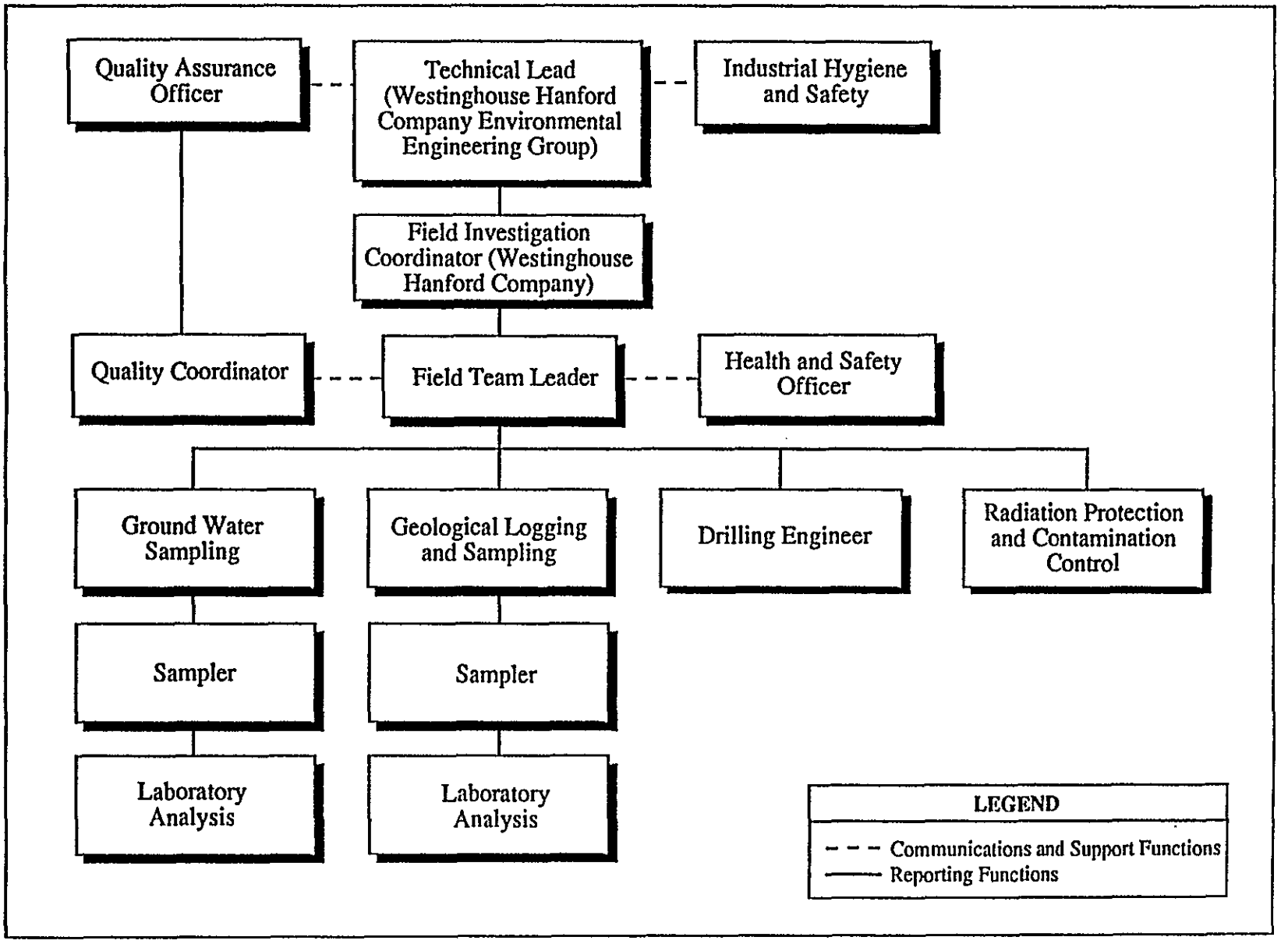

Figure C-6. Drilling, Sampling, and Well-Development Team.

Table C-1. Hanford Site RI/FS Technical Resources. Page 1 of 2

Subject/Activity	Technical Resources	
	RI	FS
Hydrology and geology	Westinghouse Hanford/Geosciences PNL/Earth and Environmental Sciences Center	Westinghouse Hanford/Geosciences
Toxicology and risk/endangerment assessment	Westinghouse Hanford/Environmental Technology PNL/Earth and Environmental Sciences Center PNL/Life Sciences Center	Westinghouse Hanford/ Environmental Technology
Environmental chemistry	Westinghouse Hanford/Geosciences PNL/Earth and Environmental Sciences Center	Westinghouse Hanford/Geosciences
Geotechnical and civil engineering	Westinghouse Hanford/Geosciences (Planning) Environmental Field Services	NA
Geotechnical and civil engineering	NA	Westinghouse Hanford/ Environmental Engineering PNL/Waste Technology Center
Groundwater treatment engineering	NA	Westinghouse Hanford/ Environmental Engineering PNL/Waste Technology Center
Waste stabilization and treatment	NA	Westinghouse Hanford/ Environmental Engineering PNL/Waste Technology Center
Surveying	Kaiser Engineers Hanford	NA

Table C-1. Hanford Site RI/FS Technical Resources.

	Technical Resources	
Subject/Activity	RI	FS
Soil and water sampling and analysis	Westinghouse Hanford/Environmental Engineering Westinghouse Office of Sampling Management PNL/Earth and Environmental Sciences Center PNL/Materials and Chemical Sciences Center	NA
Drilling and well installation	Westinghouse Hanford/Geosciences Environmental Field Services Kaiser Engineers	NA
Radiation monitoring	Westinghouse Hanford/Operational Health Physics	NA

NA = Not applicable.

APPENDIX D

INFORMATION MANAGEMENT OVERVIEW

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ACRONYMS AND ABBREVIATIONS

AR	administrative record
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CMS	Corrective Measures Study
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
Ecology	Washington Department of Ecology
EDMC	Environmental Data Management Center
EHPSS	Environmental Health and Pesticide Services Section
EII	Environmental Investigations Instructions
EIMP	Environmental Information Management Plan
EPA	U.S. Environmental Protection Agency
ER	environmental restoration
ERRA	Environmental Restoration Remedial Action
FOMP	Field Office Management Plan
FS	feasibility study
GIS	geographic information system
HEHF	Hanford Environmental Health Foundation
HEIS	Hanford Environmental Information System
HLAN	Hanford Local Area Network
HMS	Hanford Meteorological Station
IMP	Information Management Plan
KEH	Kaiser Engineers Hanford
OSM	Office of Sample Management
PNL	Pacific Northwest Laboratory
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RFI	RCRA Facility Investigation
RI	remedial investigation
ROD	record of decision
TR	training records
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
TSD	treatment, storage, and disposal
Westinghouse Hanford	Westinghouse Hanford Company

DEFINITIONS OF TERMS

Action Plan. Action plan for implementation of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1990). A negotiation between the U.S. Environmental Protection (EPA), the U.S. Department of Energy (DOE), and the State of Washington Department of Ecology (Ecology). The Action Plan defines the methods and processes by which hazardous waste permits will be obtained, and by which closure and post-closure actions under the Resource Conservation and Recovery Act of 1976 (RCRA) and by which remedial actions under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) will be conducted on the Hanford Site.

Administrative Record (AR). In CERCLA, the official file that contains all information that was considered or relied on by the regulatory agency in arriving at a final remedial action decision, as well as all documentation of public participation throughout the process. In RCRA, the official file that contains all documents to support a final RCRA permit determination.

Administrative Record File. The assemblage of documents compiled and maintained by an agency pertaining to a proposed project of administrative action and designated as AR or that are candidates for inclusion in the AR once a record of decision (ROD) is attained.

Data Management. The planning and control of activities affecting data.

Data Quality. The totality of features and characteristics of data that bears on its ability to satisfy a given purpose. The characteristics of major importance are accuracy, precision, completeness, representativeness, and comparability.

Data Validation. The process whereby data are accepted or rejected based on a set of criteria. This aspect of quality assurance involves establishing specified criteria for data validation. The quality assurance project plan (QAPP) must indicate the specified criteria that will be used for data validation.

ENCORE. The name given to the combination of hardware, software, and administrative subsystems that serve to integrate the management of the Hanford Site environmental data.

Environmental Data Management Center (EDMC). The central facility and services that provide a files management system for processing environmental information.

Environmental Information. Data related to the protection or improvement of the Hanford Site environment, including data required to satisfy environmental statutes, applicable DOE orders, or the Tri-Party Agreement.

Field File Custodian. An individual who is responsible for receipt, validation, storage, maintenance, control, and disposition of information or other records generated in support of Environmental Division activities.

Hanford Environmental Information System (HEIS). A computer-based information system under development as a resource for the storage, analysis, and display of investigative data collected for use in site characterization and remediation activities. Subject areas currently being developed include geophysics/soil gas, vadose zone soil (geologic), atmospherics, and biota.

Information System. Collection of components relate to the management of data and reporting of information. Information systems typically include computer hardware, computer software, operating systems, utilities, procedures, and data.

Lead Agency. The regulatory agency (EPA or Ecology) that is assigned the primary administrative and technical responsibility with respect to actions at a particular operable unit.

Nonrecord Material. Copies of material that are maintained for information, reference, and operating convenience and for which another office has primary responsibility.

Operable Unit. An operable unit at the Hanford Site is a group of land disposal and groundwater sites placed together for the purposes of doing a remedial investigation/ feasibility study. The primary criteria for placement of a site into an operable unit are geographic proximity, similarity of waste characteristics and site types, and the possibility for economies of scale.

Primary Document. A document that contains information on which key decisions are made with respect to the remedial action or permitting process. Primary documents are subject to dispute resolution and are part of the administrative record file.

Project Manager. The individual responsible for implementing the terms and conditions of the Action Plan on behalf of his respective party. The EPA, DOE, and Ecology will each designate one project manager.

Quality Affecting Record. Information contained on any media, including but not limited to, hard copy, sample material, photo copy, and electronic systems, that is complete in terms of appropriate content and that furnishes evidence of the quality of items and/or activities affecting quality.

Quality Assurance. The systematic actions necessary to provide adequate confidence that a material, component, system, process, or facility performs satisfactorily or as planned in service.

Quality Assured Data. Data developed under an integrated program for assurance of the reliability of data.

Raw Data. Unprocessed or unanalyzed information.

Record Validation. A review to determine that records are complete, legible, and meet records requirements. Documents are considered valid records only after the validation process has been completed.

Retention Period. The length of time records must be held before they can be disposed of. The time is usually expressed in years from the date of the record, but may also be expressed as contingent on the occurrence of an event.

Secondary Document. A document providing information that does not, in itself, reflect or support key decisions. A secondary document is subject to review by the regulatory agencies and may be part of the administrative record field. It is not subject to dispute resolution.

Validated Data. Data that meet criteria contained in an approved company procedure.

Verified Data. Data that have been checked for accuracy and consistency following a transfer action (e.g., from manual log to computer, or from distributed database to centralized data repository).

1.0 INTRODUCTION AND OBJECTIVES

1.1 INTRODUCTION

An extensive amount of data will be generated over the next several years in connection with the activities planned for the T Plant Aggregate Area. The quality of these data are extremely important to the full remediation of the aggregate area as agreed on by the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA) the Washington Department of Ecology (Ecology), and interested parties.

The Information Management Plan (IMP) provides an overview of the data management activities at the operable unit level. It identifies the type and quantity of data to be collected and references the procedures which control the collection and handling of data. It provides guidance for the data collector, aggregate area investigator, project manager, and reviewer to fulfill their respective roles.

This DMP addresses handling of data generated from activities associated with the aggregate area activities. All data collected will be in accordance with the Environmental Investigations Instructions (EII) contained in the Westinghouse Hanford Company's (Westinghouse Hanford) *Environmental Investigations and Site Characterization Manual* (WHC 1991a).

Development of a comprehensive plan for the management of all environmental data generated at the Hanford Site is under way. The *Environmental Information Management Plan* (EIMP) (Steward et al. 1989), released in March 1989, described activities in the Environmental Data Management Center (EDMC) and long-range goals for management of scientific and technical data. The scientific and technical data part of the EIMP was reviewed, revised, and expanded in fiscal year 1990 (Michael et al. 1990). An *Environmental Restoration Remedial Action Program Records Management Plan* (WHC 1991b) issued in July 1991, enables the program office to identify, control, and maintain the quality assurance (QA), decisional, or regulatory prescribed records generated and used in support of the Environmental Restoration Remedial Action (ERRA) Program.

1.2 OBJECTIVES

This DMP describes the process for the collection and control procedures for validated data, records, documents, correspondence, and other information associated with this aggregate area. This DMP addresses the following:

- Types of data to be collected
- Plans for managing data
- Organizations controlling data

- Databases used to store the data
- EIMP
- Hanford Environmental Information System (HEIS).

2.0 TYPES OF DATA

2.1 TYPES OF DATA

The general types of technical data to be collected and the associated controlling procedures are as follows:

Type of data	Procedure
Historical reports	EII 1.6
Aerial photos	EII 1.6
Chart recordings	EII 1.6
Technical memos	EII 1.6
Validated samples analyses	EII 1.6
Reports	EII 1.6
Logbooks	EII 1.5
Chain-of-custody forms	EII 5.1
Sample quality assurance/ quality control (QA/QC)	Office of Sample Management (OSM)

All such data are submitted to the EDMC for entry into the administrative record (AR).

General types of related administrative data is shown in Table D-1, which is organized in terms of general types of personnel and compliance/regulatory data. Table D-1 references the appropriate procedures and the record custodians. Data associated with aggregate area investigations will be submitted to the EDMC for entry into the AR, as appropriate.

2.2 DATA COLLECTION

Data will be collected according to the aggregate area sampling and analysis plans and the Quality Assurance Project Plan (QAPP). Section 2.1 listed the controlling procedures for data collection and handling before turnover to the organization responsible for data storage. All procedures for data collection shall be approved in compliance with the Westinghouse Hanford *Environmental Investigations and Site Characterization Manual* (WHC 1991a).

2.3 DATA STORAGE AND ACCESS

Data will be handled and stored according to procedures approved in compliance with applicable Westinghouse Hanford procedures (WHC 1988). The EDMC is the central files manager and process facility. All data entering the EDMC will be indexed, recorded, and placed into safe and secure storage. Data designated for placement into the AR will be copied, placed into the Hanford Site AR file, and distributed by the EDMC to the user community. The hard copy files are the primary sources of information; the various electronic data bases are secondary sources.

Normal access to data is through EDMC which is responsible for the AR. The Administrative Record Public Access Room is located in the 345 Hills Street Facility in Richland, Washington. This facility includes AR file documents (including identified guidance documents and technical literature).

Project participants may access data that are not in the AR by requesting it at the monthly unit managers' meeting for the operable unit of concern. As the project moves to completion, it is expected that all of the relevant data will be contained in the AR and the need to access data will be minimal.

The following types of data will be accessed from and reside in locations other than the EDMC:

Data Type	Data location
• QA/QC laboratory data	OSM (Westinghouse Hanford)
• Sample status	OSM (Westinghouse Hanford)
• Archived samples	Laboratory performing analyses
• Training records	Technical Training Support Section (Westinghouse Hanford)
• Meteorological data	Hanford Meteorological Station (HMS) (Pacific Northwest Laboratory [PNL])
• Health and safety records	Hanford Environmental Health Foundation (HEHF)
• Personal protective fitting	Environmental Health and Pesticide Services Section (Westinghouse Hanford)
• Radiological exposure	Pacific Northwest Laboratory.

2.4 DATA QUANTITY

Data quantities for the investigative activities will be estimated based on the sampling and analysis plans developed for investigation of sites within the aggregate area.

3.0 INFORMATION MANAGEMENT PLAN

3.1 OBJECTIVE

A considerable amount of data will be generated through the implementation of the aggregate area sampling and analysis plans. The QAPP will provide the specific procedural direction and control for obtaining and analyzing samples in conformance with requirements to ensure quality data results. The sampling and analysis plans will provide the basis for selecting the location, depth, frequency of collection, etc., of media to be sampled and methods to be employed to obtain samples of selected media for cataloging, shipment, and analysis. Figure D-1 displays the general DMP outline for data generated through work plan activities.

3.2 ORGANIZATIONS CONTROLLING DATA

This section addresses the organizations that will receive data generated from aggregate area activities.

3.2.1 Environmental Engineering Group

The Westinghouse Hanford Environmental Engineering Group provides the operable unit technical coordinator. The technical coordinator is responsible for maintaining and transmitting data to the designated storage facility.

3.2.2 Office of Sample Management

The Westinghouse Hanford OSM will validate all analytical data packages received from the laboratory. Validated summary data (sample results and copies of chain-of-custody forms) will be forwarded to the technical coordinator. Nonvalidated data will be forwarded to the technical coordinator on request. Preliminary data will be clearly labeled as such. The OSM will maintain raw sample data, QA/QC laboratory data, and the archived sample index.

3.2.3 Environmental Data Management Center

The EDMC is the Westinghouse Hanford Environmental Division's central facility and service that provides a file management system for processing environmental information. The EDMC manages and controls the AR and Administrative Record Public Access Room at the Hanford Site. Part 1 of the EIMP (Michael et al. 1990) describes the central file system and services provided by the EDMC. The following procedures address data transmittal to the EDMC:

- EII 1.6, Records Management (WHC 1991a)
- EII 1.11, Technical Data Management (WHC 1991a)
- TPA-MP-02, Information Transmittals and Receipt Controls (DOE-RL 1990)
- TPA-MP-07, Administrative Record Collection and Management (DOE-RL 1990)

3.2.4 Information Resource Management

Information Resource Management is the designated records custodian (permanent storage) for Westinghouse Hanford. The procedural link from the EDMC to the Information Resource Management is currently under development.

3.2.5 Hanford Environmental Health Foundation

The HEHF performs the analyses on the nonradiological health and exposure data (Section 3.3.2) and forwards summary reports to the Fire and Protection Group and the Environmental Health and Pesticide Services Section within the Westinghouse Hanford Environmental Division. Nonradiological and health exposure data are maintained also for other Hanford Site contractors (PNL and Kaiser Engineers Hanford [KEH]) associated with aggregate area activities. The HEHF provides summary data to the appropriate site contractor. EII 2.1, Preparation of Hazardous Waste Operations Permits, and EII 2.2, Occupational Health Monitoring (WHC 1991a) address the preparation of health and safety plans and occupational health monitoring, respectively.

3.2.6 Environmental Health and Pesticide Services Section

The Westinghouse Hanford Environmental Health and Pesticide Services Section maintains personal protective equipment fitting records and maintains nonradiological health field exposure and exposure summary reports provided by HEHF for Westinghouse Hanford Environmental Division and subcontractor personnel.

3.2.7 Technical Training Records and Scheduling Section

The Westinghouse Hanford Technical Training Records and Scheduling Section provides training and maintains training records (Section 3.3.4).

3.2.8 Pacific Northwest Laboratory

The PNL operates the HMS and collects and maintains meteorological data (Section 3.3.1). Data management is discussed in Andrews (1988).

The PNL collects and maintains radiation exposure data (Section 3.3.3).

3.3 DATABASES

This section addresses databases that will receive data generated from the aggregate area activities. These and other databases are described in the EIMP (Michael et al. 1990). All of these databases exist independently of this aggregate area and serve other site functions. Data pertinent to the operable unit, housed in these databases, will be submitted to the AR.

3.3.1 Meteorological Data

The HMS collects and maintains meteorological data. Their database contains meteorological data from 1943 to the present, and Andrews (1988) is the document containing meteorological data management information.

3.3.2 Nonradiological Exposure and Medical Records

The HEHF collects and maintains data for all nonradiological exposure records and medical records.

3.3.3 Radiological Exposure Records

The PNL collects and maintains data on occupational radiation exposure. This database contains respiratory personal protective equipment fitting records, work restrictions, and radiation exposure information.

3.3.4 Training Records

Training records for Westinghouse Hanford and subcontractor personnel are managed by the Westinghouse Hanford Technical Training Support Section. Other Hanford Site contractors (PNL and KEH) maintain their own personnel training records. Training records for non-Westinghouse personnel are entered into the Westinghouse (soft reporting) database to document compliance.

Training records include:

- Initial 40-h hazardous waste worker training
- Annual 8-h hazardous waste worker training update
- Hazardous waste generator training
- Hazardous waste site specific training
- Radiation safety training
- Cardiopulmonary resuscitation
- Scott air pack
- Fire extinguisher
- Noise control
- Mask fit.

3.3.5 Environmental Information/Administrative Record

Environmental information and the AR are managed by Westinghouse Hanford EDMC personnel. They provide an index and key information on all data transmitted to the EDMC. This database is used to assist in data retrieval and to produce index lists as required.

3.3.6 Sample Status Tracking

The OSM maintains the sample status tracking database. This database contains information about each sample. Information maintained includes sample number, ship date, receipt date, and laboratory identification.

4.0 ENVIRONMENTAL INFORMATION AND RECORDS MANAGEMENT PLAN

This section briefly discusses the EIMP (Michael et al. 1990) that was developed to provide an overview of an integrated approach to managing Hanford Site environmental data, and the *Environmental Restoration Remedial Action Program Records Management Plan* (WHC 1991b).

4.1 ENVIRONMENTAL INFORMATION MANAGEMENT PLAN

The EIMP provides an overview of how information is managed throughout the lifetime of Hanford Site environmental programs.

The Environmental Division of Westinghouse Hanford is responsible for the protection and improvement of the Hanford Site environment. To fulfill responsibility, the Environmental Division has assumed a management role with respect to Hanford Site environmental information. This management role includes (1) establishing standards for how data are validated and controlled, (2) developing and maintaining a supporting computer-based environment, and (3) sustaining a centralized file management system.

Hanford Site environmental information is defined as data related to the protection or improvement of the Hanford Site environment, including data required to satisfy environmental statutes, applicable DOE orders, or the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1990), (Tri-Party Agreement).

Environmental information falls into several overlapping categories, such as administrative versus technical and electronic versus manual or hard copy. A considerable amount of data are recorded in documents, which are governed by company-wide document and records control practices. Other data are collected or generated by computer and, therefore, exist in electronic form. The name ENCORE has been given to the combination of administrative, hardware, and software systems that serve to integrate the management of this electronic data.

Administrative information (e.g., budgets and schedules) is subject to accounting and other standard business practices. Scientific and technical data are subject to a different set of legal, classification, release, and engineering requirements.

Superimposed over these categories is the files management system for environmental information. This management system, has been developed to meet a number of Environmental Division needs, including requirements for compilation of AR files. The AR files are compilations of all material related to environmental restoration and remedial action records of decision (ROD) for each operable unit and treatment, storage, and disposal (TSD) group described in the Tri-Party Agreement.

Data in electronic form flows from information systems in the ENCORE realm to both scientific/technical and administrative documents. Environmental documents distributed within the Hanford Site and from regulatory agencies are received by the EDMC for storage and future processing.

Part I of the EIMP describes the overall Westinghouse Hanford systems that are generally applied to documents and records. Part I also describes, in greater detail, the files management system developed to manage the AR file information. The EDMC compiles the AR files and provides controlled distribution of specified information to the AR files held by

DOE, Ecology, and the EPA. The EDMC also provides controlled distribution of specified community relations information to regional information repositories.

Part II addresses computer-based information, with an emphasis on scientific and technical data. The long-term nature of environmental programs and the complex interrelationships of environmental data require that the data be preserved, retrievable, traceable, and sufficient for future use. To ensure data availability for response to regulatory and agency requirements, the plan is directed toward optimizing the use of automated techniques for managing data. The current processing environment and the proposed ENCORE realm are described, and the plans for implementation of ENCORE are addressed.

4.2 ENVIRONMENTAL RESTORATION REMEDIAL ACTION PROGRAM RECORDS MANAGEMENT PLAN

The ERRA Program records management plan was developed to fulfill the requirements of the U.S. Department of Energy, Richland Operations Office (DOE-RL) *Environmental Restoration Field Office Management Plan* (FOMP) (DOE-RL 1989). The FOMP describes the plans, organization, and control systems to be used for management of the Hanford Site ERRA Program. The Westinghouse Hanford ERRA Program Office has developed this ERRA Program records management plan to fulfill the requirements of the FOMP. This records management plan will enable the program office to identify, control, and maintain the quality assurance, decisional, or regulatory prescribed records generated and used in support of the ERRA Program.

The ERRA Program records management plan describes how the applicable records management requirements will be implemented for the ERRA Program. The plan also develops the criteria for identifying the appropriate requirements for each individual piece of information related to ERRA work activities.

This records management plan applies to all ERRA Program records and documents generated, used, or maintained in support of ERRA-funded work activities on the Hanford Site. The terms, information, documents, nonrecord material, records, record material, and QA records used throughout the ERRA records management plan are interpreted as ERRA information, ERRA documents, ERRA nonrecord material, ERRA records, ERRA record material, and ERRA QA records.

5.0 HANFORD ENVIRONMENTAL INFORMATION SYSTEM

5.1 OBJECTIVE

The Hanford Environmental Information System (HEIS) has been developed by PNL for Westinghouse Hanford as a primary resource for computerized storage, retrieval, and

analysis of quality-assured technical data associated with Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) remedial investigation/ feasibility study (RI/FS) activities and RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) activities being undertaken at the Hanford Site. The HEIS will provide a means of interactive access to data sets extracted from other databases relevant to implementation of the Tri-Party Agreement (Ecology et al. 1990). The HEIS will support graphics analysis, including a geographic information system. Implementation of HEIS will serve to ensure that data consistency, quality, traceability, and security are achieved through incorporation of all environmental data within a single controlled database.

The following is a list of data subjects proposed to be entered into HEIS:

- Geologic
- Geophysics
- Atmospheric
- Biotic
- Site characterization
- Soil gas
- Waste site information
- Surface monitoring
- Groundwater.

5.2 STATUS OF THE HANFORD ENVIRONMENTAL INFORMATION SYSTEM

The HEIS, a computerized database containing technical data and information used to support the Hanford environmental restoration (ER) activities, is operational. The data for the Hanford groundwater wells and groundwater samples is currently accessible via the Hanford Local Area Network (HLAN) to local users and to offsite users via a modem link to the HEIS database computer. Additional data, including geologic, biota, and other pertinent environmental sample results, are being entered into the HEIS database.

The *Hanford Environmental Information System (HEIS) User's Manual* (WHC 1990) was issued in October 1990. An operator manual is being prepared and is expected to be issued in 1992.

The HEIS geographic information system (GIS) will display detailed maps for the Hanford restoration sites including data from the HEIS database. Such spatially related data will be used to support analysis of waste site technical issues and restoration options. The combination of the HEIS for data and the GIS spatial displays offers some powerful tools for many users to analyze and collectively evaluate the environmental data from the ER and site-wide monitoring programs.

6.0 REFERENCES

Andrews, G. L., 1988, *The Hanford Meteorological Data Collection System and Data Base,* PNL-6509, Pacific Northwest Laboratory, Richland, Washington.

DOE-RL, 1989, *Environmental Restoration Field Office Management Plan,* DOE/RL-89-29, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1990, *Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) Handbook,* RL-TPA-90-0001, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE-RL, 1990, *Hanford Federal Facility Agreement and Consent Order,* First amendment, Two Volumes, 89-10 Revision 1, Washington Department of Ecology, Olympia, Washington, U.S. Environmental Protection Agency, Region X, Seattle, Washington, and U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Michael, L. E., G. C. Main, and E. J. See, 1990, *Environmental Information Management Plan,* WHC-EP-0219, Revision 1, Westinghouse Hanford Company, Richland, Washington.

Steward, J. C., G. C. Main, and E. J. See, 1989, *Environmental Information Management Plan,* WHC-EP-0219, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988, *Quality Assurance Manual,* WHC-CM-4-2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991a, *Environmental Investigations and Site Characterization Manual,* WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991b, *Environmental Restoration Remedial Action Program Records Arrangement Plan,* WHC-EP-0430, Westinghouse Hanford Company, Richland, Washington.

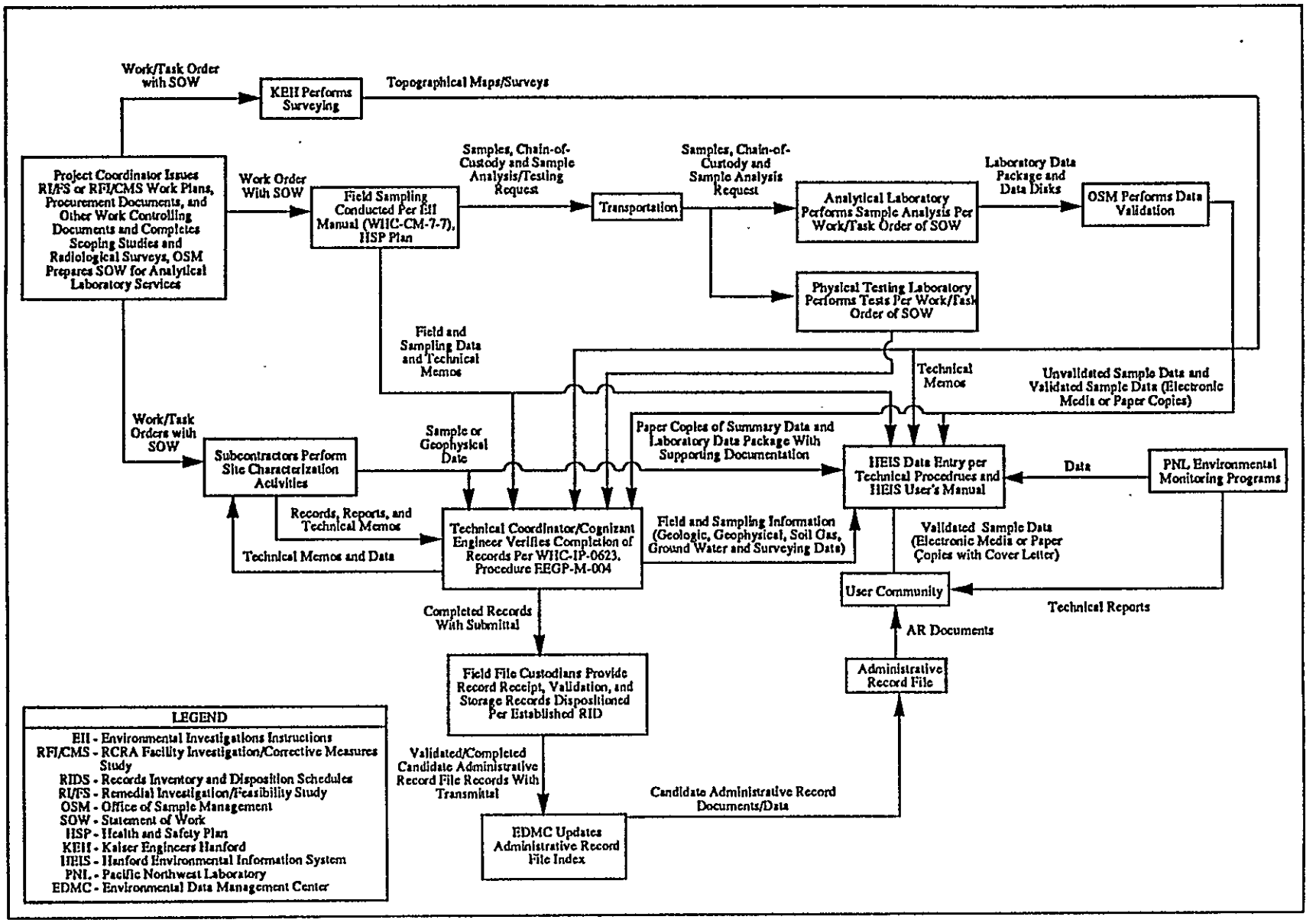

Figure D-1. Environmental Engineering, Technology and Permitting Data Management Model.

Table D-1. Types of Related Administrative Data.

Type of Data	Controlling document/procedure	Record Custodians				
		TR	HEHF	PNL	EDMC	EHPSS
Personnel						
Personnel training and qualifications	EII 1.7[a/]	X				
Occupational exposure records (nonradiological)	EII 2.2[a/]		X			X
Radiological exposure records				X		
Respiratory protection fitting						X
Personnel health and safety records	EII 2.1[a/]		X			X
Compliance/regulatory						
Action-specific requirements/screening levels	EII 1.6[a/]				X	
Guidance document tracking	EII 1.6[a/]				X	
Compliance issues	EII 1.6[a/]				X	
Problem resolution	EII 1.6[a/]				X	
Administrative record	TPA-MP-11[b/]				X	

a/ WHC 1991a, *Environmental Investigations and Site Characterization Manual.*
b/ DOE-RL 1990, *Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) Handbook.*
EDMC = Environmental Data Management Center (Westinghouse Hanford Company).
EHPSS = Environmental Health and Pesticide Services Section (Westinghouse Hanford Company).
EII = Environmental Investigations Instructions.
HEHF = Hanford Environmental Health Foundation.
TR = training records (Westinghouse Hanford Company, Pacific Northwest Laboratory [PNL], Kaiser Engineers Hanford [KEH]).

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APPENDIX E

SUPPORTING DOCUMENTATION

9 3 1 2 8 - 0 7 0 2

TABLE OF CONTENTS

11/18/66	Battelle Low-Level Waste Disposal, by S.J. Beard
10/13/77	Contaminated Rabbit Fecal Pellets Near the 155-TX Diversion Box, Unusual Occurrence #77-180
09/30/86	Fiscal Year 1986 Scintillation Logging Status, by M.A. Chamness
05/18/88	Fiscal Year 1987 Inactive Crib Monitoring Report, by J.R. Brodeur

9312565703

November 18, 1966

R. E. Tomlinson, Manager
Research and Engineering

Subject: BATTELLE LOW-LEVEL WASTE DISPOSAL

INTRODUCTION

For many years it has been the practice to truck low-level liquid waste from the 300 Area to the 200 Areas for crib disposal. In recent years the volume of this waste has been relatively constant at 3 to 4 million gallons per year but the radionuclide content has markedly increased. Activity concentrations are now so high that crib breakthrough is occurring after only a few months of use. Tanker discharges to the 231-Z Building's Z-7 Crib caused strontium breakthrough in October, 1966, and for the last month the 231-Z Building has been discharging waste to the failed crib since no spare is available. Tanker waste is now being discharged to Battelle's new crib, T-34, and after 5 months' use activity has been detected in the ground water. Around the end of December, 1966, this crib is also expected to fail.

The purpose of this letter is to discuss Battelle waste disposal requirements and recommend action to permit Isochem to continue to offer waste disposal service to Battelle. Prompt cooperation and funding from Battelle and the AEC will be necessary to minimize ground water contamination and to avoid curtailment of laboratory activities.

SUMMARY AND RECOMMENDATIONS

New Isochem waste disposal facilities are needed to permit continued acceptance of low-level aqueous waste from the 231-Z Building and tanker waste from the 300 Area 340 Building. The 231-Z Building disposal requirements can be met by making some minor piping changes and constructing a crib to replace the failed Z-7 Crib. Tanker waste is no longer suitable for ground disposal and should be treated as high-level waste after volume reduction by evaporation. An interim crib will be required for emergency disposal of tanker waste while evaporation facilities are being constructed. Charges for disposal of tanker waste will increase sharply since annual evaporation energy alone will cost about $40,000.

The recommended facility modifications and additions with their associated capital costs can be summarized as follows:

1. Temporarily route 231-Z Building waste to Z-5 Crib with provision for overflow to Z-7 Crib. Preliminary cost

9 3 1 2 8 0 7 0 4

2. Construct a new crib by January 1, 1967, to receive 231-Z Building waste. Preliminary cost estimate - $25,000 - $40,000.

3. Build a crib by January 1, 1967, to temporarily receive tanker waste from Battelle. Preliminary cost estimate - $45,000 - $60,000.

4. Provide evaporation facilities for continued tanker waste disposal by June 1, 1967. Preliminary cost estimate - $45,000 - $60,000.

DISCUSSION

Low-level 300 Area laboratory waste has been trucked to the 200 Areas for crib disposal since the early fifties. Figures 1 and 2 show the average monthly volume and curie disposal rates from 1953 to the present time and Table I summarizes pertinent crib statistics for the same period of time. This information shows that the amount of activity in the waste has been steadily increasing since 1958 and large increases occurred in 1965 and 1966. The rapid failure of Cribs T-28, T-27, Z-7 and T-34 in 1965 and 1966 can be attributed directly to the sudden increase in the curie content of the waste. Soil column studies made with a composite waste sample collected during May and June of 1966 show that the waste does not react favorably with the soil and in its present form should not be considered for ground disposal.

There are two problems that must receive immediate attention:

1) 231-Z Building is discharging waste to a failed crib (Z-7); and

2) T-34 Crib is expected to break through around the end of December, 1966, and all alternate sites have already been expended.

The first problem appears to be the easier to solve. Waste from the 231-Z Building is known to be satisfactory for cribbing. A possible way to immediately reduce the contamination entering the ground water is to repipe 231-Z Building to the Z-5 Crib and provide a Z-5 Crib overflow to Z-7 Crib. This action is suggested only as an emergency measure since the Z-5 Crib is not expected to handle the total flow. Z-5 Crib was abandoned in 1947 when pluggage reduced the crib percolation rate below 13,000 gallons per day. Overflow to Z-7 will avoid flooding of Z-5 but sustained overflow to the failed Z-7 cannot be tolerated since water below this crib has a strontium concentration 20-fold above the ground water limit. Recommended action is to immediately design and build a replacement crib for Z-7 and use

9 3 1 2 8 6 7 0 5

Z-5 on an emergency basis. If piping changes or changes in the 231-Z Building operation permit reduction in water discharge rates so that adequate Z-5 capacity is assured, Z-5 can be considered for interim use while a new crib is provided on a normal construction schedule. Preliminary cost estimates indicate piping changes will cost $2000 - $2500 and a new crib will cost $25,000 - $40,000.

The 340 Building waste problem is more difficult to solve. This waste is no longer suitable for ground disposal and timing requires prompt action to minimize further contamination of the ground water. It is recommended that a new temporary crib be provided on an accelerated construction schedule targeted for use January 1, 1967. This crib would be located about 400 feet from T-34 but piped so that the existing unloading station could be used. Preliminary cost estimates indicate this crib would cost $45,000 - $60,000. Enough time should be gained during the life of this crib to permit construction of evaporation facilities within the West Area tank farms for continuing disposal of this waste. Evaporation facilities are estimated to cost $45,000 to $60,000. During the construction period Battelle could undertake a program to try and render the waste suitable for ground disposal by waste treatment or waste segregation. Continued use of the crib could be considered if this program were successful and would be economically desirable since just the cost of energy for waste evaporation will amount to $40,000 per year.

Battelle management at the supervisor and subsection levels has been informally apprised of these waste disposal problems and Isochem Facilities Engineering Section is proceeding with preparation of project proposals for a new 231-Z Building crib and a temporary replacement crib for T-34. Formal correspondence with higher Battelle management should proceed to ensure prompt support of Isochem requirements. Full cooperation and funding from Battelle and the AEC are necessary to avoid further contamination of the ground water beneath the 200 Area.

Original Signed by
S. J. Beard
Manager
Fission Products Process Engineering
Research and Engineering

SJ Beard:jas

Attach: Figs. 1, 2
Table I
References

cc: JB Fecht
MK Harmon
CC Oberg
HP Shaw
RE Smith
JH Warren
IB
File

9 3 1 2 8 0 2 7 0 6

W-16

CONTRACTOR	FACILITY	WORK AREA
ROCKWELL HANFORD OPERATIONS	155-TX Diversion Box	200-W

REPORT NO.				DATE AND TIME OF OCCURRENCE
77-180	☐ PRELIMINARY 10/13/77	☐ INTERIM 11/29/77 02/10/78 03/10/78 4/13/78	[X] FINAL	August 24, 1977

OCCURRENCE SUBJECT

CONTAMINATED RABBIT FECAL PELLETS NEAR THE 155-TX DIVERSION BOX

1. DESCRIPTION OF OCCURRENCE AND DESIGNATION OF APPARENT CAUSE

☐ DESIGN ☐ MATERIAL ☐ PERSONNEL [X] PROCEDURE ☐ OTHER

While performing a noncutline survey on August 24, 1977, a Radiation Monitor found rabbit fecal pellets contaminated with radioactivity in the immediate vicinity of the 155-TX Diversion box excavation. A more extensive survey revealed an area approximate 50 yards by 100 yards around the diversion box scattered with contaminated pellets wit as high as 100 mRad/hr readings.

Radioisotopic analyses on two individual pellets revealed:

18.6	μCi	^{137}Cs/gram of sample
0.044	μCi	^{134}Cs/gram of sample
0.093	μCi	^{106}Ru/gram of sample
0.026	μCi	^{144}Ce/gram of sample
2.63	μCi	^{90}Sr/gram of sample

Subsequent surveys of the area revealed additional contamination reading 500 to 100,00 in small spots within a 500-foot radius of the 155-TX Diversion box.

The source of the radioactivity was traced to contamination leaks from the 155-TX Dive box.

cc:
J. C. [illegible] - [illegible]
D. J. Elgert - [illegible]
F. G. Harris - DOE-RL
J. H. Straub - DOE-RL
M. W. Tiernan - DOE-RL

bcc:
D. C. Bartholomew
J. D. Briggs
D. J. Cockerham
J. M. Garbrick
R. J. Gisera
R. S. Gruhn
J. M. Haines (3)
R. D. Hammond
W. F. Heine
S. Marchetti
G. L. Owens
J. V. Panesko
J. H. Roecker
H. T. S[illegible]
J. A. Swenso
D. J. Washen
R. E. Wheele
R. A. Zinsli
Central File

2. OPERATING CONDITIONS OF THE FACILITY AT TIME OF OCCURRENCE (IF APPLICABLE)

The 155-TX Diversion box was partially exposed due to excavation that was started in [illegible] and left open for more than a year. The excavation on the east side of the diversion box exposed high radiation fields due to solutions which had leaked from the diversion box. The radioactivity was thought to be held in place by an application of plastic spray.

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IMMEDIATE EVALUATION, CORRECTIVE ACTION TAKEN AND RESULTS

Rockwell Environmental Protection and BNWL Ecosystems Department collected samples for evaluations.

The 50-yard by 100-yard area around the box was cleaned up and the contaminated pellets and soil were taken to dry waste burial.

Contaminated soil was removed from the excavation hole to the extent possible and buri Clean soil was used to replace the removed soil and covered the remaining contaminatior

A. RECOMMENDATIONS

A. TEMPORARY CORRECTIVE ACTION

A routine survey schedule was set up to monitor the zone for the next several months. There was no additional contamination found.

B. PERMANENT CORRECTIVE ACTION

See Attachment 1.

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CORRECTIVE ACTION TO BE IMPLEMENTED:	R. E. Wheeler	DATE 7/05/7

CROSS REFERENCE: OR REPORT NUMBER AND OCCURRENCE REPORT

76-21 Uncontrolled Release of Water in 241-TX-155 Diversion Box.

76-22 Liquid Level Increase in 105-TX Exceeding Increase Criteria (water over flowed into 155-TX).

76-23 Liquid Level Decrease of Diversion Box 155-TX and Catch Tank TX-302-B.

R. E. Wheeler	Environmental Engineer	5/31/
J. H. Garbrick	Mgr. Tank Farm Operations	6-1-
W. F. Heine	Dir. Health, Safety & Environment	6-2-
R. A. Zinsli	Program Mgr., Waste Concentration	6-1-
G. C. Owens	Mgr. Environ. & Occupational Safety	5/31/
J. H. Roecke	Program Mgr., Waste Management	6-5-7

94-3000.

9312861708

Occurrence Report No. 77-180

4b.

Permanent corrective actions are:

1. Project B-208 was initiated to provide the 152-TX Diversion Box as replacement for the 155-TX Diversion Box.

2. The excavated hole at 155-TX was backfilled with soil and the potential for contamination spread was eliminated.

3. Quarterly surveys of the 155-TX Diversion Box area will be conducted as part of the Environmental Surveillance Program. Responsible person: R. E. Wheeler, Engineer, Environmental Protection.

4. A standard has been developed which establishes control measures for excavations and other work in radiation zones that require the removal of protective cover from contamination. Responsible person: R. E. Wheel Engineer, Environmental Protection. The standard is to be distributed b July 5, 1978.

9 3 1 2 3 5 1 7 0 9

Rockwell International

September 30,1986

65633-86-107

V.W. Hall
Waste Management Program Office
2750E/D100/200 East

M.A. Chamness
Geotechnical Engineering
222U/2/200 West

Fiscal Year 1986 Scintillation Logging Status

Ref: RHO-RE-PL-23, September 1984, G.V. Last, K.R. Fecht, M.A. Chamness, "Scintillation Logging Plan for Monitoring Inactive Cribs"

In 1984, the "Scintillation Logging Plan for Monitoring Inactive Cribs" was written to provide a plan and schedule to monitor gamma-emitting radionuclides in the vadose zone (the zone between the surface and the ground water) around inactive cribs (Reference). Scintillation logs provide the means for determining changes in radionuclide intensity due to decay or movement. The plan schedules monitoring at a frequency sufficient for discovering changes in the concentrations or location to permit timely implementation of remedial action before a problem develops.

The scintillation logging plan indicates that a year-end status report will be written covering each year's logging efforts, with a document to be issued once every five years covering the entire scintillation logging network for the past five years. This letter meets the requirement for a year-end status report for Fiscal Year (FY) 1986.

Over 160 wells were to be logged during FY 1986, in an effort to catch up to the schedule given in the scintillation logging plan (Reference). Of these, 122 wells were logged. An appendix is available with digitized logs for each of these wells and copies of the original logs are kept in the Geotechnical Engineering Unit files. The remaining wells could not be logged this year, either because they have been destroyed, were inaccessible, or safety concerns around old wooden cribs prohibited access. When safety measures have been taken around the wooden cribs, those wells still accessible will be logged. Table 1 provides a list of the wells which could not be logged and the reason why.

Table 2 gives a list of the wells logged and the cribs they monitor, along with the results of a qualitative comparison with previous logs. This list contains only those wells logged this year, and not necessarily all of the wells monitoring the crib. Wells with the comment "no change" have always been, and still are, at background levels. Cribs which were used to dispose of waste with long half-lives have logs indicating the radionuclides are "decaying slowly", while those with short half-life waste are "decaying" or have "decayed to background".

9312850710

Rockwell International

There are no indications of movement or increases in intensity of gamma-emitting radionuclides in any of the wells, except for well 299-E28-7, which monitors the 216-B-5 reverse well. It shows background levels of contamination for the vadose zone, as before, but an increase in the ground water from 200 counts per second (cps) in 1976 to 9000 cps this year. Arrangements are being made to log other nearby ground-water monitoring wells, and to have the water in those wells sampled in an effort to determine the reason for the increase in contamination. Another type of problem was encountered when wells around the 216-Z-1 and Z-2 cribs were found to have corroded casing, allowing contaminated sediments to fall into the well. These wells (299-W18-60, W18-61, W18-62, W18-63, and W18-64) will be filled in with grout and destroyed, while W18-65 will have a liner grouted into place so that there will be one well to log immediately adjacent to the Z-1 and Z-2 cribs.

Scintillation logging probes with different backgrounds and sensitivities have been used over the past 10 years, making interpretation of the intensities of the logs difficult. In the future, one probe will be specified for use in scintillation logging of wells, making the logs directly comparable.

If you have any questions, please contact me on 373-2119.

Mickie Chamness

M.A. Chamness, Advanced Geologist
Geotechnical Engineering Unit

MAC/mac

cc: M.A. Adams
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R.C. Routson
A.L. Schatz
T.B. Veneziano
G.L. Wagenaar
R.E. Wheeler

TABLE 1. LIST OF WELLS THAT COULD NOT BE LOGGED

CRIB	WELL NUMBER	COMMENTS
A-2	E24-65	Inside security fence at PUREX
A-4	E24-54	" " " " "
A-5	E24-55	" " " " "
	E24-56	" " " " "
	E24-57	" " " " "
	E24-58	" " " " "
A-31	E24-9	" " " " "
B-8	E33-81	Wooden crib
	E33-82	" "
S-7	W22-13	Wooden crib
	W22-14	" "
	W22-32	" "
	W22-33	" "
S-20	W22-74	" "
T-7	W10-59	" "
	W10-60	" "
	W10-61	" "
	W10-62	" "
	W10-63	" "
	W10-66	" "
	W10-67	" "
	W10-68	" "
	W10-69	" "
	W10-70	" "
	W10-71	" "
	W10-72	" "
	W10-74	" "
	W10-77	" "
	W10-78	" "
	W10-79	" "
	W10-80	" "
	W10-81	" "
U-1 & -2	W19-72	" "
U-8	W19-69	" "
	W19-70	" "
	W19-71	" "
Z-1A	W18-77	Well cap welded on
	W18-79	" " " "
	W18-80	" " " "
	W18-149	" " " "
Z-3	W18-67	Cannot locate
	W18-68	" "

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TABLE 1 Continued

CRIB	WELL NUMBER	COMMENTS
Z-5	W15-52	Well cap locked, wooden crib
	W15-53	" " " " "
	W15-54	" " " " "
	W15-55	" " " " "
	W15-56	" " " " "
	W15-57	" " " " "
	W15-58	" " " " "
Z-6	W15-60	Wooden crib
Z-10	W15-59	Well cap locked
	W15-60	" " "
Z-12	W18-70	Contaminated tools in well
	W18-156	Well under fence

9 3 1 2 8 3 6 3 7 1 3

TABLE 2. LIST OF WELLS LOGGED AND RESULTS

CRIB	WELL NUMBER	DATE LOGGED	COMMENTS
A-6	E25-53	9/86	no change
A-7	E25-54	9/86	decaying
A-9	E24-63	9/86	no change
A-24	E26-2	2/86	decayed to background
	E26-3	2/86	decayed to background
	E26-4	2/86	decayed to background
	E26-5	2/86	decayed to background
A-27	E17-3	7/86	decaying
A-36A	E17-4	7/86	decaying slowly
	E17-10	9/86	no change
B-5	E28-7	7/86	increased from 200 cps to 9000 cps in the ground water
	E28-24	9/86	never logged before
	E28-73	9/86	never logged before
	E28-74	9/86	never logged before
B-44	E33-2	9/86	decaying
	E33-22	9/86	decaying slowly
B-45	E33-22	9/86	decaying slowly
B-46	E33-4	9/86	decaying slowly
	E33-23	9/86	decaying slowly
S-1	W22-6	2/86	no change except for spike at 46'
	W22-11	2/86	decaying
	W22-15	2/86	decaying
	W22-29	2/86	decaying slowly
	W22-31	2/86	decaying slowly
	W22-36	2/86	decaying slowly
	W22-67	2/86	decaying slowly
S-2	W22-5	2/86	decayed to background
	W22-10	2/86	decayed to background
	W22-16	2/86	decayed to background
	W22-17	2/86	decayed to background
	W22-18	2/86	decaying
	W22-29	2/86	decaying slowly
S-9	W22-25	9/86	decaying
	W22-34	9/86	decaying
	W22-35	9/86	decaying
T-3	W11-7	7/86	decaying slowly
	W11-79	7/86	decaying slowly
T-7	W10-3	7/86	decaying
T-14	W11-68	6/86	decayed to background
T-16	W11-80	6/86	no change
T-17	W11-81	6/86	decaying slowly

9 3 1 2 8 5 0 7 1 4

TABLE 2 Continued

CRIB	WELL NUMBER	DATE LOGGED	COMMENTS
T-19	W14-51	7/86	no change
	W14-52	7/86	no change
	W15-65	7/86	no change
	W15-66	7/86	no change
T-21	W15-80	6/86	no change
T-22	W15-209	6/86	decaying slowly
T-23	W15-210	6/86	decaying slowly
T-24	W15-211	6/86	decaying slowly
T-25	W15-212	6/86	decaying slowly
T-26	W11-70	7/86	decaying slowly
	W11-82	7/86	decaying slowly
T-27	W14-53	7/86	decaying slowly
	W14-62	7/86	decaying slowly
T-28	W14-1	9/86	decaying
	W14-3	9/86	decaying slowly
	W14-4	9/86	decaying slowly
	W14-53	7/86	decaying slowly
Z-1	W18-65	7/86	never logged before
Z-1A	W18-7	9/86	no change
	W18-66	7/86	never logged before
	W18-150	7/86	never logged before
	W18-158	7/86	never logged before
	W18-159	7/86	never logged before
	W18-163	7/86	never logged before
	W18-164	7/86	never logged before
	W18-165	7/86	never logged before
	W18-166	7/86	never logged before
	W18-167	7/86	never logged before
	W18-168	7/86	never logged before
	W18-169	7/86	never logged before
	W18-170	7/86	never logged before
	W18-171	7/86	never logged before
	W18-173	7/86	never logged before
	W18-174	7/86	never logged before
	W18-175	7/86	never logged before
Z-2	W18-60	7/86	never logged before
	W18-61	7/86	never logged before
	W18-62	7/86	never logged before
	W18-63	7/86	never logged before
	W18-172	7/86	never logged before
Z-3	W18-88	9/86	no change

9 3 1 2 5 6 3 7 1 5

TABLE 2 Continued

CRIB	WELL NUMBER	DATE LOGGED	COMMENTS
Z-7	W15-62	7/86	decaying
	W15-63	7/86	decaying
	W15-64	7/86	no change
	W15-76	7/86	decaying
	W15-77	7/86	no change
	W15-78	7/86	decaying
Z-12	W18-72	7/86	never logged before
	W18-75	7/86	never logged before
	W18-151	7/86	never logged before
	W18-152	7/86	never logged before
	W18-153	7/86	never logged before
	W18-154	7/86	never logged before
	W18-155	7/86	never logged before
	W18-157	7/86	never logged before
Z-18	W18-9	7/86	decaying
	W18-11	7/86	decaying
	W18-82	6/86	no change
	W18-93	7/86	decaying
	W18-94	7/86	no change
	W18-95	7/86	no change
	W18-96	7/86	decaying
	W18-97	7/86	decaying
	W18-98	7/86	no change
Z-19	W18-15	9/86	never logged before
	W18-177	9/86	never logged before

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Westinghouse
Hanford Company

Internal
Memo

From: Geosciences Group 80230-88-004
Phone: 3-2119 S0-04
Date: May 10, 1988
Subject: FISCAL YEAR 1987 INACTIVE CRIB MONITORING REPORT

To: V. W. Hall R1-15

cc: M. R. Adams R2-78 K. A. Gasper R1-15
T. A. Curran _____ R2-84 JRB File/LB

This is a letter report discussing the fiscal year 1987 inactive crib monitoring work.

The crib monitoring program is specified by a program plan provided in Last (et al., 1984). This current program does not satisfy the objectives specified in the program plan because it has not been fully implmented. New equipment, calibration facilities and more personnel would be required to fully implement such a program.

For 1987, the scope of the monitoring effort was redirected from that specified in the plan. The scope was directed at determining qualitative change in the characteristics of the gross gamma logs from vadose zone monitoring wells at inactive cribs. This includes qualitative assessments of the distribution of gamma emitting radionuclides along the boreholes and an indication of significant changes evidenced by changes in the shapes of the gamma-ray curves.

An attempt was made by the logging contractor (Pacific Northwest Laboratory) to standardize the gross gamma-ray logging tool by repeated logging of a borehole dubbed to be a site "standard". Although this is not a "calibration", it provides an indication that the tool is working and may allow a qualitative comparison of the logs from year to year. This limited standardization does not allow the quantitative comparison of gamma activity levels nor does it necessarily allow a precise determination of the location of gamma emitting radionuclides.

In 1987, approximately 140 wells were logged with a gross gamma-ray geophysical logging tool. Those wells are associated with 39 of the inactive crib sites. Table 1 provides a listing of cribs at which vadose zone wells were logged along with some comments on the sites. Those comments are limited to a qualitative assessment of any changes in the gamma-ray curves compared to previous logs. If the data indicate that radionuclides are migrating to the groundwater, this is also identified in the comment section of Table 1.

All gross gamma-ray geophysical logs are on file and available in Geotechnical Engineering Unit files.

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Twenty-three of the 39 cribs that were monitored in 1987, show no significant changes in the gross gamma logs from previous logs, based on a comparison of the curve shapes and amplitudes relative to an assumed background.

For cribs 216-A-2, 216-A-27, 216-B-9, 216-C-9 and 216-S-20, comparison with previous logs was not possible because no previous logs exist, because the data were not recorded in the same manner, or because the instrumentation was not working properly, resulting in bad data.

In the past, several cribs show elevated gamma activity in the groundwater as evidenced by previous reports or old gross gamma logs. These include 216-A-6, 216-A-36A and B, 216-B-5, the entire BC crib area, the BY cribs, 216-S-1 and 2, 216-T-3 and 216-U-17. In each of these cribs or crib areas, no significant changes can be seen in the logs. This suggests that the radionuclides deposited below and around the cribs are not migrating. However, more data would be required to make that determination. The groundwater beneath cribs 216-A-36 and 216-U-17 is currently being monitored and some remedial investigations are being conducted at these sites.

Two problem areas are identified in Table 1. The T trenches (216-T-14, 15, 16 and 17) and the 216-T-26, 27 and 28 cribs show significant changes in the gross gamma log signatures (changes in the shapes of the curves) as compared to previous years. It is not known if the radionuclides are migrating or being redistributed. To make that assessment, quantitative radionuclide monitoring data are needed as well as water content data from a compensated neutron porosity geophysical log. Additional definition of the geology would also be required.

John R. Brodeur

J. R. Brodeur, Senior Engineer
Geotechnical Engineering Unit

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Attachment

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Table I CRIB MONITORING SUMMARY

CRIBS	BOREHOLES	DATE LOGGED	PAST LOGS	Comments
A- 2	299-E24- 53 299-E24- 65	-- 9-87	8-82 --	Activity from 30 to 45 ft; Comparison with previous logs not possible, no previous data
A- 4	299-E24- 54	9-87	8-82	Activity from 20 ft to TD; No change in logs
A- 5	299-E24- 1 299-E24- 56 299-E24- 57 299-E24- 58	9-87 9-87 9-87 9-87	6-84,8-82,2-76,4-70,5-63 6-84,8-82,4-76,5-63,5-59 6-84,8-82,4-76,5-63,5-59 6-84,8-82,4-76,5-63,5-59	Two activity peaks (60 and 90 ft); Some activity is seen at water table; Previous logs show relatively high gamma activity in groundwater, Gamma radionuclides have migrated to groundwater in the past, No recent change in gamma logs
A- 6	299-E25- 3 299-E25- 53	7-87 8-87	7-84,6-84,2-76,4-68,5-63 8-84,5-76	Activity at 35 feet; No change in gamma logs
A-24	299-E26- 2 299-E26- 3 299-E26- 4 299-E26- 5 299-E26- 7	8-87 8-87 8-87 8-87 --	2-86,6-84 2-86,6-84 2-86,6-84 2-86,6-84 6-84	Activity between 200 and 240 ft in well E26-3, E26-4 and E26-5; Gamma emitting radionuclides have migrated to groundwater; Currently, little activity is seen in the vadose zone
A-27	299-E17- 2 299-E17- 3	7-87 --	6-84 7-76,4-70,5-63	High gamma at water table in E17-3; No activity at is seen at the water table in E17-2; Contaminated groundwater, source unknown. Comparison with previous logs not possible due to different tool response.
A-31	299-E24- 9	9-87	2-76,4-70,5-63	No activity evident; No change in log
A-36 A&B	299-E17- 4 299-E17- 5 299-E17- 7	7-87 -- 7-87	7-86,6-84,8-82,2-76,4-70 9-82,2-76,4-70,4-68,10-65 6-84,4-76,4-70,3-67	Activity from 60 to 140 ft and in groundwater; Groundwater contamination has occurred, probably from 36A crib; GW monitoring in progress.
A-38	299-E17- 8 299-E24- 11	-- 7-87	4-76.4-70,4-60 2-76,4-70,4-68	Crib was never used; Activity evident only in groundwater; No change in logs.
B- 5	299-E28- 3 299-E28- 7 299-E28- 24 299-E28- 73 299-E28- 74	-- 7-87 7-87 -- --	7-86,5-765,5-63,8-59 9-86	Activity evident in the groundwater; Groundwater contamination is caused by this injection well; Little change is seen in the gamma logs.

Table I CONTINUED

CRIBS	BOREHOLES	DATE LOGGED	PAST LOGS	Comments
B- 9	299-E20- 53	--	5-76,5-63	Only one monitoring well logged; no gamma activity is evident; Additional data are needed.
	299-E20- 54	--	5-76,5-63	
	299-E20- 55	--	5-76,5-63	
	299-E20- 56	--	5-76	
	299-E20- 57	--	--	
	299-E20- 58	--	5-76,5-63	
	299-E20- 59	8-07	5-76,5-63	
	299-E20- 60	--	5-76	
	299-E20- 61	--	5-76,5-63	
B-12	299-E20- 9	8-07	5-76	Gamma activity in well E20-76; Little change in this well
	299-E20- 12	--	3-84,6-83,8-82	
	299-E20- 16	--	5-76	
	299-E20- 64	--	5-76,9-67	
	299-E20- 65	--	5-76,9-60	
	299-E20- 66	--	5-76,9-60	
	299-E20- 76	8-87	3-84	
216-BC Cribs	299-E13- 1	7-87	3-85,4-76,4-60	Three of the logs show gamma activity from the surface down to and into the groundwater; Lateral migration of radionuclides may also have occurred; 1977 report indicates breakthrough; Current logs support this conclusion.
B-14	299-E13- 2	7-87	3-85,4-76,4-60	
B-15	299-E13- 3	7-87	4-85,3-85,4-76,4-60	
B-16	299-E13- 4	7-87	3-85,5-59	
B-17	299-E13- 5	--	5-85,3-85	
B-18	299-E13- 6	7-87	4-85,1-854	
B-19	299-E13- 20	7-87	3-85	
	299-E13- 21	7-87	3-85,4-76,4-60	
UC Area Cribs	299-E13- 7	7-87	3-84,4-76,4-60	Elevated gamma activity is seen in the groundwater near wells E13-12 and E13-10; Well E13-7 is the only groundwater well showing near surface gamma activity (20-40 ft). All nearby shallow vadose wells show gamma activity from the surface to about 40 ft. This suggests that the gross gamma monitoring equipment is not adequately sensitive for monitoring through groundwater wells. Contamination of the groundwater has occurred in the past. Little change is seen from previous logs.
B-20	299-E13- 8	7-87	4-84,2-76,4-60	
B-21	299-E13- 9	7-87	3-84,4-76,4-60	
B-22	299-E13- 10	7-87	3-84,4-76,4-60	
B-23	299-E13- 11	7-87	3-84,4-76	
B-24	299-E13- 12	7-87	3-84,4-76	
B-25	299-E13- 13	--	4-60,5-63	
B-26	299-E13- 14	--	3-84,5-76,4-60	
B-27	299-E13- 15	7-87	3-84,5-76,4-60	
B-28	299-E13- 16	7-87	3-84,4-76,4-60	
B-29	299-E13- 17	7-87	3-84,5-76	
B-30	299-E13- 18	7-87	3-84,5-76,5-63	
B-31	299-E13- 19	7-87	4-84	
B-32	299-E13- 54	7-87	3-84	
B-33	299-E13- 55	7-87	3-84	

Table I CONTINUED

CRIBS	BOREHOLES	DATE LOGGED	PAST LOGS	Comments
DC AREA CRIBS				
B-34	299-E13- 56	7-87	3-84	
B-52	299-E13- 57	7-87	3-84	
B-53A	299-E13- 58	7-87	3-84	
D-53B	299-E13- 59	7-87	3-84	
B-54	299-E13- 60	7-87	3-84	
D-58	299-E13- 61	7-87	3-84	
216-A Trenches	299-E33- 8	--	2-76,5-59	The data available for this group of cribs show stratified gamma activity from 20 to 50 ft. No data are available at depths greater than 50 feet. Little change in gamma logs
B-35	299-E33- 10	--	--	
B-36	299-E33- 21	--	5-76,4-70,5-63,5-59	
B-37	299-E33- 28	--	--	
B-38	299-E33- 29	--	--	
B-39	299-E33-286	7-87	3-84	
B-40	299-E33-287	7-87	3-84	
B-41	299-E33-288	7-87	3-84	
B-42	299-E33-289	7-87	3-84	
	299-E33-290	7-87	3-84	
216-BY Cribs	299-E33- 1	--	4-76,4-68,5-63	All groundwater wells show gamma activity throughout the vadose zone and into the groundwater. Little change in gamma logs.
B-43	299-E33- 2	7-87	9-86,5-76,4-70,5-63	
B-44	299-E33- 3	--	5-76,4-70,5-63	
B-45	299-E33- 4	7-87	9-86,7-76,4-70,5-63	
B-46	299-E33- 5	--	5-76,4-70,5-63	
B-47	299-E33- 6	7-87	5-76,4-70,5-63	
B-48	299-E33- 7	7-87	2-76,4-68,1-59	
B-49	299-E33- 13	7-87	5-76	
B-50	299-E33- 22	7-87	9-86,5-76,9-65	
	299-E33- 23	7-87	9-86,5-76,4-70,9-65	
B-56	299-E28- 14	5-87	5-76	Gamma activity is evident 15 ft below the water table. No gamma activity is seen on the log in the vadose zone. No change
C- 9	299-E27- 1	7-87	--	No gamma activity is seen in the vadose zone in this well. Elevated activity occurs in the bottom of this well. No previous logs to allow comparison.

Table I CONTINUED

CRIBS	BOREHOLES	DATE LOGGED	PAST LOGS	Comments
S- 1	299-W22- 1			Some wells show elevated gamma activity
S- 2	299-W22- 2		5-76,4-70,2-60	throughout the vadose zone.
	299-W22- 5	8-87	5-76,2-60,5-63	Gamma activity may have decreased in some
	299-W22- 6	8-87	2-86,5-76,2-60	wells. Cribs have broken through to ground-
	299-W22- 10	3-87	2-86,5-76,2-60,5-63	water sometime in the past as evidence by
	299-W22- 11	8-87	2-86	gamma logs.
	299-W22- 15	8-87	2-86,5-76,5-63,4-66	
	299-W22- 16	8-87	2-86,5-76,4-70,5-63	
	299-W22- 17	8-87	2-86,5-76,2-60	
	299-W22- 18	8-87	2-86,5-76,2-60,5-63	
	299-W22- 29	--	2-86,5-76,2-60	
	299-W22- 30	--	6-80,5-76,2-60	
	299-W22- 31	--	2-86,5-76,2-60	
	299-W22- 36	--	5-76,2-60	
	299-W22- 67	8-87	2-86,5-76,2-60	
S- 7	299-W22- 12	--	2-76,2-60,2-50	Older logs suggest radionuclides have
	299-W22- 13	8-87	5-76,2-60,5-63	reached the groundwater. Current logs show
	299-W22- 14	--	2-87,5-76,5-63,2-50	slightly elevated gamma activity which may
	299-W22- 32	--	5-76,2-60	or may not be due to contaminants. Most
	299-W22- 33	8-87	5-76,2-60	activity is confined to the vadose zone.
S- 9	299-W22- 25	8-87	9-86,2-76,3-70,2-60	There appears to be elevated gamma activity
	299-W22- 26	--	5-76,3-70,3-66	at the top of the groundwater table.
	299-W22- 34	8-87	9-86,5-76	The level appears to be low however, and may
	299-W22- 35	8-87	9-86,5-76	be due to natural activity. No change
S-20	299-W22- 19	--	3-84,2-76,2-60,7-63	Gamma activity is evident in vadose zone in
	299-W22- 20	--	5-76,2-60,5-63	well W22-74. Gamma log is not comparable
	299-W22- 74	2-87	3-84	with previous log because of poor recording
T- 3	299-W11- 1	7-87	--	Gamma activity is only seen above the water
	299-W11- 7	8-87	7-86,2-76,2-70,6-59	table. Well W11-79 shows gamma activity
	299-W11- 79	--	7-86,4-84	along length and into GW. Minimal change.
T- 5	299-W10- 1	8-87	2-76,5-63,6-59	Low level activity. No change

Table I CONTINUED

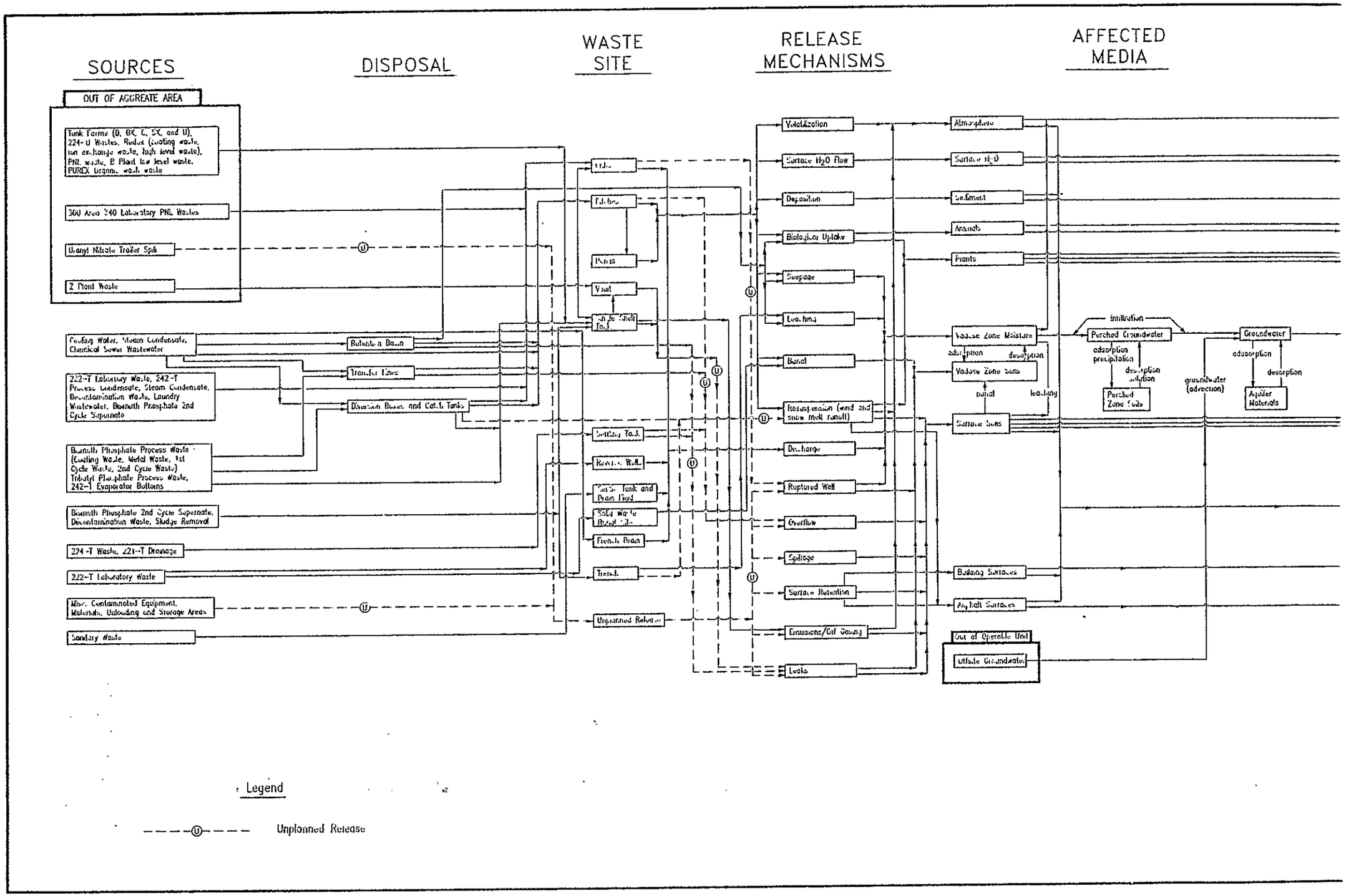
CRIBS	BOREHOLES	DATE LOGGED	PAST LOGS	Comments
T- 6	299-W11- 1	7-87	5-76,2-60	Some of the current logs show high activity between 30 and 40 ft. No change in logs.
	299-W11- 54	--	5-76,4-63,2-50	
	299-W11- 55	--	5-76,4-63,2-50	
	299-W11- 56	--	5-76,4-63	
	299-W11- 57	7-87	5-76,4-63	
	299-W11- 58	--	5-76,4-63	
	299-W11- 59	7-87	5-76,4-63	
	299-W11- 60	--	5-76,4-63	
	299-W11- 61	--	5-76,4-63	
	299-W11- 62	--	5-76,4-63	
	299-W11- 63	7-87	5-76,4-63	
	299-W11- 64	--	5-76,4-63	
	299-W11- 65	7-87	5-76,4-63	
	299-W11- 66	--	5-76,4-63	
	299-W11- 67	7-87	5-76,4-63	
T- 7	299-W10- 2	7-87	--	The gamma log from well W10-72 shows several high gamma activity zones. All other current logs do not show significantly high gamma activity. Decrease from previous logs is due to migration or decay of radionuclides.
	299-W10- 3	--	7-86,2-76,4-70,6-59	
	299-W10- 59	--	5-63	
	299-W10- 60	--	--	
	299-W10- 61	--	5-63	
	299-W10- 62	--	--	
	299-W10- 63	--	4-63	
	299-W10- 66	--	--	
	299-W10- 67	--	5-63	
	299-W10- 68	--	5-63	
	299-W10- 69	8-87	5-76,5-63	
	299-W10- 70	8-87	5-76,5-63	
	299-W10- 71	8-87	5-76,5-63	
	299-W10- 72	8-87	5-76,5-63	
	299-W10- 74	8-87	--	
	299-W10- 77	8-87	5-76	
	299-W10- 78	8-87	--	
	299-W10- 79	8-87	--	
	299-W10- 00	--	5-76,5-63	
	299-W10- 01	8-87	5-76	
216-T Trenches				Current well logs show a zone of gamma activity between 90 and 100 ft. Changes in shapes of gamma curves are significant. Quantitative data are required to assess changes.
T-14	299-W11- 68	7-87	6-86,5-76,4-63	
T-15	299-W11- 69	7-87	5-76,4-63	
T-16				
T-17				

Table I CONTINUED

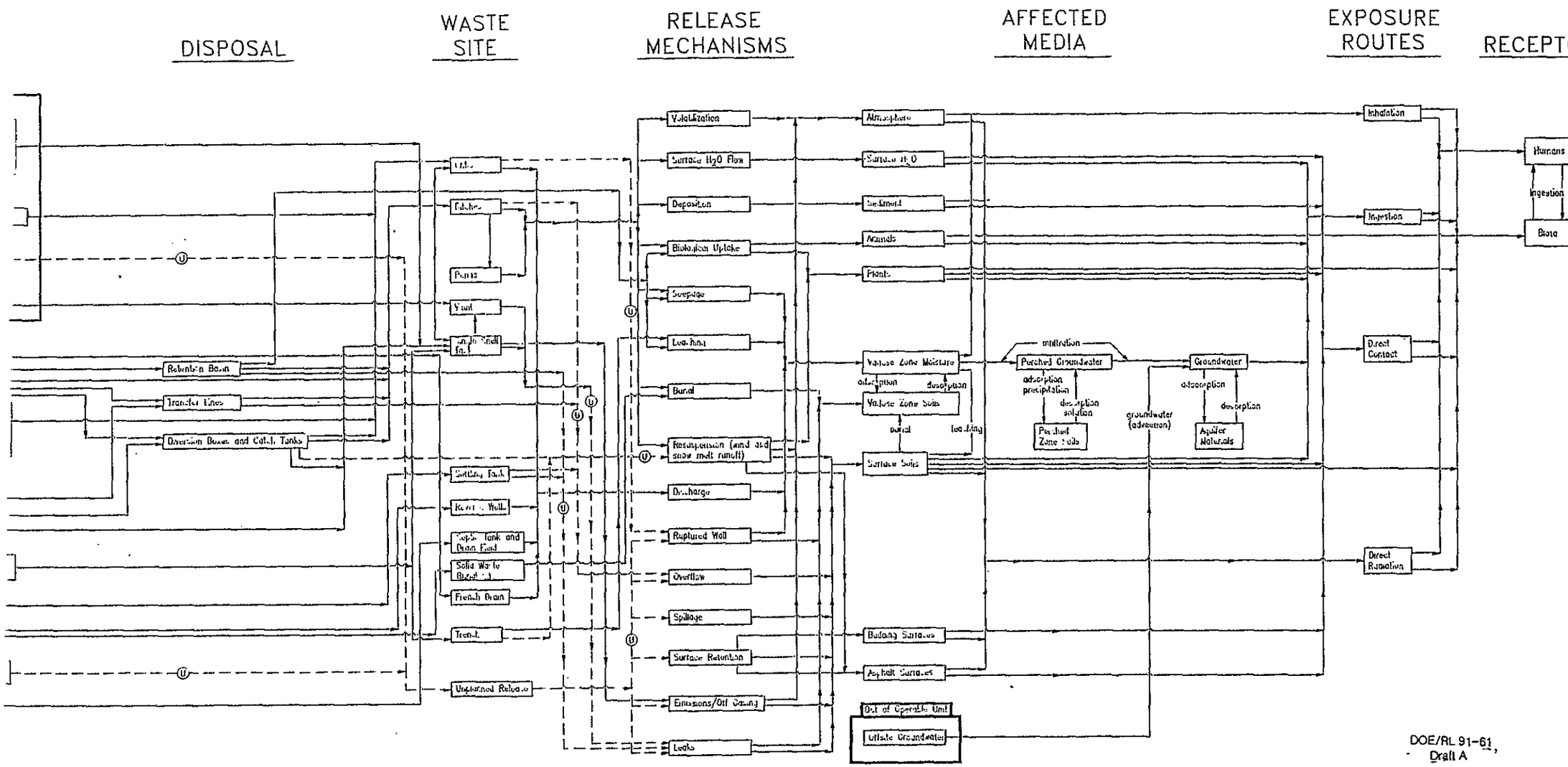
CRIBS	BOREHOLES	DATE LOGGED	PAST LOGS	Comments
T-26 T-27 T-20	299-W11- 11 299-W11- 70 299-W11- 82 299-W14- 1 299-W14- 2 299-W14- 3 299-W14- 4 299-W14- 59 299-W14- 62	-- 8-87 8-87 7-87 -- 8-87 8-87 8-87 8-87	-- 3-86,4-84 3-86,4-84 9-86 -- 9-86 9-86 7-86,4-84 7-86,4-84	Two zones of gamma activity are seen. One centered near 25 ft; one at 95 ft. Changes in gamma logs are evident. Quantitative data are required to assess changes.
T-33	299-W11- 14	7-87		Two possible contamination zones; 100 ft and 170 ft. Levels are low relative to an assumed background. Little change from previous logs.
T-34	299-W11- 15 299-W11- 16	-- 7-87	5-76,2-70,2-60 5-76,2-70,2-60	No high activity is seen in W11-16. Little change from previous logs.
T-35	299-W11- 17 299-W11- 18 299-W11- 19 299-W11- 20 299-W11- 21	7-87 -- 7-87 7-87 7-87	5-76,2-70,2-67 2-76,2-70,3-67 5-76,2-70 5-76,2-70 5-76	No high activity is seen in the gamma logs. Previously recorded gamma activity has decayed or migrated.
T-36	299-W10- 2 299-W10- 4	7-87 --	5-76 5-76,4-63,7-59	No high activity is seen in W10-2. Little change from previous logs.
U- 3	299-W19- 1	5-87	--	No high gamma activity is seen in this well
U-17	299-W19- 19 299-W19- 20 299-W19- 23 299-W19- 24 299-W19- 25 299-W19- 26	1-87 -- 3-87 -- 4-87 4-87	-- 6-86 -- -- -- --	Gamma activity is evident throughout wells W19-19, W19-20, W19-23, and W19-24. Gamma emitting radionuclides have migrated recently and they have migrated to ground-water. Ground-water minitoring is occurring Significant changes from previous logs.

Table I CONTINUED

CRIBS	BOREHOLES	DATE LOGGED	PAST LOGS	Comments
Z- 9	299-W15- 6	3-87	5-76,2-68,5-63	Data from this crib show several strata with gamma emitting radionuclides in the unsaturated zone. No gamma activity is seen in the saturated zone. Minimal changes from previous logs.
	299-W15- 8	3-87	4-73,2-70,10-68	
	299-W15- 9	3-87	5-76,4-73,2-67	
	299-W15- 82	3-87	5-76,5-63	
	299-W15- 84	3-87	5-76,4-73,5-63	
	299-W15- 85	3-87	5-76,4-73,5-63	
	299-W15- 86	3-87	5-76,4-73	
	299-W15- 95	3-87	5-76,4-73,5-63	
	299-W15-101	--		
Z-12	299-W18- 2	--	5-76,2-68,5-63	No gamma activity is seen in the groundwater in these wells. Little activity is seen in the unsaturated zone. Little change in the well logs.
	299-W18- 4	8-87	--	
	299-W18- 5	--	5-73,2-68,2-67	
	299-W18- 8	--	--	
	299-W18- 69	--	2-68,2-67	
	299-W18- 70	--	--	
	299-W18- 71	8-87	5-73,2-70	
	299-W18- 72	8-87	7-86	
	299-W18- 73	8-87	5-73	
	299-W18- 74	8-87	5-73	
	299-W18- 75	--	7-86	
	299-W18-151	--	7-86	
	299-W18-152	--	7-86	
	299-W18-153	--	7-86	
	299-W18-154	--	7-86	
	299-W18-155	--	7-86	
	299-W18-156	--	--	
	299-W18-157	--	7-86	
Z-18	299-W18- 9	7-87	7-86	Several high gamma activity peaks are found between 20 and 70 ft. One zone of high gamma activity may occur between 124 and 146 ft. The three groundwater wells in this area do not indicate any gamma activity in the groundwater. Little change from previous logs.
	299-W18- 10	--	--	
	299-W18- 11	7-87	7-86	
	299-W18- 12	--	--	
	299-W18- 13	--	--	
	299-W18- 82	7-87	6-86	
	299-W18- 93	7-87	7-86	
	299-W18- 94	7-87	7-86	
	299-W18- 95	7-87	7-86	
	299-W18- 96	7-87	7-86	
	299-W18- 97	7-87	7-86	
	299-W18- 98	7-87	7-86	
	299-W18-177	9-87	6-86	


SOURCES
DISPOSAL
WASTE SITE
RELEASE MECHANISMS
AFFECTED MEDIA
OUT OF AGGREATE AREA
Tank Farms (B, BX, C, SX, and U), 224-U Wastes, Redox (cooling waste, ion exchange waste, high level waste), PNL waste, B Plant low level waste, PUREX Organic wash waste
300 Area 340 Laboratory PNL Wastes
Uranyl Nitrate Trailer Spill
Z Plant Waste
Cooling Water, Steam Condensate, Chemical Sewer Wastewater
222-T Laboratory Waste, 242-T Process Condensate, Steam Condensate, Decontamination Waste, Laundry Wastewater, Bismuth Phosphate 2nd Cycle Supernate
Bismuth Phosphate Process Waste (Cooling Waste, Weld Waste, 1st Cycle Waste, 2nd Cycle Waste) Tributyl Phosphate Process Waste, 242-T Evaporator Bottoms
Bismuth Phosphate 2nd Cycle Supernate, Decontamination Waste, Sludge Removal
224-T Waste, 224-T Drainage
222-T Laboratory Waste
Misc. Contaminated Equipment, Materials, Unloading and Storage Areas
Sanitary Waste
Retention Basin
Transfer Lines
Diversion Boxes and Catch Tanks
Pipes
Vault
Settling Tank
Reactor Well
Septic Tank and Drain Field
Solid Waste Burial Site
French Drain
Trench
Unplanned Release
Volatilization
Surface H2O Flow
Deposition
Biological Uptake
Seepage
Leaching
Burial
Resuspension (wind and snow melt runoff)
Discharge
Ruptured Well
Overflow
Spillage
Surface Retention
Emissions/Off Gassing
Leaks
Atmosphere
Surface H2O
Sediment
Animals
Plants
Vadose Zone Moisture
Vadose Zone Soils
Surface Soils
Building Surfaces
Asphalt Surfaces
Out of Operable Unit
Offsite Groundwater
infiltration
Perched Groundwater
adsorption
precipitation
desorption
solution
Perched Zone Soils
groundwater (advection)
Groundwater
adsorption
desorption
Aquifer Materials
Legend
Unplanned Release

9 3 1 2 8 5 6 7 2 6



Legend

- - - - Unplanned Release

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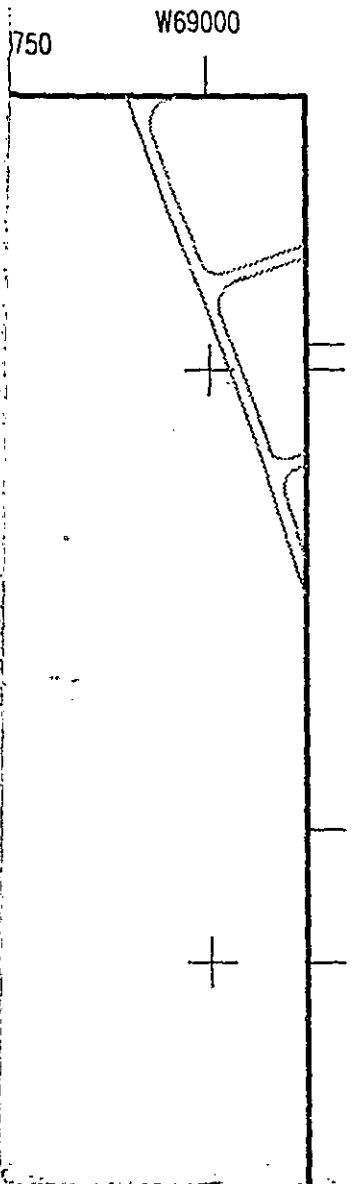
PLATE 4 CONCEPTUAL MODEL
T PLANT AGGREGATE AREA

Mar. 6, 1992



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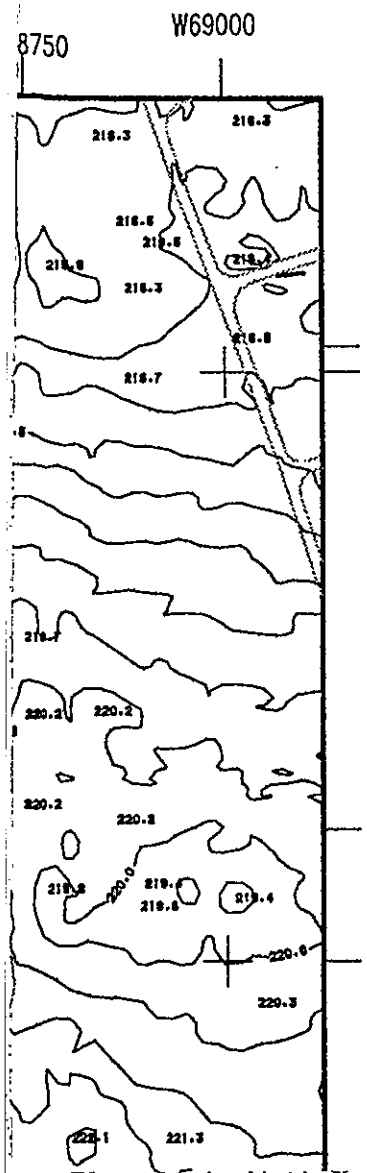
T PLANT AGGREGATE AREA
PLATE 1 - Facilities, Sites, & Unplanned Releases



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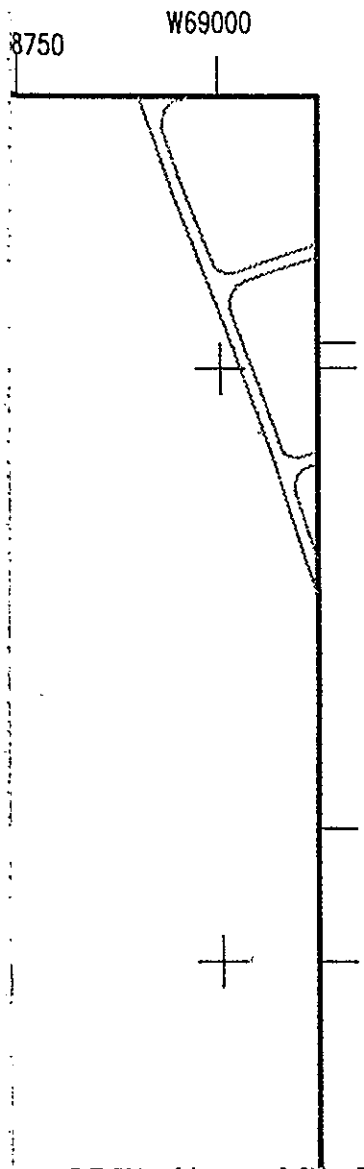
T PLANT AGGREGATE AREA
PLATE 2 - Topography



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T PLANT AGGREGATE AREA
PLATE 3 - Monitor Wells & Sample Locations

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