DOE/EIS-0189-SA3

Supplement Analysis for the Tank Waste Remediation System

Prepared by
U.S. Department of Energy
Office of River Protection

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Notice To Reader:

The environmental impact analyses in this Supplement Analysis were based on the best information available at the time from ORP, BNLF Inc., and CHG. In areas where data was not available environmental impacts were quantified by scaling from the environmental impacts evaluated in the TWRS EIS.

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LIST OF TERMS

DOE	U.S. Department of Energy
DST	double-shell tank
Ecology	Washington State Department of Ecology
ERPG	Emergency Response Planning Guideline
HLW	high-level waste
LAW	low-activity waste
LCF	latent cancer fatality
LDMM	leak detection, monitoring, and mitigation
MEI	maximally exposed individual
NEPA	*National Environmental Policy Act of 1969*
ORP	Office of River Protection
PCB	polychlorinated biphenyl
RCRA	*Resource Conservation and Recovery Act of 1976*
RL	Richland Operations Office
RPP	River Protection Project
SST	single-shell tank
TRC	total recordable case
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1996)
TRU	transuranic
TSCA	*Toxic Substance Control Act*
TWRS EIS	*Tank Waste Remediation System Environmental Impact Statement* (DOE/EIS-0189)
TWRS FSAR	*Tank Waste Remediation System Final Safety Analysis Report* (HNF-SD-WM-SAR-067)
TWRS ROD	"Record of Decision for the Tank Waste Remediation System, Hanford Site, Richland, Washington" (62 FR 8693)

1.0 INTRODUCTION

This Supplement Analysis addresses the potential effect that new data and information developed since preparation of the *Tank Waste Remediation System Environmental Impact Statement* (DOE/EIS-0189), hereinafter referred to as the TWRS EIS, may have on the environmental impacts presented in that report to support a determination of whether these new data warrant further *National Environmental Policy Act of 1969* (NEPA) analysis at this time. Examples of two changes resulting from the new information included a (1) deferral in single-shell tank (SST) retrieval and (2) expanded capacities for both the Phase I and Phase II pretreatment and vitrification facilities.

In 1996 the U.S. Department of Energy (DOE) and Washington State Department of Ecology (Ecology) issued the TWRS EIS to address alternatives for the safe management and remediation of approximately 210 million curies of radioactive, hazardous, and mixed waste stored in the 177 underground storage tanks in the 200 Areas of the Hanford Site. DOE subsequently issued the "Record of Decision for the Tank Waste Remediation System, Richland, Washington" (62 FR 8693), hereinafter referred to as the TWRS ROD, which documented the selection of the Phased Implementation alternative and the decision to privatize certain portions of the project. Ecology concurred in the selection of the Phased Implementation alternative. The waste will be separated into low-activity waste (LAW) and high-level waste (HLW) streams and immobilized. The immobilization method selected for both the LAW and HLW streams is vitrification. The vitrified LAW will be disposed of onsite, and the vitrified HLW be disposed of at a geologic repository. The Phased Implementation alternative includes Phase I pretreatment and vitrification facilities that will be used to verify that the vitrification processes will function effectively in the Phase II production phase.

In May 1996 DOE awarded contracts to BNFL Inc. (BNFL) and Lockheed Martin Advanced Environmental Systems to perform initial planning and engineering for Phase I. Based on the results of this initial planning and engineering stage, DOE chose to terminate the contract with Lockheed Martin Advanced Environmental Systems and, in August of 1998, proceeded with the next stage of the contract with BNFL. The next stage of the BNFL contract was scheduled to be completed by August 2000 and was proceeding into the design of the processing facilities, sufficient to arrive at a fixed-unit price for the treatment of waste in Phase I. However, in May 2000 after reviewing the BNFL proposal, DOE issued a Stop Work Order and in June 2000 terminated its contract with BNFL for the convenience of the Government. DOE will seek new bidders and through open competition will award a new contract by January 2001 to complete the design work and to construct the facilities. During the transition period DOE has tasked CH2M HILL Hanford Group, Inc. with the interim design effort for the waste treatment and vitrification plant to avoid future delays.

There are many technical uncertainties associated with implementation of the Phased Implementation alternative. To address these uncertainties and ensure that data developed during the various phases of the project are incorporated into project planning, DOE committed in the TWRS ROD to perform future analysis at specific points in the program. These points were:

- Prior to proceeding into Privatization Phase I Part B (completed August 1998)

- Prior to the start of hot operations of Privatization Phase I Part B (scheduled in the TWRS EIS for December 2002/December 2003)

- Before deciding to proceed with Privatization Phase II (scheduled in the TWRS EIS for December 2005).

The DOE prepared and issued *Supplement Analysis for the Tank Waste Remediation* System (DOE/EIS-0189-SA2) prior to proceeding into Privatization Phase I Part B in accordance with the commitment in the TWRS ROD. The analysis demonstrated that the information developed since preparation of the TWRS EIS had a small effect on the impacts calculated for the TWRS EIS and that the changes in environmental impacts were bounded by the impacts presented in the TWRS EIS. New data related to the composition of the tank contents, contamination in the vadose zone, DOE Office of River Protection (ORP) accident evaluations, and updated engineering data warrant another analysis at this time, in advance of the commitments made in the TWRS ROD.

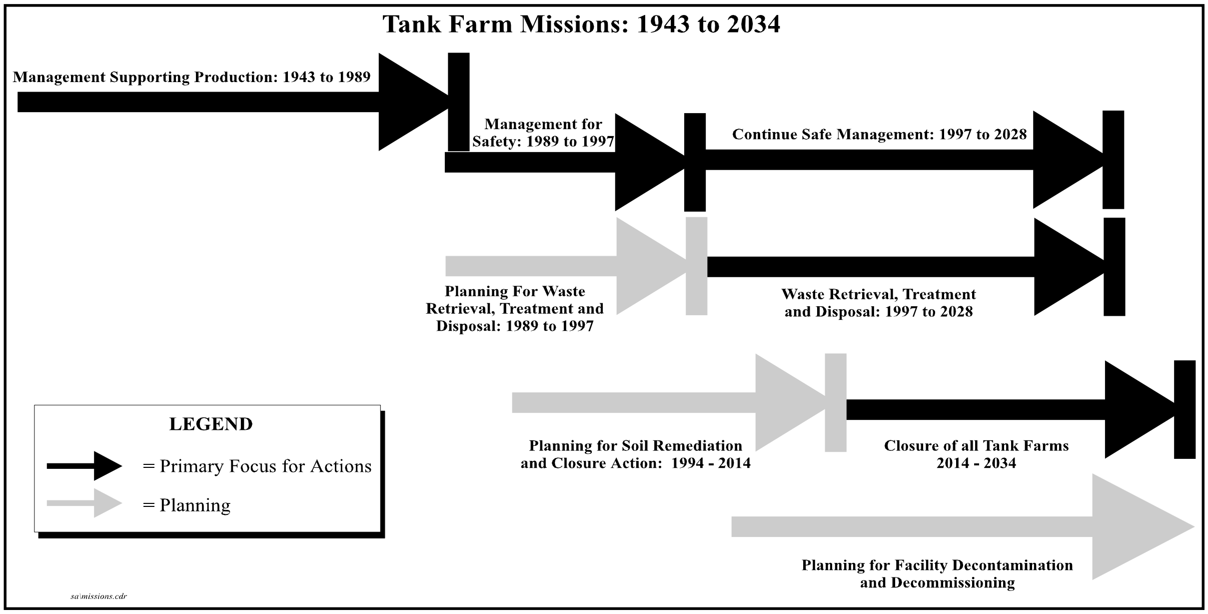
1.2 CURRENT TANK WASTE PROGRAM

From 1991 to 1998 an organization known as the Tank Waste Remediation System was in place to manage all aspects of the Hanford Site tank farms. In 1998 DOE created a new organization, the ORP. Creation of this organization was required of the Secretary of Energy in the *Strom Thurmond National Defense Authorization Act for Fiscal 1999*. The manager of ORP is responsible for managing all aspects of the Hanford Site tank farm operations, including those portions under privatization contracts. The project that carries out the activities associated with the storage, vitrification, and disposal of the Hanford Site tank waste under ORP is the River Protection Project (RPP). The RPP mission comprises four distinct activities:

- Safely manage the tank waste
- Remediate the tank waste
- Remediate the tanks, associated equipment, and contaminated soils (i.e., close the tanks)
- Decommission facilities.

The diagram in Figure 1.1 reflects a master view of the evolution of RPP program mission focus.

Figure 1.1. River Protection Project Program Mission Focus



Safely managing the tank waste is a program that has been ongoing for many years and remediating the tank waste is the program for constructing and operating the pretreatment and vitrification facilities. DOE determined that decisions cannot be made at this time concerning closure of the tank farms because not enough information is known about past-practice releases from the tanks or technologies for remediating the tank farm system (59 FR 4052). However, DOE is collecting environmental data through the vadose zone characterization program to evaluate the need for corrective actions under the *Resource Conservation and Recovery Act of 1976* (RCRA) and to support future decisions on how to close the tank farms. Emerging information on the rate of migration of past leaks from the tanks demonstrates that certain contaminants have moved faster than previously anticipated through the vadose zone to the groundwater. The cause of this is under investigation by DOE and likely results from several factors including larger volume leaks than previously estimated, changes in information on the mobility of contaminants in the upper layers of the vadose zone due to chemical processes, and physical properties of the subsurface soils. This new information is important to the future assessment of measures to close the tank farms. Decommissioning is too far in the future to be addressed at this time because of a lack of information on what facilities will require decommissioning.

Work to initiate retrieval, pretreatment, and vitrification of tank waste is under way. Detailed design is being performed on double-shell tank (DST) waste mixing and retrieval systems and waste transfer systems. Construction has been initiated on necessary infrastructure upgrades to support the Phase I pretreatment and vitrification facilities. Large-scale nonradioactive testing of a LAW melter prototype is being performed and detailed design of waste pretreatment and vitrification facilities is in progress.

1.3 TANK WASTE PROGRAM UNCERTAINTIES

The RPP is one of the most complex and costly remediation programs in the country and involves a number of technical uncertainties, some of which cannot be fully resolved until waste is actually processed. A major focus of the RPP is managing these uncertainties while making progress towards remediating the tank waste. DOE determined that the many years of research and development throughout the DOE complex have reduced the technical uncertainties to a manageable level and the risks associated with proceeding with remediation are less than the risks of future releases of contaminants to the groundwater and of accidents in unremediated tanks that are structurally deteriorating (62 FR 8693). A major accident, such as a tank dome collapse, could result in a significant loss of life and a major additional cost for remediation. DOE also determined that it is necessary to retrieve waste from the tanks to meet regulatory requirements, avoid long-term releases to the groundwater that could threaten human health and the environment, and reduce health impacts to inadvertent intruders into the waste if administrative control of the Hanford Site were to be lost (62 FR 8693).

However, DOE is concerned about the technical uncertainties associated with the program and the Phased Implementation alternative was selected, in part, because it provides an opportunity to reduce the technical uncertainties prior to making final commitments to a remediation strategy by learning from early phases of the program and from technology development activities. If necessary, mid-course corrections can be made to the program to apply the new information that is obtained.

The uncertainties that have the potential to impact the course of the RPP were identified in the TWRS EIS and in *The Hanford Tanks, Environmental Impacts and Policy Choices* (National Research Council 1996). The following is a summary of these uncertainties.

- **Waste Inventory –** The inventory of the tank waste is not completely understood. Complete records were not kept on the waste that was put into the tanks, how the waste was transferred between tanks, and the waste that was decanted off and discharged into shallow subsurface cribs for leaching into the soils. In addition, the waste is composed of many chemical and radiological elements and compounds that are constantly reacting to form new chemical compounds. This results in an uncertain and continuously changing inventory of waste that adds a degree of complexity to the safe management, separations, and vitrification components of the project.

- **Waste Retrieval and Transfer** – The efficiency and effectiveness of current methods (i.e., hydraulic sluicing) for retrieving waste from the tanks and how much liquid waste might be released to the environment during retrieval is uncertain. Sluicing is a process that involves adding water to the tanks and mixing it with the wastes to suspend particles so they can be pumped to the surface. Although hydraulic sluicing has been performed in the Hanford Site tanks, its effectiveness in removing the hard pan (i.e., hard heel) in the bottom of the tanks has not been proven. Other technologies may be necessary to remove this waste. Also, hydraulic sluicing uses relatively large volumes of liquids and the amount of liquids that may be released through cracks in the SSTs is uncertain. There are 67 known or suspected leaking SSTs. These and other tanks may leak liquids during retrieval. Using currently available leak detection and mitigation technologies and/or procedures, it is estimated that a tank leak could not be detected before 15,200 L (4,000 gal) have been released and not stopped for most tanks before approximately 30,400 L (8,000 gal) have been released (WHC-SD-WM-ES-377). Alternative technologies may need to be deployed for the 67 known or suspected leaking tanks.

- **Waste Vitrification** – The processes for separating the waste into HLW and LAW waste streams and vitrifying the waste have not been performed on the Hanford Site tank waste, and the efficiency and effectiveness of these processes are uncertain. The vitrified HLW must meet the waste form specifications for the national geologic repository, which are based on a high-quality borosilicate glass. Separations and vitrification of similar waste have been performed at other DOE sites and in Europe but they have not been performed at a production scale on the Hanford Site waste.

- **Long-Term Health Effects** – The long-term health effects associated with losses during retrieval, residual wastes, and onsite and offsite disposal facilities are not fully understood. The TWRS EIS provided best-estimate and bounding estimates for these long-term risks. These estimates of the risks vary considerably because of uncertainties associated with residual waste inventory, transport mechanisms through the vadose zone, separations processes, and future site uses. Because of this the TWRS EIS did not specify a level of retrieval that would be necessary to protect public health and safety or support decisions related to closure of the tank farms. The *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989), hereinafter referred to as the Tri-Party Agreement, specifies an interim goal of no more than 10 m^3 (360 ft^3) per tank of residual waste in the tanks, but this number is not based on estimates of potential health effects. This number may be more restrictive than necessary to be protective of public health and the environment or it may not be restrictive enough. This is not an issue that needs to be resolved for Phase I but will be very important to resolve prior to Phase II and closure of the tank farms.

- **Cumulative Impacts** – The relationship between remediation of the tank waste and remediation of other areas adjacent to the tanks, including past tank leaks, and the Hanford Site as a whole has not been established. There are many other sites within the 200 Areas and the Hanford Site that are releasing contaminants to the groundwater and require remediation. The impact of some of these sites on the groundwater is additive to the potential impacts of RPP, and an understanding of these cumulative impacts is important in establishing cleanup goals.

- **Vitrified HLW Disposal** – The location and costs for disposal of the vitrified HLW generated from the vitrification process have not been firmly established. The TWRS EIS used the Yucca Mountain Site as the planning basis for the final disposal location of the vitrified HLW because it is the only site that is being characterized for potential siting of the geologic repository. However, a final decision has not been made on the selection of this site.

- **Regulations** – The regulations governing the disposal of radioactive, hazardous, and mixed waste have historically been subject to significant changes, and there is potential for future changes to occur, which could impact plans to remediate the tank waste.

The final waste classifications of certain waste streams has not been determined, and these classifications may affect the remedial actions implemented.

DOE has and continues to implement actions to reduce these uncertainties. Section 4.0 contains a discussion of how the data developed since preparation of the TWRS EIS have reduced these uncertainties and how the remaining uncertainties apply to the Phased Implementation alternative.

1.4 SUMMARY OF NEW DATA

The new data and information form the basis of the analysis presented in this Supplement Analysis. A list of engineering and environmental parameters that formed the basis of the impacts calculated for the TWRS EIS was developed, and any new data or information relative to each of the environmental and engineering parameters were assembled for analysis. New data and information are presented in Table 1.1. The document sections where the new data are discussed and evaluated are also provided in the table.

Section 2.0 identifies the new information with potential to substantively change the impacts presented in the TWRS EIS and resource areas where little or no new information is available to support analysis of changes in TWRS EIS impacts.

1.5 SUMMARY OF REVISED IMPACTS

This Supplement Analysis demonstrates that the impacts from the new information developed since preparation of the TWRS EIS are not substantially changed from the impacts presented in the TWRS EIS with the following exceptions:

- High technical uncertainty for Phase II SST waste retrieval
- High technical uncertainty for the scale-up of the HLW vitrification facility from Phase I to Phase II
- Substantive increase of injuries and fatalities to the workers during Phase II.

Table 1.1. Summary of New Data and Information

New Data and Information	Location of Discussion and Evaluation in Document (Section Number)
Most recent inventory of chemical and radiological constituents in the tank waste and new waste that is planned to be sent to the tanks for vitrification	2.2.1 3.12.1.1 3.12.1.2 3.12.2.1 3.12.2.2 3.12.3.1 3.12.3.2
Updated engineering documentation	2.2.2
Expanded capacities for both the Phase I and Phase II pretreatment and vitrification facilities	2.2.2.2 3.1.1 3.1.2 3.5.1 3.5.2 3.6.1 3.6.2 3.7.1 3.7.2 3.8.1 3.8.2 3.11.1 3.11.2 3.12.1.1 3.12.1.2 3.16.1 3.16.2 4.0 4.1 4.2 5.0
Deferral in SST retrieval	2.2.2.3 4.1 5.0
Waste retrieval	2.2.2.4 4.1 5.0
Relocation of staging tanks within vaults inside the pretreatment facility	2.2.2.5 3.13.3.1 3.13.3.2
Air emissions from Phase I vitrification facilities	2.2.2.6 3.4.1.2 3.4.2.1 3.12.1.1 3.12.1.2
Vitrified waste form, waste loading, and vitrified waste volume	2.2.2.6 3.12.1.1 3.12.1.2 3.13.2.1 3.13.2.2
Change in the disposal concept for the vitrified LAW from vaults to remote-handled trenches	2.2.2.7 3.1.1 3.1.2 3.5.1 3.5.2 3.6.1 3.6.2 3.7.1 3.7.2 3.8.1 3.8.2 3.12.1.1 3.12.1.2 3.12.2.1 3.12.2.2 3.12.3.1 3.12.3.2 5.0
Most currently available RPP authorization basis accident analysis	2.2.3 3.13.3.1 3.13.3.2 5.0
Emerging information on the contamination in the vadose zone	2.2.4 3.3.1
Technology development activity updates	2.2.5
Hanford Reach National Monument designation[a]	2.2.6
Mitigation Action Plan[b]	2.2.7
Hanford Comprehensive Land-Use Plan[c]	2.2.8
Rail system currently not available to the Hanford Site	2.2.9
Source of Phase I borrow material changed from offsite to onsite	2.2.10 3.1.1 3.1.2 3.5.1 3.5.2 3.6.1 3.6.2 3.8.1 3.8.2 5.0

[a] 65 FR 7319.
[b] DOE-RL 1998.
[c] DOE/EIS-0222.

LAW = low-activity waste.
RPP = River Protection Project.
SST = single-shell tank.

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2.0 SUMMARY OF NEW INFORMATION

2.1 INTRODUCTION

This section summarizes the new data and information developed since preparation of the TWRS EIS. The new data and information form the basis of the analysis presented in this Supplement Analysis. A list of engineering and environmental parameters that formed the basis of the impacts calculated for the TWRS EIS was developed, and any new data or information relative to each of the environmental and engineering parameters were assembled for analysis.

Section 2.2 identifies the new information with potential to substantively change the impacts presented in the TWRS EIS, and Section 2.3 identifies resource areas where little or no new information is available to support analysis of changes in TWRS EIS impacts.

2.2 ENGINEERING AND ENVIRONMENTAL INFORMATION

2.2.1 Waste Inventory

2.2.1.1 Tank Waste. The tank waste inventory used in the TWRS EIS was based on estimates developed using the best available information at the time of publication. The SST inventory estimate was based on normalized Track Radioactive Component data (see TWRS EIS, Appendix A). The DST inventories were developed using tank sample data in combination with historical tank data. The TWRS EIS acknowledged that considerable uncertainty existed for the inventory data and that additional characterization and inventory evaluations were being conducted.

In an effort to reduce inventory uncertainties, resolve differences among the many reported inventory values, and provide a consistent and technically defensible inventory for all waste management and disposal activities, a task was initiated in fiscal year (FY) 1996 to establish a best-basis standard inventory for chemicals and radionuclides in the tank waste.

In September 1998 the RPP released the latest version of *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes* (HNF-SD-WM-TI-740), which provides a global best-basis inventory (referred to as the revised inventory in this Supplement Analysis) for 26 chemical and 46 radionuclide components. The revised inventory for each component includes the total inventory of that component currently stored in the tanks. Information used to establish global inventories originated from key historical records, various chemical flow sheets, and calculations for radionuclide isotope generation and decay. The revised inventory effort is ongoing and will provide updated inventory data through a controlled revision process as new characterization data and information become available. Although the revised inventory will be refined in the future, it is the best available inventory data, and the methodology that followed it provides a degree of refinement over the TWRS EIS inventory. The revised inventory is accepted as the Hanford Site inventory to be used for all RPP activities.

Over the past 20-plus years more than 7 different global tank waste inventory documents have been issued (HNF-SD-WM-TI-740). Each inventory report was based on the best available knowledge at the time of publication. The different reports were based on different methodologies; different models; and, to varying degrees, available sampling data. The different inventory reports did not always provide consistent inventory values.

The methodology used to develop the revised inventory involved a thorough review of all pertinent information sources to identify errors, biases, inconsistencies, and missing information. The information sources included process flowsheets, waste transaction records, reactor fuel data, and essential material records. The chemical constituents and radionuclides are discussed individually. The technical basis for the inventory estimate along with reconciliation with previously reported inventories are provided in HNF-SD-WM-TI-740. This methodology provides an inventory that serves as the single source of waste composition data for RPP process flowsheet modeling work; safety analyses; risk assessments; and waste retrieval, vitrification, and disposal system design.

In addition to the global best-basis inventory, tank-by-tank inventory estimates have been developed using all available information, mainly sample analysis results, and provide a revised inventory for each of the SSTs and DSTs (TWINS 1999). Table 2.1 provides a comparison of the TWRS EIS and revised inventories for chemical and radiological constituents. The revised inventory reflects the best available data as of October 5, 1999. The scaling factor provided is defined as the ratio of the inventory estimate for the revised inventory to the TWRS EIS inventory. The changes in potential environmental impacts that could occur from changes in inventory estimates are discussed in Section 3.0.

A number of constituents were included in the TWRS EIS inventory that are not reported in the revised inventory. The revised inventory estimate efforts focused on a subset of chemicals and radionuclides of greatest concern to multiple data users. The TWRS EIS inventory for constituents not reported in the revised inventory are assumed to be unchanged.

2.2.1.2 K Basins Sludge. In addition to the tank waste inventory, the TWRS EIS included inventory estimates for the K Basins sludge as an additional waste stream that would be transferred to the tanks to be processed during Phases I and II. The K Basins sludge inventory was included in the analysis because the TWRS EIS identified the potential for relocating K Basins sludge to the DSTs for storage and subsequent vitrification with the tank waste. However, recent evaluations of this proposal showed that costs to meet the ORP acceptance criteria were excessive (Williams 1999). The current planning basis for the K Basins sludge includes initial storage at T Plant, chemical treatment of the sludge with other remote-handled transuranic (TRU) waste at the Hanford Site, and final disposition of the treated sludge at the Waste Isolation Pilot Plant or another suitable location (Williams 1999). This proposal was submitted to DOE, Richland Operations Office for approval, and has received concurrence (Loscoe 1999). The TWRS EIS included approximate inventories for select radionuclides (TWRS EIS, Appendix A). However, because of this change regarding final disposition of the K Basins sludge, this Supplement Analysis does not include the sludge inventory in the overall inventory to be processed.

Table 2.1. Comparison of TWRS EIS Inventory and Revised Inventory (2 Sheets)

Constituent Name	Units (Decayed to 12/31/99)	TWRS EIS Inventory (SSTs and DSTs)	BBI SST and DST data as of 10/05/99	Delta Increase (positive) or Decrease (negative) from the TWRS EIS Inventory	Scaling Factor from TWRS EIS to 10/05/99 BBI
Al	kg	2.10E+06	8.09E+06	5.99E+06	3.85E+00
Bi	kg	2.60E+05	6.31E+05	3.71E+05	2.43E+00
Ca	kg	1.50E+05	3.05E+05	1.55E+05	2.03E+00
Ce	kg	2.40E+05	N/R	N/R	N/R
Cl	kg	3.10E+05	9.34E+05	6.24E+05	3.01E+00
TIC as CO_3	kg	N/R	9.57E+06	N/R	N/R
Cr	kg	1.20E+05	6.46E+05	5.26E+05	5.38E+00
F	kg	1.20E+06	1.16E+06	-3.98E+04	9.67E-01
Fe	kg	7.80E+05	1.38E+06	5.96E+05	1.76E+00
Hg	kg	9.60E+02	1.66E+03	7.04E+02	1.73E+00
K	kg	5.70E+05	8.60E+05	2.90E+05	1.51E+00
La	kg	2.10E+04	5.04E+04	2.94E+04	2.40E+00
Mn	kg	1.50E+05	1.85E+05	3.46E+04	1.23E+00
Na	kg	6.90E+07	4.84E+07	-2.06E+07	7.02E-01
Ni	kg	1.90E+05	1.69E+05	-2.05E+04	8.92E-01
NO_2/NO_3 *	kg	1.20E+08	6.53E+07	-5.47E+07	5.44E-01
OH TOTAL	kg	7.80E+06	2.33E+07	1.55E+07	2.98E+00
Pb	kg	5.20E+03	8.02E+04	7.50E+04	1.54E+01
PO4	kg	5.00E+06	5.37E+06	3.72E+05	1.07E+00
Si	kg	5.30E+05	9.23E+05	3.93E+05	1.74E+00
SO4	kg	2.00E+06	3.27E+06	1.27E+06	1.63E+00
Sr	kg	3.60E+04	4.29E+04	6.92E+03	1.19E+00
TOC	kg	1.50E+06	1.62E+06	1.21E+05	1.08E+00
U	kg	1.40E+06	8.95E+05	-5.05E+05	6.39E-01
Zr	kg	5.20E+02	4.70E+05	4.70E+05	9.04E+02
Cd	kg	1.00E+04	N/R	N/R	N/R
Ag	kg	1.70E+03	N/R	N/R	N/R
Th	kg	N/R	N/R	N/R	N/R
W	kg	1.50E+04	N/R	N/R	N/R
Total mass	kg	2.10E+08	1.74E+08	-3.63E+07	8.27E-01

Table 2.1. Comparison of TWRS EIS Inventory and Revised Inventory (2 Sheets)

Constituent Name	Units (Decayed to 12/31/99)	TWRS EIS Inventory (SSTs and DSTs)	BBI SST and DST data as of 10/05/99	Delta Increase (positive) or Decrease (negative) from the TWRS EIS Inventory	Scaling Factor from TWRS EIS to 10/05/99 BBI
H-3	Ci	2.40E+03	2.38E+04	2.14E+04	9.92E+00
C-14	Ci	5.30E+03	3.57E+03	-1.73E+03	6.74E-01
Ni-59	Ci	5.00E+03	8.75E+02	-4.12E+03	1.75E-01
Co-60	Ci	N/R	2.23E+04	N/R	N/R
Ni-63	Ci	2.70E+05	8.63E+04	-1.84E+05	3.20E-01
Se-79	Ci	9.10E+02	6.95E+02	-2.15E+02	7.64E-01
Sr-90	Ci	5.40E+07	5.85E+07	4.53E+06	1.08E+00
Y-90	Ci	5.40E+07	5.85E+07	4.53E+06	1.08E+00
Nb-93m	Ci	3.20E+03	2.55E+03	-6.50E+02	7.97E-01
Zr-93	Ci	3.90E+03	3.49E+03	-4.14E+02	8.94E-01
Tc-99	Ci	3.20E+04	3.03E+04	-1.73E+03	9.46E-01
Ru-106	Ci	3.80E-02	1.27E+05	1.27E+05	3.34E+06
Cd-113m	Ci	N/R	1.68E+04	N/R	N/R
Sb-125	Ci	N/R	2.57E+05	N/R	N/R
Sn-126	Ci	6.30E+02	1.18E+03	5.53E+02	1.88E+00
I-129	Ci	3.80E+01	8.48E+01	4.68E+01	2.23E+00
Cs-134	Ci	N/R	8.71E+04	N/R	N/R
Ba-137m	Ci	3.30E+07	5.14E+07	1.84E+07	1.56E+00
Cs-137	Ci	3.50E+07	5.44E+07	1.94E+07	1.55E+00
Sm-151	Ci	6.30E+05	2.62E+06	1.99E+06	4.16E+00
Eu-152	Ci	N/R	1.48E+03	N/R	N/R
Eu-154	Ci	5.50E+04	1.94E+05	1.39E+05	3.52E+00
Eu-155	Ci	N/R	2.09E+05	N/R	N/R
Ra-226	Ci	2.70E-07	6.51E+02	6.51E+02	2.41E+09
Ac-227	Ci	2.20E-02	8.75E+01	8.75E+01	3.98E+03
Ra-228	Ci	7.40E-14	7.76E+01	7.76E+01	1.05E+15
Th-229	Ci	2.00E-05	1.81E+00	1.81E+00	9.04E+04
Pa-231	Ci	3.80E-02	1.56E+02	1.56E+02	4.10E+03
Th-232	Ci	6.40E-13	4.36E+00	4.36E+00	6.81E+12
U-232	Ci	N/R	1.20E+02	N/R	N/R
U-233	Ci	1.20E-02	4.61E+02	4.61E+02	3.84E+04
U-234	Ci	2.10E-01	3.35E+02	3.35E+02	1.59E+03
U-235	Ci	2.10E+01	1.38E+01	-7.16E+00	6.59E-01
U-236	Ci	2.90E-03	1.17E+01	1.17E+01	4.03E+03
Np-237	Ci	7.00E+01	1.71E+02	1.01E+02	2.44E+00
Pu-238	Ci	1.10E+03	2.68E+03	1.58E+03	2.44E+00
U-238	Ci	4.80E+02	2.99E+02	-1.81E+02	6.22E-01
Pu-239	Ci	2.60E+04	5.74E+04	3.14E+04	2.21E+00
Pu-240	Ci	6.70E+03	1.14E+04	4.70E+03	1.70E+00
Am-241	Ci	1.00E+05	1.09E+05	8.53E+03	1.09E+00
Pu-241	Ci	7.50E+04	1.64E+05	8.88E+04	2.18E+00
Cm-242	Ci	5.70E+01	1.75E+02	1.18E+02	3.07E+00
Pu-242	Ci	4.30E-04	1.08E+00	1.08E+00	2.50E+03
Am-243	Ci	3.30E+01	1.78E+01	-1.52E+01	5.40E-01
Cm-243	Ci	N/R	2.82E+01	N/R	N/R
Cm-244	Ci	1.20E+02	6.61E+02	5.41E+02	5.50E+00
Radionuclide Total	Ci	1.80E+08	2.27E+08	4.69E+07	1.26E+00

*NO_2/NO_3 combined equals NO_2 inventory plus NO_3 inventory.

N/R = not reported.

BBI = best basis inventory.

DST = double-shell tank.

SST = single-shell tank.

2.2.1.3 Other Waste. In the mid-1980s cesium and strontium were vitrified in the 300 Area. This vitrified material has been moved from the 324 Building in the 300 Area to the 200 Area where it is being stored on a storage pad. The material is classified as special-case waste. No decision has been made regarding the disposition of this waste, and it is therefore not addressed in this Supplement Analysis.

Recent analyses of samples from the T Plant Complex 221-T tank system have indicated that sludge contained in that system contains polychlorinated biphenyls (PCBs) at levels above the *Toxic Substances Control Act* (TSCA) limits. This discovery was documented in "Notification of Preexisting Condition" (Plush 1999). Analyses of samples from tanks 5-7, 6-1, and 15-1 were conducted in preparation for transfer of tank waste to the DST system in compliance with the waste acceptance criteria. The three sludge samples analyzed had PCB levels up to 702 parts per million and exceeded the TSCA limit of 50 parts per million. Reviews of waste transfers and activities at T Plant indicated that the PCBs were likely introduced into the 221-T tank system prior to October 1, 1996, and that the storage of the PCBs should be considered a preexisting condition. Transfer records since October 1, 1996 indicate that transfers of waste from the 221-T tank system to the 204-AR vault have occurred, although no information is available to determine to where the waste was transferred from the 204-AR vault. The environmental impacts in Section 3.0 do not address PCBs because it has not yet been determined that this PCB waste was introduced into the tank waste inventory or at what concentrations it may have been introduced. Uncertainties related to this issue are discussed in Section 4.1.

2.2.2 Engineering

2.2.2.1 Tank Waste Management. In the Phased Implementation alternative, the TWRS EIS included an evaluation of the operations necessary to maintain the tanks and associated facilities until they are no longer required for waste management. The operations that were considered components of routine tank farm operations are identified in Section 1.2 of this Supplement Analysis.

In the TWRS EIS it was assumed that as a part of current tank farm operations interim stabilization would be completed in accordance with the Tri-Party Agreement schedule. As of April 30, 2000, DOE completed interim stabilization by salt well pumping of 123 SSTs, including 65 of the 67 tanks that are assumed to have leaked (HNF-EP-0182-145). The remaining two SSTs will be pumped in FY 2000 (HNF-2358). Salt well pumping also has begun in 6 of the remaining 26 non-leaking SSTs to be stabilized. The consent decree date for completion of SST interim stabilization by salt well pumping is September 2004 (Ecology et al. 1999a).

2.2.2.2 Description of Facilities. RPP Phase I facilities will be located in the 200 East Area. Most of the operations will be contained in the process buildings, which are divided into three major areas for pretreating and vitrifying LAW and HLW. Figure 2.1 shows a layout of the proposed Phase I facilities. More detailed descriptions of the activities are provided in the following sections. When available, information regarding Phase II has been included. However, detailed planning for Phase II has not been completed to date.

Figure 2.1. Office of River Protection Phase I Facility Layout

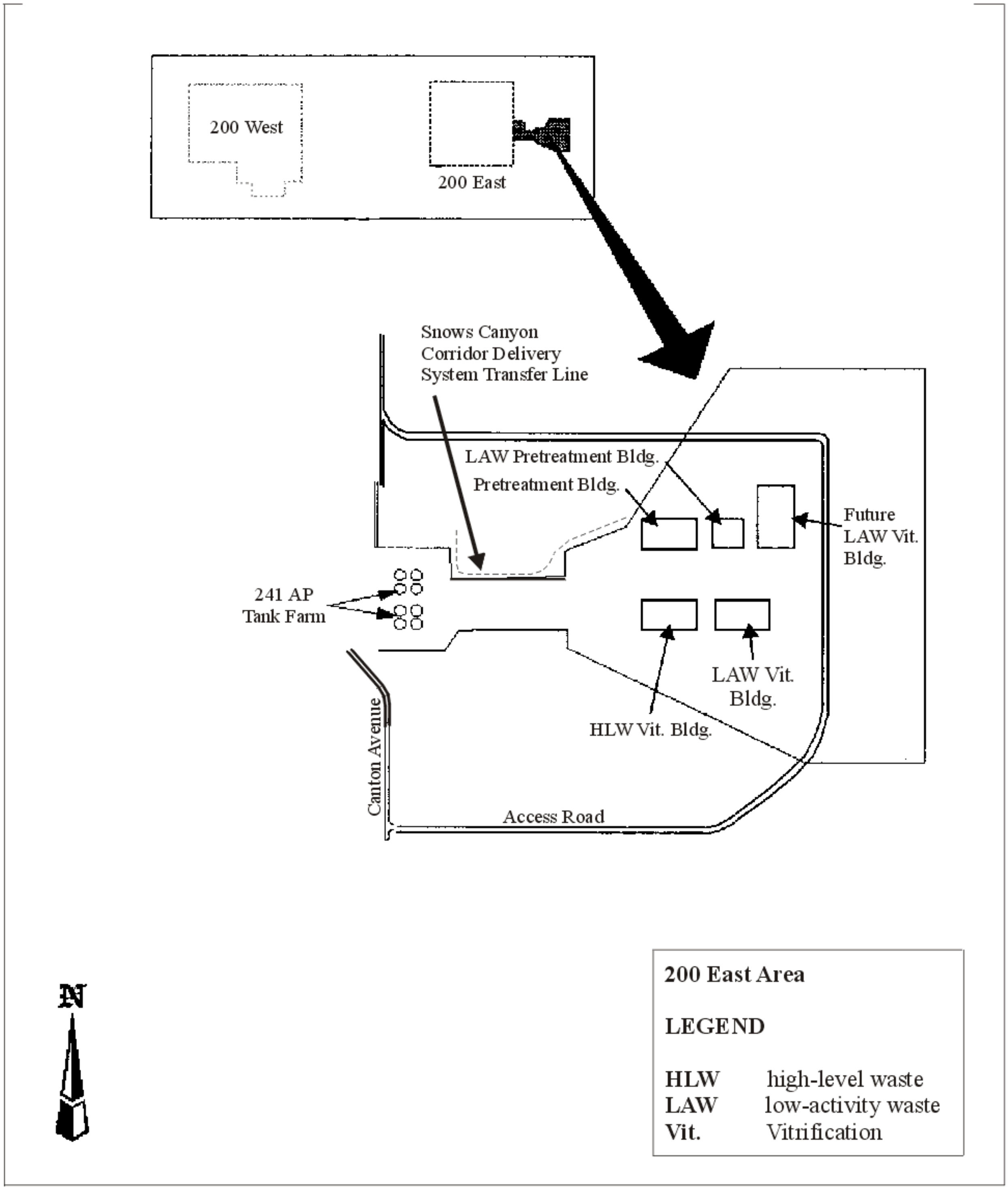

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Table 2.2 shows a comparison of the LAW and HLW vitrification plant capacities that were assumed in the TWRS EIS to those used in this Supplement Analysis. Plant capacities for Phase I and Phase II are listed separately. It should be noted that these capacities refer to design capacity, not operating capacity. As shown in Table 2.2, the Phase II vitrification plant capacities used in this Supplement Analysis are significantly larger than those assumed in the TWRS EIS. The TWRS ROD and Tri-Party Agreement milestones specify that all SSTs will be retrieved by FY 2018 with all immobilization being completed by FY 2028. There are 149 SSTs to be retrieved and back-filled into 28 DSTs as the DSTs are retrieved and vitrified. Prior to vitrification, SSTs would be staged in the DST system. Notwithstanding other technical issues concerning the availability of suitable retrieval technologies for SSTs, the most significant limitation on the feasibility of completing SST retrieval by FY 2018 is the lack of adequate DST storage to accommodate interim storage of SST waste prior to vitrification. DST storage shortfall is mitigated by vitrifying DST waste, thus providing capacity for SST backfill as new DST volume is made available.

Table 2.2. Vitrification Plant Design Capacity

Facility Type	TWRS EIS	Current Planning Baseline
Phase I LAW Vitrification	2 facilities at 20 MT/day each (40 MT/day total)	1 facility at 30 MT/day[a]
Phase I HLW Vitrification	1 facility at 1 MT/day	1 facility at 1.5 MT/day[a]
Phase II LAW Vitrification	2 facilities at 100 MT/day each (200 MT/day total)	2 facilities at 150 MT/day each (300 MT/day total)[b]
Phase II HLW Vitrification	1 facility at 10 MT/day	1 facility at 30 MT/day[b]

[a] HNF-4612.
[b] The plant design capacity data was obtained from HNF-SD-WM-SP-012, Rev. 1. The number of facilities was obtained from Erickson (1999).

HLW = high-level waste.
LAW = low-activity waste.
MT = metric tons.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

A staff issue report submitted by the Defense Nuclear Facilities Safety Board (Jones 2000) discusses the need for the construction of new DSTs. The 28 DSTs constructed between 1967 and 1986, along with their network of piping systems, are expected to exceed their original design lives (50 years) before the waste can be removed. Current schedules for removing the waste from the DSTs rely on the integrity of the tanks through the year 2028. Also, if the DSTs are used during retrieval and stabilization of the waste in the SSTs, additional DST storage space will be needed. A systematic approach is being developed to support an April 2005 recommendation on the need to construct new DSTs at the Hanford Site. The recommendation is expected to provide ample time for the construction of new tanks to support the retrieval of all HLW from the DSTs by 2028. However, Jones (2000) states that under the current waste disposal plan roughly 60 to 100 new 1 million gallon DSTs would be required to meet the existing Tri-Party Agreement milestone of retrieving all the HLW from the SSTs by 2018. The construction of this many DSTs is not feasible and therefore it is unlikely that the 2018 SST retrieval milestone will be met (Jones 2000). A decision to build new tanks is not bound by the TWRS EIS. If a decision is made to construct additional tanks further NEPA analyses would be required.

In the FY 2000 multi-year work plan (MYWP), Phase I and II overlap by bringing a 130 MT Phase II vitrification plant online in FY 2012. By providing Phase II capacity in 2012, it would be possible to accomplish SST retrieval by FY 2018. However, the BNFL contract for Phase I does not contemplate Phase II expansion until FY 2018. Based on contractual waste volume treatment projections, the BNFL Contract would only provide sufficient capacity in DSTs to accommodate approximately 20 SST retrievals through FY 2018 although the FY 2000 MYWP, Tri-Party Agreement, and TWRS ROD all project 149 SST retrievals by FY 2018. In fact, current RPP pre-concept project planning for SST retrieval is currently baselined at only 20 SST retrievals through FY 2018, notwithstanding the FY 2000 MYWP. Actual commitment of resources to Phase II retrieval (a commitment to a 20 tank retrieval by FY 2018) would actually begin in FY 2003. Because this commitment is a deviation from the existing TWRS ROD decision on SST tank retrieval (149 tank retrieval by FY 2018), it appears appropriate to address the NEPA ramifications for Phase II in the FY 2001 timeframe. Consequently, the determination found in Section 5.0 of this document commits to additional NEPA analysis for Phase II baseline planning.

As a result of not bringing the 130 MT Phase II vitrification plant online in FY 2012 (a ramification of actual waste treatment commitments ORP has made in the BNFL design/construct contract), combined with delays in SST retrieval limited by DST backfill capacity (again based on actual vitrification commitments specified in the BNFL contract), the size of the Phase II vitrification plant escalates to 300 MT in FY 2012 to achieve vitrification of sufficient DST waste and provide sufficient capacity to complete SST retrieval by FY 2018.

This NEPA review has two functions:

- Assess whether Phase I as committed in the BNFL contract and ORP infrastructure projects which support the Phase I vitrification facilities remains bounded within the framework of the existing NEPA documentation based on best available knowledge of the current vitrification plant design and commitments, infrastructure support projects, and other factors used to bound the TWRS EIS.

- Evaluate whether Phase II of the vitrification remains bounded based on current understanding of the vitrification plant specifications and DOE commitment of resources to implement the Phase II TWRS ROD decision.

Specifically, the issues discussed above relating to technical feasibility are almost exclusively limited to the Phase II viability.

2.2.2.3 Phase I and Phase II Schedule. The TWRS EIS Phased Implementation alternative maintained compliance with the Tri-Party Agreement with respect to project milestones. This current planning also complies with the Tri-Party Agreement milestones, although the hot start dates for pretreatment, HLW vitrification, and LAW vitrification have been delayed until October 2007, September 2008, and January 2008, respectively (CCN: 012779). Table 2.3

compares the major project milestones for the Phased Implementation alternative in the TWRS EIS to those contained in current planning documents for Phase I and II.

Table 2.3. Major Project Milestones

Milestone	TWRS EIS	Current Planning Baseline
Pretreatment facility construction	1998-2002 (Phase I); 2006-2012 (Phase II)	February 2002 – February 2006[a]
HLW vitrification facility construction		February 2002 – August 2006[a]
LAW vitrification facility construction		February 2002 – December 2005[a]
Start pretreatment hot start (Phase I Part B)	NA	October 2007[a]
Start HLW vitrification hot start (Phase I Part B)	2002	September 2008[a]
Start LAW vitrification hot start (Phase I Part B)	2002	January 2008[a]
Start Phase II Part B HLW processing	2012	October 2011[b]
Start Phase II Part B LAW processing	2011	October 2011[b]
Complete Phase I Part B HLW processing	2008	July 2018[a]
Complete Phase I Part B LAW processing	2012	October 2018[a]
Complete SST retrieval	2018	August 2018[c]
Complete DST retrieval	2028	October 2021[c]
Complete Phase II Part B HLW processing	2028	September 2028[d]
Complete Phase II Part B LAW processing	2024	December 2024[d]
Complete SST farm closure	2040	September 2024[d]
Complete DST farm closure	2040	September 2034[e]

[a] CCN: 012779.
[b] HNF-SD-WM-SP-012, Rev. 1.
[c] Jacobs (2000).
[d] Ecology et al. (1989).
[e] RPP-5044.

DST = double-shell tank.
HLW = high-level waste.
LAW = low-activity waste.
NA = not available.
SST = single-shell tank.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

2.2.2.4 Waste Retrieval

2.2.2.4.1 TWRS EIS. Waste retrieval technologies for SSTs evaluated in detail in the TWRS EIS (Volume One, Section 3.4.6) included hydraulic sluicing and robotic arm-based retrieval systems. Hydraulic sluicing would use pressurized water and recycled tank liquid sprayed from a nozzle to dissolve, dislodge, and suspend the waste into a slurry, which would be pumped from the tank. Hydraulic sluicing was identified as the baseline retrieval technology and robotic arm-based systems would be used for cases where hydraulic sluicing could not achieve the required recovery, where sluicing would not be deployed because of pre-existing breaches in the particular SST, or where sluicing was to be discontinued because of emergent tank leakage during retrieval operations. Robotic arm-based systems could use a number of end effectors for waste removal. Engineering data developed for the TWRS EIS were based on sluicing 110 SSTs and deploying robotic arm-based retrieval in 50 SSTs (11 SSTs were assumed to require both types of retrieval). A total of 24 sluicing systems and 12 arm-based systems with confinement structures were included in the impact analysis.

Waste retrieval technologies for DSTs evaluated in detail in the TWRS EIS (Volume One, Section 3.4.6) included slurry pumping using mixer pumps to break up and suspend solids into a slurry. This retrieval technique would be supplemented by hydraulic sluicing or robotic arm-based methods if required. A minimum of two and up to four mixer pumps were assumed to be used in the retrieval of waste from each DST. These mixer pumps were assumed to be permanently installed in each of the DSTs and were not moved from tank to tank.

Waste retrieval systems evaluated in the TWRS EIS (Volume One, Section 3.4.6) were assumed to be supported by four waste transfer annexes and a waste staging and sampling facility (five support facilities total). Each system would circulate sluicing liquid to the tanks as well as receive and accumulate slurry for batch transfer to the waste vitrification facilities. The waste staging and sampling facility would accumulate waste in the 200 West Area for cross-site transfer to the 200 East Area.

In the TWRS EIS (Volume One, Section 3.4.10.7) one of the major areas of technology uncertainty related to meeting the interim Tri-Party Agreement goal of not more than 10 m^3 (360 ft^3) of residual waste remaining in each tank. As indicated in the TWRS EIS, this uncertainty was compounded by potential environmental impacts associated with waste retrieval from SSTs that are known or suspected to be leakers or that develop leaks during retrieval operations. To address these uncertainties the TWRS EIS adopted a number of assumptions that served to bound the potential human health and environmental impacts associated with waste retrieval. The following were among the assumptions.

- To bound short-term impacts associated with worker and public exposure to contaminants during routine retrieval operations and worker and public exposure during waste retrieval accidents, it was assumed that all tank waste inventory would be retrieved from all 177 tanks.

- To bound long-term impacts the following was assumed.

  – Hydraulic sluicing was selected as the baseline SST retrieval technology to provide conservative estimates of potential leak losses during retrieval operations.

  – All 149 SSTs were assumed to develop leaks during retrieval and, on average, 15,000 L (4,000 gal) of liquids were assumed released to the soil from each tank. This leakage volume was based on best available information for leakage volume at the time the TWRS EIS was prepared. The volume selected was intended to be a reasonably conservative value that would be applied to every SST. Additional discussion on the uncertainty associated with retrieval leakage volumes is provided in

Section 4.2. Additionally, the concentration of contaminants in the leakage was assumed to be at or near saturation and not diluted by water additions during retrieval.

- Several technologies were identified that could be used if hydraulic sluicing were not able to remove sufficient waste to meet removal requirements or could not be deployed due to past tank leaks or leaks occurring during retrieval actions. Among the technologies were a robotic arm using sluicing liquids, alternate liquids including alkali and acid solutions instead of water, mechanical retrieval, robotic crawler, and pneumatic retrieval. From among these technologies, DOE selected hydraulic sluicing and robotic arm-based retrieval for detailed analysis. However, as indicated in the TWRS EIS, the other retrieval technologies could "be used to retrieve tank waste during any of the ex situ alternatives."

- Hydraulic sluicing was assumed for purposes of analysis to be used on 110 of the 149 SSTs, robotic arm-based retrieval used in 50 SSTs, and both types of retrieval used in 11 SSTs.

The analysis presented in the TWRS EIS addressed retrieval technologies other than hydraulic sluicing for use in the tanks. The TWRS EIS addressed the Hanford Tanks Initiative as a project designed to "reduce the uncertainties associated with waste retrieval by developing and demonstrating the technologies required to meet retrieval requirements" and that among the demonstrations would be deployment of technology to retrieve tank residuals from tank C-106 and development of technologies and criteria to retrieve waste from known or assumed leaking SSTs.

2.2.2.4.2 New Information. The *Tank Waste Remediation System Operation and Utilization Plan* (HNF-SD-WM-SP-012, Rev. 0) assumes that three waste retrieval facilities are required to support the waste retrieval and transfer function. This would reduce the number of support facilities required for waste retrieval and transfer from five to three, eliminating the Waste Staging and Sampling Facility in the 200 West Area and one of the waste transfer annexes in the 200 East Area. The HNF-SD-WM-SP-012, Rev. 0 assumes routing the waste retrieved in the 200 West Area through the SY tank farm and retrieving waste from the A, AX, and C tank farms in 200 East Area directly into DST AY-102. Details on how the waste retrieval facilities might change based on reducing the number of facilities from five to three are not currently available to support a quantitative comparison. However, it is believed that reducing the number of retrieval support facilities from five to three would be expected to result in reduced resource and construction requirements. There are no new definitive data on waste retrieval that would indicate that the current basis for waste retrieval is appreciably different from the basis used in the TWRS EIS.

The FY 2000 MYWP is based on waste retrieval by two organizations (Erickson 1999). The Site contractor retrieval project would retrieve waste from the SSTs and DSTs to support Phase I waste processing. The tanks to be retrieved during Phase II would be retrieved by a private contractor. This retrieval implementation strategy would not be expected to result in changes to environmental parameters.

In October 1998 retrieval of tank C-106 by hydraulic sluicing was initiated. The purpose of this retrieval effort was to remove sludge so that the tank's high heat load would be reduced to the point where cooling water additions were no longer necessary to maintain the tank in a safe mode. During sluicing of this waste it was discovered that the hard pan layer of tank C-106, for which sluicing was not believed to be an adequate technology, was not as thick as previously thought. Sluicing was continued until approximately 95% of the waste in tank C-106 had been removed. This activity was the first retrieval effort since the 1970s and confirmed that sluicing could still be used to retrieve sludge waste from the underground storage tanks.

Retrieval demonstrations were planned following completion of tank C-106 hydraulic sluicing. However, in FY 1999 ORP cancelled near-term planning for deployment of demonstration technologies in tank C-106. *Single-Shell Tank Program Plan* (HNF-5095) includes plans for technologies to be adapted and used to demonstrate retrieval of residuals from tank C-106 or other SSTs that will be needed for Phase I waste feed delivery. Recent program changes include the evaluation of alternate retrieval technologies (e.g., crawler based system) for retrieving waste from tank C-104 and the evaluation of tank C-106 for interim closure utilizing the residual waste volume remaining in the tanks.

New information also identifies a change in the waste feed delivery system transfer line from the southern route to the northern route (Snows Canyon corridor). The Snows Canyon corridor is the preferred route and would be a more direct line to the Phase I pretreatment facilities. Because it is a more direct route it would require less resources and disturb less land than the southern transfer feed line corridor and therefore would have no additional impacts on the TWRS EIS.

2.2.2.5 Pretreatment

2.2.2.5.1 TWRS EIS. The pretreatment, or separations, processes will separate the retrieved waste into HLW and LAW fractions prior to vitrification. Separations processes (e.g., sludge washing and ion exchange) are used to minimize the volume of vitrified HLW and remove specific constituents from the waste stream designated for LAW vitrification. The level of separation has an affect on short- and long-term risks. The number and type of separations processes control the final inventory and volume of the HLW and LAW vitrified waste forms and impact the construction and operation of the waste vitrification facility.

The TWRS EIS Phased Implementation alternative included processes for separating the following constituents from waste prior to vitrification as LAW:

- Entrained solids
- Cesium
- Strontium
- Technetium
- TRU.

The pretreatment of waste designated for HLW vitrification included sludge washing and solid/liquid separations.

2.2.2.5.2 New Information. No significant changes to the pretreatment or separation processes to be used prior to vitrification have been made since issuance of the TWRS EIS. After the waste is received at the Phase I waste vitrification facilities it will be analyzed for selected parameters before pretreatment. Pretreatment of the LAW feed will include processes for reducing the volume of waste fed to the LAW vitrification system (via evaporation), and for removing strontium, TRU compounds, entrained solids, cesium, and technetium from the feed (these separations processes were evaluated in the TWRS EIS). These removed constituents either will be incorporated into the HLW melter feed or transferred to an appropriate vitrification, storage, or disposal facility. Pretreatment of the HLW feed includes processes to concentrate the HLW feed and add constituents that are removed from the LAW feed. The structures of the pretreatment facilities will be supported by a reinforced concrete foundation. The superstructure will be made of structural steelwork with a metal roof. Typically, the process cells will be constructed of reinforced concrete to protect facility operations from radiation. The cell floors and a portion of the cell walls will be lined with stainless steel to provide secondary containment for the process tanks (BNFL-5193-RCRA-01).

One modification to the design of the vitrification facilities that was evaluated in the TWRS EIS consists of the use of waste storage tanks within the facilities instead of DSTs for feed staging. Current plans cited in *RPP-WTP Dangerous Waste Permit Application* (BNFL-5193-RCRA-01) are to construct six staging tanks within a vault inside the pretreatment facility rather than using DST capacity as lag storage for the feed waste. Consequences of this design change with respect to accident scenarios are discussed in Section 3.13.

No new information is available for Phase II, although it is assumed that the pretreatment and vitrification processes used would be similar to those planned for Phase I.

The ORP maintains an RPP process flowsheet to develop retrieval sequencing and provide vitrified waste volume projections that incorporate the latest inventory and enhanced sludge washing data. HNF-SD-WM-SP-012, Rev. 2 discusses the sludge washing and leach factors used in the Hanford Tank Waste Operations Simulator model. Sludge washing comprises washing the solids with water and using caustic to wash (leach) the solids. The ability of the sludge washing process to remove glass volume-controlling constituents has been the subject of ongoing studies because glass volumes directly relate to disposal costs. The total vitrified HLW glass volume can be managed at a reasonable level because the blending that occurs as waste is retrieved and transferred through the tank farms makes sludge batches more uniform, and sludge washing removes from sludges sufficient amounts of glass volume-controlling constituents.

An effort was made to accumulate sludge wash and leach factors for all revised inventory analytes in all tanks using data sources available as of July 1998. This accumulated information provides:

- Tank-specific wash and leach factors utilizing chemical analysis data for water washes and caustic leaches from SSTs
- Historical analytical results
- Characterization sampling and analysis results

- Experimental data
- Chemical simulations
- Tank waste groupings.

The updated wash factors were implemented in the Hanford Tank Waste Operations Simulator to simulate the tank contents as they are retrieved or mobilized.

2.2.2.6 Vitrification

2.2.2.6.1 TWRS EIS. Vitrification was the baseline immobilization technology in the TWRS EIS for LAW and HLW. The LAW vitrification process was based on a uniform blend of tank waste with the LAW glass limited to a 15 wt% sodium oxide loading. It was also assumed that the molten LAW glass would be quenched in a water bath producing a cullet. Glass cullet was the assumed vitrified LAW form used in the TWRS EIS because it provided conservative values for waste volume and release rates. The void spaces between the individual pieces of glass cullet result in approximately 30% more waste volume for packaging and disposal than for glass monoliths. The waste loading value and waste form assumptions were selected to provide conservative volume projections for vitrified HLW and vitrified LAW. The HLW vitrification process was based on a borosilicate glass at a 20 wt% waste oxides (excluding sodium and silica [31 wt% including sodium and silica]), and a 1.2 blending factor was applied to the total volume of HLW to accommodate inefficiencies in waste blending.

2.2.2.6.2 New Information. After the LAW and HLW waste feed streams are pretreated, two systems will be used in the vitrification facilities. One system will immobilize the pretreated LAW feed, and the other system will vitrify the pretreated HLW feed. The vitrified LAW and vitrified HLW produced will be in the form of glass sealed in steel containers. The structures of the vitrification facilities will be supported by a reinforced concrete foundation. The superstructure will be made of structural steelwork with a metal roof. In addition, the superstructure for the LAW vitrification facility also will include reinforced concrete. The floor and a portion of the walls in the process rooms, which house process tanks and the melter pour caves, will be lined with stainless steel to provide secondary containment (BNFL-5193-RCRA-01).

No information is available regarding Phase II vitrification activities. However, it is assumed that the Phase II processes will be similar to those used for Phase I.

The *Environmental Report Letter Revision* (CCN: 012779) includes the most recent data for criteria pollutant and radiological emission rates from Phase I operations of LAW/HLW vitrification facilities. It does not include data for criteria pollutant emission concentrations and radiological doses at the Federal and State receptor locations nor does it include emission data from construction. *Tank Waste Remediation System Privatization Project Environmental Report* (BNFL-5193-ER-01) contains an evaluation of criteria pollutant emission rates and concentrations from Phase I construction and operations.

The HNF-SD-WM-SP-012, Rev. 2 technical basis includes vitrification of both the LAW and HLW streams. The sodium oxide loading in the vitrified LAW is 20 wt% (an increase from 15 wt%, and the vitrified LAW glass form will be monolithic. Although the shape of the vitrified LAW glass form has changed since preparation of the TWRS EIS, the chemical composition of the glass has not been altered from the composition discussed in the TWRS EIS and in DOE/RL-97-69. The revised inventory of sodium is also approximately 30% smaller than the inventory used in the TWRS EIS. The increased loading and smaller inventory would result in a smaller vitrified LAW stream that could be expected to reduce the requirements for LAW vitrification during Phase II. The decrease in vitrified LAW glass would subsequently translate into a reduction in Phase II LAW vitrification operations duration or into construction of a smaller plant.

The Hanford Tank Waste Operations Simulator computer model, as described in HNF-SD-WM-SP-012, Rev. 2, uses tank retrieval sequences coupled with tank-by-tank inventories to allow direct prediction of vitrified HLW volumes without the use of blending factors. The Hanford Tank Waste Operations Simulator model provides a more sophisticated tool for estimating total vitrified HLW volume by using glass formulation ranges and reduces uncertainties in assessing disposal requirements. Changes in inventory result in a projected increase of vitrified HLW, which translates into a slightly larger Phase II HLW vitrification facility. Alternately, operation of the Phase I HLW vitrification facilities could be extended. This change would result in higher operating resource requirements for HLW vitrification. The nominal fill volume of the HLW canisters in the TWRS EIS is 1.17 m^3 (41.3 ft^3) and in HNF-SD-WM-SP-012, Rev. 2 is 1.15 m^3 (40.6 ft^3).

Table 2.4 compares the vitrified waste forms, volumes, and constraints between the TWRS EIS and HNF-SD-WM-SP-012, Rev. 0.

Table 2.4. Comparison of Vitrified Waste Forms and Volumes

Component	TWRS EIS Phased Implementation alternative		HNF-SD-WM-SP-012, Rev 2[a]	
	LAW	HLW	LAW	HLW
Waste form[b]	Vitrified, cullet	Vitrified, monolith	Vitrified, monolith	Vitrified, monolith
Waste loading	15 wt% sodium oxide	30 wt% waste oxides[c]	20 wt% sodium oxide	37 wt% waste oxides[d]
Volume, m^3	350,000	14,000	141,000	14,500
Number of containers	140,000[e]	12,200[f]	64,100[g]	12,600[h]

[a] Includes both Phase I and Phase II.
[b] Monolith refers to a waste form resulting from a single pour of molten glass into a canister or container. Cullet refers to the small pieces of glass formed when molten glass is quenched in a water bath and the individual pieces of glass are placed into the disposal container. Assuming cullet as the vitrified LAW is more conservative from the standpoint of calculating environmental impacts.
[c] Equal to 20 wt % waste oxides less sodium and silica.
[d] Based on the glass properties model. The contract specification for Phase I requires at least 25 wt% waste oxides (excluding sodium and silica).
[e] LAW containers = 2.6 m^3 containers.
[f] HLW containers = 1.2 m^3 (4.6 m long) containers.
[g] LAW containers = 2.23 m^3 containers.
[h] HLW containers = 1.15m^3 (4.5 m long) containers.

HLW = high-level waste.
LAW = low-activity waste.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

2.2.2.7 Vitrified Low-Activity Waste Retrievable Disposal

2.2.2.7.1 TWRS EIS. The conceptual design for vitrified LAW retrievable disposal in the TWRS EIS describes use of steel containers (2.6 m^3 [92 ft^3]) placed inside of a 5,300 m^3 (187,167 ft^3) below-grade, engineered disposal vault. In this design, a total of 66 vaults were required for retrievable disposal of all the vitrified LAW. The vitrified LAW vaults were assumed to be constructed of reinforced concrete. It was assumed that during Phase I the existing grout vaults would be modified to accommodate interim vitrified LAW storage.

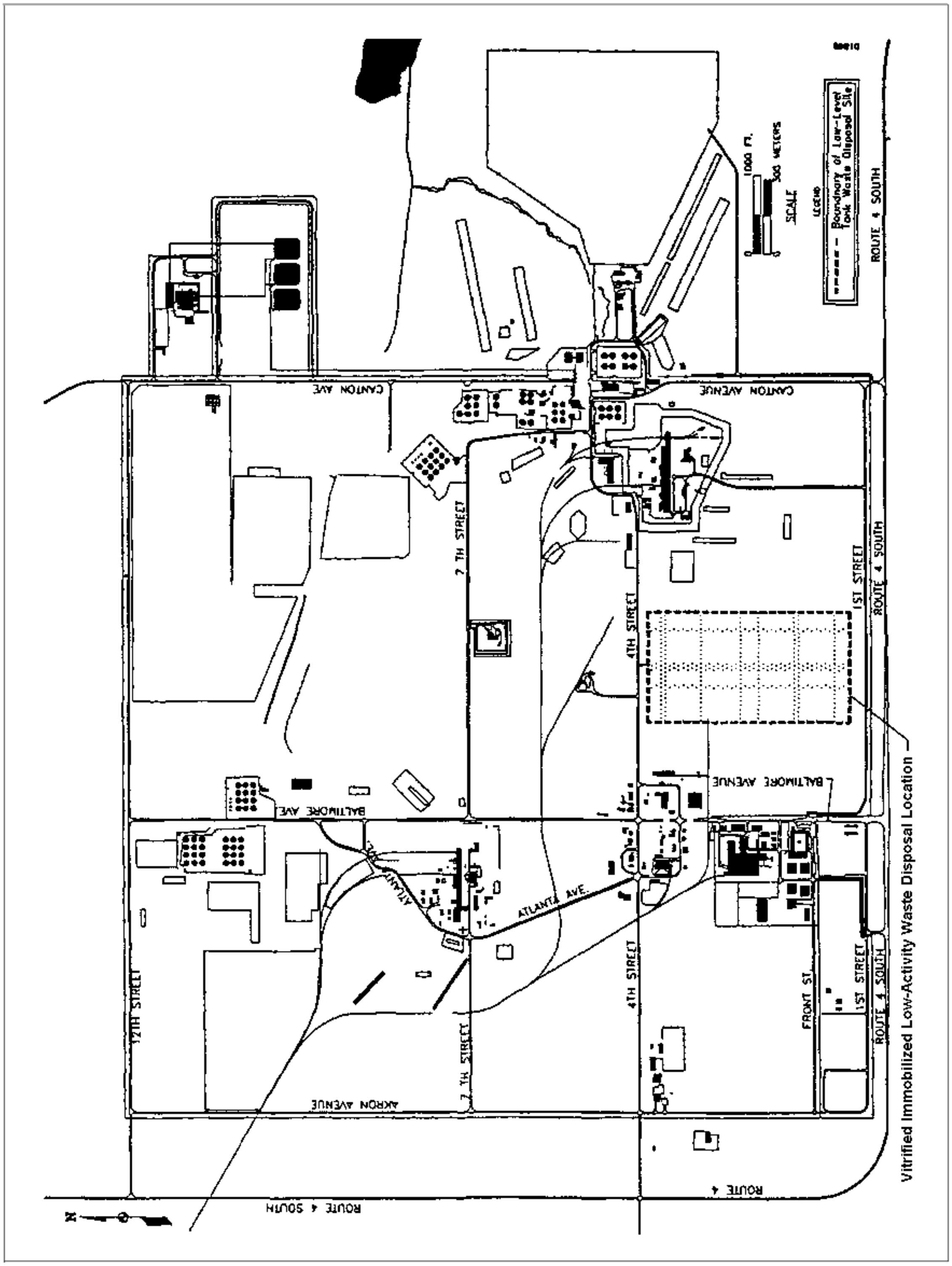
2.2.2.7.2. New Information. In December 1999 a new baseline was approved for the disposal of vitrified LAW on the Hanford Site in "Decision to Change Immobilized Low-Activity Waste (ILAW) Disposal Baseline to Proceed with the Remote-Handled Trench Alternative" (Taylor 1999). Instead of using the grout vaults, the current baseline will use a remote-handled trench concept for vitrified LAW disposal. The remote-handled trench is a RCRA-compliant landfill (i.e., double-lined trench with leachate collection system). Many operational aspects and ancillary activities of the landfill (e.g., leachate collection and disposition, storm water control, installation of surface barrier at closure) would be similar to that incorporated into the radioactive mixed-waste burial trench, which was designed and constructed under the Solid Waste Program. However, operational activities related to vitrified LAW package receipt and emplacement in the trench would be modified to accommodate the increased frequency at which vitrified LAW packages must be received and emplaced and to accommodate the potentially higher radiation dose rate from remote-handled vitrified LAW. Based on the data in "Breakthrough Initiative—Immobilized Low-Activity Waste Disposal Alternative" (Shah 1999) the trench location is the same as that planned for Project W-520 vitrified LAW vaults (southwest of Plutonium Uranium Extraction Plant between 1st and 4th streets and between Canton Avenue and Baltimore Avenue) as shown in Figure 2.2 and the surface area required for the trenches is approximately the same as for the vaults, so no increase in land disturbance would be seen. The trench site layout is depicted in Figure 2.3. The remote-handled trench internal dimensions are 260 m (853 ft) long by 80 m (262 ft) wide by 10 m (33 ft) deep. The trench sides have a 3:1 slope. Trench construction requires excavation of 190,000 m^3 (6,707,000 ft^3). The trench liner surface area is about 29,000 m^2 (311,750 ft^2). The trench is provided with a primary and secondary liner as depicted in Figure 2.4. Beneath both the primary and secondary liner is an admix layer (bentonite clay/soil mixture) 0.5 m (1.6 ft) and 1 m (3 ft) thick, respectively. Permanent disposal vaults were evaluated in DOE/EIS-0189-SA2 and were shown to have no appreciable changes in impacts to short-term or long-term health effects. The surface barrier for the proposed concept would be a modified RCRA Subtitle C barrier, as opposed to the currently proposed Hanford barrier.

2.2.2.8 Interim Storage of Vitrified High-Level Waste

2.2.2.8.1 TWRS EIS. The interim storage of vitrified HLW canisters evaluated in the TWRS EIS was based on placing the canisters in a large multi-purpose canister for interim onsite storage and transport to a geologic repository. The interim storage concept included placing the multi-purpose canisters on a reinforced concrete pad and placing a concrete shielding cover over each canister to reduce exposures. Adequate interim onsite storage was included to allow for storage of all the projected vitrified HLW in the event there were delays in opening the geologic repository. Phase I also included modification of the 200 East Area Canister Storage Building for interim storage of vitrified HLW produced during Phase I.

2.2.2.8.2 New Information. The ORP baseline planning assumption for interim storage of vitrified HLW canisters is for placement of canisters in a building or buildings similar in concept to the spent nuclear fuel Canister Storage Building. Interim storage of all Phase I and Phase II vitrified HLW would require approximately 11 times the storage capacity of the entire spent nuclear fuel Canister Storage Building. Larger interim storage facilities are being considered, which would reduce the number of additional facilities required. Engineering data are not currently available to support a detailed comparison of resource data between the vitrified HLW interim storage concept used in the TWRS EIS and the current planning basis. In general it would be expected that interim storage of vitrified HLW in canister storage buildings would involve higher construction requirements and lower land use requirements compared to interim storage of vitrified HLW on concrete pads.

Figure 2.2. Location of New Vitrified Immobilized Low-Activity Waste Disposal Facility



Docprod\SA3\figures\fig2.2.cdr

Figure 2.3. Remote-Handled Trench Site

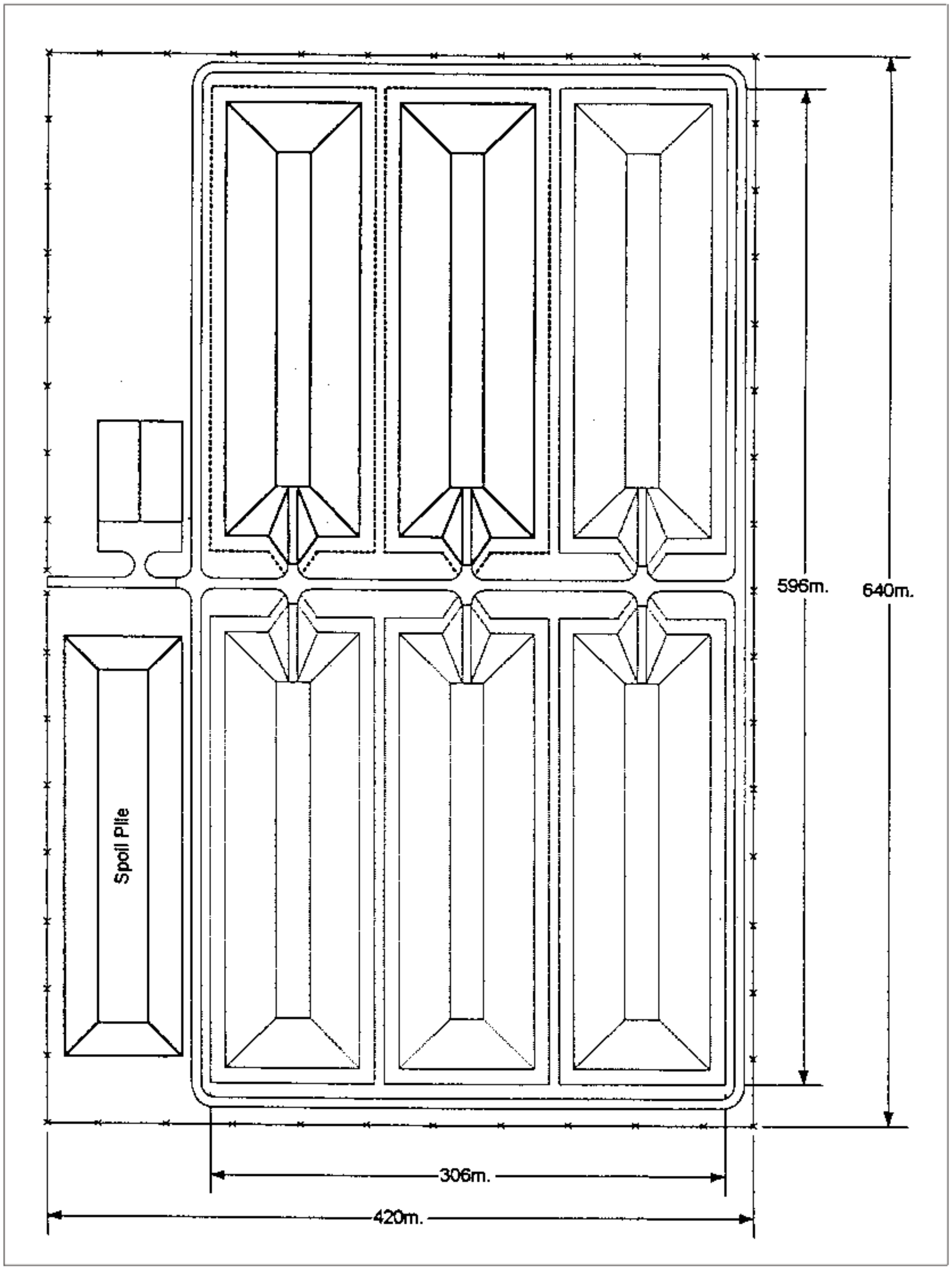


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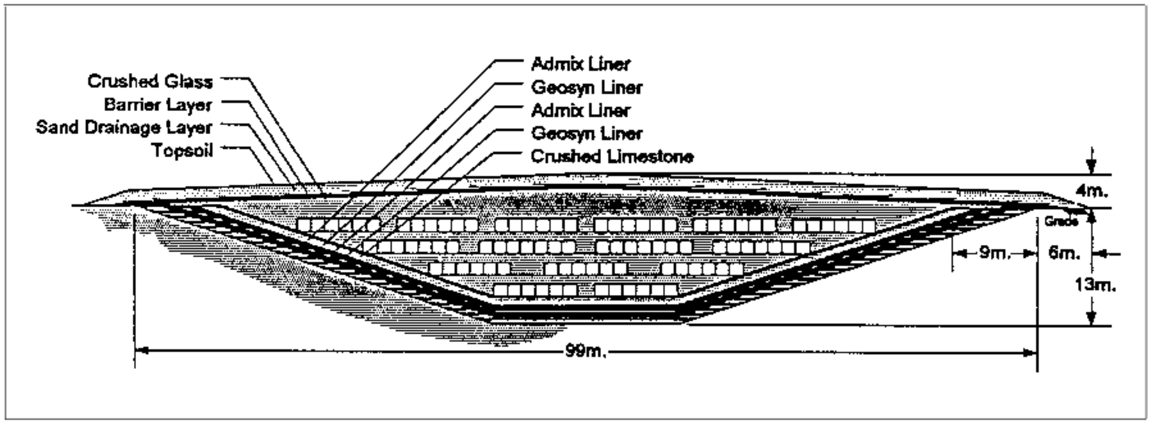
Figure 2.4. Schematic for Remote-Handled Vitrified Immobilized Low-Activity Waste Disposal Trench



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2.2.2.9 Vitrified High-Level Waste Disposal

2.2.2.9.1 TWRS EIS. For purposes of analysis, the TWRS EIS assumed a geologic repository candidate site at Yucca Mountain, Nevada to be the final disposal site for all RPP vitrified HLW. The TWRS EIS acknowledged the current legislation that limits the amount of spent fuel and vitrified HLW that can be placed in the first repository until a second repository is operating and that DOE will evaluate the need for a second repository no sooner than FY 2007.

2.2.2.9.2 New Information. The current baseline program planning basis includes final disposal of all RPP vitrified HLW at the national geologic repository. DOE is continuing efforts to evaluate Yucca Mountain as a potential site for the national geological repository. DOE is currently preparing a final EIS for a potential repository at Yucca Mountain. There is no new information regarding the disposal of vitrified HLW that would affect the engineering data for disposal of vitrified HLW at the geologic repository.

2.2.3 Accident Analysis

Since release of the TWRS EIS, new information on potential radiological and chemical accidents during routine operations of the tank farm waste has been made available in *Tank Waste Remediation System Final Safety Analysis Report* (HNF-SD-WM-SAR-067), hereinafter referred to as the TWRS FSAR. The TWRS FSAR establishes an improved authorization basis for RPP facilities and operations required for the storage of high-level radioactive waste (current and future tank waste). The TWRS FSAR documents the basis for the conclusion that authorized RPP facility operations can be conducted safely complying with the requirements of *Technical Safety Requirements* (DOE Order 5480.22) and *Nuclear Safety Analysis Reports* (DOE Order 5480.23). New information in this document will change the radiological and chemical risk calculated in the TWRS EIS for the beyond design basis earthquake scenario and accidents that could occur during routine operations. These changes are discussed in Section 3.13.

Since release of the TWRS EIS, new information on potential radiological and toxicological accidents during processing of the tank waste has been made available in *Design Safety Features February 1999* (RPT-W375-RU00001). New information in the document would change the radiological risk calculated in the TWRS EIS for accidents that could occur during pretreatment and vitrification activities. These changes are discussed in Section 3.13. It should be noted that the accident evaluation in RPT-W375-RU00001 is preliminary and more detailed hazard and accident analyses are currently being developed. Therefore, the process accidents evaluated in Section 3.13 are likely to change.

2.2.4 New Groundwater Data

This section summarizes new data and the potential effects that new data has on the groundwater impacts analysis presented in the TWRS EIS. The summary in this section builds on the data and evaluations presented in the TWRS EIS and in DOE/EIS-0189-SA2. The following lists the new groundwater data, including that about the vadose zone and underlying saturated zone, discussed in this section. It should be noted that this new data does not change the conclusions reached in the TWRS EIS, as the following sections substantiate. The purpose of including the new groundwater data in this report is to show that the new data does not change the conclusions reached in the TWRS EIS.

- Continuation of the spectral gamma logging of drywells around the tank farms (Section 2.2.4.1.1)
- Final data and evaluations from the borehole 41-09-39 extension at the SX tank farm (Section 2.2.4.1.2)
- Final contaminant mobility inferences (Section 2.2.4.1.3)
- Final evaluations related to recharge of precipitation at the tank farms (Section 2.2.4.1.4)
- Final data and evaluations on the clastic dikes (Section 2.2.4.1.5)
- New groundwater level and groundwater quality data (Sections 2.2.4.2.1 and 2.2.4.2.2)
- Emerging groundwater radiological characteristics from the ongoing RCRA-required investigations at waste management area S-SX (Section 2.2.4.2.2).

2.2.4.1 New Vadose Zone Information. New vadose zone data are summarized in this section. A more detailed discussion is provided in Jacobs (2000).

2.2.4.1.1 Spectral Gamma Logging of Drywells at the Tank Farms. DOE has implemented a program to develop baseline gamma-specific radioisotope information in the vadose zone near the SSTs. This program builds on a previous one in which gross gamma data were collected as a means of leak detection from the SSTs. Both programs used the networks of drywells (i.e., wells that do not extend to groundwater) that are installed around each tank in each SST farm. Spectral gamma logging data from the AX, BX (tank BX-102 only), BY, SX, T (tanks T-107 and T-110 only), TX, and U tank farms were available and considered in the NEPA evaluations documented in DOE/EIS-0189-SA2. Spectral gamma data have been collected and are available for the remaining SST farms and are considered in the NEPA evaluations provided in this document.

The new spectral gamma logging provides more information about the distribution of contaminants beneath the waste tanks. This information may support refinement to the vadose zone conceptual model and reduction in uncertainty in the distribution of gamma-emitting contaminants in the vadose zone. The evaluations documented in the TWRS EIS are still bounding because the gamma-emitting contaminants as described in Jacobs (2000) would not contribute to long-term human health risk due to their short half-life and relative immobility.

2.2.4.1.2 Results of Sampling and Analysis from Extending Borehole 41-09-39 at the SX Tank Farm. Borehole 41-09-39 in the SX tank farm was extended from 40 m (130 ft) to the water table, a depth of approximately 64 m (210 ft). The preliminary findings from the borehole extension were reported in DOE/EIS-0189-SA2. Since then, the data have been finalized and documented in HNF-2855. The final data are consistent with the preliminary findings. These new data provide more information about the distribution of contaminants beneath the waste tanks and support further refinement of the vadose zone conceptual model. The results reported in HNF-2855 indicate a large variability in the relatively short-lived radioisotopes cesium-137 and strontium-90 mobility. Even so, they would still be much less mobile than the long-lived radioisotope technetium-99 which is a major contributor to the long-term human health risk. The evaluations documented in the TWRS EIS are still bounding because neither cesium-137 nor strontium-90 would persist long enough to provide an impact to human health risk, even in light of the uncertainty surrounding their mobility.

2.2.4.1.3 Information on Distribution Coefficients that Affect Contaminant Mobility. Measurements of the distribution coefficient for tank waste and Hanford Site sediments were completed with samples from extended borehole 41-09-39 and are documented in HNF-2855. Also, samples were collected from borehole 299-E17-21, which was drilled at the proposed vitrified LAW disposal site in the south-central 200 East Area. The distribution coefficients determined from the borehole 299-E17-21 samples are documented in *Radionuclide Distribution Coefficients for Sediments Collected from Borehole 299-E17-21: Final Report for Subtask a* (PNNL-11966).

These data are generally consistent with previous work including the *Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site* (PNNL-11800) prepared in response to *Recommendation 94-2 to the Secretary of Energy* (DNFSB 94-2), and the *Retrieval Performance Evaluation Methodology for the AX Tank Farm* (DOE/RL-98-72). Although both PNNL-11800 and DOE/RL-98-72 were works-in-progress at the time of DOE/EIS-0189-SA2, much of the information from these two efforts was considered in DOE/EIS-0189-SA2. The new data presented in HNF-2855 provide more information about the distribution of contaminants beneath the waste tanks and support further refinement of the vadose zone conceptual model. The data presented in PNNL-11966 provide additional confidence in the estimated mobility of some key vitrified LAW constituents (i.e., cesium-137, selenium-79, strontium-90, technetium-99, and uranium). Overall evaluations developed in the TWRS EIS continue to be bounding considering these new data because contaminant concentrations in the groundwater would be greater using the TWRS EIS mobility assumptions than in those in either PNNL-11966 or HNF-2855 were used. Also, the final released information in both PNNL-11800 and DOE/RL-98-72 are consistent with the preliminary data evaluated in DOE/EIS-0189-SA2.

2.2.4.1.4 Recharge of Precipitation at the Tank Farms. At writing of DOE/EIS-0189-SA2, there were no new recharge data but reevaluation of the initial recharge rate was ongoing under the two studies documented in PNNL-11800 and DOE/RL-98-72. The final recharge rates cited in the two studies are within the bounds of the TWRS EIS. An additional study, documented in *Recharge Data Package for the Immobilized Low-Activity Waste 2001 Performance Assessment* (PNNL-13033), has been undertaken to support a revision to the vitrified LAW performance assessment planned for FY 2001. The results of this study are also within the bounds of the TWRS EIS. Four periods were considered in PNNL-11800 and DOE/RL-98-72:

- Period of pre-tank construction
- Current period of time, from tank construction to placement of a barrier over the tanks
- Period in which the barrier is functioning
- Post-barrier period, when the barrier has degraded and the tank farm has reverted back to the shrub-steppe type of ground cover with no additional recharge restriction from the barrier.

The analysis in PNNL-11800 uses values acquired from the first draft of the performance assessment for the vitrified LAW disposal facility, *Estimation of Natural Groundwater Recharge for the Performance Assessment of a Low-Level Waste Disposal Facility at the Hanford Site* (PNL-10508). Best estimate recharge rates for the vitrified LAW surface cover recommended for the FY 2001 revision of the vitrified LAW performance assessment are 0.01 cm/yr (0.004 in./yr) (PNNL-13033) based on a RCRA Subtitle C design. The TWRS EIS assumes a recharge rate of 0.05 cm/yr (0.02 in./yr)for the first 1,000 years after which the recharge rate is assumed to increase to 0.1 cm/yr (0.04 in./yr) for the remainder of the period of interest. The higher recharge rate assumed in the TWRS EIS would generally result in higher contaminant mass flux through the vadose zone and higher groundwater contaminant concentrations compared to the recharge rate recommended for the FY 2001 revision of the vitrified LAW. Thus, evaluations provided in the TWRS EIS continue to be bounding considering the information developed in PNNL-13033.

2.2.4.1.5 Potential Preferential Pathways. As noted in the TWRS EIS, the presence of relatively immobile contaminants at the SX tank farm at depths greater than previously predicted is not fully understood. Reviews of the literature associated with preferential flow in the vadose zone, additional measurements of contaminant concentrations in the vadose zone from spectral gamma logging, and data from the extension of borehole 41-09-39 provided some inferences on contaminant migration and were summarized in DOE/EIS-0189-SA2. Also, new information on clastic dikes (a feature that could be associated with preferential flow, Jacobs 2000) relative to preferential flow is reported in *Clastic Injection Dikes of the Pasco Basin and Vicinity*

(BHI-01103). This geologic atlas provides a more complete compilation of clastic dike occurrence, physical and hydraulic characteristics, and potential genesis than has previously been available. While there are ample references in the literature pointing to the notion that preferential flow paths can significantly impact the transport of contaminants in the vadose zone (Parlange et al. 1988), the new data so far do not support significant preferential flow processes in the vadose zone at the Hanford Site. The evaluations provided in the TWRS EIS continue to be bounding considering this new information because there are no indications that vertical preferential flow in the vadose zone associated with clastic dikes would cause a measurable increase in contaminant concentrations in the underlying unconfined aquifer.

2.2.4.1.6 Sluicing Loss Characteristics. In the TWRS EIS, sluicing losses were assumed to leak over the full area at the base of a tank. DOE/RL-98-72 includes evaluation of alternative tank leak scenarios including those where the tank leak area was assumed to be limited to a discrete subsection of the tank bottom. Those preliminary evaluations cited in DOE/RL-98-72 were discussed in DOE/EIS-0189-SA2. The evaluations provided in the final DOE/RL-98-72 revision are consistent with the preliminary evaluations and indicate that the tank area from which the leak occurs can affect the arrival time and peak concentration of contaminants to the water table.

The information provided in DOE/EIS-0189-SA2 indicates that the first arrival of mobile contaminants (e.g., technetium-99) may be sooner for the sluicing loss component of the source terms than was calculated in the TWRS EIS. However, there is still much uncertainty related to what the tank leak area may be during sluicing, the volume loss, and the actual number of SSTs that may leak. The TWRS EIS assumed that all 149 SSTs would leak. This is unlikely because some of the SSTs are nearly empty and the ongoing development of a retrieval method(s) that will be safe to workers and result in less or no retrieval losses. Overall evaluations developed in the TWRS EIS continue to be bounding considering these new data and direction from DOE because the number of tanks to experience releases during retrieval are expected to be fewer than assumed in the TWRS EIS and the volume of releases per tank can be assumed to be smaller than assumed in the TWRS EIS.

2.2.4.1.7 Data for a Performance Assessment of the Vitrified LAW in 2001. The performance assessment for the LAW vitrification facility, planned for 2001, will represent a revision of earlier work documented in *Hanford Immobilized Low-Activity Tank Waste Performance Assessment* (DOE/RL-97-69). Data for the 2001 performance assessment will be derived from the following sources.

- **Geology** – Data from *Geologic Data Package for 2001 Immobilized Low-Activity Performance Assessment* (PNNL-12257) provides a compilation of exiting geologic data and new site-specific data developed for the 2001 vitrified LAW performance assessment.

- **Near-Field Hydrology** – Data from *Near-Field Hydrology Data Package for the Immobilized Low-Activity Waste 2001 Performance Assessment* (PNNL-13035) provides a compilation of exiting hydraulic data (e.g., estimates of saturated hydraulic conductivity, unsaturated hydraulic conductivity, bulk density, and diffusion coefficient) required for near-field numerical model inputs for generation of contaminant flux.

- **Far-Field Hydrology** – Data from *Far-Field Hydrology Data Package for Immobilized Low-Activity Waste Performance Assessment* (HNF-4769) provides a compilation of exiting hydraulic data (e.g., effective upscaled) estimates of saturated hydraulic conductivity, soil moisture retention, unsaturated hydraulic conductivity, bulk density, unretarded macrodispersivity, and sorption-enhanced macrodispersivity) required for far-field numerical model inputs for generation of contaminant concentrations.

- **Recharge** – Data from PNNL-13033 provides recommended recharge rate for use in the 2001 vitrified LAW performance assessment. Also see Section 2.2.4.1.4.

- **Geochemical** – Data from *Geochemical Data Package for the Hanford Immobilized Low-Activity Waste Performance Assessment* (PNNL-13037) provides a compilation of distribution coefficients for the expected contaminants in the vitrified LAW inventory for five discrete zones ranging from the near-field adjacent to the source to the saturated zone (groundwater).

It is a given that the data (e.g., hydraulic conductivity, porosity, and contaminant distribution coefficient) used in all recent groundwater impact assessments, including the TWRS EIS, are approximations. The "real" data values vary in space and can never be known for the whole space. The data for the 2001 performance assessment represent a refinement and confirmation of assumed values. These data, presented in the listed reports, are generally consistent with the previous interpretations and approximations. The data provide additional confidence in the estimated parameter values. Overall, evaluations developed in the TWRS EIS continue to be bounding.

2.2.4.2 Saturated Zone. New data about the saturated zone have been collected from groundwater levels and concentrations of contaminants and other constituents in the groundwater. These data are summarized in *Hanford Site Groundwater Monitoring for Fiscal Year 1998* (PNNL-12086) and *Hanford Site Environmental Report* (PNNL-12088). Additional interpretations of these data are provided in the individual draft RCRA reports on the tank waste management areas.

2.2.4.2.1 Groundwater Levels. Groundwater level data are used to infer groundwater flow gradient direction and magnitude. The most recently published data on water levels are for June of 1998 (PNNL-12086) in which groundwater levels were recorded from over 600 wells in the unconfined aquifer on the Hanford Site and immediately surrounding area. The most notable observation from these data is the continued trend of groundwater level decline in many areas of the Hanford Site. This would have a localized effect on groundwater flow patterns (i.e., flow direction and gradient magnitude) but would not be expected to change the long-term peak contaminant concentrations in the groundwater.

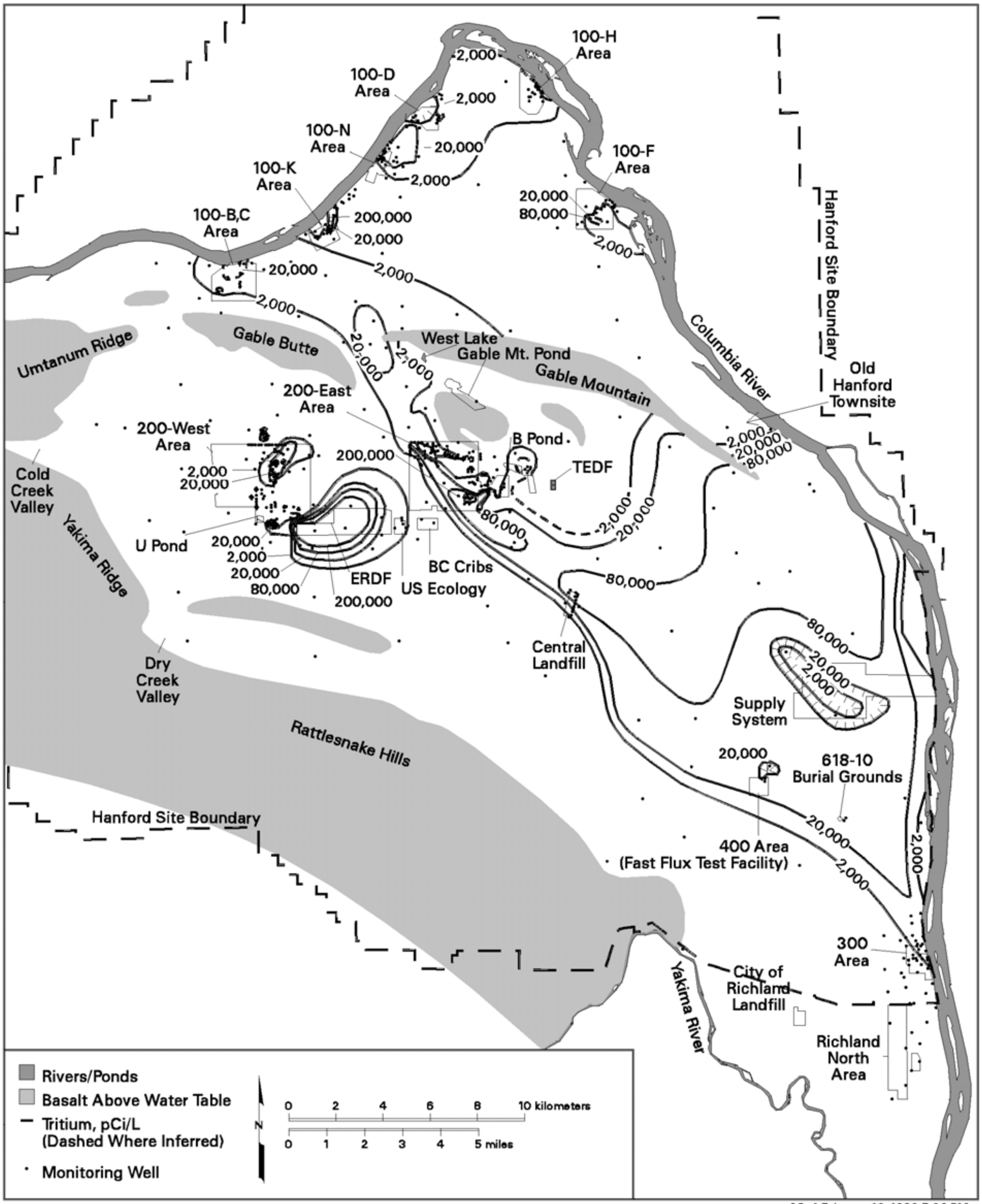
2.2.4.2.2 Groundwater Quality. Much of the Hanford Site continues to be impacted by past releases of contaminants from many sources. The extent of this impact can be inferred by the distribution of tritium in the unconfined aquifer (Figure 2.5) because of its widespread occurrence on the Site and its high mobility in groundwater. For comparison purposes the drinking water standard for tritium cited in "National Primary Drinking Water Regulations" (40 CFR 141) is 20,000 pCi/L. DOE/EIS-0189-SA2 summarizes information on the impacts to groundwater quality from the leaking SSTs that were emerging at the time of DOE/EIS-0189-SA2 publication. The evaluations presented in DOE/EIS-0189-SA2 would not change for this analysis except for one addition. New groundwater data is emerging from the RCRA investigations at waste management area S-SX. Borehole B8809 has been advanced to a depth of about 67 m (220 ft). The borehole is located about 3 m (10 ft) southwest of tank SX-115. Groundwater was sampled and preliminary analytical results indicate the technetium-99 concentration is 34,000 pCi/L, compared to the 900 pCi/L interim drinking water standard (Stang 1999). Previously, the highest documented technetium-99 activity found in the Hanford Site was in the 200 West Area where the activity was reported to be 22,600 pCi/L in well 299-W19-29, located about 1,655 m (5,430 ft) northeast of the new borehole (PNNL-12088). The source of the high levels of technetium-99 is not readily explained. Technetium-99 has been detected at levels above the interim drinking water standard near the SX tank farm; however, two monitoring wells immediately to the east of the new borehole show low concentrations of technetium-99.

The impact of the newly discovered technetium-99 levels to the vadose zone and groundwater conceptual models is not yet determined. However, the new information is believed to support the continued refinement of the conceptual models and ultimately would reduce uncertainty associated with long-term predictions of contaminant transport through the vadose zone from tank waste and vitrified LAW sources because this new data may allow better discrimination of sources (i.e., release volume and contaminant concentration). The evaluations provided in the TWRS EIS continue to be bounding considering this new information. In the TWRS EIS technetium-99 was assumed to be mobile (i.e., moving at the speed of water).

2.2.5 New Technology Development

There are numerous technologies that could be used for remediating tank waste. The viable technologies evaluated in the TWRS EIS included technologies for waste retrieval, separations, and vitrification. For each of the main technology areas associated with the Phased Implementation alternative and other alternatives, a search was performed to determine if technology development efforts had identified new technologies that would affect the alternatives analyzed in the TWRS EIS. No new technologies that would change the overall approach to remediation or would support redefining the TWRS EIS alternatives were identified.

Figure 2.5. Average Tritium Concentrations in the Unconfined Aquifer, 1998



A number of technology developments under way at the Hanford Site and throughout the DOE complex are aimed at improving the process of remediating HLW in buried tanks. Technology development activities are planned or ongoing for most components of the Phased Implementation alternative (e.g., waste separations, retrieval, vitrification). Most of the technology development activities under way are for technologies that are the same as or functionally equivalent to those evaluated in the TWRS EIS. Many of the technologies evaluated in the TWRS EIS have been developed to the point where technology demonstrations are being performed on simulated or actual tank waste samples in preparation for waste vitrification. Technology development activities include the following:

- Testing of variable-depth retrieval pumps for enhanced sludge removal from DSTs
- Examination of technologies for retrieving SST waste
- Testing of salt cake dissolution concentrations and dissolution rates.

2.2.6 Hanford Reach National Monument

On June 9, 2000 by presidential proclamation, President W. J. Clinton created the Hanford Reach National Monument (65 FR 7319). A memorandum from President W. J. Clinton to the Secretary of Energy (Clinton 2000) was also released on the same day that reads as follows.

> The area being designated as the Hanford Reach National Monument forms an arc surrounding much of what is known as the central Hanford area. While a portion of the central area is needed for Department of Energy missions, much of the area contains the same shrub-steppe habitat and other objects of scientific and historic interest that I am today permanently protecting in the monument. Therefore, I am directing you to manage the central area to protect these important values where practical. I further direct you to consult with the Secretary of the Interior on how best to permanently protect these objects, including the possibility of adding lands to the monument as they are remediated.

Areas that may be impacted in the future are those associated with site-wide permits and land use plans. Those areas can be addressed through permit and document revisions, modification, or applications under existing regulatory processes.

2.2.6.1 Borrow Sites. Three borrow sites were identified in the TWRS EIS for the purpose of analysis: Pit 30 which would supply sand and gravel, McGee Ranch which would supply silt, and Vernita Quarry which would supply rip rap. A decision on exactly which borrow site would be used and to what extent it would be used was to be made through future NEPA analysis. McGee Ranch and parts of Vernita Quarry are included in the Hanford Reach National Monument and would therefore be subject to the constraints, permits, and regulations that fall under the proclamation. Recognizing the potential impacts the proclamation has on borrow sites, the potential environmental impacts evaluated in Section 3.0 refer to generic borrow sites (e.g., sand and gravel borrow site, silt borrow site, and rip rap borrow site) with the understanding that when specific borrow sites are selected those sites will require further NEPA analysis.

2.2.6.2 Receptor Location for Human Health Analysis. State ambient air quality standards for radionuclides were measured at receptor locations along the Columbia River and on State Route 240. Compliance with the Federal standard for radionuclide releases are determined at the nearest residence. The monument proclamation would not have an impact on those receptor locations.

2.2.6.3 Class 1 Designation for Air Emissions. The Hanford Reach National Monument has not yet been re-designated from unclassified to Class 1 for air emissions. Class 1 areas are usually reserved for National Parks, Wilderness areas, and other air quality resources of an unusual pristine character. Current projected air emissions would only become a potential issue in the future if the Hanford Reach National Monument is re-designated to Class 1.

2.2.7 Clean Air Act General Conformation Requirements and the National Environmental Policy Act Process

The purpose of *Clean Air Act General Conformity Requirements and the National Environmental Policy Act Process* (NEPA 2000) guidance is to ensure that actions conform to applicable implementation plans for achieving and maintaining the standards from "National Primary and Secondary Ambient Air Quality Standards" (40 CFR 50) for criteria pollutants. Because of the relatively low emissions (as compared to Federal and State standards) of criteria pollutants from the vitrification facilities the conformity determination requirements do not apply to the action. Additionally, the facility is exempt from the conformity requirements because it is subject to Clean Air Act permitting.

2.2.8 Threatened and Endangered Species Management Plan

Threatened & Endangered Species Management Plan: Salmon and Steelhead (DOE/RL-2000-27) was prepared to define the DOE Richland Operations Office (RL) commitment to protecting and enhancing stocks of spring chinook salmon and steelhead within the Hanford Reach of the Columbia River. The report concludes that if Hanford Site activities are carried out in accordance with this plan, such actions are not likely to adversely affect steelhead, spring chinook salmon, or their critical habitat.

2.2.9 Mitigation Action Plan

The overall process that will be implemented to mitigate the impacts from the loss of habitat due to the construction of the Phase I facilities and associated infrastructure is presented in *Mitigation Action Plan for the U.S. Department of Energy, Hanford Site, Tank Waste Remediation System Privatization Phase I Facility Construction* (DOE-RL 1998) mitigation action plan. Habitat disturbance estimates of 47 ha (116 ac) were used to derive the mitigation measures identified in the mitigation action plan. The habitat disturbance evaluated in this Supplement Analysis was estimated to be 47 ha (116 ac) and would therefore fall within the bounds of the mitigation action plan.

2.2.10 Hanford Comprehensive Land Use Plan

Three borrow sites were identified in the TWRS EIS for the purpose of analysis: Pit 30 which would supply sand and gravel, McGee Ranch which would supply silt, and Vernita Quarry which would supply rip rap. A decision on exactly which borrow site would be used and to what extent it would be used would be made through future NEPA analysis. The future development of and access to Hanford Site geologic resources would require review under the policies and implementing procedures cited in *Final Hanford Comprehensive Land-Use Plan* (DOE/EIS-0222). Facilities to be constructed and operated under the TWRS EIS are included in the industrial exclusive land use area defined under DOE/EIS-0222. Neither EIS authorizes the use of the borrow sites.

2.2.11 Borrow Site for Phase I Construction

The TWRS EIS assumed that the Phase I contractor would obtain borrow material necessary for construction of Phase I waste vitrification facilities from offsite sources. However, because of the increase in the footprint of the BNFL Phase I waste vitrification facility design it is proposed that the borrow material for construction of Phase I waste vitrification facilities would be obtained form onsite borrow sources (CCN: 012779). If this recommendation were accepted, further analysis of the onsite borrow sites would be required.

2.2.12 Rail System Availability

The rail system is currently not available to the Hanford Site. New documentation for Phase I does not assume the use of rail shipment but is dependent on trucks to transport construction and operation materials and equipment to and from the Site. Phase II does assume the use of the rail system for transporting construction and operation materials and equipment to and from the Hanford Site as well as transporting vitrified HLW to an offsite repository. Therefore, this Supplement Analysis assumes the Hanford Site rail system will be restored and operational for Phase II.

2.3 RESOURCES WITH LITTLE OR NO NEW DATA

A review of new information developed since release of the TWRS EIS resulted in identifying areas where little or no new definitive information is available. In areas where data was not available, environmental impacts were qualified by scaling from the environmental impacts evaluated in the TWRS EIS.

Areas with little or no new available definitive information are as described below.

- The resource estimates for the assumed 330 MT/day Phase II vitrification facilities (i.e., steel, concrete, sand and gravel, water, electrical power, gasoline, diesel, kerosene, propane, process chemicals, and permanently committed land) were scaled from the 210 MT/day Phase II vitrification facilities evaluated in the TWRS EIS.

- Routine radiological and criteria pollutant air emission rates and concentrations from the 330 MT/day Phase II waste vitrification facilities were scaled from the 210 MT/day facilities evaluated in the TWRS EIS.

- Construction and operation labor requirements for the 330 MT/day Phase II waste vitrification facilities were scaled from the 210 MT/day facilities evaluated in the TWRS EIS.

- Peak year of combined construction and operation personnel (year and number of workers) for the 330 MT/day Phase II waste vitrification facilities were scaled from the 210 MT/day facilities evaluated in the TWRS EIS.

- The number of radiation workers to support and exposure rates for the 330 MT/day Phase II waste vitrification facilities were scaled from the 210 MT/day facilities evaluated in the TWRS EIS.

- Waste processing accidents (e.g., receipt tank failure, cesium ion-exchange column failure, melter failure, and design basis earthquake) for the 31 MT/day Phase I waste vitrification facilities were based on accidents evaluated in RPT-W375-RU00001. There is not enough information to base an accident analysis on similar operation accidents for the Phase II waste vitrification facilities; therefore, the Phase II radiological accidents for waste vitrification operations did not change from the TWRS EIS accidents.

2.4 REFERENCES USED TO SUPPORT ENVIRONMENTAL IMPACT ANALYSES

The environmental impact analyses in this Supplement Analysis were based on the best information available at the time from ORP; BNFL; CH2M HILL Hanford Group, Inc.; and others. In areas where data was not available, environmental impacts were quantified by scaling from the environmental impacts evaluated in the TWRS EIS. New information identified in the review and prior to the final Supplement Analysis will be incorporated as appropriate. Table 2.5 shows source documents from which the new information was obtained to perform the environmental impact analyses.

Table 2.5. References Used to Support Environmental Impact Analyses (4 Sheets)

Supplement Analysis Section	New Information	Source
3.1 Geology and Soils	Estimated disturbed areas for Phase I infrastructure.	HNF-3239
	Estimated disturbed area for Phase I waste vitrification facilities.	CCN: 012779
	Larger Phase II waste vitrification facilities.	HNF-SD-WM-SP-012, Rev. 1 and Rev. 2
	Change in vitrified LAW disposal concept.	Taylor 1999 Shah 1999
3.2 Surface Water	Revised waste inventory.	Best-basis inventory of 10/5/99
3.3 Groundwater	Revised waste inventory.	Best-basis inventory of 10/5/99
3.4 Air Quality	Revised air emissions.	TWINS 1999
	Criteria pollutant emission rates and concentrations from Phase I construction of a LAW/HLW facility.	BNFL-5193-ER-01
	Criteria pollutant emission rates from Phase I operations of a LAW/HLW facility.	CCN: 012779
	Radiological emission rates during Phase I operations.	CCN: 012779
	Larger Phase II waste vitrification facilities used to scale Phase II air emissions.	HNF-SD-WM-SP-012, Rev. 1 and Rev. 2
3.5 Biological Resources	Estimated disturbed areas for Phase I infrastructure.	HNF-3239
	Estimated disturbed area for Phase I waste vitrification facilities.	CCN: 012779
	Larger Phase II waste vitrification facilities used to scale Phase II disturbance of previously undisturbed land.	HNF-SD-WM-SP-012, Rev. 1 and Rev. 2
3.6 Cultural Resources	Estimated disturbed areas for Phase I facilities.	HNF-3239
	Estimated disturbed area for Phase I waste vitrification facilities.	CCN: 012779
	Larger Phase II waste vitrification facilities used to scale Phase II disturbance of previously undisturbed land.	HNF-SD-WM-SP-012, Rev. 1 and Rev. 2

Table 2.5. References Used to Support Environmental Impact Analyses (4 Sheets)

Supplement Analysis Section	New Information	Source
3.7 Socioeconomics	The Hanford Site and Tri-Cities area employment.	PNNL-6415
	Peak employment level during construction and operation of Phase I processing facilities.	CCN: 012779
	Larger Phase II waste vitrification facilities used to scale Phase II employment.	HNF-SD-WM-SP-012, Rev. 1 and Rev. 2
3.8 Land Use	Estimated disturbed areas for Phase I facilities.	HNF-3239
	Estimated disturbed area for Phase I waste vitrification facilities.	CCN: 012779
	Larger Phase II waste vitrification facilities used to scale Phase II land disturbance.	HNF-SD-WM-SP-012, Rev. 1 and Rev. 2
	Change in vitrified LAW disposal concept.	Taylor 1999 Shah 1999
3.9 Visual	Plant design.	HNF-SD-WM-SP-012, Rev. 1 and Rev. 2
3.10 Noise	No new data.	--
3.11 Transportation	Peak employment level during construction and operation of Phase I processing facilities.	CCN: 012779
	Larger Phase II waste vitrification facilities used to scale Phase II employment.	HNF-SD-WM-SP-012, Rev. 1 and Rev. 2
3.12.1 Remediation Risk	Revised air emissions from routine tank farm operations and Phase II waste vitrification operations.	TWINS 1999
	Air emissions from Phase I waste vitrification operations.	CCN: 012779
	Exposure rates for Phase I radiation workers.	CCN: 012779
	Radiation worker-years.	CCN: 012779
	Pretreatment and vitrification process accidents.	RPT-W375-RU00001
	Larger Phase II waste vitrification facilities used to scale Phase II LCF risk.	HNF-SD-WM-SP-012, Rev. 1 and Rev. 2
	LCF risk from transporting vitrified HLW to offsite repository based on revised inventory.	TWINS 1999

Table 2.5. References Used to Support Environmental Impact Analyses (4 Sheets)

Supplement Analysis Section	New Information	Source
3.12.2 Long-Term Health Effects	Revised waste inventory.	Best-basis inventory of 10/5/99
	Performance Assessment of vitrified LAW vaults.	DOE/RL-97-69
	Change in vitrified LAW disposal concept.	Taylor 1999 Shah 1999
3.12.3 Intruder Scenario	Revised waste inventory.	Best-basis inventory of 10/5/99
	Performance assessment of vitrified LAW vaults.	DOE/RL-97-69
	Change in vitrified LAW disposal concept.	Taylor 1999 Shah 1999
3.14 Regulatory Compliance	Requirements for managing radioactive or mixed waste facilities.	DOE O 435.1
	Identification, implementation, and compliance with environment, safety and health requirements.	DOE P 450.2A
	Safety and health reporting requirements.	DOE O 231.1
	Establishes the framework for an effective worker protection program that will reduce or prevent accidental losses, injuries, and illnesses by providing DOE Federal and contractor workers with a safe and healthful workplace.	DOE O 440.1A
	Deletion of uncompleted milestones and target dates from DOE's high-level radioactive waste tank interim stabilization program (M-41-00) and interim milestone M-40-07 from the scope of the Tri-Party Agreement. A consent decree was filed with the United States District Court.	Hanford Site High-Level Radioactive Waste Tank Interim Stabilization Program and Interim Stabilization Consent Decree through Tri-Party Agreement Change Number M-41-99-01 (August 1999) (Ecology et al. 1989)
	Commitment to start hot operations for Hanford Site tank waste vitrification by 2007 and to complete vitrification of 10% of tank waste by volume and 25% of the tank waste by activity by 2018.	Agreement on Principal Regulatory Commitments pertaining to Hanford Tank Waste vitrification complex Construction and Operations (November 15, 1999) (Ecology et al. 1989)
3.14 Regulatory Compliance (Cont'd)	RCRA Corrective Action at 4 SST WMAs located at the Hanford Site. The program addresses vadose zone and groundwater contamination issues and characterization.	Tri-Party Agreement Modification for Initial SST WMA Corrective Actions, Vadose Zone and Groundwater Characterization, Assessment, and the Integration of Vadose Zone and Groundwater Activities at Specified Associated Sites Change Number M-45-98-03 (Ecology et al. 1999b)

Table 2.5. References Used to Support Environmental Impact Analyses (4 Sheets)

Supplement Analysis Section	New Information	Source
3.15 Irreversible and Irretrievable Commitment of Resources	Commitment of resources for Phase I waste vitrification facilities.	CCN: 012779
	Commitment of resources for Phase II were scaled.	HNF-SD-WM-SP-012, Rev. 1 and Rev. 2
3.16 Pollution Prevention	No new information.	--
3.17 Environmental Justice	No new information.	--
3.18 Mitigation Measures	No new information.	--
3.19 Cumulative Impacts	No new information.	--

DOE = U.S. Department of Energy.
HLW = high-level waste.
LAW = low-activity waste.
LCF = latent cancer fatality.
RCRA = *Resource Conservation and Recovery Act of 1976*.
SST = single-shell tank.
Tri-Party Agreement = *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989)
WMA = waste management area.

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3.0 POTENTIAL ENVIRONMENTAL IMPACTS

3.1 GEOLOGY AND SOILS

3.1.1 TWRS EIS Baseline

Geology and soils impacts addressed in the TWRS EIS included impacts to mineral resources, topography, and soils. The TWRS EIS determined that the level of impacts to these resources would be linked directly to the amount of land disturbed. Generally, the greater the land disturbance the higher the level of impacts to geologic resources and soils.

Mineral resources (i.e., silt, sand, gravel, and rip rap) that would be required to implement the Phased Implementation alternative are presented in Table 3.1. Phase I impacts would result from constructing Phase I remediation facilities and conducting remediation operations. Phase II impacts would result from constructing Phase II remediation facilities, conducting remediation operations, and performing tank farm closure activities. During remediation, earthen materials would be used primarily to make concrete for constructing vitrification facilities and vitrified LAW vaults. During closure, the earthen materials would be used primarily for filling tanks and constructing earthen surface barriers over the tank farms and vitrified LAW vaults. All of the earthen material was assumed to be obtained from one of three potential borrow sites located on the Hanford Site. Because sand, silt, gravel, and rip rap are all readily available on and near the Hanford Site, the TWRS EIS concluded that there would be no substantive impact on the local availability or cost of these resources.

Topographic changes that would result from implementing the Phased Implementation alternative were determined to be small and localized. The changes would result from constructing remediation facilities and earthen surface barriers over the vitrified LAW vaults and the tank farms during closure. Drainage would not be substantially disturbed and all facilities and earthen barriers would be constructed to conform with the surrounding terrain to promote drainage without causing increased erosion. The use of borrow sites as the source of earthen materials would also cause topographic changes. The depressions created at the borrow sites by the removal of earthen materials would be mitigated by recontouring to conform with the surrounding terrain and drainage systems.

Soil disturbance under the Phased Implementation alternative would result from the construction of remediation facilities, the removal of earthen materials from potential borrow sites, and the construction of earthen surface barriers over the tank farms and vitrified LAW vaults. Much of the soil in the areas that would be affected has been previously disturbed. Soil at the tank farms has been disturbed, as has much of the soil within the representative vitrification facilities sites in the 200 East Area that were analyzed in the TWRS EIS. The TWRS EIS assumed that some soil disturbance would be temporary and some permanent. Temporary disturbance included areas such as the trample zones around work areas, heavy equipment traffic areas, material laydown areas, and areas used at the three potential borrow sites. Permanent disturbance included areas such as the tank farms and vitrified LAW vaults that would be permanently committed to waste disposal and covered by surface barriers and the vitrification facilities following decontamination and decommissioning. A summary of the soil disturbance presented in the TWRS EIS for the Phased Implementation alternative is shown in Table 3.1. Further details on land disturbance and land use commitments are presented in Section 3.8.

Table 3.1. Mineral Resources and Soil Impacts—Changes from the TWRS EIS Phased Implementation Alternative

Impact		TWRS EIS		Current Planning Baseline	
		Phase I[a]	Phase II[b]	Phase I[a]	Phase II[b]
Mineral resources in m^3	Sand and gravel borrow site	3.2E+04	2.6E+06	1.53E+05	3.3E+06
	Silt borrow site	NR	5.7E+05	NR	5.7E+05
	Rip rap borrow site	NR	9.6E+05	NR	9.6E+05
Soil disturbance[c] in ha	Temporary	3.3E+01	2.8E+02	8.2E+01	3.6E+02
	Permanent	0	4.9E+01	0	6.5E+01

Note: Numbers for mineral resource impacts have been rounded to two significant digits.

[a] Soil disturbance is the sum of the land requirements, tank farm infrastructure requirements and the vitrified LAW vault land requirements (current planning baseline would be remote-handled vitrified LAW trenches). TWRS EIS soil disturbance includes 32 ha (74 ac) for the vitrification facilities and 1 ha (2 ac) at the sand and gravel borrow site. Current planning baseline soil disturbance includes 48 ha (119 ac) for the vitrification facilities, 26 ha (64 ac) for the tank farm infrastructure, 3 ha (7 ac) for the vitrified LAW remote-handled trenches, and 5 ha (12 ac) at the sand and gravel borrow site.

[b] Phase II estimates include closing tank farms by filling tanks with gravel and covering them with a Hanford Barrier and covering vitrified LAW vaults with a Hanford Barrier (current planning baseline would be remote-handled vitrified LAW trenches that would be covered with a RCRA Subtitle C cover). Soil disturbance is the sum of remediation and closure requirements as follows. TWRS EIS remediation includes 3 ha (7.4 ac) for retrieval annexes, 41 ha (101 ac) at sand and gravel borrow site, 107 ha (264 ac) for the vitrification facility, and 11 ha (27 ac) for vitrified LAW vaults. Current planning baseline remediation includes 3 ha (7.4 ac) for retrieval annexes, 66 ha (163 ac) at sand and gravel borrow site, 150 ha (371 ac) for the vitrification facility, and 24 ha (59 ac) for vitrified LAW remote-handled trenches. Closure for TWRS EIS and current planning baseline includes 24 ha (59 ac) at the tank farms, 45 ha (111 ac) at sand and gravel borrow site, 19 ha (47 ac) at silt borrow site, and 32 ha (79 ac) at rip rap borrow site.

[c] Soil disturbance estimates include closing tank farms as landfills. See Section 3.8 for detailed estimates of land disturbance and land use commitments.

LAW = low-activity waste.
NR = none required.
RCRA = *Resource Conservation and Recovery Act of 1976*.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

3.1.2 New Information

Since publication of the TWRS EIS, new information has been generated that could change the understanding of the impacts to geologic resources and soils presented in the TWRS EIS. The new information includes:

- Estimated disturbed areas for Phase I facilities (CCN: 012779)

- Estimated disturbed areas for infrastructure to support the Phase I facilities (HNF-3239)
- Changes in the assumed location for construction borrow material for Phase I (CCN: 012779)
- Larger Phase II waste vitrification facilities (HNF-SD-WM-SP-012, Rev. 1)
- Change in the disposal concept for the vitrified LAW from vaults to remote-handled trenches (Taylor 1999).

3.1.2.1 Phase I Soil Disturbance. Detailed discussion of the revised Phase I land use impacts is provided in Section 3.8. The revised impacts can be summarized as follows:

- The Phase I facilities would require temporary soil disturbance of 48 ha (119 ac) of land in the 200 East Area (CCN: 012779) and 5 ha (12 ac) of land at the sand and gravel borrow site (Jacobs 2000)
- Tank farm infrastructure would require 26 ha (64 ac) of land in the 200 East Area (Jacobs 2000)
- Remote-handled vitrified LAW trenches would require 3 ha (8 ac) of land in the 200 East Area (Shah 1999).

The TWRS EIS assumed that the Phase I contractor would obtain borrow material necessary for construction of Phase I waste vitrification facilities from offsite sources. However, because of the increase in the footprint of the BNFL Phase I waste vitrification facility design it is proposed that the borrow material for construction of Phase I waste vitrification facilities would be obtained from onsite borrow sources (CCN:012779). (If this recommendation were accepted, further analysis of the onsite borrow sites would be required.) The increased volume of Phase I borrow material presented in Table 3.1 was calculated by assuming a 3-m (10-ft) -deep cut over the area disturbed at the sand and gravel borrow site. The TWRS EIS assumed no borrow material would be required in Phase I from the silt and rip rap borrow sites. These two borrow sites were assumed to be used only during Phase II to secure borrow material for closure.

3.1.2.2 Phase II Soil Disturbance. To meet the current Tri-Party Agreement milestones for retrieval and closure, the capacity of the Phase II waste vitrification facilities would have to be increased. The Phase II waste vitrification facilities evaluated in the TWRS EIS consisted of two 100 MT/day LAW facilities and one 10 MT/day HLW facility (combined 210 MT/day total capacity). To meet the current milestones, these Phase II facilities would need to be increased to two 150 MT/day LAW facilities and one 30 MT/day HLW facility (combined 330 MT/day total capacity) (HNF-SD-WM-SP-012, Rev. 1). The soil disturbance associated with the larger Phase II capacity was scaled (Jacobs 2000) from the Phase II soil disturbance presented in the TWRS EIS. Detailed discussion of the revised Phase II land use impacts is provided in Section 3.8.

The vitrified LAW disposal program has been rebaselined by changing the scope of Project W-520 from a vault concept to incorporate the remote-handled trench concept

(Taylor 1999). The change results in the vitrified LAW being disposed of in RCRA-compliant, remote-handled landfill trenches instead of in vaults. Based on the available preconceptual design information (Shah 1999), the vitrified LAW disposal complex would consist of approximately six double-lined trenches with leachate collection systems located on vacant land in the 200 East Area and southwest of the Plutonium-Uranium Extraction Plant. This site location is the same as that planned for Project W-520 vitrified LAW vaults.

The revised Phase II land use impacts can be summarized as follows.

- Temporary soil disturbance on 201 ha (496 ac) of land in the 200 East area (including 24 ha [59 ac] for the vitrified LAW remote-handled trenches) and 111 ha (274 ac) of land at the sand and gravel borrow site (soil disturbance at the silt and rip rap borrow sites would remain unchanged at 51 ha [126 ac]).

- Permanent soil disturbance on a total of 65 ha (161 ac) of land in the 200 East Area.

The increased volume of Phase II borrow material shown in Table 3.1 was calculated by assuming a 3-m- (10-ft-) deep cut over the area disturbed at the sand and gravel borrow site (consistent with the approach used in the TWRS EIS).

The new information on the footprint of the Phase II vitrification facilities does not affect closure planning and therefore does not change the borrow requirements for the silt and rip rap borrow sites.

3.1.3 Impact of the New Information

The impacts to geologic resources and soils associated with the new information reviewed for this Supplement Analysis are presented in Table 3.1. A discussion of the changes in these impacts compared with the impacts in the TWRS EIS is provided in the following paragraphs.

3.1.3.1 Phase I. The Phase I sand and gravel resource requirements for currently planned facilities would exceed those presented in the TWRS EIS for the Phased Implementation alternative by 378%. The increase is the result of the change in assumption on the source of the Phase I construction borrow material from offsite to onsite because of the increased footprint of the BNFL Phase I waste vitrification facility. If this assumption were accepted, further analysis of the onsite borrow sites would be required.

There would be small additional changes in topography compared with those presented in the TWRS EIS, but they would be recontoured to conform with the surrounding terrain and drainage systems and would not alter the understanding of topography impacts presented in the TWRS EIS.

The Phase I temporary soil disturbance for currently planned facilities would exceed that presented in the TWRS EIS for the Phased Implementation alternative by 148%. The increase is related mainly to the increased footprint for the Phase I vitrification facilities and tank farm infrastructure.

3.1.3.2 Phase II. The Phase II sand and gravel resource requirements for currently planned facilities would exceed those presented in the TWRS EIS for the Phased Implementation alternative by 27%. This increase is related mainly to the increased footprint for the Phase II vitrification facilities. The borrow requirements from the silt and rip rap borrow sites remain unchanged from those presented in the TWRS EIS.

There would be small additional changes in topography compared with those presented in the TWRS EIS but they would be recontoured to conform with the surrounding terrain and drainage systems and would not alter the understanding of topography impacts presented in the TWRS EIS.

The Phase II temporary soil disturbance for currently planned facilities would exceed that presented in the TWRS EIS for the Phased Implementation alternative by 29%. Likewise, the Phase II permanent soil disturbance exceeds that in the TWRS EIS by 33%. The increase is related mainly to the increased footprint for the Phase II vitrification facility and the increased number of containers of vitrified LAW.

3.1.3.3 Total Alternative. Because the Phase I or Phase II geology and soils impacts calculated for the current planning baseline are not bound by the Phased Implementation alternative calculated in the TWRS EIS, the next step would be to determine if they are bound by other alternatives in the TWRS EIS. The impacts from Phase I and Phase II are summed so that the total alternative is compared with the other alternatives. There are no alternatives evaluated in the TWRS EIS that would bound the results of the geology and soil impacts evaluated for the current planning baseline. However, the increased sand and gravel requirements represent only a small fraction of the total sand and gravel reserves available at the Hanford Site and would not change the TWRS EIS conclusion that there would be no substantive impact on the local cost or availability of this resource. In addition, the increased soil disturbance (temporary and permanent combined) is small and represents an additional 3% of the 2,600 ha (6,400 ac) of land in the 200 Areas. Therefore, none of the increased Phase I and Phase II impacts shown in Table 3.1 substantially change the understanding of impacts to geologic resources and soils presented in the TWRS EIS.

3.2 SURFACE WATER

3.2.1 Water Releases

The Phased Implementation alternative considered in the TWRS EIS would generate liquid effluent; however, the effluent would not be discharged to surface waters and there would be no direct impacts to surface waters from implementation of the alternative. Liquid currently in the tanks and liquid added to the tanks during waste retrieval activities ultimately would be removed and sent to an evaporator. Condensate from the evaporator would be sent to the Effluent Treatment Facility in the 200 East Area. The evaporator condensate would be treated in the Effluent Treatment Facility with a variety of systems, including evaporation, to meet applicable regulatory standards. Ultimately the waste would be discharged, with most contaminants removed except tritium, from the Effluent Treatment Facility to the State-approved land disposal facility site. The State-approved disposal site is a subsurface drain field near the north-central part of the 200 West Area. The discharged water would move through the vadose zone into the groundwater where it would slowly flow toward, and discharge to, seeps along the Columbia River and directly into the Columbia River. An estimated 100 years would be required for any contaminants to reach the Columbia River where it would rapidly mix with the large volumes of water in the Columbia River. All levels of contaminants would meet the requirements of the approved permit.

Concern has been raised in the past about the amount of tritium that would be released from the land disposal facility. As discussed in DOE/EIS-0189-SA2, the specifications for the maximum amount of contaminants that can be sent to the Effluent Treatment Facility and the new revised inventory of the tanks have been developed since preparation of the TWRS EIS. The maximum allowable concentration of tritium that can be sent to the Effluent Treatment Facility from the vitrification facility is 2.0×10^{-6} Ci/L. The estimated discharge rate for the Effluent Treatment Facility is 568 L/min (150 gal/min).

A calculation was provided in DOE/EIS-0189-SA2 that indicated that the Federal drinking water standard (40 CFR 141) for tritium (20,000 pCi/L) would still be met even though the estimated amount of tritium in the tank waste had increased to 24,300 Ci. The DOE/EIS-0189-SA2 calculation resulted in a maximum tritium concentration at seeps along the Columbia River of 2,700 pCi/L, which is well below the 20,000 pCi/L drinking water standard. The inventory of tritium in the waste tanks is now estimated at 23,800 Ci; therefore, the drinking water standard for tritium should be met by even a larger margin, compared to that calculated in DOE/EIS-0189-SA2.

The Phased Implementation alternative would result in contaminated liquids entering the groundwater as discussed in Section 3.3. Contaminants would enter the groundwater from the following sources:

- Liquid losses during retrieval
- Residual waste left in the tanks following retrieval
- Vitrified waste in the vitrified LAW vaults.

Contaminants from past tank leaks would also migrate into the groundwater. Although these past-practice releases may have been large and may be important to future plans to close the tank farms and remediate the groundwater, they were not addressed in the TWRS EIS because there is not enough known about the amount of losses and their transport through the vadose zone to provide a meaningful comparison of alternatives for remediating the releases. These past-practice releases will be the subject of a future NEPA analysis.

Some contaminants from losses during retrieval or leached from the residual waste or the vitrified LAW vaults may eventually enter the groundwater and discharge into the Columbia River through seeps and springs along the river bank or directly into the river bed where it intersects the groundwater. Once in the Columbia River, the contaminants would rapidly mix with the large flows in the Columbia River due to turbulence of the river flow and the large volume of water in the river.

Table 3.2 shows the maximum concentration of selected contaminants of concern (CoCs) for long-term risk in the Columbia River based on the revised inventory, along with the reference

40 CFR 141 drinking water standards. This Supplement Analysis shows that for the Phased Implementation alternative the concentration of all contaminants would be well within the drinking water standards.

Table 3.2. Concentration of Selected Contaminants of Concern in the Columbia River for the Phased Implementation Alternative Based on Revised Waste Tank Inventory

Constituent	Revised Waste Tank Inventory	Federal Drinking Water Standards* (mg/L)	Concentration in the Columbia River Based on Revised Inventory Alternative (mg/L)
NO_3	6.5E+10 g	4.5E+01	3.8E-03
C-14	3.6E+03 Ci	4.5E-07	6.7E-12
Tc-99	3.0E+04 Ci	5.3E-05	3.8E-08
I-129	8.5E+01 Ci	5.7E-06	1.6E-08
U (total)	8.5E+08 g	2.0E-02	3.6E-03

*40 CFR 141.

3.2.2 Surface Water Drainage Systems

The facilities for the Phased Implementation alternative would be constructed on relatively level and flat terrain. No major drainage features are present. Construction activities would result in slightly altered localized drainage patterns for the temporary construction areas and for the remediation facilities. The area around remediation facilities would be recontoured to conform with RCRA requirements. Small increases in surface water runoff during the infrequent heavy precipitation events or rapid snow melt would occur, but there would be no flooding of drainage systems. There is no new information that would result in a substantive change in the potential impacts to the surface water drainage systems from those presented in the TWRS EIS.

3.3 GROUNDWATER

The new data and information discussed Section 2.0 and Jacobs (2000) support continued refinement of the vadose zone conceptual model and reduce uncertainty associated with long-term predictions of contaminant transport through the vadose zone from tank waste and vitrified LAW sources. This new information in Sections 3.3.1 and 3.3.2 will have no impact on the NEPA analysis but is included to show that the new information has been reviewed in the preparations of this Supplemental Analysis. This information may be used in subsequent NEPA analysis to evaluate tank closure and site remediation. The evaluations provided in the TWRS EIS continue to be bounding with the incorporation of these refinements.

The groundwater is a pathway for potential releases. Releases from the waste tanks and vitrified LAW vaults travel by advection downward through the vadose zone, intercept the unconfined aquifer (saturated zone), and move laterally to points of discharge along the Columbia River. In the TWRS EIS and in this discussion, the sources of the releases include retrieval losses from the waste tanks, residual waste in the tanks, and releases from the vitrified LAW vaults. Past leaks from the waste tanks were not addressed in detail in the TWRS EIS because not enough was known about their distribution and chemical and physical parameters. The following discussion on impacts to the groundwater system is divided into the following segments:

- Flow and contaminant transport through the vadose zone
- Flow and contaminant transport through the underlying saturated zone (groundwater).

Impacts to the groundwater would be the presence of contaminants from tank waste and vitrified LAW vaults at concentrations that vary spatially and temporally in the unconfined aquifer.

3.3.1 Vadose Zone

The following is a summary of how data and information relative to the vadose zone may affect the TWRS EIS groundwater impact assessment. These new data and information, which are discussed in detail in Jacobs (2000), are the following:

- Completion of the spectral gamma logging of drywells around the tank farms
- Final data and evaluations from the borehole 41-09-39 extension and decommissioning at the SX tank farm
- Final data and evaluations from the vitrified LAW site-specific characterization (e.g., vadose zone stratigraphy and hydraulic properties, contaminant mobility, groundwater quality, recharge)
- Final contaminant mobility inferences
- Final data and evaluations on the clastic dikes.

The *Assessment of Historical Leak Model Methodology as Applied to the REDOX High-Level Waste Tank SX-108* (HNF-4756) review of the historical leak model methodology as applied to the SX tank farm in *Analysis of Tank Farm Leak Histories – Historical Leak Model (HLM)* (LA-UR-96-3537) suggests the data are insufficient to reproduce the leak estimates.

As discussed in Sections 3.0 and 4.0, there remains a substantial amount of uncertainty associated with which vadose zone transport mechanisms are important in explaining the transport of past tank leaks. It is likely that all play a role at one or more SSTs. Continuation of the ongoing field investigations are necessary to resolve the effect of these mechanisms on past SST leaks. Current information indicates that, once in the groundwater, mobile contaminants (e.g., technetium-99) will be transported laterally at the previously anticipated rates and the less mobile contaminants (e.g., cesium-137) will not be transported away from the 200 Areas by the groundwater but will be retarded by chemical reactions with the earthen materials that will essentially stop migration of many of the contaminants (PNL-8889).

Leaching of residual SST waste that may be left in the tanks after closure and of the vitrified waste in the vitrified LAW vaults will be largely unaffected by the new data identified in DOE/EIS-0189-SA2 and this Supplement Analysis because of the following factors.

- The residual waste and vitrified LAW will be covered by a low-permeability earthen cover that will reduce infiltration of water to very low levels so the leaching of residual waste into the vadose zone will be very slow.

- The chemistry and physical form of the residual tank waste and vitrified LAW will be substantially different from the past tank leaks. These two factors prevent the potential transport mechanism described in Jacobs (2000) and in DOE/EIS-0189-SA2 from substantively affecting the contaminant transport of the residuals tank waste and vitrified LAW.

3.3.2 Saturated Zone (Groundwater)

The second half of the groundwater pathway is lateral contaminant transport through the unconfined aquifer flow from points of entry at the vadose zone/water table interface beneath the tank and vitrified LAW sources to the Columbia River. The unconfined aquifer is generally located in the unconsolidated to semiconsolidated Ringold Formation and Hanford formation that overlie the basalt rock. The groundwater in the unconfined aquifer generally flows from the recharge areas near the western boundary of the Hanford Site toward the Columbia River, which is a discharge zone for the unconfined aquifer. New data for the unconfined aquifer include the following:

- Water levels at over 600 wells

- Concentration of contaminants in the groundwater Site-wide, including the areas around the tank farms

- The revised inventory.

The impacts presented in the TWRS EIS were revised for this Supplement Analysis to provide groundwater impact comparisons for the revised tank waste inventory for the selected years (i.e., 2,500, 5,000, and 10,000 years into the future for tank sources and 5,000, and 10,000 for vitrified LAW vaults). The impact revision was accomplished by multiplying the groundwater contaminant concentration estimated in the TWRS EIS by the ratio of the revised tank inventory to the TWRS EIS inventory for selected contaminants. As shown in Tables 3.3 and 3.4, the only contaminants to exceed the drinking water standards (40 CFR 141) for tank waste releases for the revised inventory are uranium-238 and total uranium. In the TWRS EIS, uranium-238 was calculated to have exceeded the standard; thus total uranium would as well. The emerging information on uranium mobility indicates that uranium would not likely exceed the drinking water standards within the 10,000-year period of interest (PNNL-11800). The mobility of uranium in the vadose zone and saturated zone is still being researched. The new data and information discussed Section 2.0 and Jacobs (2000) support continued refinement of the saturated zone conceptual model. The evaluations provided in the TWRS EIS continue to be bounding with the incorporation of these refinements.

Table 3.3. Comparison of Maximum Concentrations Calculated in Groundwater Between the TWRS EIS and Revised Best-Basis Inventories Phased Implementation Total Alternative (Tank Sources)

Constituent	Drinking Water Standard[a] (mg/L)	2,500 years		5,000 years		10,000 years	
		TWRS EIS (mg/L)	Best-Basis Inventory (mg/L)	TWRS EIS (mg/L)	Best-Basis Inventory (mg/L)	TWRS EIS (mg/L)	Best-Basis Inventory (mg/L)
C-14	4.5E-07	3.4E-10	2.3E-10	6.8E-09	4.6E-09	2.0E-13	1.3E-13
I-129	5.7E-06	5.3E-08	1.2E-07	2.0E-06	4.5E-06	1.3E-10	2.9E-10
Np-237	NA	7.2E-08	1.8E-07	2.2E-06	5.4E-06	8.4E-11	2.1E-10
Se-79	NA	7.5E-09	5.7E-09	2.8E-07	2.1E-07	1.7E-11	1.3E-11
Tc-99	5.3E-05	3.8E-07	3.6E-07	1.5E-05	1.4E-05	1.5E-09	1.5E-09
U-233	NA	7.0E-13	2.7E-08	2.3E-11	8.9E-07	0.0	0.0
U-234	NA	2.4E-11	3.9E-08	1.4E-09	2.3E-06	0.0	0.0
U-235	NA	7.4E-06	4.9E-06	5.8E-04	3.8E-04	7.2E-09	4.7E-09
U-236	NA	4.6E-11	1.8E-07	6.6E-10	2.7E-06	0.0	0.0
U-237	NA	0.0	0.0	0.0	0.0	0.0	0.0
U-238	NA	1.1E-03	6.9E-04	8.9E-02[b]	5.5E-02[b]	1.0E-06	6.3E-07
Total U	2.0E-02 (total)	1.1E-03	6.9E-04	8.9E-02[b]	5.5E-02[b]	1.0E-06	6.3E-07
NO_3- NO_2	4.5E+01 (NO_3)	2.4E-02	1.3E-02	5.4E+00	3.0E+00	2.5E-04	1.4E-04

[a] 40 CFR 141.
[b] Calculated value exceeds the drinking water standard (40 CFR 141.16) based on a calculated dose equivalent of 4 mrem/year.

NA = not applicable.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

Table 3.4. Comparison of Maximum Concentration Calculated in Groundwater Between the TWRS EIS and Revised Best-Basis Inventories for the Phased Implementation Total Alternative (Low-Activity Waste Vaults)

Constituent	Drinking Water Standard* (mg/L)	5,000 years		10,000 years	
		TWRS EIS (mg/L)	Best-Basis Inventory (mg/L)	TWRS EIS (mg/L)	Best-Basis Inventory (mg/L)
Np-237	NA	5.3E-08	1.3E-07	1.4E-07	3.5E-07
Tc-99	5.3E-05	4.6E-06	4.3E-06	1.2E-05	1.2E-05
U-233	NA	2.0E-13	7.7E-09	6.0E-13	2.3E-08
U-234	NA	6.6E-12	1.1E-08	1.8E-11	2.8E-08
U-235	NA	2.1E-06	1.4E-06	5.6E-06	3.7E-06
U-236	NA	7.6E-12	3.1E-08	2.0E-11	8.3E-08
U-238	NA	3.1E-04	1.9E-04	8.3E-04	5.2E-04
U (total)	2.0E-02 (total)	3.1E-04	1.9E-04	8.4E-04	5.2E-04

* 40 CFR 141.

NA = not applicable.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

3.4 AIR QUALITY

3.4.1 TWRS EIS Baseline

Air pollutant emission estimates were calculated and air dispersion modeling was performed to analyze air quality impacts for the Phased Implementation alternative in the TWRS EIS. The analyses were conducted to compare the calculated impacts of potential criteria pollutant releases against Federal and Washington State (State) air quality standards. The analyses also compared the calculated impacts of emissions of radionuclides against applicable Federal and State standards.

Compliance with Federal and State ambient air quality standards for criteria pollutant releases and compliance with State ambient air quality standards for radionuclides were measured in the TWRS EIS analysis at maximum receptor locations including the Hanford Site boundary, along the Columbia River, and on State Route 240. Compliance with the Federal standard for radionuclide releases was measured at the nearest residence.

The results of the modeling were compared with State air quality standards or emission levels listed in the *Washington Administrative Code* (WAC 173-470, WAC 173-474, WAC 173-475, and WAC 173-480) and with 40 CFR 50. The State ambient air quality standards are equal to or more stringent than the Federal standards, thus compliance with the State air quality standards results in compliance with the Federal standards. All criteria pollutant concentrations and radionuclide doses calculated in the TWRS EIS are below the Federal and State standards. All criteria pollutants and radiological doses are at least one order of magnitude below the standards except for fugitive dust (PM-10) and the radiological dose, which are 65% and 13% of the standards, respectively.

3.4.2 New Information

Since publication of the TWRS EIS new information has been generated that could change the conclusions reached in the TWRS EIS for air quality impacts. The new information includes changes in the tank waste inventory, Phase I air quality data from the waste vitrification facilities, and larger Phase II waste vitrification facilities.

3.4.2.1 Revised Inventory. A revised best-basis tank waste inventory as of October 5, 1999 was evaluated as discussed in Section 2.2.1. Table 2.1 provides a comparison of the TWRS EIS inventory to the revised inventory for chemical and radiological constituents. The revised inventory was compared against CoCs in the inventory used to calculate criteria pollutants and radionuclide concentrations from air emissions evaluated in the TWRS EIS. Scaling factors, presented in Table 3.5, were calculated for estimating criteria pollutant air concentrations from Phase II vitrification activities based on the revised inventory data. They also were used for estimating a radiological dose to the nearest resident (Federal standard) and a maximum offsite receptor (State standard) resulting from routine tank farm operations and Phase II vitrification activities. The scaling factors reflect a directly proportional change in the emissions evaluated in the TWRS EIS.

Table 3.5. Scaling Factors for Estimating Criteria Pollutant Air Concentrations and Radiological Doses

Constituent of Concern	Scaling Factor*
NO_x	5.4E-01
SO_x	1.6E+00
CO	No new data
PM-10	No new data
Am-241	1.1E+00
Cs-137	1.6E+00
Pu-239/240	1.7E+00
Sr-90	1.1E+00
Tc-99	9.5E-01
C-14	6.7E-01
I-129	2.2E+00

* Scaling factors are taken from Table 2.1 and were calculated by dividing the revised best-basis inventory by the TWRS EIS inventory.

TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

3.4.2.2 Phase I Data Reports. CCN: 012779 includes the most recent data for criteria pollutant and radiological emission rates from Phase I operations of LAW/HLW vitrification facilities. It does not include data for criteria pollutant emission concentrations and radiological doses at the

Federal and State receptor locations nor does it include emission data from construction. Criteria pollutant and radiological emission rates from Phase I vitrification facilities are summarized in Table 3.6.

Table 3.6. Criteria Pollutant and Radiological Air Emission Rates

Constituent of Concern	Emission Rate
Criteria Pollutant (g/sec)	
SO_x	7.0E-01
CO	4.9E-01
NO_x	1.9E+00
PM-10	1.9E-01
Radiological Constituents (Ci/yr)	
Am-241	1.7E-07
C-14	7.1E+00
Cs-137	6.0E-02
I-129	1.2E-01
Pu-239	3.7E-07
Sr-90	1.1E-03
Tc-99	3.3E-04

Source: CCN: 012779.

BNFL-5193-ER-01 contains an evaluation of criteria pollutant emission rates and concentrations from Phase I construction and operations of a LAW/HLW facility. The data are summarized in Table 3.7.

3.4.2.3 Phase II Waste Vitrification Facilities. The capacity of the Phase II waste vitrification facilities evaluated in the TWRS EIS would have to be increased to meet the Tri-Party Agreement milestone to complete SST waste retrieval by 2018 and waste vitrification by 2028. The facilities evaluated in the TWRS EIS were two LAW facilities, each at 100 metric tons (MT) of processed waste per day, and one HLW facility at 10 MT/day (combined 210 MT/day). To meet Tri-Party Agreement milestones the capacity would need to be increased to two LAW facilities each at 150 MT/day and one HLW facility at 30 MT/day (combined 330 MT/day) (HNF-SD-WM-SP-012, Rev. 1). The criteria pollutant air concentrations and radiological doses from the 330 MT/day facilities were estimated in Jacobs (2000) based on the increased Phase I to Phase II emissions evaluated in the TWRS EIS for the 41 MT/day facilities and the 210 MT/day facilities, respectively. The estimated emission concentrations and radiological doses from the 330 MT/day facilities are summarized in Table 3.8.

Table 3.7. Criteria Pollutant Air Emission Rate and Concentration Data

Constituent of Concern – Averaging period	Concentration ($\mu g/m^3$)		Emission Rate (g/sec)	
	Construction	Operation	Construction	Operation
SO_x ($\mu g/m^3$)			6.0E-01	4.4E+00
1 hour	4.7E+01	5.3E+01		
3 hours	3.3E+01	4.0E+01		
24 hours	7.8E+00	1.5E+01		
Annual	4.0E-01	2.2E+00		
CO ($\mu g/m^3$)			1.7E+01	1.7E-01
1 hour	1.3E+03	2.1E+00		
8 hour	6.3E+02	9.3E-01		
NO_x ($\mu g/m^3$)			5.7E+00	1.7E+00
Annual	3.9E+00	9.1E-01		
PM – 10 ($\mu g/m^3$)			4.0E+00	7.4E-01
24 hours	5.2E+01	2.5E-01		
Annual	2.8E+00	3.7E-02		

Source: BNFL-5193-ER-01.

Table 3.8. Criteria Pollutant Air Concentrations and Radiological Dose as Estimated for 330 MT/day Facilities

Constituent of Concern – Averaging period	Construction	Operations
SO_x ($\mu g/m^3$)		
1 hour	7.6E+00	6.5E+00
3 hours	6.8E+00	5.9E+00
24 hours	3.0E+00	2.6E+00
Annual	2.9E-02	3.3E-02
CO ($\mu g/m^3$)		
1 hour	3.2E+03	4.8E+01
8 hour	2.2E+03	3.4E+01
NO_x ($\mu g/m^3$)		
Annual	2.1E+00	6.5E-02
PM – 10 ($\mu g/m^3$)		
24 hours	9.8E+01	7.5E-01
Annual	1.1E+00	7.9E-03
Radionuclide (mrem/yr)		
Nearest resident	1.8E-03	1.3E+00
Site boundary	2.6E-03	1.5E+00

3.4.3 Impacts of the New Information

The revised inventory and the air emissions data from CCN: 012779 and BNFL-5193-ER-01 could change the level of impact to air quality as evaluated in the TWRS EIS for Phase I. Likewise, the revised inventory and the new data for the larger Phase II waste vitrification facilities could change the level of impact to air quality as evaluated in the TWRS EIS for Phase II. These potential impacts, based on the new information, are evaluated in this section.

3.4.3.1 Phase I Impacts. The Phase I air quality evaluated in the TWRS EIS is impacted by a combination of the revised inventory presented in Table 2.1 and the criteria pollutant emissions and radiological emissions data taken from CCN: 012779 and BNFL-5193-ER-01.

The most current data for criteria pollutant air emissions during construction were obtained from BNFL-5193-ER-01 and summarized in Table 3.7. These emissions would come primarily from heavy excavation and construction equipment. The criteria pollutant air concentrations are presented in Table 3.9, along with the Federal and State averaging periods, where they are compared with Federal and State Standards and concentrations calculated in the TWRS EIS.

The source of radiological emissions during construction would be from routine tank farm operations. The most current radiological emissions data from routine tank farm operations are found in Appendix G, Table G.4.0.21 of the TWRS EIS and presented in Table 3.10. The radiological doses from Table 3.10 are adjusted by applying scaling factors from Table 3.5 to account for the revised best-basis tank waste inventory as discussed in Section 2.2.1. The radiological doses from each isotope are calculated and summed in Table 3.11 and presented in Table 3.9 where they are compared with Federal and State Standards and doses calculated in the TWRS EIS.

The most current data for criteria pollutant air emissions during operations were obtained from CCN: 012779 and summarized in Table 3.6. The data included emission rates but no criteria pollutant air concentrations. Therefore, the air concentrations resulting from the emission rates were scaled from the emission rate and air concentration ratio calculated in BNFL-5193-ER-01. The emission rates and air concentrations calculated in BNFL-5193-ER-01 are summarized in Table 3.7. The criteria pollutant air concentrations based on the most current emission rate data in CCN: 012779 are presented in Table 3.9, along with the Federal and State averaging periods, where they are compared with Federal and State Standards and concentrations calculated in the TWRS EIS.

The most current data for radiological air emissions during operations was obtained from CCN: 012779 and summarized in Table 3.6. The data included emission rates but no radiological doses at the Federal and State receptor sites. Therefore, the doses resulting from the emission rates were scaled from the emission rate and receptor dose ratio calculated in the TWRS EIS. The TWRS EIS was used because BNFL-5193-ER-01 did not include doses at both the Federal and State receptor sites. The emission rates and radiological doses at the Federal and State receptor sites, as calculated in the TWRS EIS, are presented in Table 3.11. The Federal and State receptor doses are presented in Table 3.9 where they are compared with Federal State Standards and doses calculated in the TWRS EIS.

Table 3.9. Maximum Criteria Pollutant Concentrations and Radiological Dose for Phase I and Phase II

Constituent of Concern Averaging Period	Construction				Operations				Standard	
	TWRS EIS		Current Planning Baseline		TWRS EIS		Current Planning Baseline		Federal	State
	Phase I	Phase II	Phase I[a]	Phase II[b]	Phase I	Phase II	Phase I[a]	Phase II[b]		
SO_x (μg/m^3)										
1 hour	4.8E+00	7.6E+00	4.7E+01	7.6E+00	2.4E+00	4.0E+00	8.5E+00	6.5E+00	NA	6.6E+03
3 hours	4.3E+00	6.9E+00	3.3E+01	6.8E+00	2.1E+00	3.6E+00	6.4E+00	5.9E+00	1.3E+03	NA
24 hours	3.2E+00	3.1E+00	7.8E+00	3.0E+00	9.0E-01	1.6E+00	2.3E+00	2.6E+00	3.7E+02	2.6E+02
Annual	2.9E-02	2.9E-02	4.0E-01	2.9E-02	1.4E-02	2.0E-02	3.5E-01	3.3E-02	8.0E+01	6.0E+01
CO (μg/m^3)										
1 hour	1.1E+03	3.2E+03	1.3E+03	3.2E+03	3.9E+01	4.8E+01	5.9E+00	4.8E+01	4.0E+04	4.0E+04
8 hour	8.0E+02	2.3E+03	6.3E+02	2.2E+03	2.7E+01	3.4E+01	2.7E+00	3.4E+01	1.0E+04	1.0E+04
NO_x (μg/m^3)										
Annual	1.3E+00	2.1E+00	3.9E+00	2.1E+00	9.6E-03	1.2E-01	1.0E+00	6.5E-02	1.0E+02	1.0E+02
PM-10 (μg/m^3)										
24 hours	8.7E+01	9.8E+01	5.2E+01	9.8E+01	5.2E-02	7.5E-01	6.3E-02	7.5E-01	1.5E+02	1.5E+02
Annual	1.2E+00	1.1E+00	2.8E+00	1.1E+00	7.1E-04	7.9E-03	9.5E-03	7.9E-03	5.0E+01	5.0E+01
Total radionuclide (mrem/yr)										
Resident	1.1E-03	1.1E-03	2.4E-03	1.8E-03	3.2E-01[c]	7.7E-01[c]	5.0E-02	1.3E+00	1.0E+01[e]	--
Boundary	1.6E-03	1.6E-03	3.5E-03	2.6E-03	4.1E-01	9.2E-01[d]	6.4E-02	1.5E+00	--	2.5E+01[f]

[a] Current planning baseline Phase I – Based on Tables 4.2 and 4.7 in BNFL-5193-ER-01 and revised best-basis tank waste inventory (Jacobs 2000).
[b] Current planning baseline Phase II – Based on scaling up to 330 MT/day facilities and revised best-basis tank waste inventory (Jacobs 2000).
[c] Misprint in TWRS EIS Table 5.3.1 shows 4.0E-01.
[d] Misprint in TWRS EIS Table 5.3.1 shows 5.0E-01.
[e] Maximum at nearest resident (Federal standard).
[f] Maximum at any offsite receptor (State standard).

NA = not applicable.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

Table 3.10. Radiological Doses During Construction Calculated in the TWRS EIS

Isotope	State (boundary) dose (mrem/yr)	Federal (resident) dose (mrem/yr)
Cs-137	2.2E-07	1.3E-07
Pu-239/240	1.6E-03	1.1E-03
Sr-90	7.1E-07	4.8E-07
I-129	6.2E-06	3.8E-06

Table 3.11. Radiological Dose for Federal and State Receptors from Operations

Isotope	TWRS EIS Emissions[a] (Ci/yr)	TWRS EIS Federal Dose[b] (mrem/yr)	TWRS EIS State Dose[b] (mrem/yr)	CCN: 012779 Emissions[c] (Ci/yr)	Supplement Analysis Federal Dose[d] (mrem/yr)	Supplement Analysis State Dose[e] (mrem/yr)
Am-241	2.4E-04	1.0E-03	1.3E-03	1.7E-07	7.1E-07	9.2E-07
C-14	1.1E+02	1.7E-01	2.2E-01	7.1E+00	1.1E-02	1.4E-02
Cs-137	1.7E-01	1.4E-03	1.8E-03	6.0E-02	4.9E-04	6.2E-04
I-129	4.4E-01	1.4E-01	1.8E-01	1.2E-01	3.9E-02	5.0E-02
Pu-239	2.6E-04	2.2E-03	3.1E-03	3.7E-07	3.1E-06	4.3E-06
Sr-90	2.7E-01	7.6E-04	9.9E-04	1.1E-03	3.2E-06	4.2E-06
Tc-99	1.8E-05	2.2E-08	2.9E-08	3.3E-04	4.1E-07	5.4E-07
Total	--	3.2E-01	4.1E-01	--	5.0E-02	6.4E-02

[a] From TWRS EIS, Appendix G, Table G.3.1.30.
[b] From TWRS EIS, Appendix G, Table G.4.0.31.
[c] From CCN: 012779, Attachment 1, Table 1.
[d] Supplement Analysis Federal dose factored as follows: Supplement Analysis Federal dose = (TWRS EIS Federal dose) x (CCN: 012779 emissions) / (TWRS EIS emissions).
[e] Supplement Analysis state dose factored as follows: Supplement Analysis State dose = (TWRS EIS State dose) x (CCN: 012779 emissions) / (TWRS EIS emissions).

A comparison of the potential air emissions from facilities as currently planned with the facilities analyzed in the TWRS EIS and Federal and State standards indicate the following for Phase I.

- Sulfur oxide emission rates have the greatest air quality impact during construction. The sulfur oxide air concentration from the currently planned facilities exceeds the concentrations calculated in the TWRS EIS by 150%. However, the sulfur oxide air concentration calculated in the TWRS EIS for the In Situ Vitrification alternative bounds the current planning concentration by approximately 90%. The current planning sulfur oxide air concentration is 3% of the standard.

- Carbon monoxide emission rates have the greatest air quality impact during construction. The carbon monoxide air concentrations from the currently planned facilities are reduced to 79% of the carbon monoxide concentration calculated in the TWRS EIS and is 6% of the standard.

- Nitrogen oxide emission rates have the greatest air quality impact during construction. The nitrogen oxide air concentrations from the currently planned facilities exceed the concentration calculated in the TWRS EIS by 200%. There are no alternatives evaluated in the TWRS EIS that bound the nitrogen oxide concentration for current planning; however, the nitrogen oxide concentrations from the currently planned facilities are 4% of the standard.

- PM-10 emission rates have the greatest air quality impact during construction. The PM-10 air concentrations from the currently planned facilities are reduced to 60% of the concentrations calculated in the TWRS EIS and are 35% of the standard.

- Radiological doses have the greatest air quality impact during operations. The radiological dose from currently planned facilities is reduced to 7% of the radiological dose calculated in the TWRS EIS and is 0.5% of the standard.

3.4.3.2 Phase II Impacts. The Phase II air quality evaluated in the TWRS EIS is impacted by a combination of the revised inventory presented in Table 3.2 and increasing the capacity of the Phase II waste vitrification facilities from the 210 MT/day to 330 MT/day. The criteria pollutant emission concentrations and radiological dose presented in Table 3.8 are adjusted by applying scaling factors from Table 3.5 to account for the revised best-basis tank waste inventory for chemical and radiological constituents as discussed in Section 2.2.1. The adjusted values are presented in Table 3.11 where they are compared with TWRS EIS values and Federal and State standards. The values represent the revised air quality impacts based on the revised inventory and emissions from constructing and operating a larger Phase II facility.

A comparison of the air emissions from currently planned facilities with those evaluated in the TWRS EIS and with the Federal and State standards indicate the following for Phase II.

- Sulfur oxide emission rates have the greatest air quality impact during construction. The sulfur oxide air concentrations from currently planned facilities would be approximately the same as calculated in the TWRS EIS and are 1% of the standard.

- Carbon monoxide emission rates have the greatest air quality impact during construction. The carbon monoxide air concentrations from currently planned facilities would be approximately the same as calculated in the TWRS EIS and are 22% of the standard.

- Nitrogen oxide emission rates have the greatest air quality impact during construction. The nitrogen oxide air concentrations from currently planned facilities would be approximately the same as calculated in the TWRS EIS and are 2% of the standard.

- PM-10 emission rates have the greatest air quality impact during construction. The PM-10 air concentrations from currently planned facilities would be approximately the same as calculated in the TWRS EIS and are 65% of the standard.

- Radiological doses have the greatest air quality impact during operations. The radiological dose from currently planned facilities would exceed the radiological dose calculated in the TWRS EIS by 69%; however, the radiological dose calculated in the TWRS EIS for the Ex Situ/In Situ Combination alternative is approximately the same as the dose from the currently planned facilities. The current planning baseline radiological dose is 13% of the standard.

3.5 BIOLOGICAL RESOURCES

3.5.1 TWRS EIS Baseline

Biological and ecological resource impacts were calculated for the Phased Implementation alternative and other selected alternatives in the TWRS EIS. The impact analysis in the TWRS EIS focused on the biological resources of the specific land areas where activities are proposed under the various TWRS EIS alternatives. Most impacts would occur in the 200 Areas where tank waste is currently, and is projected to be, stored and where waste vitrification, storage, and disposal facilities would be located. Smaller impacts would be located at potential borrow sites where varying levels of borrow material would be secured to support facility construction and post-remediation tank farm activities. Biological and ecological impacts identified in the TWRS EIS included potential impacts to vegetation and wildlife habitat, especially shrub-steppe habitat. Impacts assessed included impacts resulting from temporary disturbance of habitat to support construction and operation of facilities, permanent disturbances supporting post-remediation activities, impacts resulting from noise and transportation impacts that would disrupt wildlife, and potential impacts to biodiversity.

For the TWRS EIS analysis, the key issues were as follows:

- Whether the land areas proposed for use currently are undisturbed or whether they have been disturbed by past activities

- Extent of potential impacts on sensitive shrub-steppe habitat, which is considered a priority habitat by Washington State

- Potential impacts on plant and animal species of concern (i.e., those listed or candidates for listing by the Federal government or Washington State as threatened, endangered, and sensitive).

The potential site for construction and operation of the alternatives contained both undisturbed and disturbed land. For example, the tank farms and their immediate surrounding areas currently are heavily disturbed and thus have minimal native vegetative or wildlife habitat.
The vitrification facility sites in the 200 East Area associated with the various alternatives contain currently disturbed land that is of minimal habitat value and undisturbed shrub-steppe that is considered valuable as vegetative and wildlife habitat. The analysis of potential impacts on species of concern focused on plant and animal species found in the Hanford Site's shrub-steppe habitat.

Where the Phased Implementation alternative activities were proposed in areas that are partly disturbed and partly undisturbed habitat, vegetation and wildlife habitat impacts were calculated proportional to the current percentage of disturbed versus undisturbed land at the particular site. For example, if 30 ha (74 ac) were required at a site that currently is 50% disturbed, the habitat impact was calculated to be 15 ha (37 ac).

3.5.2 New Information

Since publication of the TWRS EIS, new information has been generated that could change the conclusions reached in the TWRS EIS for biological resources. The new information includes the following:

- Estimated disturbed areas for infrastructure (HNF-3239)
- Estimated disturbed areas for Phase I waste vitrification facilities (CCN: 012779)
- Changes in the assumed location for construction borrow material for Phase I (CCN: 012779)
- Larger Phase II waste vitrification facilities (HNF-SD-WM-SP-012, Rev. 1)
- Changes in the disposal concept for the vitrified LAW from vaults to remote-handled trenches (Taylor 1999).

3.5.2.1 Phase I Shrub Steppe Disturbance. New information related to shrub steppe disturbance includes the following:

- Impacts on 31 ha (77 ac) for the waste vitrification facilities (CCN: 012779)
- Impacts on 5 ha (12 ac) at the sand and gravel borrow site for constructing the waste vitrification facilities (Jacobs 2000)
- Impacts on 9 ha (22 ac) for tank farm infrastructure construction including 4 ha (10 ac) for transmission corridor access road and 5 ha (12 ac) for transmission tower pads (HNF-3239)
- Impacts on 2 ha (5 ac) for vitrified LAW remote-handled trenches (Jacobs 2000).

3.5.2.2 Phase II Shrub Steppe Disturbance. To meet the Tri-Party Agreement milestone, the capacity of the Phase II waste vitrification facilities evaluated in the TWRS EIS would have to be increased. The facilities evaluated in the TWRS EIS were 2 LAW facilities each at 100 MT/day and 1 HLW facility at 10 MT/day (combined 210 MT/day). The capacity of these facilities would need to be increased to 2 LAW facilities each at 150 MT/day and 1 HLW facility at 30 MT/day (combined 330 MT/day) (HNF-SD WM-SP-012, Rev. 1). The area of shrub steppe impacts resulting from building the larger facilities was scaled (Jacobs 2000) from the Phase II facility evaluated in the TWRS EIS.

The vitrified LAW disposal program has been rebaselined by changing the scope of Project W-520 from a vault concept to incorporate the remote-handled trench concept (Taylor 1999). The change results in the vitrified LAW being disposed of in RCRA-compliant, remote-handled landfill trenches instead of in vaults. Based on the available preconceptual design information (Shah 1999), the vitrified LAW disposal complex would consist of approximately six double-lined trenches with leachate collection systems located on vacant land in the 200 East Area and southwest of the Plutonium-Uranium Extraction Plant. This site location is the same as that planned for Project W-520 vitrified LAW vaults.

The revised Phase II shrub steppe impacts can be summarized as follows:

- Impacts on 101 ha (249 ac) for the waste vitrification facilities
- Impacts on 16 ha (40 ac) for vitrified LAW remote-handled trenches
- Impacts on 59 ha (146 ac) at the sand and gravel borrow site for constructing the waste vitrification facilities
- Impacts on 41 ha (101 ac) at the sand and gravel borrow site for closure
- Impacts on 14 ha (35 ac) at the silt borrow site for closure
- Impacts on 26 ha (64 ac) at the rip rap borrow site for closure.

3.5.3 Impacts of the New Information

The new shrub steppe disturbance information would change the level of biological and ecological resource impacts as calculated in the TWRS EIS for Phase I. Likewise, the new data for the larger Phase II waste vitrification facilities would change the level of impacts as calculated in the TWRS EIS for Phase II. These potential impacts, based on new information, are presented in Table 3.12 and calculated in this section.

3.5.3.1 Phase I. The total shrub steppe disturbance for the current planning baseline would exceed the total shrub-steppe disturbance calculated in the TWRS EIS for the Phased Implementation alternative, Phase I, by 124%.

3.5.3.2 Phase II. The total shrub-steppe disturbance for the current planning baseline would exceeds the total shrub-steppe disturbance calculated in the TWRS EIS for the Phased Implementation alternative, Phase II, by 30%.

Table 3.12. Comparison of Shrub-Steppe Impacts – Change from the TWRS EIS

Activity	TWRS EIS		Current Planning Baseline	
	Phase I (ha)	Phase II (ha)	Phase I (ha)	Phase II (ha)
Vitrification facility (remediation)	20	79	31	101
Tank farm infrastructure (remediation)	0	0	9	0
Vitrified LAW vaults (remediation)[a]	0	0[b]	2	16
Sand and gravel borrow site (remediation)	1	37	5	59
Sand and gravel borrow site (closure)	0	41	0	41
Silt borrow site (closure)	0	14	0	14
Rip rap borrow site (closure)	0	26	0	26
Total disturbance	21	197	47	257

[a] Current planning baseline assumes vitrified LAW remote-handled trenches.
[b] Shrub-steppe impacts are included with vitrification facility impacts.

LAW = low-activity waste.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

3.5.3.3 Total Alternative. Because the Phase I or Phase II shrub-steppe disturbance for the current planning baseline are not bound by the Phased Implementation alternative calculated in the TWRS EIS, the next step would be to determine if they are bound by other alternatives in the TWRS EIS. The impacts from Phase I and Phase II are summed so that the total alternative is compared with the other alternatives in the TWRS EIS. There are no alternatives evaluated in the TWRS EIS that would bound the results of the shrub-steppe disturbance for the current planning baseline. However, the increased shrub-steppe disturbance for the current planning baseline are small and represent a 1% impact of the remaining shrub-steppe habitat on the Central Plateau. Therefore, none of the increased Phase I and Phase II impacts shown in Table 3.12 substantially change the understanding of impacts to shrub-steppe presented in the TWRS EIS.

3.6 CULTURAL RESOURCES

3.6.1 TWRS EIS Baseline

Potential impacts on prehistoric and historic Hanford sites were analyzed in the TWRS EIS for a Phased Implementation alternative and various other alternatives. The approach used was to define specific land areas that would be disturbed by construction and operation activities and identify any prehistoric or historic materials or sites at those locations that might be adversely impacted. For the TWRS EIS, cultural resource surveys of the proposed sites for Phased Implementation Phase I and Phase II facilities determined that there were no archaeological or historical sites in the potentially impacted area and, thus, there were minimal potential impacts to prehistoric and historic sites. The TWRS EIS analysis concluded that it is possible the disturbed areas may contain cultural resources that were not identified in past surveys. Thus, additional cultural resource surveys would be conducted and construction would include procedures and monitoring activities to protect cultural resources encountered during construction.

Phase I of the Phased Implementation alternative would disturb approximately 21 ha (52 ac) of previously undisturbed land including the following:

- Disturbance of 20 ha (49 ac) for the waste vitrification facilities
- Disturbance of 1 ha (2 ac) at the sand and gravel borrow site.

Phase II would disturb approximately 116 ha (287 ac) previously undisturbed land including the following:

- Disturbance of 79 ha (195 ac) for the waste vitrification facilities
- Disturbance of 37 ha (91 ac) at the sand and gravel borrow site.

Closure would disturb approximately 81 ha (200 ac) of previously undisturbed land including the following:

- Disturbance of 41 ha (101 ac) at the sand and gravel borrow site
- Disturbance of 14 ha (35 ac) at the silt borrow site
- Disturbance of 26 ha (64 ac) at the rip rap borrow site.

3.6.2 New Information

Since publication of the TWRS EIS, new information has been generated that changes the amount of previously undisturbed land that could change the impacts on cultural resources. The new information includes the following:

- Estimated disturbed areas for infrastructure (HNF-3239)

- Estimated disturbed areas for Phase I waste vitrification facilities (CCN: 012779)

- Changes in the assumed location for construction borrow material for Phase I (CCN: 012779)

- Larger Phase II waste vitrification facilities (HNF-SD-WM-SP-012, Rev. 1)

- Changes in the disposal concept for the vitrified LAW from vaults to remote-handled trenches (Taylor 1999).

On May 12, 1999, the Cultural Resource Manager of the Confederated Tribes of the Umatilla Indian Reservation requested that RL provide documentation that the Hanford Site is in compliance with cultural resource laws and regulations for Project W-519 (Project W-519 is the preparation of the infrastructure for the vitrification plant). RL responded in "Project W-519 Documentation of Compliance With Cultural Resource Laws and Regulations" (Lloyd 1999). RL concluded that based on previous archaeological surveys conducted in and around the project area, and based on known archaeological sites and isolated artifacts, no known significant archaeological resources are located within the project area and that RL is in full compliance with all relevant and appropriate regulations.

RL has prepared *Draft Plan of Action for the Treatment of Cultural Items Inadvertently Discovered During Construction of the W-519 Project on the Hanford Site, United States Department of Energy, Office of River Protection* (DOE-RL 1999). The purpose of this plan of action is to establish procedures that will be followed if cultural resources are inadvertently discovered during Project W-519 construction activities at the Hanford Site.

3.6.2.1 Phase I Previously Undisturbed Land Disturbance. Previously undisturbed land disturbances would include the following:

- Disturbance of 31 ha (77 ac) for the waste vitrification facilities (CCN: 012779)
- Disturbance of 5 ha (12 ac) at the sand and gravel borrow site for the waste vitrification facilities (Jacobs 2000)
- Disturbance of 9 ha (22 ac) for tank farm infrastructure including 4 ha (10 ac) for transmission corridor access road and 5 ha (12 ac) for transmission tower pads (HNF-3239).
- Disturbance of 2 ha (5 ac) for vitrified LAW remote-handled trenches (Jacobs 2000).

3.6.2.2 Phase II Previously Undisturbed Land Disturbance. To meet the Tri-Party Agreement milestone, the capacity of the Phase II waste vitrification facilities evaluated in the TWRS EIS would have to be increased. The facilities evaluated in the TWRS EIS were 2 LAW facilities each at 100 MT/day and 1 HLW facility at 10 MT/day (combined 210 MT/day). The capacity of these facilities would need to be increased to 2 LAW facilities each at 150 MT/day and 1 HLW facility at 30 MT/day (combined 330 MT/day) (HNF-SD-WM-SP-012, Rev. 1). The area of previously undisturbed land that would become disturbed as a result of building the larger facility was scaled (Jacobs 2000) from the Phase II waste vitrification facilities evaluated in the TWRS EIS.

The vitrified LAW disposal program has been rebaselined by changing the scope of Project W-520 from a vault concept to incorporate the remote-handled trench concept (Taylor 1999). The change results in the vitrified LAW being disposed of in RCRA-compliant, remote-handled landfill trenches instead of in vaults. Based on the available preconceptual design information (Shah 1999), the vitrified LAW disposal complex would consist of approximately six double-lined trenches with leachate collection systems located on vacant land in the 200 East Area and southwest of the Plutonium-Uranium Extraction Plant. This site is the same as that planned for Project W-520 vitrified LAW vaults. The surface barrier placed over the filled trenches would be a modified RCRA Subtitle C cover.

The revised Phase II previously undisturbed land use impacts can be summarized as follows:

- Disturbance of 101 ha (249 ac) for the waste vitrification facilities

- Disturbance of 16 ha (40 ac) for vitrified LAW remote-handled trenches
- Disturbance of 59 ha (146 ac) at the sand and gravel borrow site for the waste vitrification facilities
- Disturbance of 41 ha (101 ac) at the sand and gravel borrow site for closure
- Disturbance of 14 ha (35 ac) at the silt borrow site for closure
- Disturbance of 26 ha (64 ac) at the rip rap borrow site for closure.

3.6.3 Impacts of the New Information

The new previously undisturbed land disturbance information can change the level of cultural impacts as calculated in the TWRS EIS for Phase I. Likewise, the new data for the larger Phase II waste vitrification facilities can change the level of cultural impacts as calculated in the TWRS EIS for Phase II. These potential impacts, based on the new information are presented in Table 3.13 and are calculated in this section.

Table 3.13. Disturbance of Previously Undisturbed Land

Previously Undisturbed Area	TWRS EIS		Current Planning Baseline	
	Phase I (ha)	Phase II (ha)	Phase I (ha)	Phase II (ha)
Vitrification facility (remediation)	20	79	31	101
Tank farm infrastructure (remediation)	0	0	9	0
Vitrified LAW vaults (remediation)[a]	0	0[b]	2	16
Sand and gravel borrow site (remediation)	1	37	5	59
Sand and gravel borrow site (closure)	0	41	0	41
Silt borrow site (closure)	0	14	0	14
Rip rap borrow site (closure)	0	26	0	26
Total disturbance	21	197	47	257

[a] Current planning baseline assumes vitrified LAW remote-handled trenches.
[b] Disturbance included in the vitrification facility impacts.

LAW = low-activity waste.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

3.6.3.1 Phase I Impacts. The total disturbance to previously undisturbed land for the current planning baseline exceeds the total disturbance to previously undisturbed land calculated in the TWRS EIS for the Phased Implementation alternative, Phase I, by 124%.

3.6.3.2 Phase II Impacts. The total disturbance to previously undisturbed land for the current planning baseline exceeds the total disturbance to previously undisturbed land calculated in the TWRS EIS for the Phased Implementation alternative, Phase II, by 30%.

3.6.3.3 Total Alternative Impacts. Because the Phase I or Phase II potential cultural impacts calculated for the current planning baseline are not bound by the Phased Implementation alternative calculated in the TWRS EIS, the next step would be to determine if they are bound by any other alternatives in the TWRS EIS. The impacts from Phase I and Phase II are summed so that the total alternative is compared with the other alternatives. There are no alternatives evaluated in the TWRS EIS that would bound the results of the cultural impacts evaluated for the current planning baseline. However, the additional areas that would be impacted are unlikely to have prehistoric or historic materials. Regardless, additional cultural resource surveys would be conducted and construction would include procedures and monitoring activities to protect cultural resources encountered during construction. Therefore, none of the increased Phase I and Phase II impacts shown in Table 3.13 substantially change the understanding of impacts to geologic resources and soils presented in the TWRS EIS.

3.7 SOCIOECONOMICS

3.7.1 TWRS EIS Baseline

The TWRS EIS analyzed the potential impacts to the socioeconomic environment associated with each of the alternatives (Volume One, Section 5.6). To support a comparison of the relative impacts of each alternative, the impact analysis focused on key indicators of the potentially impacted area including Hanford Site employment and the effects of Site employment levels on employment, population, taxable retail sales, and housing prices in the surrounding area. These impacts are addressed in more detail in Volume Five, Appendix H of the TWRS EIS. Based on the results of the socioeconomic modeling of the key indicators of socioeconomic impacts, analyses of potential impacts to public services and facilities (schools, police and fire protection, medical services, sanitary and solid waste disposal, and electricity, natural gas, and fuel oil) were completed. Socioeconomic impacts identified in the TWRS EIS were a direct function of the number of labor hours associated with each alternative. In other words, the more labor hours worked under each alternative the higher the level of impact on the key indicators of socioeconomic impacts.

For Phase I in the TWRS EIS the Phased Implementation alternative was projected to result in employment levels that would cause large increases in Hanford Site employment compared to the calculational baseline between FY 1997 and FY 2001 with a peak employment level of 3,280 in FY 2001.

For Phase II in the TWRS EIS the Phased Implementation alternative was projected to result in employment levels that would peak in FY 2010 with about 6,700 additional workers, which would be an approximately 65% increase over the calculational baseline.

3.7.2 New Information

To determine if new information developed since completion of the TWRS EIS indicated changes in understanding of potential socioeconomic impacts, a review of new data was completed. The new data includes the following:

- The Hanford Site and Tri-Cities area employment for FY 1998 (PNNL-6415)
- Anticipated work force for the Phase I waste vitrification facilities (CCN: 012779)
- Larger Phase II waste vitrification facilities (HNF-SD-WM-SP-012, Rev. 1)
- Change in the disposal concept for the vitrified LAW from vaults to remote-handled trenches (Taylor 1999).

3.7.2.1 Hanford Site and Tri-Cities Area Employment for FY 1998. DOE and its contractors, including Fluor Hanford, Inc. (and its subcontractors); Pacific Northwest National Laboratory; Bechtel Hanford, Inc.; and the Hanford Environmental Health Foundation employed an average of 10,420 employees during FY 1998 (PNNL-6415). This is lower than the 14,900 baseline employment level in the TWRS EIS.

3.7.2.2 Phase I Environmental Report. Environmental report CCN: 012779 projects a peak employment level of 3,600 full-time equivalent employees (including construction, engineering, and operations) during FY 2003.

3.7.2.3 Increased Size of Waste Vitrification Facilities for Phase II. To meet the Tri-Party Agreement milestones for waste retrieval and vitrification, the capacity of the Phase II waste vitrification facilities evaluated in the TWRS EIS would have to be increased. The facilities evaluated in the TWRS EIS were 2 LAW facilities each at 100 MT/day and 1 HLW facility at 10 MT/day. The capacity of these vitrification facilities would have to be increased to 2 LAW facilities each at 150 MT/day and 1 HLW facility at 30 MT/day (HNF-SD-WM-SP-012, Rev. 1). The increase in facility footprint and production capacity would result in increased labor requirements and based on the ratio of facility footprint and production capacity the peak employment level would be approximately 9,800 (or 47% higher than the 6,700 full-time equivalent employees in the TWRS EIS) in FY 2010.

3.7.2.4 Vitrified LAW Remote-Handled Trenches. The labor requirements for the vitrified LAW remote-handled trenches are assumed to be the same as the labor requirements for the vitrified LAW vaults evaluated in the TWRS EIS. This is a conservative assumption because the labor requirements for the vitrified LAW remote-handled trenches would be less than the labor requirements for the vaults.

3.7.3 Impacts of the New Information

The employment levels for the Hanford Site and for Phase I were lower than those estimated in the TWRS EIS. The FY 1998 Hanford Site employment level was 4,480 employees (approximately 30%) lower than that used in the TWRS EIS. The peak employment levels projected for Phase I are 300 employees (approximately 9%) more than those estimated in the TWRS EIS.

In the TWRS EIS, socioeconomic impacts were calculated to peak in FY 1999 based on a construction workforce of 3,300. All other impacts (e.g., area employment increase of 5,900 jobs; a housing price increase of 12.9%; and increases in demand for public services that would require additional police and fire personnel and school capacity) are a function of the following:

- Size of the workforce employed under the alternative
- Projected size of the Hanford Site workforce
- Size of the total nonfarm workforce in the Tri-Cities area.

Peak employment projected for Phase I would be 3,600, or 300 more than that used in the TWRS EIS. The increase would be offset by decreases in the Hanford Site baseline employment level. Therefore, when size of the work force and duration of activities are considered, the current planning baseline Phase I projections would not exceed the impacts on the local economy as calculated in the TWRS EIS.

Expanding the footprint and production capacity of the Phase II vitrification facilities would increase the labor requirements compared to the labor requirements in the TWRS EIS. The increase would be largely offset by decreases in the Hanford Site baseline employment level. If the baseline Site employment level were to remain at 10,420 through FY 2010 with a Phase II peak employment level of 9,800 employees, the combined employment level would be 20,220. This combined level would be approximately 5% higher than the peak Hanford Site employment level of approximately 19,000 that occurred in FY 1994 (Daly 1995) as sited in the TWRS EIS.

3.8 LAND USE

3.8.1 TWRS EIS Baseline

Land use impacts were analyzed in the TWRS EIS for the Phased Implementation alternative and various other alternatives. Land use impacts were addressed in terms of temporary and permanent land use commitments. The TWRS EIS concluded that none of the alternatives would require temporary or permanent land use commitments that would exceed the available land for waste management within the 200 Areas. All land use commitments would constitute a small fraction of the 200 Areas' 2,600 ha (6,400 ac).

The greatest impact on land use would result from the Phased Implementation alternative. Phase I of the Phased Implementation alternative would involve temporary disturbance of 33 ha (82 ac) of land during construction and operation. This would include the following:

- Disturbance of 30 ha (7 ac) for new waste vitrification facilities located in the 200 East Area

- Disturbance 2 ha (5 ac) for tank farm infrastructure activities located in the 200 Areas

- Disturbance of 1 ha (2 ac) at the sand and gravel borrow site to support Phase I construction.

There would be no permanent land use commitments resulting from Phase I.

Phase II of the Phased Implementation alternative would involve temporary disturbance of 282 ha (697 ac) of land during construction, operation, and closure. This would include the following:

- Disturbance of 107 ha (264 ac) for new waste vitrification facilities located in the 200 East Area

- Disturbance of 11 ha (27 ac) for vitrified LAW vaults located in the 200 East Area

- Disturbance of 86 ha (212 ac) at the sand and gravel borrow site to support Phase II construction and closure

- Disturbance of 3 ha (7 ac) for retrieval annexes located in the 200 Areas

- Disturbance of 24 ha (59 ac) for tank farm closure in the 200 Areas

- Disturbance of 19 ha (47 ac) at the silt borrow site to support Phase II closure

- Disturbance of 32 ha (79 ac) at the rip rap borrow site to support Phase II closure.

Permanent land use disturbance for Phase II would involve 49 ha (121 ac) of land during construction, operation, and closure. This would include the following:

- Disturbance of 10 ha (25 ac) for waste vitrification facilities located in the 200 East Area
- Disturbance of 14 ha (35 ac) for vitrified LAW vaults located in the 200 East Area
- Disturbance of 25 ha (62 ac) for tank farm closure in the 200 Areas.

The TWRS EIS concluded that potential land use commitments would not conflict with land uses in the area of the Hanford Site immediately surrounding the 200 Areas and recreational resources that would include:

- Hanford Reach of the Columbia River located 11 km (7 mi) from the 200 Areas

- Fitzner Eberhardt Arid Land Ecology Reserve located 3 km (2 mi) southwest of the 200 Areas

- Saddle Mountain National Wildlife Refuge located 8 km (5 mi) north of the 200 Areas

- Wahluke Slope Wildlife Recreation Area located 8 km (5 mi) northeast of the 200 Areas

- McNary National Wildlife Refuge located 20 km (13 mi) southwest of the 200 Areas.

3.8.2 New Information

Since publication of the TWRS EIS, new information has been generated that could change the conclusions reached in the TWRS EIS for land use commitments. The new information includes the following:

- Estimated disturbed area for infrastructure (HNF-3239)
- Estimated disturbed area for Phase I facilities (CCN: 012779)
- Changes in the assumed location for construction borrow material for Phase I (CCN: 012779)
- Larger Phase II waste vitrification facilities (HNF-SD-WM-SP-012, Rev. 1)

Changes in the disposal concept for the vitrified LAW from vaults to remote-handled trenches (Taylor 1999).

3.8.2.1 Phase I Land Use Disturbance. New information related to temporary land commitment includes the following:

- Disturbance of 48 ha (119 ac) of land for Phase I waste vitrification facilities located in the 200 East Area
- Disturbance of 26 ha (64 ac) of land for tank farm infrastructure activities located in the 200 Areas
- Disturbance of 3 ha (7 ac) of land disturbance associated with vitrified LAW remote-handled trenches located in the 200 East Area
- Disturbance of 5 ha (12 ac) of land at the sand and gravel borrow site located between the 200 East and 200 West Areas.

Permanent land use commitment would include 2 ha (5 ac) of land for vitrified LAW remote-handled trenches.

It should be noted that the TWRS EIS assumed the Phase I contractor would obtain borrow material necessary for construction of Phase I waste vitrification facilities from offsite sources. Based on the increase in the footprint of the BNFL Phase I waste vitrification facility design, it is proposed that the current planning baseline assumes that borrow material for construction of Phase I waste vitrification facilities would be obtained from onsite borrow sources. If this recommendation were accepted, further analysis of the borrow sites would be required.

3.8.2.2 Phase II Land Use Disturbance. To meet the Tri-Party Agreement milestone, the Phase II waste vitrification facilities evaluated in the TWRS EIS would have to be increased. The complex evaluated in the TWRS EIS were 2 LAW facilities each at 100 MT/day and 1 HLW facility at 10 MT/day (combined 210 MT/day). The capacity of these facilities would need to be increased to 2 LAW facilities each at 150 MT/day and 1 HLW facility at 30 MT/day (combined 330 MT/day) (HNF-SD-WM-SP-012, Rev. 1). The amount of land that would be committed to facilitate building the larger facility was scaled (Jacobs 2000) from the Phase II waste vitrification facilities evaluated in the TWRS EIS.

The vitrified LAW disposal program has been rebaselined by changing the scope of Project W-520 from a vault concept to incorporate the remote-handled trench concept (Taylor 1999). The change results in the vitrified LAW being disposed of in RCRA-compliant, remote-handled landfill trenches instead of in vaults. Based on the available preconceptual design information (Shah 1999), the vitrified LAW disposal complex would consist of approximately six double-lined trenches with leachate collection systems located on vacant land in the 200 East Area, southwest of the Plutonium-Uranium Extraction Plant. This site location is the same as that planned for Project W-520 vitrified LAW vaults. The surface barrier placed over the filled trenches would be a modified RCRA Subtitle C cover.

The revised Phase II land use impacts can be summarized in the following lists. Temporary land use commitment would include the following:

- Use of 150 ha (371 ac) of land for Phase II waste vitrification facilities located in the 200 East Area
- Use of 24 ha (59 ac) of land for vitrified LAW remote-handled trenches located in the 200 East Area
- Use of 66 ha (163 ac) of land for at the sand and gravel borrow site to support remediation construction
- Use of 3 ha (7 ac) of land for construction of retrieval annexes located in the 200 Areas
- Use of 24 ha (59 ac) of land for tank farm closure in the 200 Areas
- Use of 45 ha (111 ac) of land at the sand and gravel borrow site to support closure activities
- Use of 19 ha (47 ac) of land at the silt borrow site to support closure activities
- Use of 32 ha (79 ac) of land at the rip rap borrow site to support closure activities.

Permanent land use commitment would include the following:

- Use of 16 ha (40 ac) of land for vitrification facilities located in the 200 East Area
- Use of 16 ha (40 ac) of land for vitrified LAW remote-handled trenches and an additional 6 ha (15 ac) of land for vitrified LAW remote-handled trench closure located in the 200 East Area
- Use of 17 ha (42 ac) of land for tank farms and an additional 8 ha (20 ac) of land for tank farm closure in the 200 Areas.

3.8.3 Impacts of the New Information

The new land use commitment information can change the level of land disturbance as calculated in the TWRS EIS for Phase I. Likewise, the new data for the larger Phase II waste vitrification facilities can change the level of land disturbance as calculated in the TWRS EIS for Phase II. These potential impacts, based on the new information, are calculated in this section and presented in Table 3.14 where they are compared with the land use commitments calculated in the TWRS EIS.

3.8.3.1 Phase I Impacts. The total temporary land disturbance calculated for the current planning baseline exceeds the total temporary land use disturbance calculated in the TWRS EIS for the Phased Implementation alternative Phase I by 148%. The total permanent land disturbance calculated for the current planning baseline would go from no permanent land disturbance as evaluated in the TWRS EIS to 2 ha (5 ac).

3.8.3.2 Phase II Impacts. The total temporary land disturbance calculated for the current planning baseline exceeds the total temporary land use disturbance calculated in the TWRS EIS for the Phased Implementation alternative Phase II by 29%. The total permanent land disturbance calculated exceeds the total permanent land use disturbance calculated in the TWRS EIS for the Phased Implementation alternative Phase II by 29%.

3.8.3.3 Total Alternative. Because the Phase I or Phase II land use impacts calculated for the current planning baseline are not bound by the Phased Implementation alternative calculated in the TWRS EIS, the next step would be to determine if they are bound by any other alternatives in the TWRS EIS. The impacts from Phase I and Phase II are summed so that the total alternative is compared with the other alternatives. There are no alternatives evaluated in the TWRS EIS that would bound the results of the land use impacts evaluated for the current planning baseline. However, when compared to the TWRS EIS the increased impacts calculated for the current planning baseline is small and represents an additional 5% temporary land disturbance and an additional 1% permanent land disturbance of the 200 Areas' 2,600 ha (6,400 ac). This is also within the committed land use designation as stated in DOE/EIS-0222. Therefore, none of the increased Phase I and Phase II impacts shown in Table 3.14 substantially change the understanding of impacts to land use presented in the TWRS EIS.

Table 3.14. Land Use Commitments

Activity	TWRS EIS				Current Planning Baseline			
	Phase I		Phase II		Phase I		Phase II	
	Temporary (ha)	Permanent (ha)	Temporary (ha)	Permanent (ha)	Temporary (ha)	Permanent (ha)	Temporary (ha)	Permanent (ha)
Vitrification facility (remediation)	30	0	107	10	48	0	150	16
Tank farm infrastructure (remediation)	2	0	0	0	26	0	0	0
Vitrified LAW vaults (remediation)[b]	0	0	11[a]	11	3	2	24	16
Tank farm (remediation)	0	0	0	17	0	0	0	17
Sand and gravel borrow site (remediation)	1	0	41	0	5	0	66	0
Retrieval annexes (remediation)	0	0	3	0	0	0	3	0
Tank farms (closure)	0	0	24	8	0	0	24	8
Vitrified LAW (closure)[b]	0	0	0	3	0	0	0	6
Sand and gravel borrow site (closure)	0	0	45	0	0	0	45	0
Silt borrow site (closure)	0	0	19	0	0	0	19	0
Rip rap borrow site (closure)	0	0	32	0	0	0	32	0
Total activity	33	0	282	49	82	2	363	63

[a] Temporary land disturbance hectares for vitrified LAW vaults were included in the temporary land disturbance hectares for the vitrification facility in the TWRS EIS, Phase II.
[b] Current planning baseline assumes vitrified LAW remote-handled trenches.

LAW = low-activity waste.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

3.9 VISUAL

There is no new information that would change the potential visual impacts from those described in the TWRS EIS.

3.10 NOISE

There is no new information concerning potential noise impacts that substantively change the impacts presented in the TWRS EIS for Phase I or Phase II.

3.11 TRANSPORTATION

3.11.1 TWRS EIS Baseline

Impacts of the vehicular traffic on the roadway system of the Hanford Site and vicinity were analyzed for the Phased Implementation alternative and other selected alternatives in the TWRS EIS. The analysis was based on the number of people that would be commuting to and from work to support activities including construction and operations. The roadways of primary concern would be:

- The segment of Stevens Drive at the 1100 Area, which is the primary Hanford Site entrance from the City of Richland

- The segment of Route 4, which is a continuation of Stevens Drive northward into the Hanford Site, west of the Wye Barricade. Stevens Drive and Route 4 are the Hanford Site's most heavily traveled north-south route, and both of the road segments experienced heavy peak hour congestion in the recent past, although congestion declined in 1995 as Hanford Site employment levels declined. The analysis focused on the peak year of activity and the peak hour of traffic during the day. Because Hanford Site traffic volumes typically reach their daily peaks during the morning shift change, the analysis focused on the morning peak hour, the period of expected greatest impact. The standard traffic level of service hierarchy ranges from level of service A (least congested) to level of service F (most congested). Conditions worse than level of service D are considered unacceptable.

For Phase I in the TWRS EIS the greatest morning peak hour traffic volumes would occur in 1999. These volumes would lead to severe congestion (level of service F) on Stevens Drive at the 1100 Area and severe congestion (level of service E to level of service F) on Route 4 west of the Wye Barricade. There also would be congestion on the State Route 240 Bypass Highway approaching the intersection with Stevens Drive. On Stevens Drive, morning peak hour volumes would be approximately 4,300 vehicles, which would be about 30% more vehicles than the volume that produced level of service F conditions in 1992. On Route 4 west of Wye Barricade, morning peak hour volumes would be about 2,700 vehicles. This would be nearly 15% more vehicles than the volume that created level of service E conditions in 1994. The impacts would begin to build up in 1998 and continue until 2000.

For Phase II in the TWRS EIS the greatest morning peak hour traffic volumes would occur in 2010 and would result in extreme peak hour congestion (level of service F) on both roadways of interest. On Stevens Drive the morning peak hour volume would be approximately 5,600 vehicles, which would be about 70% more vehicles than the volume that produced level of service F conditions in 1992. On Route 4 the morning peak hour volume would be approximately 4,200 vehicles, which would be about 80% more vehicles than the volume that created level of service E conditions in 1994. Congestion would begin to build in 2007 and would continue at high levels and continue for several years after the 2010 peak.

3.11.2 New Information

Since publication of the TWRS EIS, new information has been generated that could change the anticipated impacts of the vehicular traffic on the roadway system of the Hanford Site and vicinity. The new information includes the following:

- Anticipated work force for the Phase I waste vitrification facilities (CCN: 012779)
- Larger Phase II waste vitrification facilities (HNF-SD-WM-SP-012, Rev. 1).

3.11.2.1 Phase I Environmental Report. A BNFL Inc. environmental report (CCN: 012779) includes the following new data that has been generated since publication of the TWRS EIS.

- The peak year of traffic would be in 2003, during which there would be a combined construction and operations work force of 3,600.

- Approximately 60% of workers would work during the day shift.

Assuming 60% of the workers work during the day shift and assuming 1.35 persons per vehicle to account for car-pooling and van pooling (assumed in the TWRS EIS), the increment traffic during the morning peak hour would be 1,600 vehicles on Stevens Drive at the 1100 Area. A 38% reduction in traffic volume on Route 4 was assumed in the TWRS EIS for traffic using State Route 240 and the use of Access Highway (Beloit Avenue), which links the 200 Areas with State Route 240. Using the same assumption, would result in a morning peak hour increment traffic volume on Route 4 of 992 vehicles.

3.11.2.2 Increased Size of Waste Vitrification Facilities for Phase II. To meet the Tri-Party Agreement milestone, the capacity of the Phase II vitrification facilities evaluated in the TWRS EIS would have to be increased. The facilities evaluated in the TWRS EIS were 2 LAW facilities each at 100 MT/day and 1 HLW facility at 10 MT/day (combined 210 MT/day). The capacity of these facilities would need to be increased to 2 LAW facilities each at 150 MT/day and 1 HLW facility at 30 MT/day (combined 330 MT/day) (HNF-SD-WM-SP-012, Rev. 1). The increment traffic on Stevens Drive at the 1100 Area and Route 4 West of the Wye Barricade from the 330 MT/day facilities were estimated (Jacobs 2000) based on the increased Phase I to Phase II increment traffic evaluated in the TWRS EIS for the 41 MT/day facilities and 210 MT/day facilities, respectively. The increment traffic on the roadway segments from the 330 MT/day facilities is summarized in Table 3.15 and compared with the Phase II 210 MT/day facilities calculated in the TWRS EIS.

Table 3.15. Increment Traffic from a 330 MT/day Facility

Roadway Segment	Increment Traffic	
	330 MT/day Facilities	210 MT/day Facilities
Stevens Drive at the 1100 Area	5.1E+03	3.5E+03
Route 4 west of the Wye Barricade	4.4E+03	2.9E+03

MT = metric tons.

3.11.3 Impacts of the New Information

The personnel requirement data provided in CCN: 012779 can change the level of transportation impacts calculated in the TWRS EIS for Phase I. Likewise, the new data for the larger Phase II waste vitrification facilities can change the level of transportation impacts as calculated in the TWRS EIS for Phase II. These potential impacts, based on the new information are presented in Table 3.16, are calculated in this section.

Table 3.16. Transportation Impacts

Parameters	TWRS EIS		Current Planning Baseline	
	Phase I	Phase II	Phase I	Phase II
Stevens Drive at 1100 Area				
Peak year	**1999**	**2010**	**2003**	**2010**
Morning peak hour traffic volume				
Increment	1,300	3,500	1,600	5,060
Baseline	3,000	2,100	3,000	2,100
Total volume[a]	4,300	5,600	4,600	7,160
Expected traffic conditions (level of service)[b]	F	F	F	F
Route 4				
Peak year	**1999**	**2010**	**2003**	**2010**
Morning peak hour traffic volume				
Increment	800	2,900	992	4,390
Baseline	1,900	1,300	1,900	1,300
Total volume[c]	2,700	4,200	2,892	5,690
Expected traffic conditions (level of service)	E to F	F	E to F	F

[a] Recorded morning peak hour traffic volume in 1992 was 3,362 vehicles, which produced level of service F conditions.
[b] Traffic levels of service range from level of service A (least congested) to level of service F (most congested). Level of service E and level of service F are considered unacceptable traffic conditions
[c] Recorded morning peak hour traffic volume in 1994 was 2,368 vehicles, which produced level of service E conditions.

TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

3.11.3.1 Phase I. The Phase I contractor data show an increase in labor requirements as compared to labor requirements in the TWRS EIS. The increase in labor requirements result in more traffic on the roadways. A comparison of the transportation impacts for the current planning baseline and impacts calculated in the TWRS EIS for the Phased Implementation alternative indicate the following for Phase I.

The transportation impacts on the Stevens Drive segment at the 1100 Area exceeds the transportation impacts calculated in the TWRS EIS for Phase I of the Phased Implementation alternative by 7%.

- The transportation impacts on Route 4 segment West of the Wye Barricade exceeds the transportation impacts calculated in the TWRS EIS for Phase I of the Phased Implementation alternative by 7%.

3.11.3.2 Phase II. Expanding the footprint and operation capacity of the Phase II separation and vitrification facilities from 210 MT/day to 330 MT/day will increase the labor requirements as compared to labor requirements in the TWRS EIS. The increased labor requirements result in increased traffic on the roadways. A comparison of the transportation impacts calculated for the current planning baseline and impacts calculated in the TWRS EIS for the Phased Implementation alternative indicate the following for Phase II.

- The transportation impacts on the Stevens Drive segment at the 1100 Area exceeds the transportation impacts calculated in the TWRS EIS for Phase II of the Phased Implementation alternative by 28%.

- The transportation impacts on Route 4 segment West of the Wye Barricade exceeds the transportation impacts calculated in the TWRS EIS for Phase II of the Phased Implementation alternative by 35%.

3.11.3.3 Total Alternative. Because the Phase I or Phase II transportation impacts calculated for the current planning baseline are not bound by the Phased Implementation alternative calculated in the TWRS EIS, the next step would be to determine if they are bound by any other alternatives in the TWRS EIS. The impacts from Phase I and Phase II are summed so that the total alternative is compared with the other alternatives. The Ex Situ Extensive Separations alternative evaluated in the TWRS EIS would bound the results of the transportation impacts evaluated for the current planning baseline. Therefore, none of the increased Phase I and Phase II impacts shown in Table 3.16 substantially change the understanding of impacts to transportation presented in the TWRS EIS.

3.12 ANTICIPATED HEALTH EFFECTS

Carcinogenic and noncarcinogenic adverse health effects on humans from exposure to radioactive and chemical contaminants associated with each of the following categories of risk were calculated for the Phased Implementation alternative and other selected alternatives in the TWRS EIS.

- Remediation risk resulting from routine remediation activities, such as retrieving waste from tanks and waste vitrification operations.

- Post remediation risk, such as the risk resulting from residual contamination remaining after the completion of remediation activities.

- Post remediation risk resulting from human intrusion directly into the residual tank waste remaining after remediation.

3.12.1 Remediation Risk

3.12.1.1 TWRS EIS Baseline. The TWRS EIS included an evaluation of radiological and chemical risks from routine emissions during remediation activities for the Phased Implementation alternative in addition to other selected alternatives. The radiological and chemical risks were calculated for Hanford Site workers involved in remediation activities, Hanford Site workers not involved in remediation activities (noninvolved workers), the general public, and a maximally exposed individual (MEI) from each of the three population groups.

The radiological risk from exposure to radionuclides were expressed in terms of latent cancer fatalities (LCFs). This affect is referred to as an LCF because the cancer may take many years to develop and for death to occur. The assumptions used to calculate the radiological risk evaluated in the TWRS EIS for the involved workers, noninvolved workers, and general public were as follows.

- The radiological risk to the involved worker would result from occupational exposure to radiation. The historical dose to a Hanford Site tank farm worker has been 14 mrem/year. This same dose was assumed for radiation workers during construction in radiation zones, tank farm operations, monitoring, maintenance, and closure activities. A dose of 200 mrem/year (the average zone worker exposure at Plutonium-Uranium Extraction Plant during 1986) was assumed for personnel operating evaporators, retrieval facilities, and pretreatment and vitrification facilities. The MEI worker dose was based on a Hanford Site administrative control level of 500 mrem/year.

- The potential exposure to the noninvolved worker was based on inhaling respirable radiological contaminants, which would be released to the atmosphere (at ground level or through an elevated stack) from remediation activities during each year of operation. The noninvolved worker population was assumed to occupy the area from the Hanford Site boundary to within 100 m (330 ft) of the point of release. The MEI was assumed to be within 100 m (330 ft) from the point of release.

- The general public could receive an exposure from air emissions released to the environment during remediation activities and transported offsite by atmospheric dispersion during each year of operation. Routes of exposure would be from inhaling gaseous and particulate emissions and ingesting vegetables, meats, and milk products contaminated by airborne plumes. The general public population was assumed to occupy the area extending to an 80 km (50 mi) radius from the release point centered in the 200 Areas. The MEI was assumed to live on the Hanford Site boundary and raise and consume all of their own food.

- The vitrified HLW would be shipped to a geologic repository assumed to be located 2,100 km (1,300 mi) offsite by a dedicated train of 10 railcars per train.

The nonradiological risk from exposure to noncarcinogenic chemicals was measured against a hazard index. The hazard index is defined as the summation of the hazard quotients (calculated dose divided by the reference dose) for each chemical and for each route of exposure. A hazard index of greater than 1.0 is indicative of potential adverse health effects. Health effects could be minor temporary effects or could be fatal, depending on the chemical and amount of exposure. The nonradiological risk from exposure to carcinogenic chemicals was expressed in terms of incremental lifetime cancer risk. The incremental lifetime cancer risk is a measurement of the risk of developing a cancer.

3.12.1.2 New Information. Since publication of the TWRS EIS, new information has been generated that could change the anticipated health risk conclusions reached in the TWRS EIS. The new information includes the following:

- Changes in the tank waste inventory (Section 2.2.1)
- The number of Phase I radiation workers and exposure rates from the waste vitrification facilities (CCN: 012779)
- Change in the duration of Phase I operations (CCN: 012779)
- Radiological air emissions from waste vitrification facilities (CCN: 012779)
- Larger Phase II waste vitrification facilities (HNF-SD-WM-SP-012, Rev. 1)
- Changes in the disposal concept for the vitrified LAW from vaults to remote-handled trenches (Taylor 1999)
- Change in number of containers of vitrified HLW that would be shipped to an offsite repository during Phase II (Section 2.2.2.6.2).

3.12.1.2.1 Revised Inventory for Phase I and Phase II. A revised best-basis tank waste inventory as of October 5, 1999 was evaluated as discussed in Section 2.2.1. Table 2.1 provides a comparison of the TWRS EIS inventory to the revised inventory for chemical and radiological constituents. The revised inventory was compared against CoCs in the inventory used to calculate radiological dose and chemical exposure evaluated in the TWRS EIS. Scaling factors presented in Table 3.17 were calculated for estimating a radiological health risk to the various receptors from tank farm operations and Phase II waste vitrification operations. The scaling factors reflect a direct proportional change in the health risk calculated in the TWRS EIS and are used to estimate new radiological health risks from tank farm operations and Phase II vitrification operations. The revised inventory data would not have an appreciable change on the health impacts from chemical exposures from those calculated in the TWRS EIS because there were only small decreases in the chemical inventory.

Table 3.17. Scaling Factors for Estimating Radiological Dose for Tank Farm and Phase II Vitrification Operations

Isotope	Scaling Factor [a]	Phase I Dose (mrem/yr)		Phase II Dose (mrem/yr)	
		TWRS EIS	Current Planning Baseline [b]	TWRS EIS	Current Planning Baseline [b]
Am-241	1.1E+00	1.3E+05	1.4E+05	1.7E+06	1.8E+06
Cs-137	1.6E+00	5.3E+03	8.2E+03	4.4E+04	6.9E+04
Pu-239/240	1.7E+00	1.5E+05	3.3E+05	5.5E+05	1.2E+06
Sr-90	1.1E+00	3.3E+04	3.6E+04	3.3E+05	3.5E+05
Tc-99	9.5E-01	1.6E-01	1.5E-01	8.5E+00	8.0E+00
C-14	6.7E-01	2.3E+05	1.5E+05	5.3E+05	3.6E+05
I-129	2.2E+00	6.6E+04	1.5E+05	3.0E+05	6.7E+05
Dose [c]		6.1E+05	8.1E+05	3.4E+06	4.5E+06
Dose Scaling Factor [d]		1.3E+00		1.3E+00	

[a] The scaling factor for each isotope came from Table 2.1 and was calculated by dividing the revised best-basis inventory by the TWRS EIS inventory.
[b] The dose from the current planning baseline for each isotope was calculated by multiplying the TWRS EIS dose for each isotope by the associated scaling factor.
[c] Dose is the sum of the doses contributed by each isotope.
[d] Dose scaling factor is calculated by dividing the dose from the current planning baseline by the TWRS EIS dose from the Phased Implementation alternative. This was done for Phase I and Phase II.

TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

Involved Worker Receptors. There are no new data that would change the radiological exposure rate to the MEI worker and worker population. Therefore, the radiological dose to the involved worker MEI from routine tank farm operations (summarized in Table 3.18) is the product of an exposure rate of 500 mrem/yr (Administrative Control dose limit assumed in the TWRS EIS) and 10 years of operation. The radiological dose to the involved worker population is the product of an exposure rate of 200 mrem/yr and the required worker-years to complete the project.

Noninvolved and General Public Receptors. The scaling factors for estimating radiological doses from tank farm operations calculated in Table 3.17 were based on the revised inventory and are used to calculate the radiological doses from routine tank farm operations. The revised doses from the TWRS EIS for the noninvolved and general public receptors from Phase I are summarized in Table 3.18.

Table 3.18. Dose to Receptors From Phase I Tank Farm Operations

Receptor	Radiological Dose*	
	TWRS EIS	Current Planning Baseline
Involved worker MEI	5.0E+00	5.0E+00
Involved worker population	2.0E+02	2.0E+02
Noninvolved worker MEI	1.0E-04	1.3E-04
Noninvolved worker population	1.3E-03	1.7E-03
General public MEI	1.5E-06	2.0E-06
General public population	5.9E-02	7.8E-02

* Units are rem for MEI and person-rem for population. Radiological dose for each receptor was calculated in Jacobs (2000).

MEI = maximally exposed individual.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

3.12.1.2.2 Environmental Report for Phase I. A BNFL Inc. environmental report (CCN: 012779) includes the following new data generated since publication of the TWRS EIS.

- The expected radiological exposure rate for Phase I personnel operating the vitrification facilities would be 100 mrem per person-year compared to 200 mrem per person-year assumed in the TWRS EIS. There was no new data that would change the radiological exposure rates assumed in the TWRS EIS for the involved worker MEI.

- The required number of radiation workers used to calculate the radiation worker population dose was estimated to be 3,180 worker-years compared to 3,360 worker-years estimated in the TWRS EIS.

- The annual radiological emissions from vitrification facilities are summarized in Table 3.19.

Involved Worker MEI. There are no new data that would change the radiological exposure rate to the MEI worker. Therefore, the radiological dose to the involved worker MEI from waste vitrification activities at the Phase I facilities (summarized in Table 3.20) is the product of 500 mrem/yr (Administrative Control dose limit assumed in the TWRS EIS) and 11 years of operation.

Involved Worker Population. The radiological dose to the involved worker population from waste vitrification activities at the Phase I facilities (summarized in Table 3.20) is the product of the 3,180 worker-years and an exposure rate of 100 mrem/worker-year.

Table 3.19. Radiological Emissions from Phase I Vitrification Facilities

Radionuclide	Phase I LAW/HLW Facilities (Ci/yr)
H-3	4.1E+01
C-14	7.1E+00
Sr-90	1.1E-03
Tc-99	3.3E-04
I-129	1.2E-01
Cs-137	6.0E-02
Pu-239	3.7E-07
Am-241	1.7E-07

Source: CCN: 012779.

LAW = low-activity waste.
HLW = high-level waste.

Table 3.20. Dose to Receptors from Phase I Vitrification Facilities

Receptor	Radiological Dose[a]
Involved worker MEI	5.5E+00
Involved worker population	3.2E+02
Noninvolved worker MEI	1.3E-05
Noninvolved worker population	1.7E-02
General public MEI	2.1E-06
General public population	1.1E-01

[a] Units are rem for MEI and person-rem for population. Radiological dose for each receptor was calculated in Jacobs (2000).

MEI = maximally exposed individual.

Noninvolved Worker Receptors. CCN: 012779 included radiological emissions from Phase I vitrification facilities but did not extend the evaluation to determine the radiological risk to the noninvolved worker population or MEI. The radiological dose to the noninvolved worker MEI and population (summarized in Table 3.20) was carried out (Jacobs 2000) and is the product of the following:

- The radiological emissions summarized in Table 3.19
- The 70-year dose commitment inhalation dose conversion factors from the GENII computer code (PNL-6584)

- Breathing rate from the TWRS EIS of 3.3 x 10^{-4} m^3/sec
- Atmospheric dispersion coefficients (χ/Q) from the TWRS EIS of 9.4 x 10^{-8} sec/m^3 for MEI and 1.2 x 10^{-4} sec/m^3 for population
- Eleven years of operation (CCN: 012779).

General Public Receptors. CCN: 012779 included radiological emissions from Phase I vitrification facilities but did not extend the evaluation to determine the radiological risk to the general public population or MEI. The radiological dose to the general public MEI and population (summarized in Table 3.20) was carried out (Jacobs 2000) and is the product of the following:

- The radiological emissions summarized in Table 3.19
- The 70-year dose commitment inhalation dose conversion factors from the GENII computer code (PNL-6584)
- Breathing rate from the TWRS EIS of 3.3 x 10^{-4} m^3/sec
- Atmospheric dispersion coefficients (χ/Q) from the TWRS EIS of 1.5 x 10^{-8} sec/m^3 for MEI and 8.0 x 10^{-4} sec/m^3 for population
- Eleven years of operation (CCN: 012779).

3.12.1.2.3 Increase Size of Waste Vitrification Facilities for Phase II. To meet the Tri-Party Agreement milestone, the Phase II vitrification facilities would have to be increased. The facilities evaluated in the TWRS EIS were 2 LAW facilities each at 100 MT/day and 1 HLW facility at 10 MT/day (combined 210 MT/day). The capacity of those facilities would need to be increased to 2 LAW facilities each at 150 MT/day and 1 HLW facility at 30 MT/day (combined 330 MT/day) (HNF-SD-WM-SP-012, Rev. 1). The radiological doses to the various receptors from the 330 MT/day facilities were estimated (Jacobs 2000) based on the increased Phase I to Phase II receptor doses calculated in the TWRS EIS for the 41 MT/day facilities and 210 MT/day facilities, respectively. The radiological doses to the various receptors from the 330 MT/day facilities are summarized in Table 3.21 and compared with the Phase II 210 MT/day facilities evaluated in the TWRS EIS for the Phased Implementation alternative.

Table 3.21. Receptor Doses from the 330 MT/day Facilities

Receptor	Radiological Dose*	
	330 MT/day Facilities	210 MT/day Facilities
Involved worker population	5.2E+03	3.3E+03
Involved worker MEI	5.0E+00	1.5E+01
Noninvolved worker population	2.0E+00	1.2E+00
Noninvolved worker MEI	7.7E-04	4.7E-04
General public population	6.2E+02	3.9E+02
General public MEI	7.8E-03	4.9E-03

* The units are person-rem for population doses and rem for MEI doses.

MEI = maximally exposed individual.
MT = metric ton.

3.12.1.2.4 Vitrified LAW Remote-Handled Trenches for Phase I and Phase II. The vitrified LAW disposal program has been rebaselined by changing the scope of Project W-520 from a vault concept to incorporate the remote-handled trench concept (Taylor 1999). The change results in the vitrified LAW being disposed of in RCRA-compliant, remote-handled landfill trenches instead of in vaults. Based on the available preconceptual design information (Shah 1999), the vitrified LAW disposal complex would consist of approximately 6 double-lined trenches with leachate collection systems located on vacant land in the 200 East Area and southwest of the Plutonium-Uranium Extraction Plant. This site location is the same as that planned for Project W-520 vitrified LAW vaults. The surface barrier placed over the filled trenches would be a modified RCRA Subtitle C cover. Based on the available preconceptual design information (Shah 1999), the radiological exposures to the radiation workers associated with the various activities for Phase I and Phase II are summarized in Table 3.22.

3.12.1.2.5 Increased Number of Vitrified HLW Canisters for Phase II. There is new information presented in Section 2.0 which shows that the number of containers of vitrified HLW would increase by 3% (from 12,200 to 12,600 canisters). This corresponds to an increase in trips to the repository and consequently an increase in radiological dose of 3% to persons living along the transportation route. Increasing the radiological dose calculated in the TWRS EIS for Phased Implementation alternative by 3% would result in the radiological dose shown in Table 3.23.

The radiological dose to the involved worker population and MEI worker dose remained unchanged from the doses calculated in the TWRS EIS. The revised inventory data would not have an appreciable change on the direct exposure received by the onsite and offsite receptors.

Table 3.22. Incremental Dose from Vitrified Low-Activity Waste Remote-Handled Trenches for Phase I and Phase II

Parameter	Driver	Health Physics Technician	Millwright	Operator	Crane Operator	Total Delta person-rem
Phase I						
Staff	2	2	2	6	2	
rem/yr	0.39	0.45	0.40	0.31	0.28	
Years	11	11	11	11	11	
Person-rem	8.6	9.9	8.8	20.5	6.2	23.2
Phase II						
Staff	16	12	8	20	8	
rem/yr	0.33	0.38	0.49	0.52	0.38	
Years	23	23	23	23	23	
Person-rem	121.1	105.7	89.8	238.7	70.5	331.4

Notes: Staffing and dose rates taken from Shah (1999). Total delta person-rem is the additional dose the vitrified LAW remote-handled trench radiation workers would receive in comparison to the vitrified LAW vault workers that were assumed to be exposed to dose rates of 200 mrem/yr in the TWRS EIS. The calculation for the total delta person-rem for Phase I and Phase II are calculated as follows:

Phase I – [48.7 person-rem (total person-rem from vitrified LAW remote-handled trench exposure)] - [(14 persons) x (200 mrem/yr) x (11 yr)].

Phase II – [626 person-rem (total person-rem from vitrified LAW remote-handled trench exposure)] - [(64 persons) x (200 mrem/yr) x (23 yr)].

LAW = low-activity waste.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

Table 3.23. Vitrified High-Level Waste Transportation Dose for Phase II

Receptor	Radiological Dose (person-rem)	
	TWRS EIS LCF Risk	Revised LCF Risk
Onsite population	7.7E-01	7.9E-01
Offsite population	6.4E+00	6.6E+00

LCF = latent cancer fatality.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

3.12.1.3 Impacts of the New Information. The revised inventory, exposure rate, personnel requirement, and radiological emission data provided in CCN: 012779 and the incremental dose from vitrified LAW remote-handled trenches would change the level of remediation health risk as calculated in the TWRS EIS for Phase I. Likewise, the revised inventory, new data for the enlarged Phase II vitrification facility, incremental dose from vitrified LAW remote-handled trenches, and the increased number of vitrified HLW canisters would change the level of remediation health risk as calculated in the TWRS EIS for Phase II. These potential impacts, based on the new information, are calculated in this section.

3.12.1.3.1 Phase I. The remediation health risk calculated in the TWRS EIS for Phase I is impacted by a combination of the following:

- Radiological dose from the revised inventory summarized in Table 3.18
- Radiological dose to the various receptors from Phase I vitrification facilities summarized in Table 3.20
- Radiological dose from vitrified LAW remote-handled trenches summarized in Table 3.22.

The radiological dose from these three contributors are summed to derive a total dose to the various receptors as shown in Table 3.24 and then multiplied by a dose-to-risk conversion factor for estimating LCFs. The conversion factors were taken from *1990 Recommendations of the International Commission on Radiological Protection* (ICRP 1991) and were used in the TWRS EIS. The LCF risk for Phase I also is presented in Table 3.25 and where they are compared with the TWRS EIS values.

Table 3.24. Revised Risk for Phase I

Receptor	Radiological Dose				Dose to Risk Conversion Factor	LCF Risk (LCF/rem)
	Vitrification[b]	Support[a, b]	Vitrified LAW Trench Delta[b]	Total[b]		
Involved worker MEI	5.5E+00	5.0E+00[c]	NA	5.5E+00[d]	4.0E-04	2.2E-03
Involved worker population	3.2E+02	2.0E+02	2.3E+01	5.4E+02	4.0E-04	2.2E-01
Noninvolved worker MEI	1.3E-05	1.3E-04	NA	1.5E-04	4.0E-04	5.9E-08
Noninvolved worker population	1.7E-02	1.7E-03	NA	1.9E-02	4.0E-04	7.5E-06
General public MEI	2.1E-06	2.0E-06	NA	4.1E-06	5.0E-04	2.1E-09
General public population	1.1E-01	7.8E-02	NA	1.9E-01	5.0E-04	9.6E-05

[a] Support includes tank farm operations, evaporator operations, and retrieval.
[b] Units are rem for MEI and person-rem for population.
[c] 5.0E+00 rem is the highest dose an MEI would receive from the various support activities.
[d] The involved worker MEI is not summed but is represented by the component with the highest MEI dose, which is vitrification.

LCF = latent cancer fatality.
MEI = maximally exposed individual.
NA = not applicable.

Table 3.25. Latent Cancer Fatality Risk from Radiological Emissions During Normal Operations

Receptor	Normal Operations Risk			
	TWRS EIS LCF Risk		Current Planning Baseline LCF Risk	
	Phase I	Phase II	Phase I	Phase II
Involved worker MEI	2.0E-03	6.0E-03	2.2E-03	4.4E-03
Involved worker population	3.6E-01	3.2E+00	2.2E-01	4.1E+00
Noninvolved worker MEI	4.1E-08	1.1E-06	5.9E-08	1.2E-06
Noninvolved worker population	4.8E-05	9.0E-04	7.5E-06	1.9E-03
General public MEI	4.0E-07	2.5E-06	2.1E-09	5.1E-06
General public population	2.9E-02	1.9E-01	9.6E-05	4.1E-01

LCF = latent cancer fatality.
MEI = maximally exposed individual.

A comparison of LCF risk for the current planning baseline with the LCF risk calculated in the TWRS EIS for the Phased Implementation alternative indicate the following for Phase I.

- The involved worker MEI risk would exceed the TWRS EIS risk by 10%. This is attributed to extending operations from 10 years as specified in the TWRS EIS to 11 years as specified in CCN: 012779.

- The involved worker population risk would be reduced to 61% of the risk calculated in the TWRS EIS for Phase I of the Phased Implementation alternative. This is attributed to the reduced number of radiation workers and the reduced exposure rate taken from CCN: 012779.

- The noninvolved worker MEI risk would exceed the TWRS EIS risk by 44%. Over 90% of the risk would result from support activities common to the TWRS EIS and the current planning baseline. Therefore, the increased risk is attributed to the increased concentrations of radiological constituents in the revised best-basis inventory.

- The noninvolved worker population risk would be reduced to 16% of the risk calculated in the TWRS EIS for Phase I of the Phased Implementation alternative. This is attributed to the Phase I offgas vitrification process, which uses technologies to reduce carbon-14 emissions.

- The general public MEI risk would be reduced to 0.5% of the risk calculated in the TWRS EIS. This is attributed to the same reducing factors that were mentioned above for the noninvolved worker population.

- The general public population risk would be reduced to 0.3% of the risk calculated in the TWRS EIS. This is attributed to the same reducing factors that were mentioned above for the noninvolved worker population.

3.12.1.3.2 Phase II. The remediation health risk calculated in the TWRS EIS for Phase II is impacted by a combination of the following:

- The radiological dose scaling factor to account for the revised inventory calculated in Table 3.17
- The radiological dose from the 330 MT/day waste vitrification facilities summarized in Table 3.21
- The radiological dose from vitrified LAW remote-handled trenches summarized in Table 3.22
- The radiological dose from an increased number of vitrified HLW canisters that would be shipped to an offsite repository during Phase II summarized in Table 3.23.

The radiological dose values from the 330 MT/day vitrification facilities and vitrified LAW remote-handled trenches are summed with the support activities and then multiplied by the radiological dose scaling factor. The radiological dose to the onsite and offsite receptors from transporting vitrified HLW to an offsite repository is then added to derive a total dose to the various receptors as shown in Table 3.26. The total dose is then multiplied by a dose-to-risk conversion factor for estimating LCFs. The LCF risk for Phase II is also presented in Table 3.25 where they are compared with the TWRS EIS values.

A comparison of LCF risk for the current planning baseline with the LCF risk calculated in the TWRS EIS indicate the following for Phase II.

- The involved worker MEI risk is reduced to 73% of the risk calculated in the TWRS EIS for Phase II of the Phased Implementation alternative. This is attributed to reducing the operations from 17 years as specified in the TWRS EIS to 10 years as estimated for a 330 MT/day facilities.
- The involved worker population risk would exceed the TWRS EIS risk by 28% of the risk calculated in the TWRS EIS for Phase II of the Phased Implementation alternative. This is attributed to the increased number of radiation workers required to operate the 330 MT/day facilities.
- The noninvolved worker MEI risk would exceed the TWRS EIS Phase II risk by 9%. The increased risk from the current planning baseline is attributed to the increased concentrations of radiological constituents in the revised best-basis inventory.

Table 3.26. Revised Risk for Phase II

Receptor	Radiological Dose					Total Dose[b]	Dose to Risk Conversion Factor	LCF Risk
	Vitrification[b]	Support[a, b]	Vitrified LAW Trench Delta[b]	Scaling Factor	Vitrified HLW Transport[b]			
Involved worker MEI	5.0E+00	1.1E+01	NA	NA	NA	1.1E+01[c]	4.0E-04	4.4E-03
Involved worker population	5.2E+03	4.6E+03	3.3E+02	NA	NA	1.0E+04	4.0E-04	4.1E+00
Noninvolved worker MEI	7.7E-04	2.4E-03	NA	1.3E+00	NA	3.1E-03	4.0E-04	1.2E-06
Noninvolved worker population	2.0E+00	1.1E+00	NA	1.3E+00	7.9E-01	4.8E+00	4.0E-04	1.9E-03
General public MEI	7.8E-03	7.6E-05	NA	1.3E+00	NA	1.0E-02	5.0E-04	5.1E-06
General public population	6.2E+02	2.1E+00	NA	1.3E+00	6.6E+00	8.2E+02	5.0E-04	4.1E-01

[a] Support includes tank farm operations, evaporator operations, and retrieval.
[b] Units are rem for MEI and person-rem for population.
[c] 1.1E+01 rem is the highest dose an MEI would receive from the various activities.
[d] The involved worker MEI is not summed but is represented by the component with the highest MEI dose, which is vitrification.

HLW = high level waste.
LAW = low-activity waste.
LCF = latent cancer fatality.
MEI = maximally exposed individual.
NA = not applicable.

- The noninvolved worker population risk would exceed the TWRS EIS Phase II risk by 111%. The increased risk is attributed to the increased concentrations of radiological constituents in the revised best-basis inventory.

- The general public MEI risk would exceed the TWRS EIS Phase II risk by 104%. The increased risk is attributed to the increased concentrations of radiological constituents in the revised best-basis inventory.

- The general public population risk would exceed the TWRS EIS Phase II risk by 116%. The increased risk is attributed to the increased concentrations of radiological constituents in the revised best-basis inventory.

3.12.1.3.3 Total Alternative. Because the Phase I or Phase II remediation health impacts calculated for the current planning baseline are not bound by the Phased Implementation alternative calculated in the TWRS EIS, the next step would be to determine if they are bound by other alternatives in the TWRS EIS. The impacts from Phase I and Phase II are summed so that the total alternative is compared with the other alternatives. There are no alternatives evaluated in the TWRS EIS that would bound the results of the remediation health impacts evaluated for the current planning baseline. However, when compared to the TWRS EIS the increased impacts calculated for the current planning baseline is small and represents the following increases.

- The involved worker MEI risk would exceed the TWRS EIS Phased Implementation total alternative risk by 10%. However, this is not a substantive impact since the risk of an LCF would remain small (i.e., 6.6×10^{-3}).
- The involved worker population risk would exceed the TWRS EIS Phased Implementation total alternative risk by 28%. This represents one additional LCF, which is a substantive increase to a significant environmental impact evaluated in the TWRS EIS.
- The noninvolved worker MEI risk would exceed the TWRS EIS Phased Implementation total alternative risk by 35%. However, this is not a substantive impact since the risk of an LCF would remain small (i.e., 1.3×10^{-6}).
- The noninvolved worker population risk would exceed the TWRS EIS Phased Implementation total alternative risk by 78%. However, this is not a substantive impact because the risk of an LCF would remain small (i.e., 1.6×10^{-3}).
- The general public MEI risk would exceed the TWRS EIS Phased Implementation total alternative risk by 108%. However, this is not a substantive impact since the risk of an LCF would remain small (i.e., 5.0×10^{-6}).
- The general public population risk would exceed the TWRS EIS Phased Implementation total alternative risk by 116%. However, this is not a substantive impact since the risk of an LCF would remain less than one.

3.12.2 Long-Term Health Effects

3.12.2.1 TWRS EIS Baseline. The TWRS EIS analyzed anticipated health effects to potential future Hanford Site users from use of groundwater contaminated by tank waste. The source term for the analysis consisted of potential liquid losses during retrieval, residual waste that may be left in the tanks, and vitrified waste disposed of onsite in vitrified LAW vaults. The DOE/EIS-0189-SA2 analysis determined that the only new information developed subsequent to the release of the TWRS EIS that could change the understanding of the long-term health risks presented in the TWRS EIS was the revised tank waste inventory. The DOE/EIS-0189-SA2 analysis presented a set of revised risks for the TWRS EIS Phased Implementation alternative that were calculated by applying constituent-specific scaling factors derived from the inventory changes between the TWRS EIS inventory and the revised inventory.

Table 3.27 summarizes the revised long-term human health risk information presented in the DOE/EIS-0189-SA2 and also shows the corresponding information from the TWRS EIS for the

Phased Implementation alternative for comparison purposes. Table 3.27 shows the calculated total cancer risk and noncarcinogenic chemical hazard for the four receptor scenarios addressed in the TWRS EIS (i.e., Native American, residential farmer, industrial worker, and recreational shoreline user). Information for times earlier than 2,500 years from start of groundwater transport modeling (i.e., 1995) is not presented because the 2,500-year period of interest is the earliest period of interest for which the TWRS EIS groundwater modeling estimated that tank waste constituents from the source terms evaluated would be present in groundwater.

Table 3.27. Comparison of Maximum Anticipated Long-Term Health Effects for the TWRS EIS

Phased Implementation Alternative and DOE/EIS-0189-SA2				
Risk/ Hazard	Year	Receptors	TWRS EIS	DOE/EIS-0189-SA2
Risk	2,500	Native American	1.2E-04	1.1E-04
		Residential farmer	9.6E-06	8.9E-06
		Industrial worker	3.0E-06	3.1E-06
		Recreational user	2.7E-07	3.0E-08
	5,000	Native American	4.3E-03	3.7E-03
		Residential farmer	3.4E-04	2.9E-04
		Industrial worker	1.0E-04	1.0E-04
		Recreational user	9.6E-06	2.2E-06
	10,000	Native American	6.9E-04	2.7E-04
		Residential farmer	6.8E-05	2.1E-05
		Industrial worker	7.4E-06	6.2E-06
		Recreational user	7.8E-07	2.3E-07
Hazard Index	2,500	Native American	7.2E-01	6.6E-01
		Residential farmer	1.2E-01	1.2E-01
		Industrial worker	1.1E-04	1.0E-04
		Recreational user	1.6E-05	2.4E-06
	5,000	Native American	1.2E+02	1.1E+02
		Residential farmer	2.1E+01	2.1E+01
		Industrial worker	2.2E-02	1.7E-02
		Recreational user	3.0E-03	2.9E-04
	10,000	Native American	7.7E-03	4.8E-03
		Residential farmer	1.6E-03	8.9E-04
		Industrial worker	3.7E-04	2.5E-04
		Recreational user	4.9E-05	1.4E-05

TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

In general, the revised cancer risk and hazard indices calculated for the DOE/EIS-0189-SA2 analysis were slightly lower than those presented in the TWRS EIS for the Phased Implementation alternative. The DOE/EIS-0189-SA2 analysis concluded that the overall slight decrease in total cancer risk was attributable to the reduced inventory of some long-term risk CoCs, such as selenium-79 and uranium-238. These decreases were enough to offset increases in other constituents, such as technetium-99; neptunium-237; and other uranium isotopes (uranium-233, uranium-234, and uranium-236). Uranium-233, uranium-234, and uranium-236 did not have a large impact on the risk values and remained as minor contributors to long-term health risks. The overall conclusion of the DOE/EIS-0189-SA2 analysis was that the new information did not substantially change the understanding of the long-term health risks presented in the TWRS EIS for the Phased Implementation alternative.

3.12.2.2 New Information. Since publication of the TWRS EIS, new information has been generated that could change the understanding of the long-term health effects presented in the TWRS EIS. The new information includes:

- Revised tank waste inventory (Section 2.2.1)
- Performance assessment review of long-term vitrified LAW vaults performance (DOE/RL-97-69)
- Change in disposal concept for vitrified LAW from vaults to remote-handled trenches (Taylor 1999)
- Change in vitrified LAW waste form from cullet to monolith (HNF-SD-WM-SP-012, Rev. 2).

3.12.2.2.1 Revised Tank Waste Inventory. Prior to performing another inventory-based scaling analysis as was done for the DOE/EIS-0189-SA2, an inventory comparison was conducted to examine the magnitude of the inventory changes between the DOE/EIS-0189-SA2 inventory and the revised inventory (note that for the current analysis "revised inventory" refers to the inventory presented in Section 2.2.1). Performing another scaling analysis is warranted only if the revised inventory is found to differ substantially from the inventory used in DOE/EIS-0189-SA2. If the two inventories are not substantially different, a new scaling analysis is not needed because the results and conclusions of the new analysis would not be expected to differ appreciably from those presented in DOE/EIS-0189-SA2. For purposes of comparison in the current analysis, a significant inventory difference was considered to be an order of magnitude or greater change in the inventory of one or more long-term risk CoCs. CoCs are tank waste constituents that are long-lived and highly mobile in the vadose zone and groundwater. These include nitrate/nitrite, carbon-14, iodine-129, selenium-79, technetium-99, and the uranium series.

3.12.2.2.2 Performance Assessment Review of Long-Term Vitrified LAW Vaults. Since release of the TWRS EIS, additional analysis of the impacts associated with long-term releases from the vitrified LAW vaults has been provided in DOE/RL-97-69. This performance assessment addressed only the radionuclide constituents in the vitrified LAW; chemical constituents were not considered. The results of the DOE/RL-97-69 analysis are expressed in terms of the dose to a receptor who extracts and uses groundwater from a well located 100 m (328 ft) down gradient from the vitrified LAW vaults; the carcinogenic health risk associated with the dose was not evaluated.

3.12.2.2.3 Change in Disposal Concept for Vitrified LAW from Vaults to Remote-Handled Trenches. The vitrified LAW disposal program has been rebaselined by changing the scope of Project W-520 from a vault concept to incorporate the remote-handled trench concept (Taylor 1999). The change results in the vitrified LAW being disposed of in RCRA-compliant, remote-handled landfill trenches instead of in vaults. Based on the available preconceptual design information (Shah 1999), the vitrified LAW disposal complex would consist of approximately 6 double-lined trenches with leachate collection systems located on vacant land in the 200 East Area and southwest of the Plutonium-Uranium Extraction Plant. This site location is the same as that planned for Project W-520 vitrified LAW vaults. The surface barrier placed over the filled trenches would be a modified RCRA Subtitle C cover.

3.12.2.2.4 Change in Vitrified LAW Waste Form from Cullet to Monolith. The HNF-SD-WM-SP-012, Rev. 2 technical basis includes vitrification of both the LAW and HLW streams into monolithic glass forms. This is a change from the TWRS EIS for LAW which was assumed to be in the form of cullets.

3.12.2.3 Impacts of the New Information

3.12.2.3.1 Revised Tank Waste Inventory. Table 3.28 provides the results of the inventory comparison between the DOE/EIS-0189-SA2 inventory and the revised inventory. As can be seen from the far right column in Table 3.28, the revised inventory for all tank waste constituents except three (ruthenium-106, radium-226, and curium-242) is within an order of magnitude of the inventory used in DOE/EIS-0189-SA2. The three constituents with significant changes in inventory are not considered CoCs for long-term risk. Therefore, a new scaling analysis has not been performed because such an analysis would not be expected to produce results and conclusions substantially different from those presented in DOE/EIS-0189-SA2. The overall conclusion of DOE/EIS-0189-SA2 analysis remains valid for the current analysis. The new information does not substantially change the understanding of the long-term health risks presented in the TWRS EIS for the Phased Implementation alternative. This conclusion is supported by the results of the groundwater analysis presented in Section 3.3.2. This analysis indicates that the revised tank waste inventory causes only minor changes to the maximum groundwater contaminant concentrations presented in the TWRS EIS. Long-term risk is linearly related to groundwater contaminant concentrations. Thus, with only minor changes in groundwater impacts the changes in long-term health impacts are expected to be similarly minor.

3.12.2.3.2 Performance Assessment Review of Long-Term Vitrified LAW Vaults. The estimated impacts from vitrified LAW vault releases presented in DOE/RL-97-69 were well below the performance objectives for all areas of protection addressed, including the performance objectives for protection of the general public (25 mrem in a year over a 10,000-year compliance period) and protection of groundwater resources (4 mrem in a year over a 10,000-year compliance period). The results of the DOE/RL-97-69 analysis do not substantially change the understanding of the long-term health risks from vitrified LAW vaults presented in the TWRS EIS.

Table 3.28. Comparison Between DOE/EIS-0189-SA2 Inventory and Revised Inventory (3 Sheets)

Constituent Name	Units (Decayed to 12/31/99)	DOE/EIS-0189-SA2 Inventory	Revised Inventory	Ratio of Revised Inventory to DOE/EIS-0189-SA2 Inventory	Order of Magnitude Change?
Al	kg	7.90E+06	8.09E+06	1.02	no
Bi	kg	5.80E+05	6.31E+05	1.09	no
Ca	kg	2.10E+05	3.05E+05	1.45	no
Ce	kg	8.80E+03	NR	NR	NA
Cl	kg	5.00E+05	9.34E+05	1.87	no
TIC as CO_3	kg	4.80E+06	9.57E+06	1.99	no
Cr	kg	7.90E+05	6.46E+05	0.82	no
F	kg	1.40E+06	1.16E+06	0.83	no
Fe	kg	1.20E+06	1.38E+06	1.15	no
Hg	kg	2.10E+03	1.66E+03	0.79	no
K	kg	4.80E+05	8.60E+05	1.79	no
La	kg	5.10E+04	5.04E+04	0.99	no
Mn	kg	1.10E+05	1.85E+05	1.68	no
Na	kg	5.40E+07	4.84E+07	0.90	no
Ni	kg	1.10E+05	1.69E+05	1.54	no
NO_2/NO_3*	kg	8.60E+07	6.53E+07	0.76	no
OH Total	kg	2.30E+07	2.33E+07	1.01	no
Pb	kg	2.80E+05	8.02E+04	0.29	no
PO4	kg	6.00E+06	5.37E+06	0.90	no
Si	kg	5.70E+05	9.23E+05	1.62	no
SO4	kg	5.00E+06	3.27E+06	0.65	no
Sr	kg	3.10E+04	4.29E+04	1.38	no
TOC	kg	4.00E+06	1.62E+06	0.41	no
U	kg	9.70E+05	8.95E+05	0.92	no
Zr	kg	4.40E+05	4.70E+05	1.07	no
Cd	kg	8.20E+03	NR	NR	NA
Ag	kg	8.90E+03	NR	NR	NA
Th	kg	2.60E+04	NR	NR	NA
W	kg	1.60E+04	NR	NR	NA
H-3	Ci	2.40E+04	2.38E+04	0.99	no
C-14	Ci	4.80E+03	3.57E+03	0.74	no
Ni-59	Ci	9.30E+02	8.75E+02	0.94	no
Co-60	Ci	5.60E+03	2.23E+04	3.98	no
Ni-63	Ci	8.80E+04	8.63E+04	0.98	no

Table 3.28. Comparison Between DOE/EIS-0189-SA2 Inventory and Revised Inventory (3 Sheets)

Constituent Name	Units (Decayed to 12/31/99)	DOE/EIS-0189-SA2 Inventory	Revised Inventory	Ratio of Revised Inventory to DOE/EIS-0189-SA2 Inventory	Order of Magnitude Change?
Se-79	Ci	7.70E+02	6.95E+02	0.90	no
Sr-90	Ci	6.20E+07	5.85E+07	0.94	no
Y-90	Ci	6.20E+07	5.85E+07	0.94	no
Nb-93m	Ci	2.00E+03	2.55E+03	1.28	no
Zr-93	Ci	3.60E+03	3.49E+03	0.97	no
Tc-99	Ci	3.30E+04	3.03E+04	0.92	no
Ru-106	Ci	1.70E+03	1.27E+05	74.56	**YES**
Cd-113m	Ci	1.30E+04	1.68E+04	1.29	no
Sb-125	Ci	4.60E+04	2.57E+05	5.60	no
Sn-126	Ci	1.20E+03	1.18E+03	0.99	no
I-129	Ci	6.30E+01	8.48E+01	1.35	no
Cs-134	Ci	1.20E+04	8.71E+04	7.26	no
Ba-137m	Ci	3.80E+07	5.14E+07	1.35	no
Cs-137	Ci	4.00E+07	5.44E+07	1.36	no
Sm-151	Ci	2.60E+06	2.62E+06	1.01	no
Eu-152	Ci	1.10E+03	1.48E+03	1.34	no
Eu-154	Ci	9.10E+04	1.94E+05	2.13	no
Eu-155	Ci	5.90E+04	2.09E+05	3.54	no
Ra-226	Ci	6.30E-02	6.51E+02	10,334.26	**YES**
Ac-227	Ci	7.20E+01	8.75E+01	1.22	no
Ra-228	Ci	3.70E+01	7.76E+01	2.10	no
Th-229	Ci	1.80E+00	1.81E+00	1.00	no
Pa-231	Ci	1.60E+02	1.56E+02	0.97	no
Th-232	Ci	2.10E+00	4.36E+00	2.08	no
U-232	Ci	1.20E+02	1.20E+02	1.00	no
U-233	Ci	4.80E+02	4.61E+02	0.96	no
U-234	Ci	3.50E+02	3.35E+02	0.96	no
U-235	Ci	1.40E+01	1.38E+01	0.99	no
U-236	Ci	9.60E+00	1.17E+01	1.22	no
Np-237	Ci	1.40E+02	1.71E+02	1.22	no
Pu-238	Ci	2.60E+03	2.68E+03	1.03	no
U-238	Ci	3.20E+02	2.99E+02	0.93	no
Pu-239	Ci	3.90E+04	5.74E+04	1.47	no
Pu-240	Ci	8.90E+03	1.14E+04	1.28	no

Table 3.28. Comparison Between DOE/EIS-0189-SA2 Inventory and Revised Inventory (3 Sheets)

Constituent Name	Units (Decayed to 12/31/99)	DOE/EIS-0189-SA2 Inventory	Revised Inventory	Ratio of Revised Inventory to DOE/EIS-0189-SA2 Inventory	Order of Magnitude Change?
Am-241	Ci	6.90E+04	1.09E+05	1.57	no
Pu-241	Ci	1.70E+05	1.64E+05	0.96	no
Cm-242	Ci	7.00E-03	1.75E+02	25,025.99	**YES**
Pu-242	Ci	1.20E+00	1.08E+00	0.90	no
Am-243	Ci	9.30E+00	1.78E+01	1.92	no
Cm-243	Ci	8.70E+00	2.82E+01	3.25	no
Cm-244	Ci	1.90E+02	6.61E+02	3.48	no

* NO_2/NO_3 combined equals NO_2 inventory plus NO_3 inventory.

NA = not applicable.
NR = not reported.

3.12.2.3.3 Change in Disposal Concept for Vitrified LAW from Vaults to Remote-Handled Trenches. The available preconceptual design information for trench disposal of vitrified LAW (Shah 1999) indicates that, under the trench concept, a modified RCRA Subtitle C barrier would be used instead of a Hanford Barrier as assumed in the TWRS EIS. Recent barrier studies (PNNL-13033) indicate that recharge through the modified RCRA barrier would be comparable to that assumed for the Hanford barrier in the TWRS EIS (< 0.1 cm/yr). However, the design life of the RCRA barrier would be only 500 years as compared with 1,000 years assumed for the Hanford barrier in the TWRS EIS. After barrier failure, the recharge rate and contaminant mass flux are assumed to increase. The effect of the earlier RCRA barrier failure would be to move the risk impacts from LAW releases slightly forward in time. This would not be expected to have an appreciable effect on overall long-term risks because the peak impacts from vitrified LAW vaults in the TWRS EIS occurred well beyond the 10,000-year period of interest. At the time of peak long-term risk in the TWRS EIS (5,000 years from the present) the vitrified LAW vaults made only a minor contribution and the risk was dominated by releases from tank sources (i.e., retrieval losses and residual waste). The vitrified LAW remote-handled trench disposal concept as currently envisioned therefore is bounded by the TWRS EIS analysis for long-term risk impacts.

3.12.2.3.4 Change in Vitrified LAW Waste Form from Cullet to Monolith. The vitrified LAW mass has a low corrosion rate and was calculated in the TWRS EIS to have a release time of 170,000 years. The impacts presented in the TWRS EIS were based on a glass cullet final vitrified LAW form instead of a monolith. The current baseline for the final vitrified LAW form is now a glass monolith. Because of its greater surface area, cullet provides a more conservative estimate of impacts than monolith. The change to a monolith waste form will increase the LAW release time and tend to offset any increase in impacts that might occur because of the shorter design life of the RCRA barrier.

3.12.3 Intruder Scenario

3.12.3.1 TWRS EIS Baseline. The TWRS EIS included an analysis of post-remediation intruder risk. The intrusion scenario used was a postulated well-drilling scenario on the Hanford Site after the assumed loss of institutional control. Separate analyses were performed for the residual tank waste and the onsite, near-surface disposal vaults containing the vitrified LAW. Carcinogenic human health effects from exposure to radionuclides in the waste exhumed during well drilling were calculated for a hypothetical driller and a post-drilling resident. The driller was assumed to be an individual who drills a well through the residual tank waste or the vitrified LAW vaults. The post-drilling resident was assumed to be an individual who lives on a parcel of land over which the exhumed waste has been spread, and who has a vegetable garden located in the exhumed waste from which 25% of that individual's vegetable intake is obtained. Risks were calculated for a time 100 years from the present (taken to be 1995 in the TWRS EIS), corresponding to the time of assumed loss of institutional control.

3.12.3.2 New Information. Since publication of the TWRS EIS, new information has been generated that could change the understanding of the intruder risk presented in the TWRS EIS. The new information includes:

- Revised tank waste inventory (Section 2.2.1)

- Performance assessment review of long-term vitrified LAW vaults performance (DOE/RL-97-69)
- Change in disposal concept for vitrified LAW from vaults to remote-handled trenches (Taylor 1999).

3.12.3.2.1 Revised Tank Waste Inventory. The revised tank waste inventory (Section 2.2.1) has the potential to change the understanding of the intruder risk presented in the TWRS EIS. To test the effect of the new inventory on the intruder risk, a revised risk was calculated for the post-drilling resident. The post-drilling resident was selected because this scenario has greater exposure and associated risk than the driller scenario and is therefore bounding. The revised post-drilling resident risk was scaled from the risk presented in the TWRS EIS by multiplying the TWRS EIS risk values by the constituent-specific inventory ratios presented in Section 2.2.1. This scaling approach assumes that any change in the current tank inventory of a given radionuclide compared to the inventory in the TWRS EIS will produce a directly proportional change in the inventory of that radionuclide in the tank residuals and vitrified LAW disposal facilities.

For the vitrified LAW disposal facilities, potential changes in waste separations processes need to be considered in addition to inventory changes. This is because the final radionuclide inventory in the vitrified LAW form depends not only on the current tank inventory but also on the level of separation of the retrieved waste into HLW and LAW fractions prior to vitrification. As discussed in Section 2.2.2, the available information indicates that the current planning basis for the number and type of separations processes to be used does not differ substantially from that evaluated in the TWRS EIS. Thus, the inventory-based scaling factors used to calculate the revised vitrified LAW intruder risks were the same as those used for tank residuals (Section 2.2.1).

3.12.3.2.2 Performance Assessment Review of Long-Term Vitrified LAW Vaults. Since release of the TWRS EIS, additional analysis of the risk from inadvertent intrusion into the vitrified LAW vaults has been provided in the Hanford Site vitrified LAW performance assessment (DOE/RL-97-69). As in the TWRS EIS, this performance assessment addressed only the radionuclide constituents in the vitrified LAW. The results of the DOE/RL-97-69 analysis are expressed in terms of the dose to the inadvertent intruder; the carcinogenic health risk associated with the dose was not evaluated.

3.12.3.2.3 Change in Disposal Concept for Vitrified LAW from Vaults to Remote-Handled Trenches. The vitrified LAW disposal program has been rebaselined by changing the scope of Project W-520 from a vault concept to incorporate the remote-handled trench concept (Taylor 1999). The change results in the vitrified LAW being disposed of in RCRA-compliant, remote-handled landfill trenches instead of in vaults. Based on the available preconceptual design information (Shah 1999), the vitrified LAW disposal complex would consist of approximately 6 double-lined trenches with leachate collection systems located on vacant land in the 200 East Area and southwest of the Plutonium-Uranium Extraction Plant. This site location is the same as that planned for Project W-520 vitrified LAW vaults. The surface barrier placed over the filled trenches would be a modified RCRA Subtitle C cover.

Such a change has the potential to change the intruder impacts presented in the TWRS EIS principally by changing the total stack height of the disposed vitrified LAW waste packages.

3.12.3.3 Impact of the New Information

3.12.3.3.1 Revised Tank Waste Inventory. Table 3.29 compares the revised intruder risk with the intruder risk presented in the TWRS EIS for the Phased Implementation alternative. Table 3.29 shows the LCF risk for the post-drilling resident from intrusion into the tank residuals and the vitrified LAW vaults at 100 years from the present (taken to be 1995 in the TWRS EIS). For both the tank residuals and vitrified LAW vaults, the new inventory information causes the intruder risk to increase compared to the risk calculated in the TWRS EIS. However, for both the tank residuals and vitrified LAW vaults the increase is less than a factor of two, which is not considered a substantive change. The new inventory information therefore does not substantially change the understanding of the intruder risk presented in the TWRS EIS.

Table 3.29. Comparison of Latent Cancer Fatality Risk at 100 Years From the Present for the Post-Drilling Resident Intrusion Scenario

Tank Residuals		Vitrified LAW Vaults	
TWRS EIS Phased Implementation Alternative	Revised	TWRS EIS Phased Implementation Alternative	Revised
3.0E-02*	4.4E-02	2.4E-02*	3.1E-02

* Because of a calculational error, the post-drilling resident risks given in Table D.7.4.2 of the TWRS EIS are annual risks, not lifetime risks. The corrected lifetime risk values are show here.

LAW = low-activity waste.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

3.12.3.3.2 Performance Assessment Review of Long-Term Vitrified LAW Vaults. The two scenarios included in DOE/RL-97-69 (i.e., driller and homesteader scenarios) are similar to the scenarios used for the TWRS EIS (i.e., driller and post-drilling resident scenarios). However, the results of the two analyses are not strictly comparable because of differences in the values assumed for many key parameters. For example, the TWRS EIS assumed a waste height of 15 m (49 ft) as compared to 7.2 m (23 ft) in DOE/RL-97-69. Thus, the exhumed waste volume used for the TWRS EIS dose calculations was greater than that used for the DOE/RL-97-69 analysis. The estimated impacts presented in DOE/RL-97-69 were well below the performance objectives for protection of the inadvertent intruder (500 mrem at 500 years after closure for the driller and 100 mrem in a year at 500 years for the post-drilling resident). The results of the DOE/RL-97-69 analysis do not substantially change the understanding of the risk from inadvertent intrusion into the vitrified LAW vaults presented in the TWRS EIS.

3.12.3.3.3 Change in Disposal Concept for Vitrified LAW from Vaults to Remote-Handled Trenches. Preconceptual design information (Shah 1999) indicates that, under the trench disposal concept, parameters other than stack height that are important for analysis of intruder impacts (e.g., waste form, waste loading) would not change from those used to generate the TWRS EIS. The available preconceptual design information indicates that the stack height for vitrified LAW packages under the trench concept would be a maximum of 10 m (33 ft) as compared to a height of 15 m (49 ft) used in the TWRS EIS (Shah 1999). A greater stack height translates to a greater volume of waste brought to the surface in a drilling scenario, which produces a greater calculated exposure and risk to the intruder. The vitrified LAW trench disposal concept as currently envisioned therefore is bounded by the TWRS EIS analysis for intruder impacts and no further detailed NEPA analysis is required at this time.

3.13 ACCIDENTS

Impacts from potential accidents associated with the Phased Implementation alternative and other alternatives were analyzed in Volume Four, Appendix E of the TWRS EIS. The analysis included occupational risks, transportation risks, radiological risks, and toxicological risks resulting from current tank farm operations; retrieval activities. Construction and operations vitrification and storage and disposal facilities that would support the various alternatives were also included. The risk associated with an accident was defined as the product of the probability of an accident occurring and the consequence of the accident.

3.13.1 Occupational Risk

3.13.1.1 TWRS EIS Baseline. Occupational risks included nonradiological and nontoxicological accidents resulting in injuries, illnesses, and fatalities from construction and operation accidents common to the work place such as falls, cuts, and operator-machine impacts. Occupational types of accidents would largely be a function of the number of worker-years of labor required to complete the total activities and the incidence rates. The total number of construction and operation worker-years identified in the TWRS EIS for the Phased Implementation alternative, Phase I, were 10,700 and 14,390, respectively. The total number of construction and operation worker-years for Phase II is calculated to be 32,100 and 71,111, respectively from data provided in the TWRS EIS (Jacobs 2000).

The incidence rates used in the TWRS EIS to calculate the risk from construction and operation accidents are as follows:

- Total recordable cases (TRCs) from construction is 9.75 per 100 worker-years
- Lost work day cases from construction is 2.45 per 100 worker-years
- Fatalities from construction is 0.0032 per 100 worker-years
- TRCs from operations is 2.2 per 100 worker-years
- Lost work day cases from operations is 1.1 per 100 worker-years
- Fatalities from operations is 0.0032 per 100 worker-years.

The occupational risks in the TWRS EIS for the Phased Implementation alternative for Phase I and Phase II construction and operations are summarized as follows:

- TRC risk from Phase I construction and operations would be 1,040 and 317 respectively, or a combined TRC risk of 1,357

- Lost work day case risk from Phase I construction and operations would be 262 and 158 respectively, or a combined lost work day case risk of 420

- Fatality risk from Phase I construction and operations would be 0.3 and 0.5 respectively, or a combined fatality risk of 0.8

- TRC risk from Phase II construction and operations would be 3,130 and 1,560 respectively, or a combined TRC risk of 4,690

- Lost workday case risk from Phase II construction and operations would be 786 and 782 respectively, or a combined lost work day case risk of 1,568

- Fatality risk from Phase II construction and operations would be 1.0 and 2.3 respectively, or a combined fatality risk of 3.3.

3.13.1.2 New Occupational Risk Data. Since publication of the TWRS EIS, new information has been generated that could change the occupational risk conclusions reached in the TWRS EIS. The new information includes labor requirements for the Phase I vitrification facilities, labor requirements to support a larger Phase II vitrification facility, labor requirements for infrastructure upgrades, and labor requirements for vitrified LAW remote-handled trenches.

3.13.1.2.1 Phase I Vitrification Facilities. The labor requirements in environmental report CCN: 012779 used to perform the occupational accident analysis in this section are as follows:

- Labor requirements for constructing the Phase I vitrification facilities were estimated to be 13,000 worker-years

- Labor requirements for operating the Phase I vitrification facilities were estimated to be 12,000 worker-years.

In addition to constructing the Phase I vitrification facilities there will be additional labor requirements for constructing infrastructure upgrades that were calculated to be 105 worker-years (DOE/EIS-0189-SA2).

There are no new data that would change the labor requirements for tank farm, evaporator, and retrieval operations. Therefore the labor requirements for the current planning baseline are assumed to be the same as the labor requirements used in the TWRS EIS and are summarized as follows:

- Tank farm operations would require 7,143 worker-years
- Evaporator facility operations would require 914 worker-years
- Retrieval operations would require 143 worker-years.

3.13.1.2.2 Phase II Vitrification Facilities. To meet the Tri-Party Agreement milestone for completing SST waste retrieval, the capacity of the Phase II vitrification facilities evaluated in the TWRS EIS would have to be increased. The facilities evaluated in the TWRS EIS were 2 LAW facilities each at 100 MT/day and 1 HLW facility at 10 MT/day (combined 210 MT/day). The capacity of these facilities would need to be increased to two LAW facilities each at 150 MT/day and 1 HLW facility at 30 MT/day (combined 330 MT/day) (HNF-SD-WM-SP-012, Rev. 1). The labor requirements for construction and operations of the

330 MT/day facilities were estimated (Jacobs 2000) based on the increased Phase I to Phase II labor requirements evaluated in the TWRS EIS for the 41 MT/day facilities and the 210 MT/day facilities, respectively. The labor requirements for the 330 MT/day facilities are summarized as follows:

- Constructing the 330 MT/day vitrification facilities would require 47,295 worker-years
- Operating the 330 MT/day vitrification facilities would require 29,262 worker-years.

There are no new data that would change the labor requirements for tank farm operations, the evaporator facility operations, and retrieval operations. Therefore the labor requirements for the current planning baseline are assumed to be the same as the labor requirements used in the TWRS EIS and are summarized as follows:

- Tank farm operations would require 20,000 worker-years
- Retrieval operations would require 31,429 worker-years.

3.13.1.2.3 Vitrified LAW Remote-Handled Trenches. The labor requirements for the vitrified LAW remote-handled trenches are assumed to be the same as the labor requirements for the vitrified LAW vaults evaluated in the TWRS EIS. This is a conservative assumption because the labor requirements for the vitrified LAW remote-handled trenches would be less than the labor requirements for the vaults.

3.13.1.3 Impacts of the New Information. The labor requirements provided in CCN: 012779 and DOE/EIS-0189-SA2 would change the level of occupational health risk as calculated in the TWRS EIS for Phase I. Likewise, the labor requirements for the enlarged Phase II vitrification facilities can change the level of occupational health risk as calculated in the TWRS EIS for Phase II. These potential impacts, based on the new information, are calculated in this section.

3.13.1.3.1 Phase I. The occupational risks evaluated in this section were calculated by multiplying the new Phase I labor requirements from CCN: 012779 and DOE/EIS-0189-SA2 by the incidence rates used in the TWRS EIS. The results of the calculation are presented in the Table 3.30. A comparison of the occupational risk for the current planning baseline with the occupational risk calculated in the TWRS EIS indicates the following for Phase I.

- The TRCs, lost work-days, and fatalities resulting from construction accidents would exceed the occupational risk calculated in the TWRS EIS for Phase I by 20%. This is attributed to the increased number of construction workers identified in CCN: 012779 and DOE/EIS-0189-SA2.

- The TRCs, lost workdays, and fatalities resulting from operation accidents would exceed the occupational risk calculated in the TWRS EIS for Phase I by 40%. This is attributed to the increased number of operation workers identified in CCN: 012779 and DOE/EIS-0189-SA2.

Table 3.30. Occupational Risk

Incidence Type	TWRS EIS	Current Planning Baseline

	Phase I[a]	Phase II[b]	Phase I[c]	Phase II[d]
Construction TRC	1,040	3,130	1,280	4,610
Construction LWC	262	786	321	1,160
Construction fatalities	0.3	1.0	0.4	1.5
Operations TRC	317	1,560	444	1,780
Operations LWC	158	782	222	888
Operations fatalities	0.5	2.3	0.6	2.6

[a] The number of incidences shown in this column for construction are taken from the TWRS EIS, Appendix E, Section E.11.1.1. Operation incidences are calculated from data provided in the TWRS EIS, Appendix D, Section D.4.10.1.1. Operation incidences calculated in the TWRS EIS, Appendix E, Section E.11.1.3.5 were not used because they did not include tank farm operations, evaporator facility operations, or retrieval.
[b] The number of incidences shown in this column are calculated by subtracting the TWRS EIS Phase I incidences from the Total Alternative incidences shown in the TWRS EIS, Appendix E, Section E.11.2.1 for construction and Section E.11.2.3.13 for operations.
[c] The number of incidences shown in this column are calculated from labor requirements provided in CCN: 012779 and DOE/EIS-0189-SA2.
[d] The number of incidences shown in this column are calculated based on labor requirements to support the 330 MT/year vitrification facilities (Jacobs 2000).

LWC = lost workday case.
TRC = total recordable case.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

3.13.1.3.2 Phase II. The occupational risks for the current planning baseline were calculated by multiplying the new labor requirements for the 330 MT/day Phase II vitrification facilities by the incidence rates used in the TWRS EIS. The results of the calculation are presented in the Table 3.30. A comparison of the occupational risk with the occupational risk calculated in the TWRS EIS indicates the following for Phase II.

- The TRCs, lost workdays, and fatalities resulting from construction accidents calculated for the current planning baseline exceed the occupational risk calculated in the TWRS EIS for Phase II of the Phased Implementation alternative by 47%. This is attributed to the increased number of construction workers to construct the larger 330 MT/day vitrification facilities.

- The TRCs, lost workdays, and fatalities resulting from operation accidents would exceed the occupational risk calculated in the TWRS EIS for Phase II of the Phased Implementation alternative by 14%. This is attributed to the increased number of operators required to operate the larger 330 MT/day vitrification facilities.

3.13.2 Transportation Risks

3.13.2.1 TWRS EIS Baseline. Transportation risks analyzed in the TWRS EIS included injuries and fatalities from accidents resulting from employees commuting to and from work and transportation of materials by truck and rail to and from the Hanford Site.

The risk from employees commuting to and from work would be a function of the number of employees and incidence rates. Each employee was assumed to work 260 days of the year and drive 140 km (87 mi) round trip with 1.35 passengers per vehicle. The incidence rates used to calculate the commuter transportation risk in the TWRS EIS are 7.14×10^{-7} injuries per kilometer and 8.98×10^{-9} fatalities per kilometer. The total worker-years for commuter transportation is the sum of the construction and operation worker-years addressed in the previous subsection. The total worker-years identified in the TWRS EIS for Phased Implementation alternative Phase I and Phase II are 17,600 and 114,400, respectively. The injury risks for Phase I and Phase II were calculated to be 340 and 2,200, respectively. The fatality risks for Phase I and Phase II were calculated to be 4.3 and 27.6, respectively.

The risk from material transport would largely be a function of the amount of construction and operating materials transported to the Hanford Site by truck and rail and the amount of vitrified HLW transported from the Hanford Site to a geologic repository and incidence rates. The repository was assumed to be located 2,100 km (1,300 mi) offsite, and the vitrified HLW would be transported by a dedicated train of 10 railcars per train. The incidence rates used to calculate the injury and fatality risks from trucks and rail cars passing through the various population zones are as follows:

- Trucks passing through an urban zone is 3.7×10^{-7} injuries per kilometer and 7.5×10^{-9} fatalities per kilometer

- Trucks passing through a suburban zone is 3.8×10^{-7} injuries per kilometer and 1.3×10^{-8} fatalities per kilometer

- Trucks passing through a rural zone is 8.0×10^{-7} injuries per kilometer and 5.3×10^{-8} fatalities per kilometer

- Rail cars passing through urban, suburban, and rural population zones is 3.3×10^{-8} injuries per kilometer and 1.7×10^{-8} fatalities per kilometer.

The combined injury risks from potential truck and rail accidents for Phase I and Phase II were calculated to be 1.1 and 9.4, respectively. The combined fatality risk from potential truck and rail accidents for Phase I and Phase II were calculated to be 0.07 and 0.5, respectively.

3.13.2.2 New Transportation Information. Since publication of the TWRS EIS, new information has been generated that could change the transportation risk conclusions reached in the TWRS EIS. The new information includes Phase I labor requirements for the vitrification facilities, Phase II labor requirements to support a larger Phase II vitrification facility, and labor requirements to support infrastructure upgrades. It also includes new requirements for materials to be transported to the Hanford Site to support the construction and operation of the Phase I vitrification facilities and the Phase II vitrification facilities. There is new data that would change the number of shipments of vitrified HLW to an offsite national repository during Phase II. It should be noted that the Hanford Site rail system is currently not available. New documentation for Phase I does not assume the use of rail shipment but is dependent on trucks to transport construction and operation materials and equipment to and from the Hanford Site. Phase II does assume the use of the rail system for transporting construction and operation materials and equipment to and from the Hanford Site as well as transporting vitrified HLW to an offsite repository. Therefore, the supplement analysis assumes the Hanford Site sail system will be restored and operational for Phase II.

3.13.2.2.1 Phase I Vitrification Facilities. The labor requirements in CCN: 012779 and DOE/EIS-0189-SA2 used to perform the transportation accident analysis in this section are as follows:

- Labor requirements for constructing and operating the Phase I vitrification facilities was estimated to be 25,000 worker-years
- Labor requirements for constructing infrastructure upgrades was calculated to be 105 worker-years.

There are no new data that would change the labor requirements for tank farm, evaporator, and retrieval operations; therefore, they are assumed to be the same requirements as those evaluated in the TWRS EIS. The labor requirements for tank farm operations, evaporator, and retrieval operations are assumed to be 7,143 worker-years; 914 worker-years; and 143 worker-years, respectively.

There is no new information that shows the transportation requirements for transporting construction and operation materials to the Hanford Site to support Phase I vitrification. Therefore, the transportation requirements for the current planning baseline are scaled from the TWRS EIS. It is assumed that because the currently planned vitrification facilities are 80% larger than the TWRS EIS Phase I waste vitrification facilities, the transportation requirements for transporting construction and operation materials to the Hanford Site would be proportionately greater.

3.13.2.2.2 Phase II Vitrification Facilities. To meet the Tri-Party Agreement milestone, the capacity of the Phase II vitrification facilities evaluated in the TWRS EIS would have to be increased. The facilities evaluated in the TWRS EIS were 2 LAW facilities each at 100 MT/day and 1 HLW facility at 10 MT/day (combined 210 MT/day). The capacity of these facilities would need to be increased to 2 LAW facilities each at 150 MT/day and 1 HLW facility at 30 MT/day (combined 330 MT/day) (HNF-SD-WM-SP-012, Rev. 1).

The labor requirements for construction and operations of the 330 MT/day facilities were estimated (Jacobs 2000) based on the increased Phase I to Phase II labor requirements evaluated in the TWRS EIS for the 41 MT/day facilities and the 210 MT/day facilities, respectively. The labor requirements for construction and operations are estimated to be 47,295 worker-years and 29,262 worker-years, respectively.

There are no new data or information that would change the labor requirements for tank farm operations and retrieval operations; therefore, they are assumed to be the same requirements as evaluated in the TWRS EIS. The labor requirements for tank farm operations and retrieval operations are assumed to be 20,000 worker-years and 31,429 worker-years, respectively.

The new information of the 330 MT/day vitrification facilities for Phase II would result in a greater demand for transporting material to the Hanford Site on truck or rail to support construction and operations of the larger facilities as compared to the Phase II vitrification facilities evaluated in the TWRS EIS. A greater demand for truck and rail transport would result in an increased risk for injuries and fatalities from truck and rail accidents.

New information presented in Section 2.2.2.6.2 shows that the number of containers of vitrified HLW would increase by 3% (from 12,200 to 12,600 canisters). This would result in more rail shipments to an offsite repository and would therefore result in an increased risk of injuries and fatalities from rail accidents.

3.13.2.3 Impacts of the New Information. The labor requirements provided in CCN: 012779 and the larger vitrification facility structure could change the level of transportation risk as calculated in the TWRS EIS for Phase I. Likewise, the labor and truck and rail transport requirements for the larger Phase II vitrification facilities could change the level of transportation risk as calculated in the TWRS EIS for Phase II. These potential impacts, based on the new information, are calculated in this section.

3.13.2.3.1 Phase I. The total miles driven and the commuter injuries and fatalities from potential accidents were calculated (Jacobs 2000) using the same assumptions that were used in the TWRS EIS and summarized in Section 3.13.2. The commuter risk values were calculated to be 638 injuries and 8.1 fatalities from traffic accidents and are presented in Table 3.31.

Because the currently planned Phase I waste vitrification facilities would be 80% larger than the TWRS EIS Phase I waste vitrification facilities, the transportation risk would be proportionately larger. Injuries and fatalities from transporting materials to the Hanford Site on combined truck and rail is therefore estimated to be 2 and 0.1, respectively. These values are presented in Table 3.31.

A comparison of the transportation risk calculated for the current planning baseline with the transportation risk calculated in the TWRS EIS indicates the following for Phase I.

Table 3.31. Transportation Risk

Activity	Impact	TWRS EIS		Current Planning Baseline	
		Phase I	Phase II	Phase I	Phase II
Commuter traffic	Injuries	480	2,200	638	2,450
	Fatalities	6.1	27.6	8.1	31
Combined truck and rail (construction/ operations)	Injuries	1.1	9.4	2	15.3
	Fatalities	0.07	0.5	0.1	0.8
Rail (vitrified HLW)	Injuries	NA	4.1	NA	4.2
	Fatalities	NA	2.1	NA	2.2

HLW = high-level waste.
NA = not applicable.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

- The commuter injury and fatality risk would exceed the risk calculated in the TWRS EIS for Phase I by 33%. This is attributed to the increased number of commuters identified in CCN: 012779.

- The truck and rail injury and fatality risk would exceed the risk calculated in the TWRS EIS for Phase I by 80%. This is attributed to the increased footprint of the Phase I vitrification facilities.

3.13.2.3.2 Phase II. The total miles driven and the commuter injuries and fatalities from potential accidents were calculated (Jacobs 2000) using the same assumptions that were used in the TWRS EIS and summarized in Section 3.13.2. The commuter risk values were calculated to be 2,450 injuries and 31 fatalities from traffic accidents and are presented in Table 3.31.

The injuries and fatalities from transportation accidents while transporting material to the Hanford Site on truck or rail to support construction and operation of the 330 MT/day facilities were estimated (Jacobs 2000). The estimate was based on the increased Phase I to Phase II labor requirements evaluated in the TWRS EIS for the 41 MT/day facilities and the 210 MT/day facilities. Risk values for injuries and fatalities from transporting materials to the Hanford Site on combined truck and rail were estimated to be 15.3 and 0.8, respectively and are presented in Table 3.31.

New information presented in Section 2.2.2.6.2 shows that the number of containers of vitrified HLW would increase by 3% (i.e., from 12,200 to 12,600 canisters). This corresponds to a 3% increase in trips to the repository; therefore, the risk from transporting vitrified waste to the repository would increase from 4.1 injuries and 2.1 fatalities to 4.2 injuries and 2.2 fatalities.

A comparison of the occupational risk with the occupational risk calculated in the TWRS EIS indicates the following for Phase II.

- The commuter injury and fatality risk would exceed the risk calculated in the TWRS EIS for Phase II by 10%. This is attributed to the increased footprint and operation capacity of the 330 MT/day vitrification facilities.
- The combined truck and rail injury and fatality risk from transporting material to the Hanford Site would exceed the risk calculated in the TWRS EIS for Phase II by 60%. This is attributed to the increased footprint and operation capacity of the 330 MT/day vitrification facilities.
- The rail injury and fatality risk from transporting vitrified HLW to an offsite geologic repository would exceed the risk calculated in the TWRS EIS for Phase II by 3%. This is attributed to the increased number of canisters of vitrified HLW.

3.13.3 Radiological And Toxicological Accidents

3.13.3.1 TWRS EIS Baseline. The potential exists for accidents to result in radiological and toxicological exposures during tank farm operations, retrieval of tank waste, vitrification operations of tank waste, and the transportation of vitrified HLW to a geological repository. The risk associated with a potential radiological release is expressed as the probability or the number of LCFs given the occurrence and consequences of an operation or transportation accident. The risk associated with a potential chemical release is determined by comparing the chemical concentrations that an MEI would be exposed to with the American Industrial Hygiene Agency *Emergency Response Planning Guidelines* (ERPGs) (AIHA 1989). ERPGs are maximum airborne concentrations below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing the following effects.

- ERPG-1 — Mild transient adverse health effects or perceiving a clearly defined objectionable odor.
- ERPG-2 — Irreversible or other serious health effects or symptoms that could impair ability to take protective action.
- ERPG-3 — Irreversible or life-threatening health effects could result from exposures exceeding one hour.

Bounding and nominal consequences from accidents were calculated in the TWRS EIS to provide a risk range. The bounding and nominal consequences were based on a bounding inventory and a nominal inventory. The bounding inventory was based on the development of a 100% inventory composite. This could be thought of as a single tank containing the highest activity concentration for each nuclide found in historical tank contents estimates and prior individual tank analyses. This maximum sample activity composite grouping means the highest radioactivity concentration for each radionuclide is combined to define a hypothetical highest concentration inventory used to bound the accidents. For the bounding consequences calculated in the TWRS EIS, the 90^{th} percentile of the highest concentration inventory was assumed.
The nominal consequences were based on a less conservative approach. Total radionuclide inventories were calculated based on the complete operating history of all of the Hanford Site production reactors. Reduction factors were then applied to the total inventories to account for

plutonium and uranium extracted from the waste sent to the tanks. Reduction factors also were applied to cesium and strontium, which also were extracted from the waste.

Each phase of the various operations associated with Phased Implementation alternative was assessed for potential accidents. From the spectrum of accidents identified in a hazard analysis, dominant accident scenarios were selected for further analysis in the TWRS EIS to determine the LCF risk and chemical risk. The same accidents were evaluated in both Phase I and Phase II. The consequences of the accidents evaluated for Phase I were assumed to be the same as the consequences of the same accidents evaluated for Phase II. However, the probability of the accidents evaluated for Phase I varied from the probabilities for Phase II. The variance was proportional to the duration of operations. The radiological and chemical risk from accidents evaluated in the TWRS EIS included the following:

- Spray release during tank waste transfers
- Hydrogen deflagration in tank waste during waste storage
- Loss of high-efficiency particulate air filters during retrieval
- Process line break during pretreatment
- Dropped canister of vitrified HLW
- Tank dome collapse resulting from a beyond design basis earthquake
- Transportation accident while shipping vitrified HLW to an offsite geologic repository.

The continued operations (tank waste transfers) accident analyzed in the TWRS EIS was a spray release scenario. In this scenario a jumper was mispositioned and pin hole leaks developed at both ends of the jumper, resulting in a pressurized spray release of tank waste when the cover block was not covering the jumper pit. The probability of the accident for Phase I and Phase II is 1.1×10^{-1} and 1.9×10^{-1}, respectively. The LCF risk and chemical risk given the occurrence of the accident as calculated in the TWRS EIS is summarized as follows:

- The MEI involved worker would receive a lethal dose of radiation

- The involved worker population would receive a lethal dose of radiation

- The MEI noninvolved worker would have a LCF risk of 1 and chemical risk of ERPG-2

- The noninvolved worker population would have a LCF risk of 6.6 and chemical risk of ERPG-2

- The MEI general public would have a LCF risk of 9.6×10^{-4} and chemical risk of less than ERPG-1

- The general public would have a LCF risk of 2 and chemical risk of less than ERPG-1.

The continued operations (waste storage tanks) accident analyzed in the TWRS EIS was a hydrogen deflagration scenario that could occur from the ignition of hydrogen gas generated in the tank resulting in high-efficiency particulate air filter failure and an unfiltered radiological release to the atmosphere. The probability of the accident for Phase I and Phase II is 7.2×10^{-2}

and 1.5 x 10^{-1}, respectively. The LCF risk and chemical risk given the occurrence of the accident as calculated in the TWRS EIS is summarized as follows:

- The MEI involved worker would receive a lethal dose of radiation
- The involved worker population would receive a lethal dose of radiation
- The MEI noninvolved worker would have a LCF risk of 1 and chemical risk of ERPG-3
- The noninvolved worker population would have a LCF risk of 9.9 and chemical risk of ERPG-3
- The MEI general public would have a LCF risk of 2.1 × 10^{-3} and chemical risk of less than ERPG-1
- The general public would have a LCF risk of 1.9 and chemical risk of less than ERPG-1.

The retrieval accident analyzed in the TWRS EIS was a ventilation heater failure that could occur due to an electrical fault, resulting in humid air plugging the high-efficiency particulate air filter and filter blow out. It was assumed that retrieval would only take place during Phase II; therefore, the accident was restricted to Phase II. The probability of the accident for Phase II is 1.8 x 10^{-4}. The LCF risk and chemical risk given the occurrence of the accident as calculated in the TWRS EIS is summarized as follows:

- The MEI involved worker would receive a lethal dose of radiation
- The involved worker population would receive a lethal dose of radiation
- The MEI noninvolved worker would have a LCF risk of 1.7 x 10^{-2} and a chemical risk of ERPG-3
- The noninvolved worker population would have a LCF risk of 3.7 x 10^{-1} and a chemical risk of ERPG-2
- The MEI general public would have a LCF risk of 4.6 x 10^{-5} and a chemical risk of less than ERPG-1
- The general public would have a LCF risk of 6.9 x 10^{-2} and a chemical risk of less than ERPG-1.

The pretreatment accident analyzed in the TWRS EIS was a line break that could occur within a ventilated vault because of an earthquake, resulting in a pressurized spray release. The probability of the accident for Phase I and Phase II is 6.5 x 10^{-3} and 1.4 x 10^{-2}, respectively. The LCF risk and chemical risk given the occurrence of the accident as calculated in the TWRS EIS is summarized as follows:

- The MEI involved worker would have a LCF risk of 2.8 x 10^{-3} and chemical risk of less than ERPG-1

- The involved worker population would have a LCF risk of 2.8 x 10^{-2} and chemical risk of less than ERPG-1
- The MEI noninvolved worker would have a LCF risk of 4.2 x 10^{-5} and chemical risk of less than ERPG-1
- The noninvolved worker population would have a LCF risk of 1.6 x 10^{-3} and chemical risk of less than ERPG-1
- The MEI general public would have a LCF risk of 2.3 x 10^{-7} and chemical risk of less than ERPG-1
- The general public would have a LCF risk of 4.8 x 10^{-4} and chemical risk of less than ERPG-1.

The treatment accident analyzed in the TWRS EIS was a canister of vitrified HLW dropped because of mechanical failure or human error in the HLW vitrification facility. The probability of the accident for both Phase I and Phase II is 1.0. The LCF risk and chemical risk given the occurrence of the accident as calculated in the TWRS EIS is summarized as follows:

- The MEI involved worker would have a LCF risk of 1.1 x 10^{-8} and chemical risk of less than ERPG-1
- The involved worker population would have a LCF risk of 1.1 x 10^{-7} and chemical risk of less than ERPG-1
- The MEI noninvolved worker would have a LCF risk of 1.6 x 10^{-10} and chemical risk of less than ERPG-1
- The noninvolved worker would have a LCF risk of 6.1 x 10^{-9} and chemical risk of less than ERPG-1
- The MEI general public would have a LCF risk of 3.0 x 10^{-13} and chemical risk of less than ERPG-1
- The general public would have a LCF risk of 6.7 x 10^{-10} and chemical risk of less than ERPG-1.

The beyond design basis accident analyzed in the TWRS EIS was a tank dome collapse resulting from a beyond design basis earthquake. The probability of the accident for Phase I and Phase II is 1.4 x 10^{-3} and 2.9 x 10^{-3}, respectively. The LCF risk and chemical risk given the occurrence of the accident as calculated in the TWRS EIS is summarized as follows:

- The MEI involved worker would receive a lethal dose of radiation
- The involved worker population would receive a lethal dose of radiation
- The MEI noninvolved worker would have a LCF risk of 1 and chemical risk of ERPG-3

- The noninvolved worker population would have a LCF risk of 11 and chemical risk of ERPG-3
- The MEI general public would have a LCF risk of 2.4 x 10^{-3} and chemical risk of ERPG-2
- The general public population would have a LCF risk of 2.1 and chemical risk of less than ERPG-1.

The radiological risk from accidents while transporting vitrified HLW by rail to a geological repository was analyzed in the TWRS EIS. The LCF risk calculated in the TWRS EIS for the integrated population and urban population was 3.1 x 10^{-5} and 8.5 x 10^{-7}, respectively.

3.13.3.2 New Information for Radiological and Toxicological Accidents. Since release of the TWRS EIS, new information on potential radiological and chemical accidents during routine operations of the tank farm waste has been made available. The new information is contained in the TWRS FSAR and *Tank Waste Remediation System Privatization Project Tank Waste Remediation System Initial Safety Analysis Report* (BNFL-5193-ISAR-01). There is revised inventory data that would change the number of shipments of vitrified HLW to an offsite geologic repository and the consequences of a potential accident.

3.13.3.2.1 TWRS FSAR. The TWRS FSAR establishes operational and institutional measures to mitigate risks associated with the program. The three bounding tank farm operation accidents analyzed in the TWRS EIS (i.e., spray release from valve pit, flammable gas deflagration in waste storage tank, and a seismic event) were also analyzed in the TWRS FSAR. A comparison of the accident parameters for these accidents as analyzed in Table 3.32. The annual frequency and consequences of these accidents are common to both Phase I and Phase II tank farm operations.

The analysis in the TWRS EIS was carried out to show the radiological LCF risk to the MEI involved worker, MEI noninvolved worker, and MEI general public receptors as well as the population for each receptor. The analysis also included a probabilistic evaluation in which the probabilities of the postulated accidents were quantified. In contrast, the analysis in the TWRS FSAR analyzed accidents resulting in radiological doses and chemical hazards to an MEI onsite (noninvolved worker) receptor and an MEI offsite (general public) receptor. The analysis was not carried out to include a calculation of the LCF risk from the postulated accidents. The annual frequency of the accidents was not quantified but was addressed qualitatively as frequency categories. Therefore only the dose consequences and chemical hazard to the MEI noninvolved worker and MEI general public in the TWRS EIS are listed in Table 3.32 for comparison with the TWRS FSAR.

Table 3.32. Comparison of Parameters in the TWRS FSAR and the TWRS EIS for Selected Accidents (2 Sheets)

Parameter	TWRS FSAR	TWRS EIS
Spray Scenario (Cover Block Off)		
Source term material	AWF	SST
Entrained solids	33 vol%	30 vol%
Leak length	5.1 cm crack	0.035 cm pinhole
Crack width	0.116 mm	0.035 cm pinhole
Gauge pressure	250 psi	207 psi
Total flow rate (L/min)	8.5	$0.027 \times 2 = 0.054$
Respirable release from spray (L/min)	0.21 (RF = 1.6%)	0.054 (RF = 100%)
Exposure duration onsite	10 min	8 hr
Exposure duration offsite	24 hr	16 hr
Total volumetric respirable release onsite (L)	1.37	26
Total volumetric respirable release offsite (L)	197	52
Breathing rate onsite (m^3/s)	3.3E-04	3.3E-04
Breathing rate offsite (m^3/s)	2.7E-04	3.3E-04
χ/Q onsite (s/m^3)	99.5 percentile	99.5 percentile
χ/Q offsite (s/m^3)	99.5 percentile	99.5 percentile
Unit liter dose (rem/L)	5.6E+07 (AWF 33/67), (50-yr CEDE)	7.8E+06 [(SST 30/70), (70-yr CEDE)]
MEI onsite radiological dose (rem)	7.4E+02	4.4E+02
MEI offsite radiological dose (rem)	8.3	1.9
MEI onsite toxicological exposure	2.5E+01 ERPG-1	5.4E+00 ERPG-2
MEI offsite toxicological exposure	8.9E-02 PEL-TWA	4.1E-04 ERPG-1
Annual frequency	Anticipated (>1.0E-02 to ≤1.0E+00)	1.1E-02 - 8.0E-03
Flammable Gas Deflagration		
Failure mode	Dome cracking	Ventilation failure, no dome collapse
Source term (L)	Total = 6.0E-01	MAR = 5.0E+05 ARF × RF = 6.5E-06 LPF = 0.75 Total = 2.4E+00
Breathing rate onsite (m^3/s)	3.3E-04	3.3E-04
Breathing rate offsite (m^3/s)	2.7E-04	3.3E-04
χ/Q onsite (s/m^3)	99.5 percentile	99.5 percentile
χ/Q offsite (s/m^3)	99.5 percentile	99.5 percentile
Unit liter dose – inhalation (rem/L)	SST solids (50 yr) = 2.2E+07	DST solids (70 yr) = 6.45E+07
MEI onsite radiological dose (rem)	150	1,760

Table 3.32. Comparison of Parameters in the TWRS FSAR and the TWRS EIS for Selected Accidents (2 Sheets)

Parameter	TWRS FSAR	TWRS EIS
MEI offsite radiological dose (rem)	1.0E-01	4.26
MEI onsite toxicological exposure	6.3E+01 ERPG-2	4.54E+02 ERPG-3
MEI offsite toxicological exposure	9.9E-01 ERPG-1	4.92E-01 ERPG-1
Annual frequency	Unlikely (>1.0E-04 to ≤1.0E-02)	7.2E-03
Beyond Design Basis Earthquake		
Peak horizontal ground acceleration	0.43 *g*	0.43 *g*
Failure mode	4 SST failures with 1 SST and 1 DST detonation	SST dome collapse
Onsite exposure source term (L)	Dome collapse SST = 0.38 SST detonation = 120 DST detonation = 120	Dome collapse SST = 7.47
Offsite exposure source term (L)	Dome collapse SST = 0.38 SST detonation = 120 DST detonation = 120	Dome collapse SST = 7.47
Breathing rate onsite (m^3/s)	3.3E-04	3.3E-04
Breathing rate offsite (m^3/s)	2.7E-04	3.3E-04
χ/Q onsite (s/m^3)	50 percentile	99.5 percentile
χ/Q offsite (s/m^3)	50 percentile	99.5 percentile
Unit liter dose (rem/L)	SST solids = 2.2E+07 DST liquids = 6.1E+05	SST (solids) = 2.3E+07
MEI onsite radiological dose (rem)	SST detonation = 5.0E+03	Dome collapse = 1.9E+03
MEI offsite radiological dose (rem)	All sources = 3.5E+00	Dome collapse = 4.7E+00
MEI onsite toxicological exposure	SST detonation = 3.6E+02 ERPG-2	Dome collapse = 2.2E+03 ERPG-3
MEI offsite toxicological exposure	All sources = 1.8E+00 ERPG-1	Dome collapse = 1.8E+00 ERPG-2
Annual exceedence frequency	Extremely unlikely (>1.0E-06 to ≤1.0E-04)	1.4E-04/yr`

ARF = airborne release fraction.
AWF = aging waste facility.
CEDE = committed effective dose equivalent.
DST = double-shell tank.
EPRG = Emergency Response Planning Guideline (AIHA 1989).
LPF = leak path factor.
MAR = material at risk.
MEI = maximally exposed individual.
PEL-TWA = permissible exposure limit - time-weighted average.
RF = respirable fraction.
SST = single-shell tank.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).
TWRS FSAR = Tank Waste Remediation System Final Safety Analysis Report (HNF-SD-WM-SAR-067).

3.13.3.2.2 Privatization Project Safety Analysis Report. BNFL-5193-ISAR-01 provided the initial safety assessment for the proposed Phase I facilities evaluated in this section. The bounding accidents analyzed in BNFL-5193-ISAR-01 for waste storage, pretreatment, and vitrification are HLW receipt tank failure, cesium ion-exchange column exothermic reaction, and molten glass spill, respectively. The health risk from a Phase I vitrification facility design basis earthquake also was evaluated. There are no new data that would change the conclusions reached in the TWRS EIS for Phase II pretreatment and vitrification facilities accidents.

The HLW receipt tank failure accident assumes a catastrophic failure of a tank resulting in the entire 225,000 L (59,500 gal) content of the tank spilling to the floor. The receipt tanks are in steel-lined cells with filtered ventilation that will reduce the source term to the various receptors. Ventilation control ensures that cells where radioactive material is handled are kept at lower pressure than nonradioactive areas. Therefore, air leakage through cell penetrations would be into the cell. The cell ventilation is routed out of the facility through an 88-m- (289-ft-) high stack. The parameters for this accident are summarized in Table 3.33. A tank failure accident inside the pretreatment and treatment facilities was not evaluated in the TWRS EIS.

The cesium ion-exchange column exothermic reaction accident assumes a thermal excursion leading to overpressure and catastrophic failure of the cesium ion-exchange column. It is assumed that a loss of cooling water occurs when the ion exchange column is fully loaded with cesium. This results in a exothermic reaction that proceeds under conditions of confinement, with inadequate provisions for dissipating the heat of reaction culminating in a thermal explosion. The cesium ion-exchange columns are in steel-lined cells with filtered ventilation that will reduce the source term to the various receptors. The parameters for this accident are summarized in Table 3.33 and compared with the breached cesium canister accident evaluated in the TWRS EIS.

The molten glass spill scenario postulates a failure of the HLW melter such that molten glass spills to the cell floor. Volatile and semivolatile radionuclides will be released from the molten glass pool into the air. The only semivolatile species that contributes significantly to the release are cesium-134, cesium-137, and technetium-99. Strontium and the TRU species are nonvolatile and therefore do not contribute significantly to the release. The analysis did not take credit for engineered barriers but assumed an unmitigated release. It should be noted that the melters would be located in shielded cells with ventilation out an 88-m (289-ft) stack and high-efficiency particulate air filters that would reduce the radiological release to the atmosphere. The parameters for this accident are summarized in Table 3.33. A molten glass spill accident inside the vitrification facility was not evaluated in the TWRS EIS.

Table 3.33. BNFL-5193-ISAR-01 Parameters (2 Sheets)

Parameter	BNFL-5193-ISAR-01	TWRS EIS
Waste Tank Storage Accident – HLW Receipt Tank Failure		
Source term material	225 m^3 Envelope D waste	This accident was not evaluated in the TWRS EIS.
Unit liter dose	1.68E+07 rem/L	
Mitigation	Receipt tanks are in steel lined cells with filtered ventilation. Airborne tank waste would be filtered before exiting stack.	
Exposure duration onsite	8 hr	
Exposure duration offsite	24 hr	
MEI onsite radiological dose (rem)	0.69	
MEI offsite radiological dose (rem)	0.15	
Annual frequency	No annual frequency was assigned to this accident.	
Pretreatment Accident – Cesium Ion-Exchange Column Exothermic Reaction		
Source term material	Cesium ion-exchange column	One cesium canister
Mitigation	Cesium ion-exchange columns are in steel-lined cells with filtered ventilation. Airborne releases from the spill would be filtered before exiting stack.	Accident occurs in cell with filtered ventilation. Airborne release from the spill would be filtered before exiting stack.
MEI onsite radiological dose (rem)	1,120	2.7E-05
MEI offsite radiological dose (rem)	0.62	1.8E-08
Annual frequency	No annual frequency was assigned to this accident.	1.0E-02
Treatment Accident – Molten Glass Spill		
Source term material	5.6 m^3 of HLW glass content in melter	This accident was not evaluated in the TWRS EIS.
Mitigation	Melters are in shielded cells with filtered ventilation. Airborne tank waste would be filtered before exiting stack. However, the Phase I analysis did not take credit for any engineered barriers.	
MEI onsite radiological dose (rem)	4.6	
MEI offsite radiological dose (rem)	8.0E-03	
Annual frequency	No annual frequency was assigned to this accident.	

Table 3.33. BNFL-5193-ISAR-01 Parameters (2 Sheets)

Parameter	BNFL-5193-ISAR-01	TWRS EIS
Design Basis Earthquake		
Failure mode	Systems assumed at risk: • TWRS Privatization transfer line • 2 LAW receipt tanks • 3 HLW receipt tanks • Cesium and technetium product storage tank • Cesium ion exchange column • HLW melter	Line break within a vault
Mitigation	Unmitigated release	Mitigated release
MEI onsite radiological dose (rem)	8,200	0.10
MEI offsite radiological dose (rem)	4.5	4.6E-04
Annual exceedence frequency	No annual frequency was assigned to this accident.	6.5E-04
Nitric Acid Spill		
Source term	18,900 L of 12.2M nitric acid	This accident was not evaluated in the TWRS EIS.
MEI onsite toxicological dose	ERPG-2	
MEI offsite toxicological dose	<ERPG-1	

ERPG = Emergency Response Planning Guideline (AIHA 1989).
HLW = high-level waste.
LAW = low-activity waste.
MEI = maximally exposed individual.
TWRS = Tank Waste Remediation System.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

A design basis earthquake was also evaluated in BNFL-5193-ISAR-01 for Phase I. vitrification facilities. An earthquake could result in simultaneous failure of multiple systems in the Phase I vitrification facilities. It was assumed that an earthquake occurs that causes catastrophic failure of systems and vessels relied upon to ensure confinement of radioactive materials. The analysis did not take credit for engineered or seismically qualified barriers but assumed an unmitigated release. It should be noted that all the systems assumed by the analysis to fail are located in cells. Therefore, if the cell structure, ventilation system, and stack are designed to continue to perform their function of routing the release to the elevated release point during and after the earthquake, the radiological release to the atmosphere would be reduced. The parameters for this accident are summarized in Table 3.33 and compared with the seismic event evaluated in the TWRS EIS.

The bounding toxicological accident evaluated in BNFL-5193-ISAR-01 for the Phase I waste treatment facilities was a nitric acid spill. Nitric acid, in various strengths, would be used in several areas of the facility. The solutions are made up from 12.2M nitric acid stored in a 18,900 L (5,000 gal) tank in the cold chemical storage area outside the pretreatment building. A spill of nitric acid, caused by leakage of lines during filling or delivery to the facility, or by a catastrophic failure of the tank, could result in inhalation of toxic fumes and vapors by workers and public. It was assumed that the entire inventory of the tank is released to the ground. A catch tank basin capable of containing the full contents of the tank is provided under the tank. Following the spill, nitric acid vapors are entrained in the air by vaporization from the pool surface. The parameters for this accident are summarized in Table 3.33. A nitric acid storage tank accident was not evaluated in the TWRS EIS.

The accident scenarios evaluated in BNFL-5193-ISAR-01 did not account for the decontamination factor provided by the high-efficiency particulate air filters. For the current planning baseline a reduction factor of 1,000 was assumed (RPT-W375-RR00001). Also, the BNFL-5193-ISAR-01 analysis only addressed radiological and toxicological exposures from the postulated accidents to the MEI onsite (collocated worker) receptor and an MEI offsite (public) receptor. Also the analysis was not carried out to include a calculation of the LCF risk from the postulated accidents, and the annual frequency of the accidents was not addressed.

3.13.3.2.3 Revised Inventory. The revised inventory information presented in Section 2.0 shows that the consequences of a transportation accident while shipping vitrified HLW would increase by 28%, and the probability of the accident (resulting from the increased number of trips) would increase by 19%.

3.13.3.3 Impacts of the New Information. The accident analyses provided in the TWRS FSAR and BNFL-5193-ISAR-01 could change the level of radiological and toxicological risk as evaluated in the TWRS EIS for Phase I. Likewise, the accident analysis provided in the TWRS FSAR could change the level of radiological and toxicological risk as evaluated in the TWRS EIS for Phase II, and the revised inventory could change the level of radiological risk from a transportation accident as evaluated in the TWRS EIS for Phase II.

It should be noted that the evaluations in the TWRS FSAR and BNFL-5193-ISAR-01 only evaluated the radiological and toxicological doses to the MEI onsite and MEI offsite receptors. These receptors are equivalent to the MEI noninvolved worker and MEI general public receptors in the TWRS EIS. For the current planning baseline the noninvolved worker population and general public population doses were calculated by assuming the population weighted atmospheric dispersion coefficients and breathing rates used in the TWRS EIS. The receptor doses were then multiplied by the dose-to-risk conversion factors used in the TWRS EIS to calculate the LCF risk for each receptor. The radiological and toxicological risk given the occurrence of the accidents for are summarized in Table 3.34.

Spray release during tank waste transfer. The MEI noninvolved worker would receive a lethal radiological dose as evaluated in the TWRS EIS and for the current planning baseline. The LCF risk for a general public MEI would exceed the LCF risk evaluated in the TWRS EIS by over four times and over one order of magnitude for the noninvolved worker and general public populations. This is attributed to the higher volume of tank waste released in the spray as evaluated in the TWRS FSAR and inventories representing a higher unit liter dose based on 33% solids and 67% liquids from the aging waste facility compared to the 30% solids and 70% liquids from the SSTs used in the TWRS EIS. Toxicological consequences in the TWRS FSAR were frequency dependent, which resulted in lower ERPG levels. The MEI noninvolved worker would be ERPG-1 and the MEI general public would be less than ERPG-1 in the TWRS EIS if the ERPGs were adjusted to frequency dependent. Therefore, there would be no change in toxicological risk. The impacts would be common to Phase I and Phase II.

Gas deflagration in waste storage tank. The noninvolved worker MEI, noninvolved worker population, general public MEI, and general public population LCF risk from a gas deflagration in a waste storage tank evaluated for the current planning baseline would be reduced to 12%, 8%, 2%, and 7%, respectively of the LCF risk evaluated in the TWRS EIS. The higher LCF risk analyzed in the TWRS EIS is attributed to a higher volume of released waste in the accident and a higher unit liter dose based on DST solids compared to SST solids used in the TWRS FSAR analysis. Toxicological consequences in the TWRS FSAR were frequency dependent, which resulted in lower ERPG levels. The MEI noninvolved worker would be ERPG-2 and the MEI general public would be less than ERPG-1 in the TWRS EIS if the ERPGs were adjusted to be frequency dependent. Therefore, there would be no change in toxicological risk. The impacts would be common to Phase I and Phase II.

Beyond design basis earthquake in tank farms. The MEI noninvolved worker would receive a lethal radiological dose as evaluated in the TWRS EIS and for the current planning baseline. The noninvolved worker population, general public MEI, and general public population LCF risk from a beyond design basis earthquake in the tank farms would be reduced to 52%, 78%, and 36%, respectively of the LCF risk calculated in the TWRS EIS. The higher LCF risk analyzed in the TWRS EIS is attributed to higher volumes of tank waste released from the breached tanks. Toxicological consequences in the TWRS FSAR were frequency dependent, which resulted in lower ERPG levels. The MEI noninvolved worker would be ERPG-2 and the MEI general public would be ERPG-1 in the TWRS EIS if the ERPGs were adjusted for frequency dependency. Therefore, there would be no change in toxicological risk. The impacts would be common to Phase I and Phase II.

Table 3.34. Radiological and Toxicological Risk Given the Occurrence of an Accident (4 pages)

Receptor	TWRS EIS				Current Planning Baseline			
	Phase I		Phase II		Phase I		Phase II	
	Radiological Risk (LCF)	Toxicological Risk	Radio logical Risk (LCF)	Toxicological Risk	Radiological Risk (LCF)	Toxicological Risk	Radiological Risk (LCF)	Toxicological Risk
Spray release from valve pit in tank farm								
Noninvolved worker MEI	1.0E+00	ERPG-2	1.0E+00	ERPG-2	1.0E+00	ERPG-2	1.0E+00	ERPG-2
Noninvolved worker population	6.6E+00	Not applicable	6.6E+00	Not applicable	1.2E+02	Not applicable	1.2E+02	Not applicable
General public MEI	9.6E-04	<ERPG-1	9.6E-04	<ERPG-1	4.2E-03	<ERPG-1	4.2E-03	<ERPG-1
General public population	2.0E+00	Not applicable	2.0E+00	Not applicable	3.8E+01	Not applicable	3.8E+01	Not applicable
Flammable gas deflagration in waste storage tank in tank farm								
Noninvolved worker MEI	1.0E+00	ERPG-3	1.0E+00	ERPG-3	1.2E-01	ERPG-2	1.2E-01	ERPG-2
Noninvolved worker population	9.9E+00	Not applicable	9.9E+00	Not applicable	8.4E-01	Not applicable	8.4E-01	Not applicable
General public MEI	2.1E-03	<ERPG-1	2.1E-03	<ERPG-1	5.0E-05	ERPG-1	5.0E-05	ERPG-1
General public population	1.9E+00	Not applicable	1.9E+00	Not applicable	1.3E-01	Not applicable	1.3E-01	Not applicable
Beyond design basis earthquake in tank farm								
Noninvolved worker MEI	1.0E+00	ERPG-3	1.0E+00	ERPG-3	1.0E+00	ERPG-3	1.0E+00	ERPG-3
Noninvolved worker population	1.1E+01	Not applicable	1.1E+01	Not applicable	5.8E+00	Not applicable	5.8E+00	Not applicable

Table 3.34. Radiological and Toxicological Risk Given the Occurrence of an Accident (4 pages)

Receptor	TWRS EIS				Current Planning Baseline			
	Phase I		Phase II		Phase I		Phase II	
	Radiological Risk (LCF)	Toxicological Risk	Radio logical Risk (LCF)	Toxicological Risk	Radiological Risk (LCF)	Toxicological Risk	Radiological Risk (LCF)	Toxicologica Risk
General public MEI	2.3E-03	ERPG-2	2.3E-03	ERPG-2	1.8E-03	ERPG-2	1.8E-03	ERPG-2
General public population	2.1E+00	Not applicable	2.1E+00	Not applicable	7.5E-01	Not applicable	7.5E-01	Not applicable
HLW receipt tank failure in waste treatment facility[a]								
Noninvolved worker MEI	NE	NE	NE	NE	9.0E-03	NE	NE	NE
Noninvolved worker population	NE	NE	NE	NE	7.3E-02	NE	NE	NE
General public MEI	NE	NE	NE	NE	7.3E-06	NE	NE	NE
General pubic population	NE	NE	NE	NE	2.4E-02	NE	NE	NE
Cesium ion-exchange column exothermic reaction in pretreatment facility[b]								
Noninvolved worker MEI	1.1E-08	<ERPG-1	1.1E-08	<ERPG-1	4.3E-04	NE	1.1E-08	<ERPG-1
Noninvolved worker population	9.2E-08	Not applicable	9.2E-08	Not applicable	3.5E-03	Not applicable	9.2E-08	Not applicable
General public MEI	9.0E-12	<ERPG-1	9.0E-12	<ERPG-1	3.5E-07	NE	9.0E-12	<ERPG-1
General public population	2.9E-08	Not applicable	2.9E-08	Not applicable	1.1E-03	Not applicable	2.9E-08	Not applicable
Molten glass spill in vitrification facility[c]								
Noninvolved worker MEI	1.6E-10	NE	1.6E-10 NE	NE	7.0E-06	NE	1.6E-10 NE	NE

Table 3.34. Radiological and Toxicological Risk Given the Occurrence of an Accident (4 pages)

Receptor	TWRS EIS				Current Planning Baseline			
	Phase I		Phase II		Phase I		Phase II	
	Radiological Risk (LCF)	Toxicological Risk	Radio logical Risk (LCF)	Toxicological Risk	Radiological Risk (LCF)	Toxicological Risk	Radiological Risk (LCF)	Toxicological Risk
Noninvolved worker population	6.1E-09	Not applicable	6.1E-09	Not applicable	5.7E-05	Not applicable	6.1E-09	Not applicable
General public MEI	3.0E-13	NE	3.0E-13	NE	5.7E-09	NE	3.0E-13	NE
General public population	6.7E-10	Not applicable	6.7E-10	Not applicable	1.8E-05	Not applicable	6.7E-10	Not applicable
Design basis earthquake impacts waste treatment facilities								
Noninvolved worker MEI	4.2E-05	<ERPG-1	4.2E-05	<ERPG-1	3.3E-03	NE	4.2E-05	<ERPG-1
Noninvolved worker population	1.6E-03	Not applicable	1.6E-03	Not applicable	2.7E-02	Not applicable	1.6E-03	Not applicable
General public MEI	2.3E-07	<ERPG-1	2.3E-07	<ERPG-1	2.7E-06	NE	2.3E-07	<ERPG-1
General public population	4.8E-04	Not applicable	4.8E-04	Not applicable	8.8E-03	Not applicable	4.8E-04	Not applicable
Nitric acid spill in waste treatment facility[d]								
Noninvolved worker MEI	NE	<ERPG-1	NE	NE	NE	ERPG-2	NE	NE
General public MEI	NE	<ERPG-1	NE	NE	NE	<ERPG-1	NE	NE
Vitrified HLW Transportation accident								
Integrated population	NE	NE	3.1E-05	NE	NE	NE	4.0E-05	NE
Urban population	NE	NE	8.5E-07	NE	NE	NE	1.1E-06	NE

Table 3.34. Radiological and Toxicological Risk Given the Occurrence of an Accident (4 pages)

Receptor	TWRS EIS				Current Planning Baseline			
	Phase I		Phase II		Phase I		Phase II	
	Radiological Risk (LCF)	Toxicological Risk	Radio logical Risk (LCF)	Toxicological Risk	Radiological Risk (LCF)	Toxicological Risk	Radiological Risk (LCF)	Toxicologica Risk

[a] A HLW receipt tank failure in waste treatment facility was not evaluated in the TWRS EIS. There was no waste receiving accidents evaluated in the TWRS EIS, therefore, no comparison can be made.
[b] The pretreatment accident evaluated in the TWRS EIS was a cesium canister failure accident. The consequences of the cesium canister accident is included for a comparison with the pretreatment (cesium ion-exchange column exothermic reaction) evaluated in for the current planning baseline.
[c] The vitrification accident evaluated in the TWRS EIS was a breached canister of vitrified HLW accident. The consequences of the breached vitrified HLW canister is included for a comparison with the vitrification accident (molten glass spill) evaluated for the current planning baseline.
[d] A nitric acid spill in the waste treatment facility was not evaluated in the TWRS EIS. Toxicological risk resulting from pretreatment, treatment, and design basis earthquake accidents evaluated in the TWRS EIS are included for a comparison.

ERPG = Emergency Response Planning Guideline (AIHA 1989).
HLW = high-level waste.
LCF = latent cancer fatality.
MEI = maximally exposed individual.
NE = not evaluated.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

Waste treatment facility HLW receipt tank failure. A tank waste receipt accident in a waste treatment facility was not evaluated in the TWRS EIS.

Cesium ion-exchange column exothermic reaction in pretreatment facility. The LCF risk to the noninvolved worker and general public receptors from a Phase I pretreatment facility accident for the current planning baseline would exceed the LCF risk as evaluated in the TWRS EIS by over four orders of magnitude. The Phase I pretreatment facility accident evaluated was a cesium ion-exchange column exothermic reaction that would release a larger quantity of cesium than the breached cesium canister accident calculated in the TWRS EIS. There is no new information that would change the conclusions reached in the TWRS EIS for Phase II.

Molten glass spill in vitrification facility. The LCF risk to the noninvolved worker and general public receptors from a Phase I vitrification facility accident evaluated for the current planning baseline would exceed the LCF risk as calculated in the TWRS EIS by over four orders of magnitude. The Phase I vitrification facility accident was a molten glass spill that would release a higher volume of radiological constituents than the breached vitrified HLW canister accident evaluated in the TWRS EIS. There is no new information that would change the conclusions reached in the TWRS EIS for Phase II.

Waste treatment facilities design basis earthquake. The LCF risk to the noninvolved worker and general public receptors from a Phase I waste treatment facilities design basis accident for the current planning baseline would exceed the LCF risk as evaluated in the TWRS EIS by over one order of magnitude. This is attributed to a higher volume of radiological constituents released than the TWRS EIS scenario. There is no new information that would change the conclusions reached in the TWRS EIS for Phase II.

Waste treatment nitric acid spill. The toxicological risk to the noninvolved and general public MEIs from a Phase I waste treatment facility accident for the current planning baseline would exceed the LCF risk as evaluated in the TWRS EIS by two ERPG levels. The Phase I waste treatment facility accident was a nitric acid spill that would release a higher volume of toxicological constituents than any of the Phase I waste treatment facility accidents evaluated in the TWRS EIS. There is no new information that would change the conclusions reached in the TWRS EIS for Phase II.

The radiological risk from accidents while transporting vitrified HLW by rail to a geological repository would exceed the integrated population LCF risk and urban population LCF risk evaluated in the TWRS EIS by 28%. This is attributed to the increased radiological constituent concentrations in the revised inventory. Because the vitrified HLW would be transported during Phase II, this would only impact Phase II.

3.13.3.4 Total Alternative. The accident analyses for the current planning baseline conclude that the overall health risk from accidents would exceed the health risk evaluated in the TWRS EIS for Phase I and Phase II of the Phased Implementation alternative. Therefore, the impacts from Phase I and Phase II of the current planning baseline are summed so that the total alternative is compared with the other alternatives. Comparing the health impacts calculated for the current planning baseline with the TWRS EIS results in the following conclusions.

- The occupational risk calculated for the current planning baseline would exceed the occupational risk of all the alternatives evaluated in the TWRS EIS. That risk exceeds the Phased Implementation total alternative (the alternative in the TWRS EIS with the bounding transportation health risk) by 30%. This 30% increase represents approximately 2,000 more TRC, 500 LWC, and 1 additional fatality, which is a substantive increase to a significant environmental impact evaluated in the TWRS EIS.

- The transportation health risk calculated for the current planning baseline would exceed the transportation health risk of all the alternatives evaluated in the TWRS EIS. It exceeds the Phased Implementation total alternative (the alternative in the TWRS EIS with the bounding transportation health risk) for injuries and fatalities by 24% and 31%, respectively. This increase represents approximately 415 more injuries and 7 additional fatalities, which is a substantive increase to a significant environmental impact evaluated in the TWRS EIS.

- The LCF risk from radiological accidents calculated for tank farm operations would be the same for all alternatives evaluated in the TWRS EIS and therefore would not impact the conclusions reached in the TWRS EIS.

- The LCF risk from radiological accidents calculated for the currently planned vitrification operations are bound by the waste vitrification accident scenarios evaluated in the TWRS EIS for the in situ alternatives by more than two orders of magnitude and therefore would not impact the conclusions reached in the TWRS EIS.

- The toxicological risk calculated for tank farm operations would be the same for all alternatives evaluated in the TWRS EIS and therefore would not impact the conclusions reached in the TWRS EIS.

- The toxicological risk calculated for the currently planned vitrification operations are bound by the vitrification accident evaluated in the TWRS EIS for the in situ alternatives by ERPG-3 (compared to ERPG-2) for the noninvolved worker and ERPG-1 (compared to <ERPG-1) for the general public and would therefore not impact the conclusions reached in the TWRS EIS.

3.14 REGULATORY COMPLIANCE

In the TWRS EIS, DOE described Federal and Washington State regulations potentially applicable to TWRS EIS alternatives, regulatory issues affecting the ability to implement the alternatives, and the ability of the alternatives to enable DOE to comply with applicable regulations. To determine if new information developed since completion of the TWRS EIS indicated changes in understanding of the ability to implement the alternatives, a review of new data was completed. This review included assessing the changes in impacts discussed elsewhere in Section 3.0 of this document and new information regarding Federal and Washington State regulations and regulatory issues affecting the ability to implement the alternatives. Based on this review it was determined that none of the changes in impacts discussed elsewhere in Section 3.0 change the conclusions reached in the TWRS EIS regarding the ability of the TWRS EIS alternatives to comply with applicable Federal and State regulations. Outstanding issues include polychlorinated biphenyls (PCBs) in the waste tanks, RCRA delisting, and "Washington State Environmental Policy Act (SEPA)" coverage of the remote-handled vitrified LAW trenches. These issues would require resolution.

Four regulatory developments were identified in DOE/EIS-0189-SA2. These included:

- Creation of the organization known as the Office of Radiological, Nuclear, and Process Safety Regulation for TWRS Privatization, or the Regulatory Unit
- DOE O 435.1 that replaces *Radioactive Waste Management* (DOE Order 5820.2A)
- Reduction of regulatory uncertainty associated with classification of the vitrified LAW stream (Paperiello 1997)
- Hanford sitewide PCBs management strategy (97-EAP-546).

3.14.1 New Data

DOE regulations are generally found in "Department of Energy (General Provisions)" (10 CFR). DOE regulations include rules for nuclear safety management, occupational radiation protection, and radiation protection for the public. As DOE issues formal regulations, and as the standards-based management approach continues to be implemented, some DOE orders are no longer needed, while others need to be consolidated. In September 1995, DOE canceled 58 orders and concurrently or subsequently DOE has issued draft or final directives known as policies. Among the draft or final directives relevant to requirements for tank waste retrieval or tank farm closure actions are as follows:

- *Identifying, Implementing, and Complying with Environment, Safety and Health Requirements* (DOE P 450.2A)
- *Safety and Health Reporting Requirements* (DOE O 231.1)
- *Worker Protection Management for DOE Federal and Contractor Employees* (DOE O 440.1A)
- *Radioactive Waste Management* (DOE O 435.1).

DOE P 450.2A sets forth the framework for identifying, implementing, and complying with environment, safety, and health requirements so that work is performed in the DOE complex in a manner that ensures adequate protection of workers, the public, and the environment.
DOE O 231.1 directs the collection and reporting of information on the environment, safety, and health that is required by law or regulation or that is essential for evaluating DOE operations and identifying opportunities for improvement needed for planning purposes within DOE.
DOE O 440.1 replaces *Occupational Safety and Health Program for Department of Energy Contractor Employees at Government-Owned Contractor-Operated Facilities* (DOE Order 5483.1A), which incorporates "Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters" (29 CFR 1960). The objective of DOE O 440.1 is to establish the framework for an effective worker protection program that

will reduce or prevent accidental losses, injuries, and illnesses by providing DOE Federal and contractor workers with a safe and healthful workplace. DOE O 435.1 is an order statement that replaced DOE Order 5820.2A, which establishes requirements for managing radioactive or mixed waste activities.

3.14.2 Interim Stabilization

The following is a description of the recent consent decree (Ecology et al. 1999) issued between Ecology and DOE regarding interim stabilization of the remaining 29 SSTs.

3.14.2.1 New Strategy. Washington State and DOE have approved a consent decree that will establish court-enforceable, technically sound schedules for pumping liquid nuclear waste out of DOE's remaining 29 (unstabilized) SSTs. The agreement came eight months after the Governor and the state Attorney General threatened to sue DOE for failing to meet its commitment to stabilize the tanks. After negotiations became deadlocked, Secretary of Energy Bill Richardson met with Governor Locke and Attorney General Gregoire in October 1998 to reach agreement on legal provisions of the consent decree. Following this, a joint technical team representing Ecology, DOE, and DOE contractors developed a schedule that was included in the decree. In addition, changes are proposed to delete out-of-date SST interim stabilization milestones from the Tri-Party Agreement. Key elements of the consent decree include the following:

- Pumping the tanks that pose the greatest environmental risk first, thus providing additional protection for the Columbia River and public health

- Accelerating the schedule for pumping so that 98% of approximately 6.2 million gallons of remaining pumpable liquid is removed by September 30, 2003, with the final 2% scheduled to be removed by September 30, 2004

- Increasing DOE funding to a level that will support successful execution of the new schedule for tank stabilization.

3.14.2.2 Other Consent Decree Commitments. DOE will determine whether the organic layer and pumpable liquids will be pumped from tank C-103 together or separately and will establish a deadline for initiating pumping of this tank no later than December 30, 2000. The parties will incorporate the initiation deadline into this schedule as provided in Section VI of the decree.

3.14.3 Vitrified Low-Activity Waste Disposal in Trenches

A new alternative approach for disposal of the vitrified LAW is utilization of a remote-handled trench. This trench would be a RCRA-compliant landfill that includes a double-liner and a leachate collection system. Based on U.S. Nuclear Regulatory Commission requirements for radioactive waste burial as cited in "Licensing Requirements for Land Disposal of Radioactive Waste" (10 CFR 61), the remote-handled trench would be compliant.

3.15 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

3.15.1 TWRS EIS Baseline

The alternatives for managing, treating, and disposing of the Hanford Site tank waste that were evaluated in the TWRS EIS would involve the irreversible and irretrievable commitment of land, energy, and materials. A summary of resource commitments for Phase I and Phase II of the Phased Implementation alternative are presented in Table 3.35.

Table 3.35. Irreversible and Irretrievable Commitment of Resources

Resource	TWRS EIS		Current Planning Baseline	
	Phase I	Phase II	Phase I	Phase II
Land permanently committed (ha)*	0	4.9E+01	2.0E+00	6.3E+01
Sand/gravel/silt/rip rap (cubic meters)	3.2E+04	4.1E+06	1.5E+05	4.8E+06
Steel (metric tons)	8.6E+04	2.1E+05	5.1E+04	3.0E+05
Stainless and alloy steel (metric tons)	1.6E+04	2.5E+04	6.4E+03	3.1E+04
Concrete (cubic meters)	3.0E+04	1.1E+06	1.9E+05	1.9E+06
Total water usage (cubic meters)	2.8E+06	1.6E+07	1.3E+07	2.5E+07
Electric power (GWh)	1.7E+03	9.3E+03	3.9E+03	1.5E+04
Gasoline (cubic meters)	6.5E+03	4.5E+03	1.0E+04	4.5E+03
Diesel (cubic meters)	1.8E+04	9.2E+04	1.3E+05	1.5E+05
Kerosene (cubic meters)	9.8E+02	6.4E+04	0	6.4E+04
Process chemicals (metric tons)	1.8E+05	8.0E+05	1.2E+05	8.0E+05

* Land permanently committed after decontamination and decommissioning.

GWh = gigawatt-hours.

3.15.2 New Information

Since publication of the TWRS EIS new information has been generated that could change the conclusions reached in the TWRS EIS for commitment of resources. The new information includes Phase I commitment of resource data for the Phase I facilities and a larger Phase II facilities.

3.15.2.1 Phase I Environmental Report. Environmental report CCN: 012779 included an evaluation of commitment of resources for Phase I construction and operation of pretreatment and treatment facilities for vitrifying the tank waste. The results of this evaluation are presented in Table 3.35.

3.15.2.2 Phase II Vitrification Facilities. The capacity of the Phase II facilities evaluated in the TWRS EIS would have to be increased to meet the Tri-Party Agreement milestone. The facilities evaluated in the TWRS EIS were 2 LAW facilities each at 100 MT/day and 1 HLW facility at 10 MT/day (combined 210 MT/day). The capacity of the facilities would need to be increased to 2 LAW facilities each at 150 MT/day and 1 HLW facility at 30 MT/day (combined 330 MT/day) (HNF-SD-WM-SP-012, Rev. 1). The resources that would be committed to these larger facilities were estimated (Jacobs 2000) based on the increased Phase I to Phase II resource commitments evaluated in the TWRS EIS for the 41 MT/day facilities and the 210 MT/day facilities respectively. The estimated commitment of resources to support the 330 MT/day facilities are summarized in Table 3.35.

3.15.3 Impacts of the New Information

The commitment of resources data from CCN: 012779 could change the level of impact to the irreversible and irretrievable commitment of resources compared to the TWRS EIS for Phase I. Likewise, the data for the larger Phase II vitrification facilities could change the level of impact to the commitment of resources compared to the TWRS EIS for Phase II. These potential impacts, based on the new information, are calculated in this section.

3.15.3.1 Phase I Impacts. A comparison of Phase I commitment of resources for the current planning baseline with the TWRS EIS Phase I commitment of resources indicate the following.

- The total permanent land disturbance calculated for the current planning baseline would go from no permanent land disturbance as evaluated in the TWRS EIS to 2 ha (5 ac).
- The commitment of sand, gravel, silt, and rip rap would exceed the commitment calculated in the TWRS EIS for Phase I of the Phased Implementation alternative by 370%.
- The commitment of steel would be reduced to 60% of the commitment calculated in the TWRS EIS for Phase I of the Phased Implementation alternative.
- The commitment of stainless and alloy steel would be reduced to 40% of the commitment calculated in the TWRS EIS for Phase I of the Phased Implementation alternative.
- The commitment of concrete would exceed the commitment calculated in the TWRS EIS for Phase I of the Phased Implementation alternative by 500%.
- The commitment of water would exceed the commitment calculated in the TWRS EIS for Phase I of the Phased Implementation alternative by 360%.
- The commitment of electrical power would exceed the commitment calculated in the TWRS EIS for Phase I of the Phased Implementation alternative by 130%.
- The commitment of gasoline would exceed the commitment calculated in the TWRS EIS for Phase I of the Phased Implementation alternative by 54%.
- The commitment of diesel would exceed the commitment calculated in the TWRS EIS for Phase I of the Phased Implementation alternative by 620%.
- The commitment of kerosene would be reduced to 0% of the commitment calculated in the TWRS EIS for Phase I of the Phased Implementation alternative.

- The commitment of process chemicals would be reduced to 67% of the commitment calculated in the TWRS EIS for Phase I of the Phased Implementation alternative.

3.15.3.2 Phase II Impacts. A comparison of the Phase II commitment of resources for the current planning baseline with the TWRS EIS Phase II commitment of resources indicate the following.

- The commitment of permanently disturbed land would exceed the commitment calculated in the TWRS EIS for Phase II of the Phased Implementation alternative by 29%.
- The commitment of sand, gravel, silt, and rip rap would exceed the commitment calculated in the TWRS EIS for Phase II of the Phased Implementation alternative by 17%.
- The commitment of steel would exceed the commitment calculated in the TWRS EIS for Phase II of the Phased Implementation alternative by 43%.
- The commitment of stainless and alloy steel would exceed the commitment calculated in the TWRS EIS for Phase II of the Phased Implementation alternative by 24%.
- The commitment of concrete would exceed the commitment calculated in the TWRS EIS for Phase II of the Phased Implementation alternative by 73%.
- The commitment of water would exceed the commitment calculated in the TWRS EIS for Phase II of the Phased Implementation alternative by 56%.
- The commitment of electrical power would exceed the commitment calculated in the TWRS EIS for Phase II of the Phased Implementation alternative by 61%.
- The commitment of gasoline would not change.
- The commitment of diesel would exceed the commitment calculated in the TWRS EIS for Phase II of the Phased Implementation alternative by 63%.
- The commitment of kerosene would likely be reduced to zero if the Phase II vitrification facilities does not use a kerosene fired melter.
- The commitment of process chemicals would not change.

3.15.3.3 Total Alternative. The commitment of resources analyzed for the current planning baseline concludes that many of the commitments would exceed the commitments evaluated in the TWRS EIS for Phase I and Phase II of the Phased Implementation alternative. Therefore, the impacts from Phase I and Phase II of the current planning baseline are summed so that the total alternative is compared with the other alternatives. Comparing the resource commitments calculated for the current planning baseline with the TWRS EIS results in the following conclusions.

- The commitment of permanently disturbed land would exceed the commitment calculated in the TWRS EIS for all alternatives. It would exceed Phased Implementation total alternative (the alternative in the TWRS EIS with the bounding permanent land disturbance requirements) by 39% or an additional 19 ha (47 ac). However, this represents a small increase or an additional 1% permanent land disturbance of the 200 Areas' 2,600 ha (6,400 ac).

- The commitment of sand, gravel, silt, and rip rap would exceed the commitment calculated in the TWRS EIS for all alternatives. It would exceed Phased Implementation total alternative (the alternative in the TWRS EIS with the bounding sand, gravel, silt, and rip rap requirements) by 23% or an additional 1 million m^3 (1.3 million yd^3). However, the increased sand and gravel requirements represents only a small fraction of the total sand and gravel reserves available at the Hanford Site.

- The commitment of steel would exceed the commitment calculated in the TWRS EIS for all alternatives. It would exceed Phased Implementation total alternative (the alternative in the TWRS EIS with the bounding steel requirement) by 43% or an additional 50,000 tons.

- The commitment of stainless and alloy steel would be bound by the stainless and alloy steel requirements evaluated in the TWRS EIS for the Ex Situ No Separations alternative.

- The commitment of concrete would be bound by the concrete requirements evaluated in the TWRS EIS for the Ex Situ No Separations alternative.

- The commitment of water would be bound by the water requirements evaluated in the TWRS EIS for the In Situ Vitrification and Ex Situ Extensive Separations alternatives.

- The commitment of electrical power would be bound by the electrical power requirements evaluated in the TWRS EIS for the Ex Situ Extensive Separations alternative.

- The commitment of gasoline would be bound by the gasoline requirements evaluated in the TWRS EIS for the Long-Term Management and In Situ Vitrification alternatives.

- The commitment of diesel would exceed the commitment calculated in the TWRS EIS for all alternatives. It would exceed Phased Implementation total alternative (the alternative in the TWRS EIS with the bounding diesel requirement) by 150% or an additional 170,000 m^3 (6,000,000 ft^3).

- The commitment of kerosene would be bound by the kerosene requirements evaluated in the TWRS EIS for the Ex Situ Intermediate Separations, Ex Situ No Separations, Ex Situ Extensive Separations, and Phase Implementation total alternatives.

- The commitment of process chemicals would be bound by the process chemical requirements evaluated in the TWRS EIS for Ex Situ Intermediate Separations, Ex Situ

No Separations, Ex Situ Extensive Separations, and Phase Implementation total alternatives.

Therefore, none of the increased Phase I and Phase II impacts shown in Table 3.35 substantially change the understanding of impacts to resources presented in the TWRS EIS.

3.16 POLLUTION PREVENTION

There are currently no new data that would change the pollution prevention planning and prevention activities presented in the TWRS EIS.

3.17 ENVIRONMENTAL JUSTICE

For each of the areas of technical analysis presented in the TWRS EIS, a review of impacts to the human and natural environment was conducted to determine if any potentially high and disproportionate adverse impacts on minority populations or low-income populations would occur. The review included potential impacts on land use; socioeconomics (e.g., employment, housing prices, public facilities, and services); water quality; air quality; health effects; accidents; and biological and cultural resources. For each of the areas of analysis, impacts were reviewed to determine if there were any potentially high and disproportionate adverse impacts to the surrounding population that would occur due to construction, routine operations, or accident conditions. If an adverse impact was identified, a determination was made as to whether minority populations or low-income populations would be disproportionately affected.

For purposes of the TWRS EIS, high and disproportionate impacts were defined as impacts that would affect minority and Native American populations or low-income populations at levels appreciably greater than their effects on nonminority populations or non-low-income populations. Adverse impacts were defined as negative changes to the existing conditions in the natural environment (e.g., land, air, water, wildlife, vegetation) or in the human environment (e.g., employment, health, land use).

During consultation with affected Tribal Nations on the TWRS EIS, representatives of the Yakama Nation and the Confederated Tribes of the Umatilla Indian Reservation expressed the view that impacts associated with all of the alternatives may adversely impact the cultural values of affected Tribal Nations to the extent that they involve disturbance or destruction of ecological and biological resources, alter land forms, or pose a noise or visual impact to sacred sites. The level of impact to cultural values associated with natural resources would be proportional to the amount of land disturbed under each alternative.

The TWRS EIS identified two areas of potentially high and disproportionate adverse impacts on minority and Native American populations or low-income populations. These impacts include the following:

- Potential increases in housing prices that could adversely impact access to affordable housing by low-income populations

- Continued restrictions on access to portions of the 200 Areas that could restrict access to the 200 Areas by all individuals.

Access restrictions also would apply to the Yakama Nation and the Confederated Tribes of the Umatilla Indian Reservation. The Tribes have expressed an interest in access to and unrestricted use of the Hanford Site.

A review of new data and impacts analysis presented in Section 3.0 was conducted to determine if any potentially disproportionate and adverse impacts on minority populations or low-income populations would occur. In one area of concern to affected Tribal Nations there were increases in impacts. Based on new data available since completion of the TWRS EIS, the total shrub-steppe disturbance would exceed the total shrub-steppe disturbance calculated in the TWRS EIS for the Phased Implementation alternative for Phase I by 114% and Phase II by 37%. The increase in impacts compared to the impacts under the Phased Implementation alternative in the TWRS EIS represents a 0.3% impact on the remaining shrub steppe and shrub-steppe habitat on the Central Plateau for Phase I and 1% for Phase II.

3.18 MITIGATION MEASURES

In the TWRS EIS measures to mitigate potential impacts of the Phased Implementation alternative were addressed. The TWRS EIS focused on measures to mitigate potential impacts during remediation and indicated that future NEPA documentation would specifically address in detail impacts and mitigation of post-remediation tank closure where, for example, most of the impacts of borrow site activities would occur.

To determine if new information developed since completion of the TWRS EIS resulted in changes in potential impacts of the Phased Implementation alternative and hence potential changes in mitigative measures, a review of new data and of impact analysis presented in Section 3.0 was conducted. This was completed to determine if any changes in impacts requiring changes in the mitigative measures identified in the TWRS EIS would occur.

The review of the impact analysis based on new information identified two potential changes in impacts that would potentially require development of new mitigative measures. Impacts for soil, water, air, biological and ecological resources, cultural resources, socioeconomics, land use, and long-term human health were within the bounds established in the TWRS EIS or the changes in impacts were not substantively different than the impacts presented in the TWRS EIS.

Based on identification of the Privatization Phase I sites and the *Mitigation Implementation Plan for Project W-519* (HNF-3239) for development of privatization Phase I sites discussed in Section 3.5, specific information is available regarding impacts to biological and ecological resources. Following siting to minimize or avoid impacts to shrub-steppe habitat, the development for Phase I and Phase II will result in unavoidable disturbance to approximately 45 ha (111 ac) and 268 ha (662 ac), respectively of previously undisturbed shrub-steppe habitat. DOE developed a TWRS EIS mitigation action plan for Phase I (DOE-RL 1998) to address replacement or compensation for the unavoidable impacts as required under the Sitewide plan for management of biological and ecological resources. Development of the mitigation action plan involved consulting with natural resource agencies and Tribal Nations. The increased disturbance on shrub steppe for Phase I could impact the mitigation action plan (DOE-RL 1998) that would warrant reevaluation of the commitments under the mitigation action plan.

3.19 CUMULATIVE IMPACTS

3.19.1 TWRS EIS Baseline

The TWRS EIS described potential cumulative impacts associated with implementing the TWRS alternatives and other actions at the Hanford Site in Volume One, Section 5.13 of the TWRS EIS. The TWRS impacts addressed in the cumulative impacts analysis included the impacts of both remediation of the tank waste and subsequent closure of the tank farms. The TWRS EIS identified other actions that could impact the Hanford Site and, when possible, provided a quantitative discussion, where possible, of the potential cumulative impacts of the TWRS alternatives and the other actions. The NEPA implementing regulations define a cumulative impact as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes other such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1500-1508).

The TWRS EIS analysis demonstrated that the post-remediation risk of the TWRS alternatives would be strongly influenced by the type and form of waste remaining in the tanks or on the Hanford Site following remediation, the amount of time and labor that would be needed to accomplish the alternative, and the environmental disturbance that would take place during the work, including permanent disturbance or long-term resource commitment. These factors were comprehensively analyzed and discussed throughout Volume One, Section 5.0 of the TWRS EIS for each resource for each of the TWRS alternatives. For purposes of discussing the potential cumulative impacts, the TWRS alternative having the highest potential cumulative impacts were drawn from the comprehensive discussion and presented in combination with the other past, present, and reasonably foreseeable sources of impact. Thus the upper bound of the reasonably foreseeable potential cumulative impacts was presented.

Actions at the Hanford Site that would have quantifiable environmental impacts that would be cumulative with RPP actions include the Hanford Site waste management and remedial action programs, the Environmental Restoration and Disposal Facility, the management of spent nuclear fuel stored in the K Basins, the US Ecology Site, and the replacement cross-site transfer system. While these activities would occur in the same general timeframe as the TWRS EIS alternatives, little quantifiable cumulative impacts of the RPP alternatives and other projects would be expected. Among the cumulative impacts that would occur would be impacts to land use and biological resources, human health, air quality, groundwater quality, and socioeconomics. For each of these impacts the TWRS EIS presented information regarding the potential cumulative impacts of the TWRS EIS alternatives and these other actions. Table 3.36 summarizes the actions that pose potential cumulative impacts with TWRS EIS alternatives and the impacts that may be cumulative.

Table 3.36. Cumulative Impacts of Other Projects and RPP Alternatives

Project	Impact Category				
	Land Use and Habitat	Health Risks	Air Quality	Groundwater Quality	Socioeconomics
Hanford Remedial Action	Yes	Yes	Yes	Yes	Yes
Environmental Restoration and Disposal Facility	Yes	Yes	Yes	No	Yes
K Basin	Yes	Yes	No	No	Yes
Safe Interim Storage of Tank Waste	Yes	No	No	No	No
Plutonium Finishing Plant	Yes	Yes	Yes	No	Yes
Canister Storage Building	Yes	No	No	No	No
Waste Management Program	Yes	Yes	Yes	Yes	Yes

No = Impact not cumulative with RPP alternatives.
RPP = River Protection Project.
Yes = Potential cumulative impact with RPP alternatives.

To determine if new information developed since completion of the TWRS EIS indicated changes in understanding of potential cumulative impacts, a review of new data was completed. This review included reviewing new data regarding the impacts associated with the TWRS EIS alternatives, as discussed in previous sections of this Supplement Analysis, and information regarding other Hanford Site actions with potential cumulative impacts.

3.19.2 Land Use and Habitat

To address cumulative land use and habitat impacts the TWRS EIS considered past Hanford Site land use and habitat uses (1944 through 1994), current operations, and future operations that would occur concurrent with 27 years of operations of the Phased Implementation alternative. The cumulative impacts are presented in Table 3.37. Table 3.37 documents that past operations had impacted 8,700 ha (21,500 ac) of land at the Hanford Site. Potential future actions would impact an additional 2,154 ha (5,340 ac), including 1,016 ha (2,515 ac) of previously undisturbed habitat. This estimate of future impacts included 320 ha (790 ac) of land commitments and 220 ha (540 ac) of habitat disturbance under the Phased Implementation alternative. Based on the new data the land use impacts of the Phased Implementation alternative would increase by 208 ha (514 ac) and habitat disturbance would increase by 93 ha (230 ac). The overall impact of this change on land use and habitat disturbance would be small, resulting in an approximately 9% increase in the total new land use commitments above baseline conditions in 1996 and less than a 2% increase in the total Hanford Site land use impacts.

Table 3.37. Cumulative Land Use and Habitat Impacts

Source of Impact	TWRS EIS		Current Planning Baseline	
	Total Land Use (ha)	Habitat Impacts[a] (ha)	Total Land Use (ha)	Habitat Impacts[a] (ha)
Hanford Remedial Action Program[b]	1,138	462	1,138	462
Environmental Restoration Disposal Facility[b]	590	314	590	314
Decommissioning eight surplus reactors	6	6[c]	6	6[c]
Management of SNF from K Basins	3.5	3.5	3.5	3.5
Safe interim storage of Hanford Site tank waste	30	9	30	9
RPP alternative (Phased Implementation)	320	220	528	313
Programmatic waste management	72	7	72	7
Baseline – previously disturbed	8,700	No data	8,700	No data
Cumulative total	10,860	1,022	11,068	1,115

[a] Shrub steppe unless otherwise noted.
[b] Highest impact alternative.
[c] Not specified as shrub steppe in data source.

RPP = River Protection Project.
SNF = spent nuclear fuel.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).

3.19.3 Health Risks

To address cumulative health risks the TWRS EIS considered past Hanford Site operations (1944 through 1994), current operations, and future operations that would occur concurrent with 27 years of operations of the Phased Implementation alternative. Based on this analysis the TWRS EIS estimated that the cumulative health effects from Hanford Site operations were 100,659 person-rem resulting in 50 LCFs. Of this total the Phased Implementation alternative would contribute 388 person-rem to the offsite population and 0.2 LCFs or 0.4% of the cumulative impact. Based on the new data presented in this Supplement Analysis regarding waste inventory, the estimate of the Phased Implementation alternative offsite population dose has been revised upward to 620 person-rem and the cumulative dose was increased by the same amount to 100,890 person-rem with no change in the estimate of LCFs (for purposes of analysis in the TWRS EIS each 2,000 person-rem was assumed to result in 1 LCF). The change in the Phased Implementation alternative dose represented an approximately 60% increase for the alternative and an increase in the cumulative impact of approximately 0.2%. It is important to note that the waste inventory change that caused the increase in impacts from the Phased

Implementation alternative would have similarly impacted all other alternatives that would retrieve and treat the tank waste.

3.19.4 Air Quality

To address cumulative impacts of the Phased Implementation alternative and other ongoing and planned Hanford Site operations, air emissions from construction and operations of all actions that could reasonably be expected to overlap were calculated, totaled, and compared to Washington State air quality standards (WAC 173-470, WAC 173-474, WAC 173-475) for four contaminants. The Phased Implementation alternative was selected for comparison purposes. Impacts are presented in Table 3.38. As the table demonstrates, all four contaminants have similar or lower values compared to the data presented in the TWRS EIS.

Table 3.38. Cumulative Air Quality Impacts

Sources	Maximum Average Concentration ($\mu g/m^3$)							
	TWRS EIS				Current Planning Baseline			
	PM-10	NO_x	SO_x	CO	PM-10	NO_x	SO_x	CO
Hanford Site baseline	3	3	19	3	3	3	19	3
Hanford remedial action	43	40	5	26	43	40	5	26
Environmental Restoration Disposal Facility	33	negli	negli	negli	33	negli	negli	negli
RPP alternative	98[a]	2.2[a]	27[a]	2,500[a]	98[b]	3.9[b]	7.8[b]	2,200[b]
Total	177	45	51	2,529	177	47	32	2,229
Standards[c]	150[d]	100[e]	365[d]	10,000[f]	150[d]	100[e]	365[d]	10,000[f]

[a] Maximum value from all alternatives in TWRS EIS.
[b] Maximum value from Phased Implementation alternative.
[c] WAC 173-470, WAC 173-474, and WAC 173-475.
[d] 24-hour averaging period.
[e] Annual averaging period.
[f] 8-hour averaging period.

RPP = River Protection Project.
TWRS EIS = Tank Waste Remediation System Environmental Impact Statement (DOE/EIS-0189).
negli = negligible.

3.19.5 Groundwater Quality

To address cumulative groundwater impacts and associated long-term health impacts, the TWRS EIS analyzed:

- Contaminants in the vadose zone of the 200 Areas that are primarily associated with past waste disposal practices using engineered structures such as cribs, drains, septic tanks and associated drain fields, and reverse wells (wells that do not penetrate to groundwater)
- Percolation from ponds, ditches, and trenches such as B pond and U pond

- Solid waste burial in backfilled trenches
- Unplanned releases such as leaks from SSTs.

In addition, the TWRS EIS considered the US Ecology Low-Level Radioactive Waste Disposal Facility located southwest of the 200 East Area, which is estimated to contain about 2.2 million curies of radioactive waste in backfilled trenches. Reasonably foreseeable additions to contaminants in the vadose zone also included future waste disposal at the 200 Areas and US Ecology solid waste burial grounds and the placement of remediation waste in the Environmental Restoration Disposal Facility.

Cumulative radionuclide concentrations that could occur in the groundwater from a potential combination of contamination from past disposal practices, currently anticipated future waste disposal, and the contamination from the Phased Implementation alternative were discussed in Volume Four, Section F.4.5 of the TWRS EIS. Peak groundwater concentrations from the various potential sources could occur at different times and different locations. However, to maximize the potential cumulative impacts the peak concentrations of the past and reasonably foreseeable future sources were assumed to combine with the peak concentrations from the Phased Implementation alternative. This resulted in a conservative bounding of the maximum potential cumulative groundwater impact for each RPP alternative.

Subsequent to publication of the TWRS EIS, new sources of information have been and continue to be developed by DOE that could affect the cumulative impacts of TWRS EIS alternatives. These sources of new information are discussed in Section 3.3. There is a large uncertainty associated with past tank leaks and other non-tank farm sources in the 200 Area and the potential cumulative impacts of these sources on existing and future groundwater quality. The uncertainty on cumulative impacts includes definition of the various source terms (e.g., volume and characteristics of waste) and contaminant transport parameters that affect migration from disposal sites to the groundwater.

Definition of the source terms is largely dependent on how well past activities were documented. Some improvements in the estimated inventory of past waste disposal have been achieved by the revised tank waste inventory and the PNNL-11800 studies in response to DNFSB 94-2 of 200 Area LAW disposal sites. The preliminary results of these efforts indicate that for the source terms included in the TWRS EIS cumulative analysis, other than the revised inventory the following are true.

- There have been no changes in the inventory for the Environmental Restoration Disposal Facility and the US Ecology sites that would change cumulative impacts. The US Ecology site as well as the LAW burial grounds are undergoing environmental impact assessments that include consideration of expanded disposal of LAW and other contaminants. However, these assessments are being conducted and no definitive data exist to support changes in the TWRS EIS analysis.
- Changes in inventory for past tank leaks and past-practice solid waste disposal tended to revise the inventory to lower levels than used in the TWRS EIS analysis, and therefore the TWRS EIS analysis bounds the potential impacts associated with these sources.

- Changes in past-practice liquid disposal that substantially increase the inventory would not affect the calculation of cumulative impacts because these releases would have migrated well ahead of the other sources, including Phased Implementation retrieval losses, residual tank waste, and vitrified LAW vaults, and hence the impacts would not be additive.

Data from Hanford Site programs such as the spectral gamma logging of drywells surrounding the tank farms, the data from borehole 41-09-39 at the SX tank farm, work performed as a part of the PNNL-11800 analysis, and some of the DOE/RL-98-72 studies are all coming together into a refined conceptualization of contaminant transport. These refinements serve to reduce the uncertainty in contaminant transport and indicate that the assumptions made in the TWRS EIS regarding contaminant transport for cumulative impacts are still bounding. In the TWRS EIS, it was assumed that past-practice liquid waste disposal resulted in only near-term impacts. It was concluded that the cumulative impacts of this waste disposal activity would be very low for the Phased Implementation alternative and the new information and data do not change this conclusion.

In the TWRS EIS, a bounding approach to past tank leaks was taken that assumed that impacts from past tank leaks would be additive with future groundwater impacts from tanks if no waste retrieval and remediation were to be implemented. This assumption puts the impacts from past tank leaks out in time where they would be additive to the impacts from implementing the Phased Implementation alternative. Available information suggests the approach is still bounding because if anything, the impacts from past leaks are occurring sooner than would be calculated using the TWRS EIS assumption and thus would be less likely to be additive to the impacts associated with implementing the Phased Implementation alternative.

For the past-practice solid waste disposal sites, the solid low-level radioactive waste disposal in the 200 West burial grounds, and solid low-level radioactive waste disposed in the US Ecology burial grounds a bounding approach was taken that assumed the contaminants from these sites would be additive with tank waste that was disposed of in the tanks with a gravel fill and a cap. The new data and information suggest this approach is still bounding.

3.19.6 Socioeconomics

Based on the review of new data presented in Section 3.7 there is no basis for revising TWRS EIS alternatives calculations of socioeconomic impacts. Therefore, there is no basis for change in the calculation of cumulative impacts. However, as noted in Section 3.7, the overall Hanford Site employment has declined from the baseline levels presented in the TWRS EIS and used in combination with the Tri-Cities area employment to calculate the impacts of the Phased Implementation alternative on housing costs, taxes, and local services (e.g., fire, police, schools). The decline in Hanford Site employment would tend to offset the adverse impacts associated with increased employment levels projected for Phase II of the Phased Implementation alternative.

4.0 UNCERTAINTIES

Remediating the Hanford Site tank waste is a very complex and costly remediation program and involves a number of technical uncertainties, some of which will not be resolved until waste retrieval, transfer, and treatment operations have been demonstrated. Technical uncertainties are being reduced through technical analysis, characterization, modeling, and testing. However, these uncertainties will not be fully resolved until sufficient quantities of the varying waste types are retrieved from the tanks and vitrified in the waste treatment facilities. The Phased Implementation alternative allows DOE to implement waste treatment on a sufficient scale to reduce uncertainties before initiating full-scale remediation efforts. By performing Phase I of the Phased Implementation alternative and proceeding with other technology development projects and tank waste characterization, the uncertainties associated with the tank waste program will be reduced further.

Some of the changes in the Phase I program identified in Section 2.0 would reduce the uncertainty for Phase I and increase the uncertainty for Phase II. These changes are primarily due to delays in the Phase I schedule while maintaining existing milestones for the completion of waste treatment and SST retrieval during Phase II. These changes reduce DOE’s ability to fully utilize lessons learned during Phase I unless the Phase II schedule was revised in a similar manner. The facilities being designed for Phase I are much larger and have a longer design life than the facilities described in the TWRS EIS. The operating life of the Phase I plants could be extended to treat additional waste. A decision to extend operations of the Phase I plants will affect Phase II planning. While the development work and planning that has been completed to date has decreased the uncertainty with implementing Phase I there are increased uncertainties in the Phase II planning for the balance of the ORP mission.

The number of SSTs that would be retrieved during Phase I has been reduced from approximately 34 in the TWRS EIS Phased Implementation alternative to 4 in the current Phase I planning baseline. This change reduces the uncertainty associated with SST retrieval during Phase I but requires a greater number of SSTs to be retrieved during Phase II. Because DOE has committed to complete retrieval of SSTs by 2018 this means that higher retrieval rates and more simultaneous retrievals will have to take place during Phase II. Current projections indicate that as many as 40 SSTs would have to be retrieved on an annual basis during Phase II to meet the 2018 date for completion of SST retrieval. The ability to meet these retrieval rates is highly uncertain.

The other issue associated with completing SST retrieval in 2018 is the size of the Phase II treatment facilities necessary to treat the waste. As presented in Section 2.0, the Phase II treatment facilities would have to be sized to produce 300 MT/day of LAW and 30 MT/day of HLW. These larger facilities involve a higher degree of technical uncertainty associated with scale up of the separations and vitrification systems.

4.1 WASTE RETRIEVAL

During Phase I, waste retrieval will be from DSTs with limited waste from SSTs; therefore, SST waste retrieval uncertainties have little affect on plans for Phase I Part B retrieval and treatment. However, to support waste processing in Phase II, a number of SSTs would require retrieval during Phase I to backfill DST space. The remaining SSTs would be retrieved during Phase II with the final SST retrieval completed in 2018. The phased schedule for waste retrieval and treatment will support operational flexibility required to develop and deploy alternate retrieval technologies to address key areas of retrieval uncertainty identified in the TWRS EIS including retrieval of SST hard-heel waste, retrieval from known or suspected leaking SSTs, and retrieval from SSTs that develop leaks during retrieval operations.

In addition to the uncertainty about waste retrieval from the standpoint of available technology, uncertainty exists in the ability to simultaneously retrieve the required number of tanks necessary to complete the privatization project. HNF-SD-WM-SP-012, Rev. 1 states that in order to meet the 2018 schedule date in the Tri-Party Agreement for completion of SST retrieval, 16 simultaneous retrievals would be necessary during a given time. Currently, no more than 7 retrievals are completed simultaneously, either because of a lack of waste transfer infrastructure or equipment, or because of the physical constraints associated with retrieval of tanks that may be located near each other (HNF-SD-WM-SP-012, Rev. 1). The ability to simultaneously retrieve 16 tanks would require significantly increased operations personnel, equipment, and transfer lines. The number of tanks retrieved on an annual basis could be as high as 40 tanks per year assuming Phase II started in 2012 if SST retrieval were to be completed by 2018. This allows 3 years for construction and start up of retrieval systems and 3 years to retrieve waste from the 130 SSTs remaining after completion of the 4 SSTs during Phase I and the 15 SSTs retrieval to provide DST backfill during Phase I. Currently, it seems impracticable to perform that number of retrievals at one time. However, if a large number of retrievals are not performed simultaneously, there is a high risk that the Tri-Party Agreement schedule date for retrieval of all SSTs will not be met.

The current multiyear planning guidance calls for privatization of all waste retrieval activities during Phase II (Erickson 1999). This is a change from the TWRS EIS where it was assumed that the Site management and integration contractor would perform all waste retrieval activities. This change adds some level of uncertainty to DOE’s ability to meet retrieval schedules due to the time required to transition between contracting approaches and the potential loss of site historical knowledge.

4.2 WASTE TRANSFER AND TREATMENT

4.2.1 Waste Transfer

Uncertainty regarding waste transfer because of chemical considerations, uncertainty exists with respect to the infrastructure necessary to conduct the necessary waste transfers. To complete Phase I activities in accordance with the Tri-Party Agreement milestone dates, additional infrastructure would be required. This infrastructure, including additional transfer lines and pump pits, would be required to accommodate the increased waste retrieval activities necessary to retrieve all SSTs by 2018. At this time, obtaining the necessary infrastructure seems unrealistic given the current funding and planning profiles for the privatization project. As such, completion of the waste processing project within the Tri-Party Agreement mandated schedule does not seem probable.

4.2.2 Waste Treatment

Separations and vitrification processes have not been demonstrated on Hanford Site tank waste on the scale described for the demonstration- and full-scale phases of the Phased Implementation alternative. The technologies such as solid/liquid separations, ion-exchange, and vitrification described for this alternative have been used to treat waste from other DOE sites and in Europe, but they have not been used on a production scale to treat Hanford Site waste.

While there is some uncertainty surrounding the implementation of the Phased Implementation alternative, more uncertainty exists with respect to the current baseline approach. For the MYWP treatment processes, three vitrification plants would be constructed (see Section 2.2.2.2). The design capacity for the Phase II LAW facilities has increased from 200 MT/day, as evaluated in the TWRS EIS, to 300 MT/day for the current planning baseline, and the HLW facility has increased from 10 MT/day to 30 MT/day. These changes result in an increase in the uncertainty associated with implementing Phase II. The design capacity for the two LAW facilities would, in total, be the size of a moderate industrial glass plant. While extensive material handling capabilities would be required (one container of LAW glass would be produced every 45 minutes) and this production scale has never been used to treat Hanford Site waste, this rate can be considered achievable. However, to process the volume of HLW in Phase II necessary to complete the mission, the design capacity of the HLW facility would need to be nearly three times the combined design capacity of all the existing HLW plants in the world. While constructing a plant of this size is not impossible, there are substantial technical uncertainties regarding the necessary scale-up. The scale-up for the HLW plant evaluated in the TWRS EIS went from a design capacity of 1 MT/day for Phase I to 10 MT/day for Phase II, or an increase of 900%. The scale-up for the current planning baseline has gone up substantially from 1.5 MT/day to 30 MT/day, or an increase of 1,900%. Because there is no experience in the United States regarding melter scaleup at this level, there is a significant risk that the melters would be undersized. The undersizing could result because the "availability" factor (the fraction of time the melter is available for operation) may be too low (ARES98-005).

In addition to scale-up issues, the facility is expected to have a design life of about 40 years. The majority of the waste processing would occur within a six-year window, indicating a large amount of inefficiency with respect to plant capacity.

Tank waste inventory uncertainties would not limit implementation of Phase I because the waste feed envelopes have been defined. Relatively well-characterized waste from DSTs would be retrieved during Phase I and this waste would be adjusted as necessary to meet the specifications before delivery to the privatization contractors. One area of uncertainty that would limit implementation of Phase I, however, would be the discovery of PCBs in the tank waste above TSCA limits. If PCBs were found to be present in the tank waste such that the waste needed to be regulated by TSCA, this finding would necessitate a redesign of the vitrification facilities and would cause delays in the completion of waste processing. Estimates in "Evaluation of Projected Impacts from Potential Toxic Substances Control Act Regulation Feed" (CCN: 008809) show that completion of Phase I processing would be delayed by 18 months and that Phase II processing would take an additional 27 months to complete. The overall price impact for this change would be over $2 billion. An uncertainty that remains to be addressed is the fate of selenium-79 in the separations and vitrification process. In an effort to be conservative, in

DOE/RL-97-69 it was assumed that all of the selenium-79 would end up in the vitrified LAW. The fate of selenium-79 was not included in the waste treatment process flowsheet modeling conducted in support of the TWRS EIS, and therefore selenium-79 was not included in the TWRS EIS vitrified LAW vault inventory. Both selenium-79 and technetium-99 are considered mobile in the vadose zone and groundwater and have similar health effects. Because the inventory of selenium-79 is approximately 2% of the technetium-99 inventory, including it in the LAW disposal vault inventory would not appreciably change the impacts (impacts to vaults are equivalent to remote-handled trenches).

A lower-than-assumed efficiency for the separations processes could result in producing higher volumes of vitrified HLW and higher concentrations of some radionuclides in the vitrified LAW. For example, if the separations process for removing technetium-99 from the LAW feed stream were less efficient than assumed, the technetium-99 inventory in the LAW vaults along with the anticipated environmental impacts would be higher. Therefore, some level of uncertainty exists in implementing the Phased Implementation alternative.

4.3 REGULATORY COMPLIANCE

Regulatory uncertainty is associated with current Hanford Site efforts to develop a Sitewide PCB strategy to address TSCA regulations. This effort is ongoing in the process and will involve extensive discussions with EPA and Ecology. However, depending on the outcome of the effort, certain tanks and the process facilities could be required to meet TSCA compliance requirements (see Section 4.1).

5.0 DETERMINATION

Information developed since approval of the TWRS EIS ROD relative to the plans for remediating Hanford Site tank waste has been assessed. The purpose of this information is to support a determination on whether there have been substantial changes in the proposed action relevant to environmental concerns or whether significant new circumstances or information has arisen relevant to environmental concerns relating to the proposed action or its environmental impacts that would require preparation of a supplemental EIS.

The new information regarding Phase I activities as envisioned in the current baseline appears to not have substantial changes to the proposed action or significant new circumstances relevant to environmental concerns, except for vitrified LAW disposal. Therefore I determine that no further NEPA review is required prior to start construction of Phase I facilities, with the exception of LAW as noted below, and subject to consideration of any new information that may be received in the future and as a result of the contractor's evaluation of the Phase I current baseline. As stated in the TWRS ROD, a NEPA supplement analysis is planned before hot start up.

Changes in the current baseline for vitrified LAW including the change in waste form from cullet to monoliths, the change from retrievable storage in vaults to disposal in shallow RCRA trenches, and the change in location within the 200 East Area represent a substantial change in scope from the preferred alternative selected in the TWRS ROD and TWRS EIS. While these changes in scope appear to be bounded by the impacts analyzed in the TWRS EIS, they have not been disclosed to the public. Therefore, I determine that these changes will be included within the scope of a supplemental TWRS EIS.

The current planning baseline for Phase II Vitrification appears to be substantially different from the baseline assumed in the preferred Phased alternative analyzed in the TWRS EIS and selected in the TWRS ROD. The impacts of a revised Phase II Vitrification project to meet the SST retrieval key assumption (retrieval of all SSTs by 2018) made in the TWRS EIS appear to exceed the bounds of the impacts analyzed in the TWRS EIS. Therefore, I determine that these changes will be included within the scope of a future supplemental TWRS EIS.

Issued at Richland, Washington, this day ___ 3/20/01

Harry L. Boston
Manager
Office of River Protection

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