APPENDIX G

REGULATORY ANALYSIS

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CONTENTS

TABLES

LIST OF TERMS

HFFACO	*Hanford Federal Facility Agreement and Consent Order*
ILCR	incremental lifetime cancer risk
Kd	distribution coefficient
RCRA	*Resource Conservation and Recovery Act of 1976*
WAC	*Washington Administrative Code*
WMA	waste management area

G.1.0 INTRODUCTION

Phase 1 RCRA Facility Investigation/Corrective Measures Study Work Plan for Single-Shell Tank Waste Management Areas (DOE-RL 2000) provides the regulatory framework for the *Resource Conservation and Recovery Act of 1976* (RCRA) Corrective Action Program. This regulatory framework is based on federal statutes and regulations, Washington State statutes and regulations, the *Hanford Federal Facility Agreement and Consent Order* (HFFACO) (Ecology et al. 1989); and the Hanford Site RCRA Permit (Ecology 2001). Applicable or relevant and appropriate requirements are provided in Appendix F of DOE-RL (2000).

The purpose of a field investigation report is to summarize data from a waste management area (WMA) investigation and evaluate the data to the extent necessary to determine the need for immediate action through interim measures or accelerated interim corrective measures at the WMA. At a minimum, the data is evaluated to determine the potential risk associated with hypothetical exposure to soil and groundwater at the WMA boundary (i.e., BX tank farm east fence line boundary) as described in Section 4.0 of DOE-RL (2000). If the potential near-term risk to human health is excessive, the U.S. Department of Energy and Washington State Department of Ecology may propose one or more interim measures to mitigate the risk or may initiate an accelerated corrective measures study to evaluate and compare more complex interim corrective measures.

The evaluation of the risks associated with existing contamination serves several purposes. Some of these purposes include the following:

- Establish the need for additional interim measures or interim corrective measures
- Provide necessary input to Hanford Site-wide cumulative risk assessments
- Serve as a basis to begin identifying cleanup standards for closure.

Cleanup standards are based on both regulatory requirements and the potential risk to human health and the environment. The potential risk depends in part on the hypothetical exposure scenario, which in turn depends on the assumed land use (including surface water and groundwater). Exposure and land use scenarios are also important in identifying the appropriate regulatory requirements for cleanup. For example, the determination of cleanup standards under the "The Model Toxics Control Act Cleanup Regulation" (*Washington Administrative Code* [WAC] 173-340) depends on whether an unrestricted (residential) or industrial scenario is applied, and the use of alternate concentration limits under "Concentration Limits" (WAC 173-303-645(5)) depends in part on future groundwater uses. In 1999, the U.S. Department of Energy issued *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (DOE 1999), which used the *National Environmental Policy Act of 1969* process to evaluate several land uses for the Hanford Site planned over the next 50 years. That environmental impact statement and associated record of decision "Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS)" (64 FR 61615), identify 'industrial-exclusive use' as the planned use for the 200 Areas Central Plateau, an area that encompasses the 200 East and 200 West Areas. The Washington State Department of Ecology is evaluating how the U.S. Department of Energy land use planning efforts fit within the Washington State Department of Ecology cleanup framework; the agency has not agreed at this time to an industrial use scenario. Therefore, potential risk and the regulatory requirements for

establishing media cleanup standards for the RCRA Corrective Action Program cannot be finalized. Section 4 and Appendix E of this report present the risk assessment and evaluation approach and results that consider several potential exposure scenarios identified in DOE-RL (2000).

G.2.0 REGULATORY PERFORMANCE MEASURES

Table G.1 identifies quantitative performance measures for various constituents, including hazardous and radiological contaminants. The level of protection established by the standards is expressed in terms of the maximum dose or contaminant concentration under various exposure scenarios. Each standard, therefore, reflects the determination by the regulatory agency of an appropriate level of protection that should be provided to protect human health. Generally, the spectrum of regulations reflected in Table G.1 demonstrates that the level of protection provided by regulatory agencies is consistent among the regulations whether they apply to dangerous contaminants (e.g., chemicals and metals) or radiological contaminants. The level of protection provided under the regulations ranges from between 1 incremental lifetime cancer risk (ILCR) in 10,000 (1.0×10^{-4}) and 1 in 1,000,000 (1.0×10^{-6}) on an annual basis.

The most important regulations related to this WMA B-BX-BY field investigation report are those addressing cleanup of soils and groundwater and the associated risk or dose to human health through the groundwater exposure pathway. The following sections discuss compliance with the applicable regulations.

Table G.1. Regulatory Performance Measures

Regulation	Requirement	Performance Measure	Point of Compliance	Notes
DOE Order 5400.5	***Protection of the general public and environment.***			
Protection of the Public	All pathways for LLW except air (mrem/yr)	25	100 m downgradient for groundwater, at waste site for direct exposure	100 years of institutional control.
	All pathways including other Hanford sources per 10 CFR 20, DOE Order 5400.5 and DNFSB 94-2 (mrem/yr)	100	100 m downgradient for groundwater, at waste site for direct exposure	
Protection of Groundwater (40 CFR 141)	Beta/proton emitters (mrem/yr)	4	100 m downgradient	100 years of institutional control. 500 years of passive control. 10,000 years for impacts analysis. Assumes water ingestion of 2 L/day. Alpha emitters: 15 pCi/L = 40 mrem/yr Radon: 3 pCi/L = 20 mrem/yr
	Alpha emitters (pCi/L)	15		
40 CFR 141 and DOE Order 5400.5	***Drinking water standards for select constituents with the potential for release to groundwater during operations, retrieval actions, or post closure***			
MCLs and derived concentration guide for select constituents Source: 40 CFR 141	H-3 C-14 I-129 U Tc-99 Cs-137 NO_3 Cr U-238 U-235	20,000 pCi/L 2,000 pCi/L 1 pCi/L 0.03 mg/L (Total) 900 pCi/L 200 pCi/L 45 mg/L 0.5 mg/L 20 pCi/L 20 pCi/L	Drinking water source	1,000 yr for compliance analysis. Alpha Emitters: 15 pCi/L = 40 mrem/yr

LLW = low-level waste
MCL = maximum contaminant level

G.3.0 REGULATORY COMPLIANCE FROM FIELD DATA

Regulatory compliance data for soils and groundwater collected during the field investigation activities are presented with comparison to regulatory requirements in Appendices B and C. The following sections discuss WAC 173-340 related to assessing derived soil concentrations for groundwater protection, "Deriving Soil Concentrations for Ground Water Protection" (WAC 173-340-747), and groundwater contamination present in WMA B-BX-BY groundwater monitoring.

G.3.1 SOILS DATA

Under WAC 173-340-747, the term 'soil concentration' means the concentration in the soil that will not cause an exceedance of the groundwater cleanup level established under "Ground Water Cleanup Standards" (WAC 173-340-720). Six different methodologies can be used to determine if the criterion has been met. This WMA B-BX-BY field investigation report uses the alternative fate and transport model (WAC 173-340-747(8)). The values used in the fate and transport modeling are based on best estimates and do not comply with the default values in WAC 173-340-747. The values used provide an estimate of groundwater impacts from the soil inventory estimate (Sections 3.3 and 4.2 and Appendix E). Numerical simulation results are obtained on long-term transient contaminant concentrations at the water table and for calculation at the BX tank farm east fence line boundary, 200 Area exclusion boundary, and the shoreline at the Columbia River. These calculation points are based on DOE-RL (2000).

Table G.2 provides the case numbers and descriptions for the numerical simulations as discussed in Section 4.0 of the main text and Appendix E. Numerical results are obtained on long-term transient contaminant concentrations and at calculation locations at the BX tank farm east fence line boundary, 200 Area exclusion boundary; and the Columbia River shoreline (DOE-RL 2000).

The groundwater concentration values based on inventory show that, for the BX tank farm east fence line boundary, drinking water standards (40 CFR 141) will be exceeded. Table G.3 lists the predicted technetium-99, uranium-238, and nitrate levels and the associated 40 CFR 141 limits. Table G.3 lists the groundwater concentration values for the BX tank farm east fence line boundary (cases 1 through 11), B-38 trench boundary (cases 12, 13, and 14), 200 Area exclusion boundary, and the Columbia River shoreline.

The predicted groundwater concentrations exceed the regulatory standards at the BX tank farm east fence line boundary. Exceedances of the groundwater maximum contaminant levels for technetium-99 occur at the BX tank farm east fence line boundary except for case 9 (Table G.3). Exceedances of the groundwater maximum contaminant levels for uranium-238 occur in cases 3 and 10 and for nitrate in cases 3, 4, 12, 13, and 14 at the BX tank farm east fence line boundary (Table G.3). At the 200 Area exclusion boundary (i.e., the rest of the Central Plateau including 200 North Area extending north to the base of Gable Butte), uranium-238, nitrate, and technetium-99 did not exceed the groundwater maximum contaminant levels for any of the cases (Table G.3). At the Columbia River shoreline, no constituent exceeded the groundwater maximum contaminant levels for any of the cases (Table G.3).

Table G.2. Case Descriptions for the Two-Dimensional Simulations

Case Number	Description[a]	Interim Barrier	Inventory Distribution	Meteoric Recharge (mm/yr)
1	Base case (no action alternative)	No	Uniform	100
2	Barrier alternative	Yes	Uniform	100
3	Water-line leak (1 gal/min for 20 years)	No	Uniform	100
4	Water line leak (200,000 gal)	No	Uniform	100
5	Alternative inventory distribution with no barrier	No	Alternative	100
6	Alternative inventory with barrier	Yes	Alternative	100
7	Base case with 50% recharge	No	Uniform	50
8	Base case with 30% recharge	No	Uniform	30
9	Base case with 10% recharge	No	Uniform	10
10	Base case with Kd = 0.1ml/g for U-238	No	Uniform	100
11	Base case with Kd = 1.0 ml/g for U-238	No	Uniform	100
12	B-38 trench with 55.4 mm/year recharge	No	Uniform	55.4
13	B-38 trench with 100 mm/year recharge	No	Uniform	100
14	B-38 trench with delayed closure barrier	No	Uniform	100

[a] See Appendix E, Section E.2.1 for details on each case.
Kd = distribution coefficient

G.3.2 GROUNDWATER DATA

Based on *Hanford Site Groundwater Monitoring for Fiscal Year 2001* (Hartman et al. 2002), groundwater monitoring well data for the RCRA groundwater wells associated with WMA B-BX-BY indicate the following constituents have exceeded the 40 CFR 141 drinking water standards during fiscal year 2001:

- Antimony
- Cyanide
- Gross alpha
- Gross beta
- Iodine-129
- Nitrate
- Technetium-99
- Tritium
- Uranium.

However, these exceedances are not correlated solely to release events in the WMA. Some of these exceedances can be attributed to cribs and trenches (Section 3.0 and Appendix C). Table G.4 provides the RCRA groundwater monitoring well exceedances for the various constituents and the number of exceedances that have occurred for fiscal year 2001.

Table G.3. Modeled Groundwater Concentrations (Average Weighted) at Specified Boundaries

Case	BX Tank Farm Boundary[a]			200 Area Exclusion Boundary			Columbia River Shoreline		
	Technetium-99 (pCi/L)	Uranium-238 (pCi/L)	Nitrate (μg/L)	Technetium-99 (pCi/L)	Uranium-238 (pCi/L)	Nitrate (μg/L)	Technetium-99 (pCi/L)	Uranium-238 (pCi/L)	Nitrate (μg/L)
Case 1	6,650	0.85	36,900	53.1	0.0349	254	22.7	—	71.4
Case 2	6,580	0.0996	36,900	46.7	0.0038	253	14.9	—	66.3
Case 3	172,000	27,600	565,000	308	19.8	901	46.6	—	137
Case 4	16,700	2.99	105,000	78.4	0.11	388	26.2	—	84.2
Case 5	5,790	0.422	34,600	44.6	0.174	232	19.5	—	67.6
Case 6	5,780	0.06	34,600	42.1	0.00223	231	13.4	—	63.2
Case 7	3,590	0.11	20,100	28	0.00409	156	11.5	—	54.4
Case 8	2,270	0.025	12,600	18.2	0.00078	101	8.01	—	42.3
Case 9	833	0.0037	4,650	6.78	0.0000059	38.1	3.39	—	19.1
Case 10	6,650	544	36,900	53.1	7.43	254	22.7	2.91	71.4
Case 11	6,650	0.044	36,900	53.1	0.0024	254	22.7	—	71.4
Case 12	24.1	—	173,000	0.0269	—	193	0.674	—	89.0
Case 13	80.8	—	579,000	0.0874	—	627	1.98	—	261
Case 14	149	—	1,070,000	0.164	—	1,170	3.76	—	496
Regulatory Standard	**900 pCi/L**	**20 pCi/L**	**45,000 μg/L**	**900 pCi/L**	**20 pCi/L[b]**	**45,000 μg/L**	**900 pCi/L**	**20 pCi/L**	**45,000 μg/L**

[a] Groundwater concentrations given are the breakthrough values for the cross-sections. See Appendix E.
[b] Based on a limit of 30 μg/L and a conversion factor of 6.93×10^{-7} Ci/g
Dash (—) indicates value is insignificant.

Table G.4. Groundwater Monitoring Results Exceeding Maximum Contaminant Levels or Drinking Water Standards at Waste Management Area B-BX-BY

Well Number	Antimony (μg/L)	Cyanide (μg/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Nitrate (μg/L)	Iodine-129 (pCi/L)	Technetium-99 (pCi/L)	Tritium (pCi/L)	Uranium (μg/L)
299-E32-9	NA	NA	NA	58 (1)	NA	3 (1)	NA	NA	NA
299-E32-10	17 (1)	NA	NA	1,200 (2)	178,000 (4)	NA	3,490 (4)	NA	NA
299-E33-7	NA	423 (3)	NA	4,210 (3)	748,000 (4)	NA	11,600 (4)	NA	NA
299-E33-9	NA	NA	357 (2)	3,090 (3)	212,000 (4)	NA	7,660 (4)	NA	678 (4)
299-E33-13	NA	NA	16 (1)	975 (2)	425,000 (2)	NA	3,290 (2)	NA	NA
299-E33-15	NA	NA	NA	80 (1)	441,000 (2)	NA	NA	NA	NA
299-E33-16	NA	NA	NA	1,400 (3)	695,000 (4)	NA	5,780 (4)	NA	NA
299-E33-17	NA	NA	NA	NA	267,000 (1)	NA	NA	NA	NA
299-E33-18	NA	NA	108 (2)	1,200 (3)	205,000 (4)	NA	3,810 (4)	NA	193 (4)
299-E33-20	NA	NA	NA	103 (1)	460,000 (3)	NA	NA	NA	NA
299-E33-26	NA	NA	53 (2)	2,720 (3)	441,000 (4)	NA	7,510 (4)	NA	137 (4)
299-E33-28	NA	NA	NA	55 (1)	NA	NA	NA	NA	NA
299-E33-31	NA	NA	33 (1)	1,310 (3)	259,000 (3)	NA	3,800 (4)	NA	79 (4)
299-E33-32	NA	NA	NA	739 (4)	98,700 (4)	NA	2,090 (5)	NA	NA
299-E33-34	NA	333 (3)	21 (1)	3,060 (4)	456,000 (4)	NA	8,170 (4)	NA	46 (2)
299-E33-35	NA	NA	NA	658 (3)	120,000 (4)	4 (1)	2,420 (4)	NA	NA
299-E33-38	NA	383 (3)	84 (2)	4,600 (3)	531,000 (4)	NA	13,000 (4)	NA	165 (4)
299-E33-41	NA	NA	70 (2)	1,140 (2)	52,700 (1)	NA	3,290 (4)	NA	118 (2)
299-E33-42	NA	NA	NA	1,190 (3)	136,000 (4)	NA	3,380 (4)	NA	31 (1)
299- E33-43	NA	NA	NA	229 (3)	77,500 (1)	NA	915 (1)	NA	NA
299-E33-44	NA	NA	245 (2)	3,320 (3)	224,000 (4)	NA	8,230 (4)	NA	567 (4)
299-E33-339	NA	NA	NA	NA	NA	NA	NA	21,400 (1)	NA
DWS or MCL	6	200	15	50	45,000	1	900	20,000	30

Bold indicates an upgradient groundwater monitoring well. Number indicates the maximum result for that well during the monitoring period from October 1, 2000 to September 30, 2001. Parenthesis indicates the number of exceedances in the particular well.

DWS = drinking water standard (40 CFR 141)
MCL = maximum contaminant level
NA = well did not exceed MCLs for the constituent

G.4.0 HUMAN HEALTH RISK AND DOSE RESULTS COMPARISON TO REGULATIONS

As presented in Section 4.0 and in Appendix E, the peak ILCR, hazard index, and dose for the industrial worker scenario is used as the baseline for comparison purposes. The results indicate that at the BX tank farm east fence line boundary, the ILCR exceeds regulatory standard of 1.0×10^{-5} (Table G.5). Based on current groundwater concentrations of technetium-99 (2,461.6 pCi/L) in RCRA groundwater well 299-E33-45, the ILCR would be 1.75×10^{-5} for the industrial worker scenario. The hazard index does not exceed the regulatory standard of 1.0 at the BX tank farm east fence line boundary (Table G.5). Dose does not exceed the regulatory standard of 4 mrem/yr for beta/photon emitters for all cases at the BX tank farm east fence line boundary (Table G.5).

Table G.5. Comparison of Peak Incremental Lifetime Cancer Risk, Hazard Index, and Dose for the Industrial Worker Scenario

Case	BX Tank Farm East Fence Line Boundary	200 Area Exclusion Boundary	Columbia River Shoreline
Industrial Worker Peak Incremental Lifetime Cancer Risk			
1	5.39E-05	5.48E-07	2.34E-07
2	5.34E-05	4.82E-07	1.54E-07
7	4.85E-05	2.89E-07	1.19E-07
8	4.83E-05	1.88E-07	8.27E-08
Industrial Worker Peak Hazard Index			
1	1.98E-01	1.74E-03	4.88E-04
2	1.98E-01	1.73E-03	4.54E-04
7	1.77E-01	1.07E-03	3.72E-04
8	1.97E-01	1.88E-04	2.89E-04
Industrial Worker Peak Dose (mrem/yr)			
1	3.18E+00	3.23E-02	1.38E-02
2	3.15E+00	2.84E-02	9.07E-03
7	2.86E+00	1.71E-02	7.00E-03
8	2.85E+00	1.11E-02	4.88E-03

G.5.0 REFERENCES

10 CFR 20, "Standards for Protection Against Radiation," *Code of Federal Regulations*, as amended.

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