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Figure L.57. Annual Drinking Water Dose from Uranium in the Columbia River at the City of Richland Pumping Station from Hanford Sources Including ILAW

The dose from technetium-99 at the City of Richland (Figure L-61) exhibits the secondary peak structure seen in the dose from technetium-99 near the 200 East Area. However, the dose from consumption of river water exhibits a greater variability in both Figures L.56 and L.57 because of the underlying variability associated with Columbia River discharge. Secondary peak structure is greatly subdued in the dose from uranium plot (Figure L.57) because uranium is sorbed onto subsurface sediments and river sediments.

The results are an approximation achieved by superimposing the results of two independently conducted analyses. Nevertheless, the results indicate that the contribution from ILAW, which represents a substantial fraction of the technetium-99 inventory at Hanford, while being equivalent to the initial assessment results does not substantially influence the overall dose prediction made in the initial assessment for all wastes other than ILAW.

L.4 References

Bergeron, M. P., E. J. Freeman, S. K. Wurstner, C.T. Kincaid, F.M. Cooney, D.L. Strenge, R.L Aaberg, and P.W. Eslinger. 2001. *Addendum to Composite Analysis for Low-Level Disposal in the 200 Area Plateau of the Hanford Site*. PNNL-11800, Addendum 1, Pacific Northwest National Laboratory, Richland, Washington.

- 1 Blanton, M. L., W. W. Gardiner, and R. L. Dirkes. 1995. *Environmental Monitoring of the Columbia*
2 *River Sediments: Grain-Size Distribution and Contaminant Association.* PNL-10535, Pacific Northwest
3 National Laboratory, Richland, Washington.
4
- 5 Bryce, R. W., C. T. Kincaid, P. W. Eslinger, and L. F. Morasch (eds.). 2002. *An Initial Assessment of*
6 *Hanford Impact Performed with the System Assessment Capability.* PNNL-14027, Pacific Northwest
7 National Laboratory, Richland, Washington.
8
- 9 Cantrell, K. J., R. J. Serne, and G. V. Last. 2002. *Hanford Contaminant Distribution Coefficient*
10 *Database and Users Guide.* PNNL-13895, Pacific Northwest National Laboratory, Richland,
11 Washington.
12
- 13 Cole, C. R., S. K. Wurstner, M. P. Bergeron, M. D. Williams, and P. D. Thorne. 1997. *Three-*
14 *Dimensional Analysis of Future Groundwater Flow Conditions and Analyte Plume Transport in the*
15 *Hanford Site Unconfined Aquifer System: FY 1996 and 1997 Status Report.* PNNL-11801,
16 Pacific Northwest National Laboratory, Richland, Washington.
17
- 18 Cole C. R., M. P. Bergeron, S. K. Wurstner, P. D. Thorne, S. Orr, and M. McKinley. 2001a. *Transient*
19 *Inverse Calibration of the Site-Wide Groundwater Flow Model to the Hydraulic Impacts of the*
20 *Unconfined Aquifer System from Hanford Operations, Southeastern Washington—1943-1996.*
21 PNNL-13446, Pacific Northwest National Laboratory, Richland, Washington.
22
- 23 Cole C. R., P. D. Thorne, M. P. Bergeron, S. K. Wurstner, C. Murray, and P. Rogers. 2001b.
24 *Uncertainty Analysis Framework for the Site-Wide Groundwater Flow and Transport Modeling at the*
25 *Hanford Site, Southeast Washington.* PNNL-13641, Pacific Northwest National Laboratory,
26 Richland, Washington.
27
- 28 Cooney, F. M. 2002. *Groundwater/Vadose Zone Integration Project Methods Used to Assemble Site-*
29 *Specific Waste Site Inventories for the Initial Assessment.* BHI-01570, Rev 0, Bechtel Hanford, Inc.,
30 Richland, Washington.
31
- 32 DOE-RL. 1996. *Focused Feasibility Study of the Engineered Barriers for Waste Management Units in*
33 *the 200 Areas.* DOE/RL-93-33, Rev. 1, prepared by Bechtel Hanford, Inc. for the U.S. Department of
34 Energy Office of Environmental Restoration and Waste Management, Richland, Washington.
35
- 36 DOE-RL. 1998. *Screening Assessment and Requirements for a Comprehensive Assessment: Columbia*
37 *River Comprehensive Impact Assessment.* DOE/RL-96-16, Rev. 1, U.S. Department of Energy,
38 Richland, Washington.
39
- 40 DOE-RL. 1999. *Groundwater/Vadose Zone Integration Project Background Information and State of*
41 *Knowledge.* DOE/RL-98-48, Vol. II, Rev. 0, U.S. Department of Energy Richland Operations Office,
42 Richland, Washington.
43

- 1 EPA. 1988. *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion*
2 *Factors for Inhalation, Submersion, and Ingestion*. Federal Guidance Report No. 11, EPA-520/1-88-020,
3 Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, D.C.
- 4
- 5 Eslinger, P. W. C. Arimescu, B. A. Kanyid, and T. B. Miley. 2002. *User Instructions for the Systems*
6 *Assessment Capability, Rev. 0, Computer Codes. Volume 2: Impact Modules*. PNNL-13932, Volume 2,
7 Pacific Northwest National Laboratory, Richland, Washington.
- 8
- 9 Farris, W. T., B. A. Napier, P. W. Eslinger, T. A. Ikenberry, D. B. Shipley, and J.C. Simpson. 1994.
10 *Atmospheric Pathway Dosimetry Report, 1944-1992*. PNWD-2228 HEDR, Battelle-Pacific Northwest
11 National Division, Richland, Washington.
- 12
- 13 Fayer, M. J. and T. B. Walters. 1995. *Estimated Recharge Rates at the Hanford Site*. PNL-10285,
14 Pacific Northwest National Laboratory, Richland, Washington.
- 15
- 16 Fayer, M. J., E. M. Murphy, J. L. Downs, F. O. Kahn, C. W. Lindenmeier, and B. N. Bjornstad. 1999.
17 *Recharge Data Package for the Immobilized Low-Activity Waste 2001 Performance Assessment*.
18 PNNL-13033, Pacific Northwest National Laboratory, Richland, Washington.
- 19
- 20 Fecht, K. R., G. V. Last, and K. R. Price. 1977. *Evaluation of Scintillation Probe Profiles from 200 Area*
21 *Cribs Monitoring Wells, Volumes II and III*. ARH-ST-156, Atlantic Richfield Hanford Company,
22 Richland, Washington.
- 23
- 24 Gupta S. K., C. R. Cole, C. T. Kincaid, and A. M. Monti. 1987. *Coupled Fluid, Energy, and Solute*
25 *Transport (CFEST) Model: Formulation and User's Manual*. BMI/ONWI-660, Battelle Memorial
26 Institute, Columbus, Ohio.
- 27
- 28 Hajek, B. F. 1966. *Soil Survey: Hanford Project in Benton County, Washington*. BNWL-243,
29 Pacific Northwest Laboratory, Richland, Washington.
- 30
- 31 Ho, C. K, R. G. Baca, S. H. Conrad, G. .A. Smith, L. Shyr, and T. A. Wheeler. 1999. *Stochastic*
32 *Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm*. SAND98-2880,
33 Sandia National Laboratories, Albuquerque, New Mexico.
- 34
- 35 Khaleel, R. and E. J. Freeman. 1995. *Variability and Scaling of Hydraulic Properties for 200 Area Soils,*
36 *Hanford Site*. WHC-EP-0883, Westinghouse Hanford Company, Richland, Washington.
- 37
- 38 Khaleel, R. 1999. *Far-Field Hydrology Data Package for Immobilized Low-Activity Tank Waste*
39 *Performance Assessment*. HNF-4769, Fluor Daniel Northwest, Inc., Richland, Washington.
- 40
- 41 Khaleel, R., T. E. Jones, A. J. Knepp, F. M. Mann, D. A. Myers, P. M. Rogers, R. J. Serne, and
42 M. I Wood. 2000. *Modeling Data Package for S-SX Field Investigation Report (FIR)*. RPP-6296,
43 Rev. 0, CH2M Hill Hanford Group, Inc., Richland, Washington.
- 44

- 1 Kincaid, C. T., M. P. Bergeron, C. R. Cole, M. D. Freshley, N. L. Hassig, V. G. Johnson, D. I. Kaplan,
2 R. J. Serne, G. P. Streile, D. L. Strenge, P. D. Thorne, L. W. Vail, G. A. Whyatt, and S. K. Wurstner.
3 1998. *Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site*.
4 PNNL-11800, Pacific Northwest National Laboratory, Richland, Washington.
5
6 Kincaid, C. T., P. W. Eslinger, W. E. Nichols, A. L. Bunn, R. W. Bryce, T. B. Miley, M. C. Richmond,
7 S. F. Snyder, and R. L. Aaberg. 2000. *System Assessment Capability (Revision 0); Assessment*
8 *Description, Requirements, Software Design, and Test Plan*. BHI-01365, Draft A, Bechtel Hanford, Inc.,
9 Richland, Washington.
10
11 Kipp, K. L. and R. D. Mudd. 1974. *Selected Water Table Contour Maps and Well Hydrographs for the*
12 *Hanford Reservation, 1944-1973*. BNWL-B-360, Pacific Northwest Laboratory, Richland, Washington.
13
14 Krupka, K. M. and R. J. Serne. 1998. *Effects of Radionuclide Concentrations by Cement/Groundwater*
15 *Interactions in Support of Performance of Low-Level Radioactive Waste Disposal Facilities*.
16 PNNL 11408, Pacific Northwest National Laboratory, Richland, Washington.
17
18 Mann, F. M., K. C. Burgard, W. R. Root, R. J. Puigh, S. H. Finfrock, R. Khaleel, D. H. Bacon,
19 E. J. Freeman, B. P. McGrail, S. K. Wurstner, and P. E. LaMont. 2001. *Hanford Immobilized Low-*
20 *Activity Waste Performance Assessment: 2001 Version*. DOE/ORP-2000-24, Rev. 0, U.S. Department of
21 Energy, Office of River Protection, Richland, Washington.
22
23 Mattigod, S. V., G. A. Whyatt, R. J. Serne, P. F. Martin, K. E. Schwab, and M. I. Wood. 2000. *Diffusion*
24 *and Leaching of Selected Radionuclides (I-129, Tc-99, and U) through Category 3 Waste Encasement*
25 *Cement Concrete and Soil Fill Material: Progress Report for 2001*. PNNL-13639, Pacific Northwest
26 National Laboratory, Richland, Washington.
27
28 Murphy E. M., T. R. Ginn, and J. L. Phillips. 1996. "Geochemical estimates of paleorecharge in the
29 Pasco Basin: Evaluation of the chloride mass-balance technique." *Water Resources Research* 32(9):
30 2853-2868.
31
32 Poston, T. M., R. W. Hanf, R. L. Dirkes, and L. F. Morasch. 2002. *Hanford Site Environmental Report*
33 *for Calendar Year 2001*. PNNL-13910, Pacific Northwest National Laboratory, Richland, Washington.
34 Online at <http://hanford-site.pnl.gov/envreport/2001/index.htm>.
35
36 Prych E. A. 1998. *Using Chloride and Chlorine-36 as Soil-Water Tracers to Estimate Deep Percolation*
37 *at Selected Locations on the U.S. Department of Energy Hanford Site, Washington*. Water-Supply Paper
38 2481, U.S. Geological Survey, Tacoma, Washington.
39
40 Richmond, M. C., W. A. Perkins, and Y. Chien. 2000. *Numerical Model Analysis of System-wide*
41 *Dissolved Gas Abatement Alternatives*. PNWD-3245, Prepared by Battelle-Pacific Northwest Division
42 for the U.S. Army Corps of Engineers, Walla Walla District, Walla Walla, Washington.
43

- 1 Serne, R. J., R. O Lokken, and L. J. Criscenti. 1992. "Characterization of Grouted Low-Level Waste to
2 Support Performance Assessment." *Waste Management* 12: 271-287.
- 3
- 4 Simpson, B.C., R.A. Corbin, and S.F. Agnew. 2001. *Groundwater/Vadose Zone Integration Project:*
5 *Hanford Soil Inventory Model*. BHI-01496, Rev 0. Bechtel Hanford Inc., Richland, Washington.
- 6
- 7 Thorne, P. D. and M. A. Chamness. 1992. *Status Report on the Development of a Three-Dimensional*
8 *Conceptual Model for the Hanford Site Unconfined Aquifer System*. PNL-8332, Pacific Northwest
9 Laboratory, Richland, Washington.
- 10
- 11 Thorne, P. D. and D. R. Newcomer. 1992. *Summary and Evaluation of Available Hydraulic Property*
12 *Data for the Hanford Site Unconfined Aquifer System*. PNL-8337, Pacific Northwest Laboratory,
13 Richland, Washington.
- 14
- 15 Thorne, P. D., M. A. Chamness. F. A. Spane Jr., V. R. Vermeul, and W. D. Webber. 1993. *Three-*
16 *Dimensional Conceptual Model of the Hanford Site Unconfined Aquifer System, FY 93 Status Report*.
17 PNL-8971, Pacific Northwest Laboratory, Richland, Washington.
- 18
- 19 Thorne, P. D., M. A. Chamness. V. R. Vermeul, Q. C. MacDonald, and S. E. Schubert. 1994. *Three-*
20 *Dimensional Conceptual Model for the Hanford Site Unconfined Aquifer System, FY 1994 Status Report*.
21 PNL-10195, Pacific Northwest Laboratory, Richland, Washington.
- 22
- 23 US Ecology. 1996. *Site Stabilization and Closure Plan for the Low-Level Radioactive Waste Disposal*
24 *Facility*. US Ecology, Inc., Richland, Washington.
- 25
- 26 van Genuchten, M. 1980. "A Closed-Form Equation for Predicting the Hydraulic Conductivity of
27 Unsaturated Soils." *Soil Sci. Am. J.* 44:892-898.
- 28
- 29 Washington State Department of Health and Washington State Department of Ecology. 2000. *Draft*
30 *Environmental Impact Statement: Commercial Low-Level Radioactive Waste Disposal Site, Richland,*
31 *Washington*. Olympia, Washington.
- 32
- 33 White, M. D. and M. Oostrom. 1996. *STOMP Subsurface Transport Over Multiple Phases: Theory*
34 *Guide*. PNNL-11217, Pacific Northwest National Laboratory, Richland, Washington.
- 35
- 36 Wood, M. I., R. Khaleel, P. D. Rittmann, A. H. Liu, S. H. Finfrock, R. J. Serne, K. J. Cantrell, and
37 T.H. DeLorenzo. 1995. *Performance Assessment for the Disposal of Low-Level Waste in the 200 West*
38 *Area Burial Grounds*. WHC-EP-0645, Westinghouse Hanford Company, Richland, Washington.
- 39
- 40 Wood, M. I. 1996. *Addendum to the Performance Assessment for Low-Level Waste Disposal in the*
41 *200 West Area Active Burial Grounds*. HNF-SD-WM-TI-798, Rev. 0. Rust Federal Services of Hanford,
42 Inc., Richland, Washington.