UNIT 4 – PATH FORWARD

29. DATA NEEDS

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29.1 OVERVIEW

Future work depends on the data, information, and understanding to make decisions. As a first step, data needs must be determined. This was first done at the beginning of the Tank Farm Vadose Zone Project in 1998. Based on new goals and the efforts of the past 10 years, a new set of data needs has been determined.

The Tank Farm Vadose Zone Program conducts activities to characterize and analyze the long-term environmental and human-health impacts from tank waste releases to the vadose zone. The project also implements interim measures to mitigate impacts, and plans the remediation of waste releases from tank farms and associated facilities. This chapter summarizes the data needs that are important to estimating long-term human-health and environmental risks. The full description of these data needs is given in *An Evaluation of Hanford Site Tank Farm Subsurface Contamination, FY 2007* (Mann et al. 2007). The scope does not include technologies needed to remediate contaminated soils and facilities, technologies needed to close tank farms, or management and regulatory decisions that will impact remediation and closure.

29.2 PROCESS

A key activity undertaken for the RCRA Facility Investigation Report was to update *A Summary and Evaluation of Hanford Site Tank Farm Subsurface Contamination* (Jones et al. 1998). In addition to summarizing data needs, Jones et al. (1998) described what was known about subsurface contamination beneath the tank farms before Phase I characterization activities were initiated. The 1998 report included a preliminary conceptual model for migration of tank wastes through the vadose zone and an assessment of data and analyses needed to update the conceptual model. Jones et al. (1998) established the technical framework for the Tank Farm Vadose Zone Project.

The Tank Farm Vadose Zone Program recognized that in order to define future work, an update of Jones et al. (1998) was needed. To accomplish this revision, the Program assembled teams of subject matter experts in geology, hydrology, geochemistry, and various fields of engineering to evaluate the past needs. The update of Jones et al. 1998 started with reviewing and updating the status needs listed in that document (See Table 1 of Jones et al. 1998). Based on the characterization during the last decade, many of the gaps identified by Jones et al. (1998) were filled through field work and characterization activities, laboratory investigations, modeling, and implementation of interim measures. The subject matter experts determined that fourteen of the nineteen needs identified in Jones et al. 1998 have been investigated to the point that the project defines the current status as acceptable (see Section 29.3).

In the effort to update Jones et al. (1998), new data needs were identified. Also, with the change in scope from Phase 1 (that is, understand the nature and extent of tank waste in the vadose zone and understand how its future movement would impact human health and the environment) to Phase 2 (that is. obtain the necessary information to remediate the vadose zone so that tank farms

can be closed), new needs to estimate future human-health and environmental impacts were identified. Thus, over 45 data needs were identified (Mann et al. 2007).

Each of these needs was individually investigated to determine how much was known about them and how they each would contribute to uncertainty in the estimation of future human health and environmental impacts. Of the new needs, 17 were identified by the subject matter experts as high priority, making a total of 21, if the four remaining high priority needs from Jones et al. (1998) are included.

29.3 Data Needs Identified in First Effort that have been Addressed

A major emphasis of the Phase 1 effort of the Tank Farm Vadose Zone Program was to obtain enough data, information, and understanding to adequately characterize the nature and extent of vadose zone contamination beneath tank farm areas known to have contamination. In doing so, the data needs identified in Jones et al. (1998) were used as a guide for the Phase I characterization process. Table 29-1 provides a summary of the status of the data needs identified in Jones et al. (1998) as stated in Mann et al. (2007).

29.4 Current High-Priority Data Needs

The current 22 data needs identified in Mann et al. (2007) are organized into groups that reflect components of the tank farm vadose zone conceptual model (see Chapter 16):

- Inventory
- Release
- Recharge
- Geohydrology
- Geochemisty
- Modeling.

The high priority data needs are presented in Table 29-2. The inventory and release components address residual wastes that will remain in the tanks and tank farm infrastructure after closure and potential losses from leaks during waste retrieval. Recharge addresses the impacts of current conditions in the tank farms (that is, gravel covers that permit infiltration and recharge) as well as the impacts of surface barriers. The geohydrology and geochemistry components address the extent of the existing subsurface contaminant inventory and drivers and pathways for contaminants to be transported through the vadose zone and groundwater. Geochemistry also addresses the mobility of key reactive contaminants, such as uranium. Modeling addresses conceptual models and how they are simulated in computers. Each of these needs is focused on filling in data needed for future performance assessments.

The data needs are being used to provide in the planning for Phase 2 activities of the Tank Farm Vadose Zone Project. For example, they guided the choice of fiscal year 2008 activities, the locations of field characterization activities, and the type and amount of laboratory analyses performed.

Table 29-1. 1998 Data Needs that have been Addressed

Data Gap	Resolution
Determine vadose zone concentrations of key radionuclides from major tank farm releases.	This was a major goal of Phase I that was achieved by extensive sample and subsequent laboratory analyses. (Chapters 8 and 17)
Perform baseline spectral gamma logging data of all tank farms.	Measurements were completed. (Section 5.2.4)
Convert gamma logging data to contaminant of concern distributions.	Determined that gamma-emitting radionuclides have different mobility than key contaminants of concerns and, hence, different distributions in the vadose zone. (Chapter 22)
Determine past leak volumes.	Extensive literature review has reduced uncertainties, and a process has been established with the Washington State Department of Ecology to establish best estimates and associated uncertainties. (Chapter 17 and Appendix B6.5)
Determine composition of past leaked tank waste.	Extensive literature review combined with extensive field sampling and laboratory analysis have reduced uncertainties. (Chapter 17)
Determine geohydrology of vadose zone formations.	Analyses of vadose zone samples throughout the Central Plateau has improved knowledge of geology underneath the Hanford Site. (Chapter 20)
Geohydrologic properties of clastic dikes.	Work by others (for example, Karl Fecht, Pacific Northwest National Laboratory, and the Integrated Disposal Facility) has created the necessary database. (Appendix E [Geology] and Appendix F [Hydrology])
Determine change in hydraulic properties for contaminated soils.	Collected samples underneath Tank SX-108, which is thought to have leaked the most caustic waste to the vadose zone, showed minimal changes. (Section 5.3.3)
Determine waste chemistry effects on radionuclide mobility in the vadose zone [except U(VI)].	Collected and analyzed numerous vadose zone samples from major tank farm release events. Except for uranium (VI), understanding is sufficient. (Chapter 22.)
Recharge effects from tank farm infrastructure (Future events - Recharge effects of processing operations).	Interim measures (berms, gutters, and interim barriers) have been installed to minimize future recharge events. Effects of tank farm infrastructure have been incorporated into models. (Chapter 11)
Projection of contaminant migration (modeling approach).	Single-Shell Tank System Performance Assessment has been issued and is being maintained. (Chapter 27)
Temperature distribution in contaminated soils.	Computer simulations contained in the S/SX Field Investigation Report [Knepp 2002a] show that thermal effects are important for the first 30 years, but that long-term impacts can be estimated using a constant temperature approach if the initial contaminant concentration is taken after the 30 year period.
Thermal effects on radionuclide-soil reactions.	Collected samples underneath Tank SX-108, which is though to have leaked the most caustic waste to the vadose zone, showed minimal changes. (Section 5.3.3)
Thermal effects on physical transport rates.	Computer simulations contained in the S/SX Field Investigation Report [Knepp 2002a] show that thermal effects are important for the first ~30 years, but that long-term impacts can be estimated using a constant temperature approach if the initial contaminant concentration is taken after the 30 year period.

Table 29-2. Current High Priority Data Needs (2 pages)

Data Need	Path Forward
Inventory	
Tank residual inventories	Prior to retrieval of waste from tanks, residual inventories will be taken from computer estimates (the Hanford Tank Waste System Operations Simulator). After tank waste retrieval, results of laboratory analyses of residual waste will be used.
Detection and measurement of tank leaks during retrieval	Surface Geophysical Exploration is now accepted as a means of tank leak detection in S Farm. Application of this technique to other farms is pending.
Retrieval leak inventories	Potential retrieval leak inventories are calculated using the Hanford Tank Waste System Operations Simulator and the associated leak volume.
Infrastructure inventories	Preliminary infrastructure inventories are under development. Impacts from direct exposure may need to be considered.
Current distribution of past tank waste discharges (a)	Data from spectral gamma logging and characterization boreholes. Analyses in Field Investigation Reports (Knepp 2002a, Knepp 2002b, Myers 2005) show less sensitivity to this issue than previously thought. Surface Geophysical Exploration is being applied to locate contamination and develop three-dimensional plume distributions and guide location of additional boreholes or direct pushes
Near-surface soil concentrations-inventories	Characterization efforts will be identified through RCRA Corrective Measures Study process. Hydraulic hammer direct-push technology makes characterization more efficient and cost effective. Impacts from direct exposure may need to be considered
Past Leak Volumes (a)	Work with the Washington State Department of Ecology to determine past leak volumes.
Release	
Tank waste residual release models	From limited laboratory experiments, the water leaching of key contaminants of concern has been found to be variable and tank specific. The path forward is to expand sampling and analysis.
Tank grout characteristics	Develop grout formulations to meet tank closure requirements.
Recharge	
Recharge through gravel surfaces	Measure recharge under tank farm gravel surfaces (for example, chlorine-36 and chloride data).
Surface barrier performance after design life	Continue collecting recharge data and reinvestigate given concerns.
Timing of initial barrier placement	Timing of initial barrier placement is not defined. Path forward is to perform sensitivity studies on the impact of barrier placement timing.
Recharge effects from tank-farm infrastructure (Past events) (a)	Impacts from past operations have been evaluated. Corrective interim measures have been deployed where appropriate. This need will be revisited as additional information becomes available.
Geohydrology	
Hydraulic properties for facility containment system	Knowledge of the current state of tank system materials hydraulic properties is incomplete (for example, unsaturated hydraulic properties). Path forward is to determine material properties and model these explicitly.
Vapor flow under low recharge	Review past work at other sites (Beatty, Nevada; Ward Valley, California; Australia) as analogs to evaluate importance of potential vapor flow under low infiltration.

Table 29-2. Current High Priority Data Needs (2 pages)

Data Need	Path Forward
Hydraulic properties at low saturation	Review past Hanford work on soil hydraulic properties (for example, ultracentrifuge measurements) and at other sites to extend existing database on relatively wet and intermediate water contents.
Geochemistry	
Waste chemistry effects on uranium(VI) mobility in the vadose zone (a)	Continue leaching studies for sediments at BX-102, TX-104, and other tank farms (for example, U) to determine the processes controlling uranium geochemistry at each location with the overall goal to determine a "unifying" conceptual model for uranium(VI). Tank residuals in C farm are highly enriched in uranium and vadose zone impacts after leaching will need to be addressed.
Chemical interactions between concrete shell and tank residue	Evaluate previous work and continue performing leaching experiments on appropriate analog concrete materials or actual tank structural concrete if available.
Chemical interactions between tank fill and residue	Evaluate previous work and continue conducting experiments on appropriate fill materials.
Modeling	
Contaminant contribution to vadose zone and groundwater from nearby non-tank farms sources	The two Department of Energy Field Offices are having the Hanford Site contractors integrate efforts on source and groundwater contamination. Path forward is to include stable and radioactive isotope signatures.
Short-term temporal and spatial variation in groundwater contaminant concentrations	Measurements show vertical and short-term temporal changes. Current models don't account for these variations. Determine the importance of variations.

(a) Data need retained from Jones et al. 1998.

29.5 REFERENCES

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