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Hanford Waste Management Area A-AX Soil Contamination Inventory Estimates

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Abstract: This report presents estimated contaminated soil inventories after waste is retrieved from tanks in Waste Management Area (WMA) A-AX at the Hanford Site. These inventory estimates were developed in support of future environmental assessments and closure decisions and will be updated as additional investigations are completed and additional information is obtained. This report will provide supporting information for the WMA A-AX Soil Inventory Working Session in support of the WMA A-AX performance assessment.

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EXECUTIVE SUMMARY

The purpose of this report is to present estimated contaminated soil inventories after waste is retrieved from tanks in Waste Management Area (WMA) A-AX at the Hanford Site. These inventory estimates were developed in support of future environmental assessments and closure decisions and will be updated as additional investigations are completed and additional information is obtained.

Figure ES-1 shows major components of WMA A-AX including:

- six single-shell tanks (SSTs) in 241-A Tank Farm and four SSTs in 241-AX Tank Farm used for waste retrieval and storage and
- catch tanks, pipelines, pits and diversion boxes used to transfer waste to and from the SSTs.

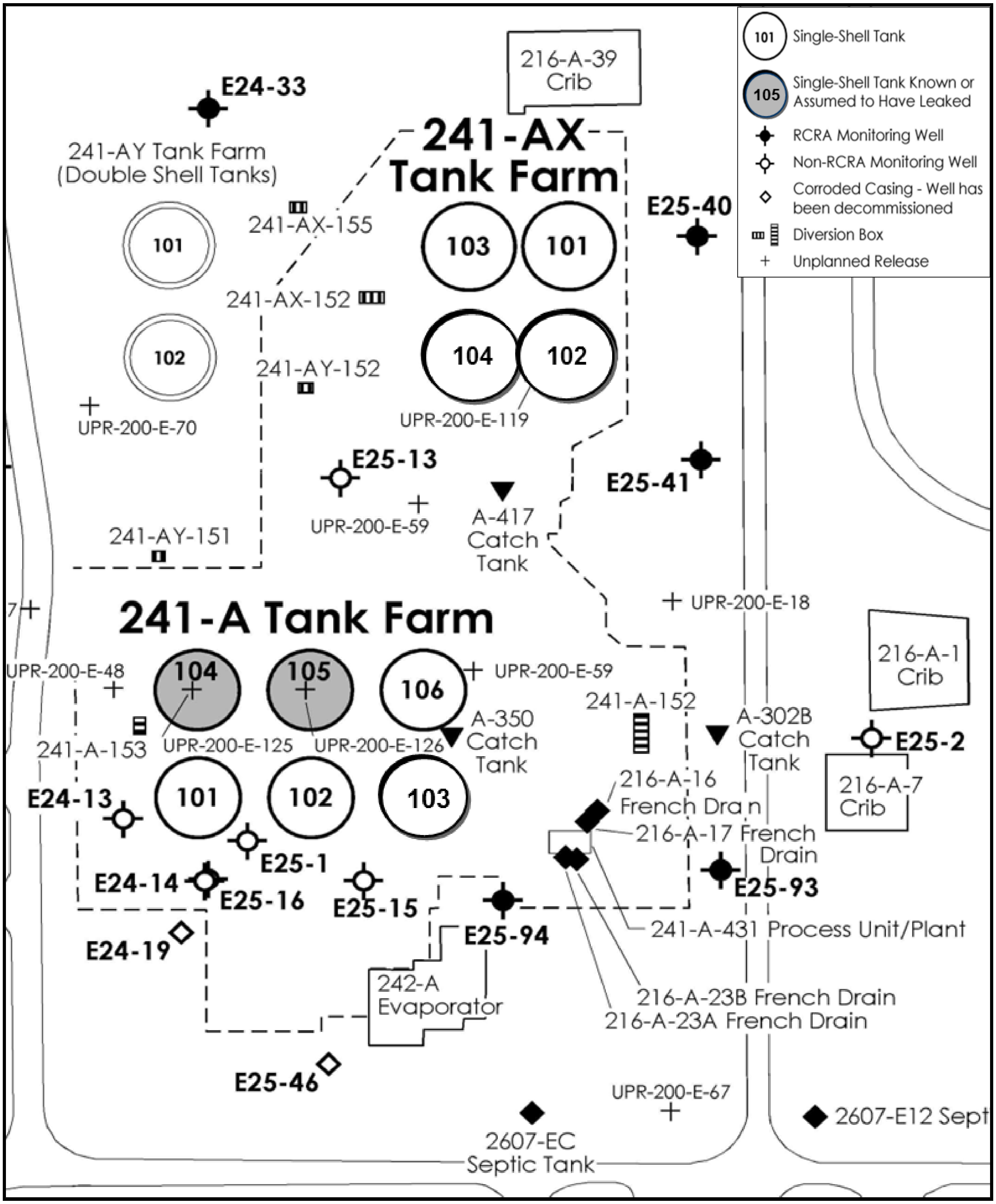
The WMA A-AX SSTs were constructed to store process waste from Hanford nuclear operations. Millions of gallons of nuclear waste were stored in the 241-A and 241-AX Tank Farm SSTs and some of the SSTs leaked in the past. In addition, spills and pipeline leaks during transfers and storage and intentional discharges to cribs and trenches resulted in releasing waste to the ground. Tank liner leaks are referred to as “leaks” and all other discharges to the soil are referred to as “releases.” Liquid waste that could be removed by pumping has been removed from all of the SSTs to reduce the potential for future leaks.

Instrumentation was installed in the 241-A and 241-AX SSTs to monitor liquid levels and monitoring wells were placed around the 241-A and 241-AX SSTs and logged at designated intervals to measure changes in gamma activity in the soils. In addition to monitoring, field investigations and vadose zone characterization of WMA A-AX have been performed in support of a *Resource Conservation and Recovery Act of 1976* Corrective Measures Study to evaluate alternatives to remediate and close WMA A-AX.

With review and agreement from the U.S. Department of Energy and the State of Washington Department of Ecology, a process was established to reassess selected tank leak volume estimates and inventories and to update tank leak and unplanned release volume and inventory estimates as emergent field data is obtained. Past investigations include geophysical logging of vadose monitoring wells (drywells), geophysical logging and sampling of soils and groundwater from direct-push boreholes and wells, mapping soil conductivity anomalies using surface geophysical methods, and evaluating past tank operations and waste processing information. Figure ES-2 illustrates the overall process used to reassess inventories of past releases to the soil for WMA A-AX. Steps of the process are discussed in Section 4.0 of this report.

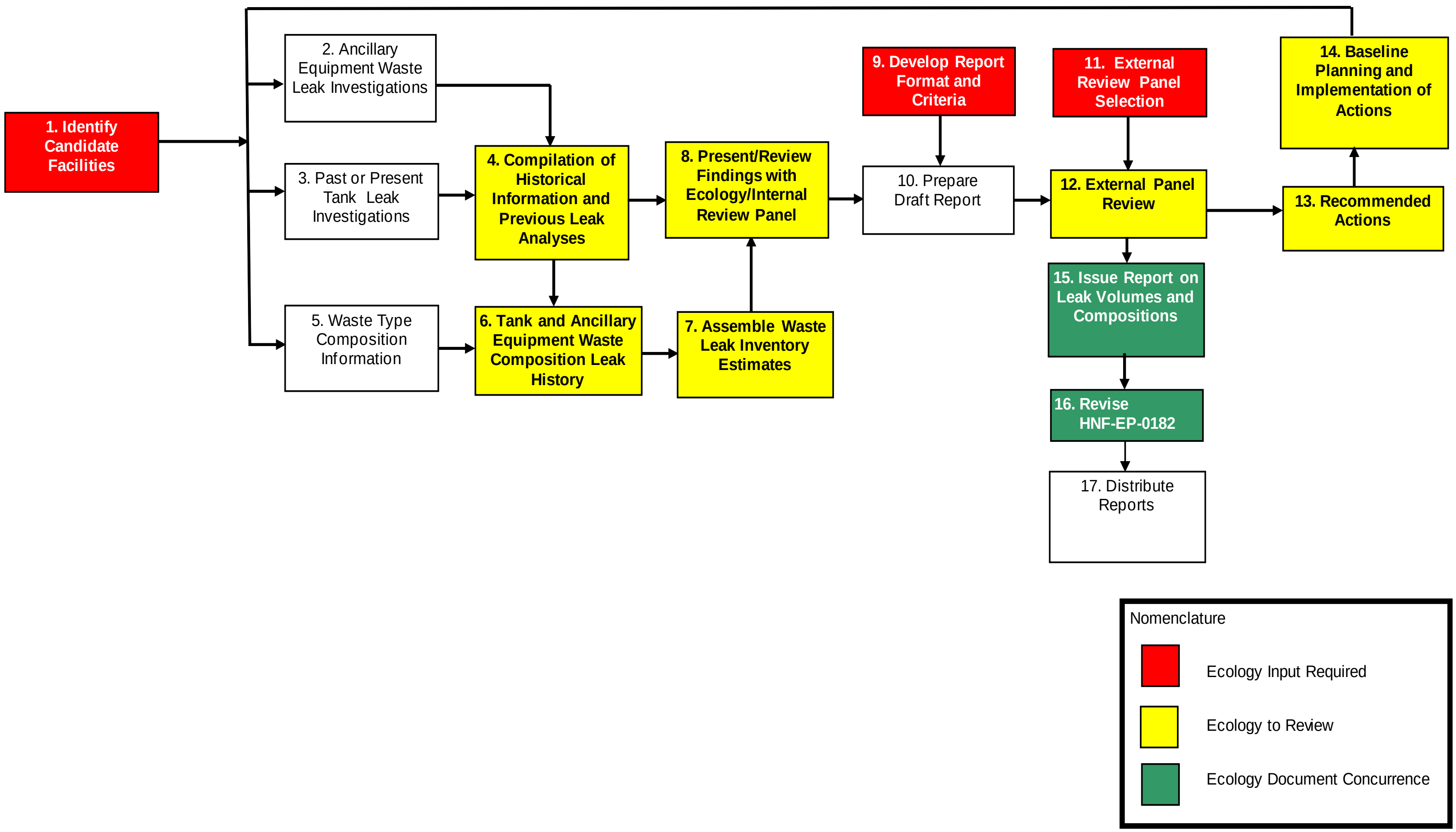
Section 5.0 of this report discusses key assessment parameters and guidelines for assessments. To estimate inventories for past releases to the soil, the key assessment parameters reviewed were: 1) the volume of a release, 2) the time a release occurred, 3) the waste type and composition of waste released, and 4) the mass of contaminant(s) released from tanks or unplanned release sites, which was estimated when possible using existing information and data. Mass is the combination of volume times concentration estimated at the time of the leak.

Figure ES-1. Location Map of Waste Management Area A-AX



RCRA = *Resource Conservation and Recovery Act of 1976*

Figure ES-2. Process to Estimate Contaminated Soil Inventories



Ecology = State of Washington Department of Ecology

Reference: HNF-EP-0182, *Waste Tank Summary Report for Month Ending December 31, 2014*, Rev. 324.

Section 6.0 summarizes updated soil inventory estimates for past releases in WMA A-AX based on Revision 2 of RPP-ENV-37956, *Hanford 241-A and 241-AX Tank Farms Leak Inventory Assessment Report* and discusses how the inventory estimates were derived. Inventory values and calculations for specific constituents are presented in Appendix A.

Section 7.0 discusses inventory uncertainties. The uncertainty of estimates varies depending on the quality and completeness of available information. Currently, although some data is available from soil samples and geophysical investigations, most soil composition estimates for past releases are largely based on a limited set of data and rely heavily on process knowledge embodied in waste process models. Volume estimates for leaks or losses are dependent on in-tank surface level measurements, SST waste transfer records and gamma measurements made with geophysical logging of drywells spaced around the tanks. Uncertainties in these measurements are discussed in this report. Past pipeline leak inventories were even more uncertain as little or no information was available to quantify leak compositions or volume. Given the limited amount of data for most tank leaks, an uncertainty distribution could not be determined. The inventory estimates and uncertainties will be updated as additional data are obtained.

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Abbreviations and Acronyms

bgs	below ground surface
BNW	Battelle Northwest (waste type)
CFR	*Code of Federal Regulations*
COI	constituent of interest
COPC	contaminant of potential concern
CW	cladding (coating) removal waste
DOE	U.S. Department of Energy
DQO	data quality objective
DST	double-shell tank
DWS	drinking water standard
Ecology	State of Washington Department of Ecology
EIS	Environmental Impact Statement
FeCN	ferrocyanide
HDW	Hanford Defined Waste
HLW	high-level waste
IX	ion exchange
ORIGEN2	Oak Ridge Isotope Generation and Depletion Code 2
PAS	PUREX acidified sludge
PCB	polychlorinated biphenyl
PNNL	Pacific Northwest National Laboratory
PSN	PUREX HLW supernate
PSS	PUREX Sludge Supernatant

PUREX	Plutonium Uranium Extraction (facility)
RCRA	*Resource Conservation and Recovery Act of 1976*
REDOX	Reduction-Oxidation (S Plant)
SIM	Hanford Soil Inventory Model
SST	single-shell tank
TEDF	Treated Effluent Disposal Facility
UPR	unplanned release
WMA	Waste Management Area

Waste Types

1C	first decontamination cycle bismuth phosphate waste
A1 Saltcake	saltcake from the first 242-A Evaporator campaign (1977-1980)
AR	water washed PUREX sludge
B	221-B Plant high-activity waste
B Saltcake	saltcake from the 242-B Evaporator campaign (1951-1953)
BIX	Bismuth ion exchange waste from 221-B Plant
CCPLX	concentrated complexed waste
CPLX	complexed waste
CSP	cesium product (221-B Plant fission product recovery campaign) via the AR vault
CWP1	PUREX cladding, aluminum clad fuel (1956-1960)
CWP2	PUREX cladding, aluminum clad fuel (1961-1972)
CWZr1	PUREX/REDOX zirconium cladding waste (1968-1972)
DSSF	double-shell slurry feed
FP	fission product waste

HS	Hot Semiworks waste (1961-1968)
MW1	$BiPO_4$ metal waste (1944-1949)
NCPLX	non-complexed waste
OWW	organic wash waste
P	PUREX high-level waste
P1	PUREX HLW (1956-1962)
P-IX	PUREX Plant Ion Exchange waste
SltCk	saltcake from the 242-A Evaporator
T1 Saltcake	saltcake from the 242-T Evaporator campaign (1951-1956)
TBP	tributyl phosphate
TFeCN	ferrocyanide sludge (1955-1958)
TH1	Thoria process waste (1966)
TH2	Thoria process waste (1970)
UR	uranium recovery waste

1.0 INTRODUCTION

1.1 OVERVIEW

This report provides inventory estimates for past leaks and releases to the soil in Waste Management Area (WMA) A-AX. The inventory estimates are based on the following information.

1. Hanford tank waste process model estimates (RPP-19822, *Hanford Defined Waste Model – Revision 5.0*).

2. WMA A-AX field investigations (RPP-35484, *Field Investigation Report for Waste Management Areas C and A-AX*).

3. 241-A and 241-AX Tank Farms leak inventory assessments (RPP-ENV-37956, *Hanford 241-A and 241-AX Tank Farms Leak Inventory Assessment Report*).

4. Soil inventory model estimates (SIM) (RPP-26744, *Hanford Soil Inventory Model, Rev. 1*).

5. Tank Integrity assessments and reports for tanks 241-A-103 (A-103) (RPP-ASMT-42278, *Tank 241-A-103 Leak Assessment Report*), 241-AX-102 (AX-102) (RPP-ASMT-42628, *Tank 241-AX-102 Integrity Assessment Report*), 241-AX-103 (RPP-RPT-26501, *Tank 241-AX-103 Leak Assessment Report*), and 241-AX-104 (AX-104) (RPP-ASMT-57574, *Tank 241-AX-104 Integrity Assessment Report*).

6. Leak causes and locations report for 241-A Tank Farm (A Farm) (RPP-RPT-54912, *Hanford Single-Shell Tank Leak Causes and Locations - 241-A-Farm*).

1.2 PURPOSE AND SCOPE

This report describes the assumptions, technical basis and uncertainty for current WMA A-AX soil inventory estimates. The purpose of this report is to provide radiological and nonradiological inventory estimates for WMA A-AX soils to be used as a source term for WMA A-AX risk and performance assessments.

The report is limited to the inventory of waste released to the soils from tank leaks, other unplanned releases (UPRs) and planned releases in and near WMA A-AX. Other data packages prepared for the WMA A-AX performance assessment will address distribution, extent and mobility of WMA A-AX soil contaminants (i.e., conceptual models of fate and transport), and modeling parameters associated with the contaminant transport pathways, recharge rates, and solubility or K_D factors for residuals and contaminants in soils.

Information for single-shell tanks (SSTs), catch tanks, pipelines and other facilities and areas within WMA A-AX were reviewed to assess evidence of tank liner leaks and other waste releases to the soil. Soil inventory estimates from past releases were determined for those facilities or areas where there was an indication that a release occurred and for which a technical basis for a soil inventory estimate could be determined. Soil inventory estimates included:

- sources and estimated time of releases
- waste type and waste composition estimates
- volume and inventory estimates for tank leaks, spills, other UPRs to the vadose zone from tank farm equipment and operations and planned releases in facilities near WMA A-AX
- uncertainty estimates or ranges for volumes, concentrations, and inventories.

Inventories were estimated for 25 chemicals and 46 radionuclides (decayed to January 1, 2020). The chemicals and radionuclides included in these estimates are those accounted for in the Hanford Defined Waste (HDW) model. In the future, a Data Quality Objectives (DQO) document will be developed to determine contaminants of potential concern (COPCs) and required characterization to close WMA A-AX. Until then, information addressing the residual waste within WMA A-AX is defined in RPP-23403, *Single-Shell Tank Component Closure Data Quality Objectives*. To date, only limited field investigations have been performed, and therefore data to identify areas where there have been known or suspected releases in or immediately adjacent to WMA A-AX will be addressed in like manner to those in WMA C through the Phase 2 *Resource Conservation and Recovery Act of 1976* (RCRA) Facility Investigation DQO, RPP-RPT-38152, *Data Quality Objectives Report Phase 2 Characterization for Waste Management Area C RCRA Field Investigation/Corrective Measures Study*.

Section 1.0 presents an overview and purpose and scope of this report. Section 2.0 presents the background for the report. Assumptions identified in DQOs are presented in Section 3.0. Section 4.0 describes the process to assess contaminated soil inventories and Section 5.0 describes the key parameters and guidelines for inventory estimates. Soil inventory estimates are summarized in Section 6.0. Section 7.0 discusses uncertainty in soil inventory estimates. The uncertainty of estimates presented varies depending on the quality and completeness of available information and includes uncertainties in source of contaminants, time and volume of release, concentration of contaminants, and distribution and extent of contaminants.

2.0 BACKGROUND

This section of the report provides background information relevant to the estimates of soil inventories including:

- A description of WMA A-AX
- A brief history of WMA A-AX tank waste management and operations
- Leak detection monitoring performed at WMA A-AX
- WMA A-AX vadose zone characterization
- Recent reassessment of tank leaks and losses from WMA A-AX.

Figure 2-1 shows a map of WMA A-AX in the 200 East Area of the Hanford Site. Figure 2-2 shows major components of WMA A-AX (241-A and 241-AX Tank Farms) including SSTs used for waste retrieval and storage and catch tanks, pipelines, pits and diversion boxes used to transfer waste to and from the SSTs.

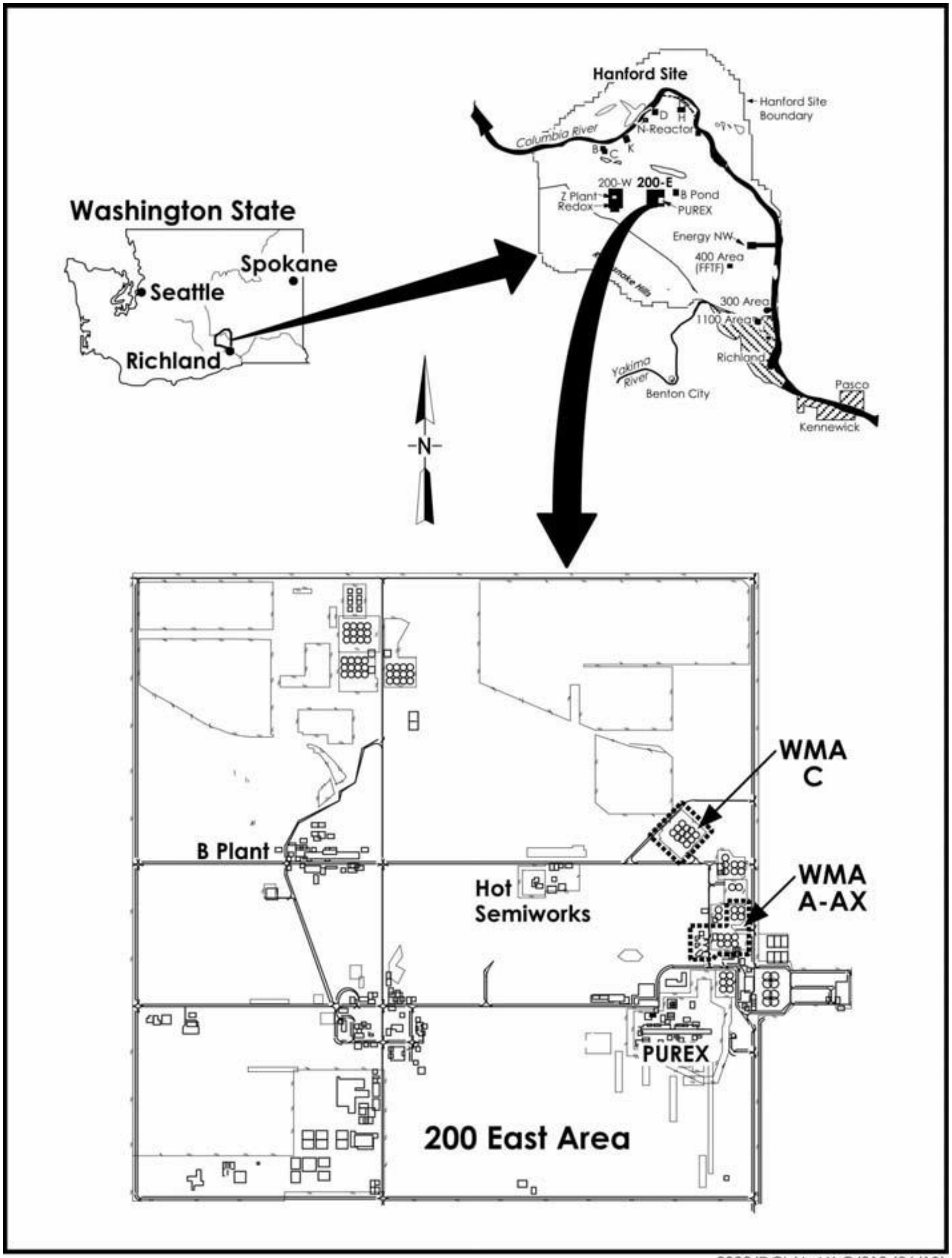
2.1 DESCRIPTION OF WASTE MANAGEMENT AREA A-AX

The 241-A Tank Farm was constructed between 1953 and 1955. The 241-AX Tank Farm (AX Farm) was constructed between 1963 and 1965. The A Farm tanks were designed for the storage of boiling waste generated from irradiated fuel reprocessing at the 202-A Plutonium Uranium Extraction (PUREX) Plant. The AX Farm tanks were designed to contain liquid and solid wastes at a maximum temperature of 350 °F (RPP-10435, *Single-Shell Tank Integrity Assessment Report*, pp. A-43). Wastes at higher temperatures could cause buckling of the steel liner and/or damage to the concrete shell. The A Farm tanks have three unique design features which are airlift circulators for cooling the boiling wastes, an underground vessel ventilation header to remove condensate and volatiles, and laterals 10 ft beneath the tank for leak detection. The AX Farm tanks also had similar design features incorporating leak detection within the tank structure.

In the A Farm tanks, the heat generated from the decay of radionuclides was sufficient to result in the evaporation of water from the wastes stored in these tanks. The water vapor and other off-gases from the A Farm tanks were drawn from each tank through an underground 20-in.-diameter pipe that connects to an underground 24-in.-diameter pipe (i.e., vapor header). When AX Farm was constructed, a similar vapor header was installed for these four tanks. An underground 20-in.-diameter pipe connects from each SST to an underground 24-in.-diameter pipe. The underground 24-in.-diameter pipe runs to the 241-AX-152 diverter station. From the 241-AX-152 diverter station, the underground 24-in.-diameter pipe from the 241-AX vapor header connects to the A Farm vapor header.

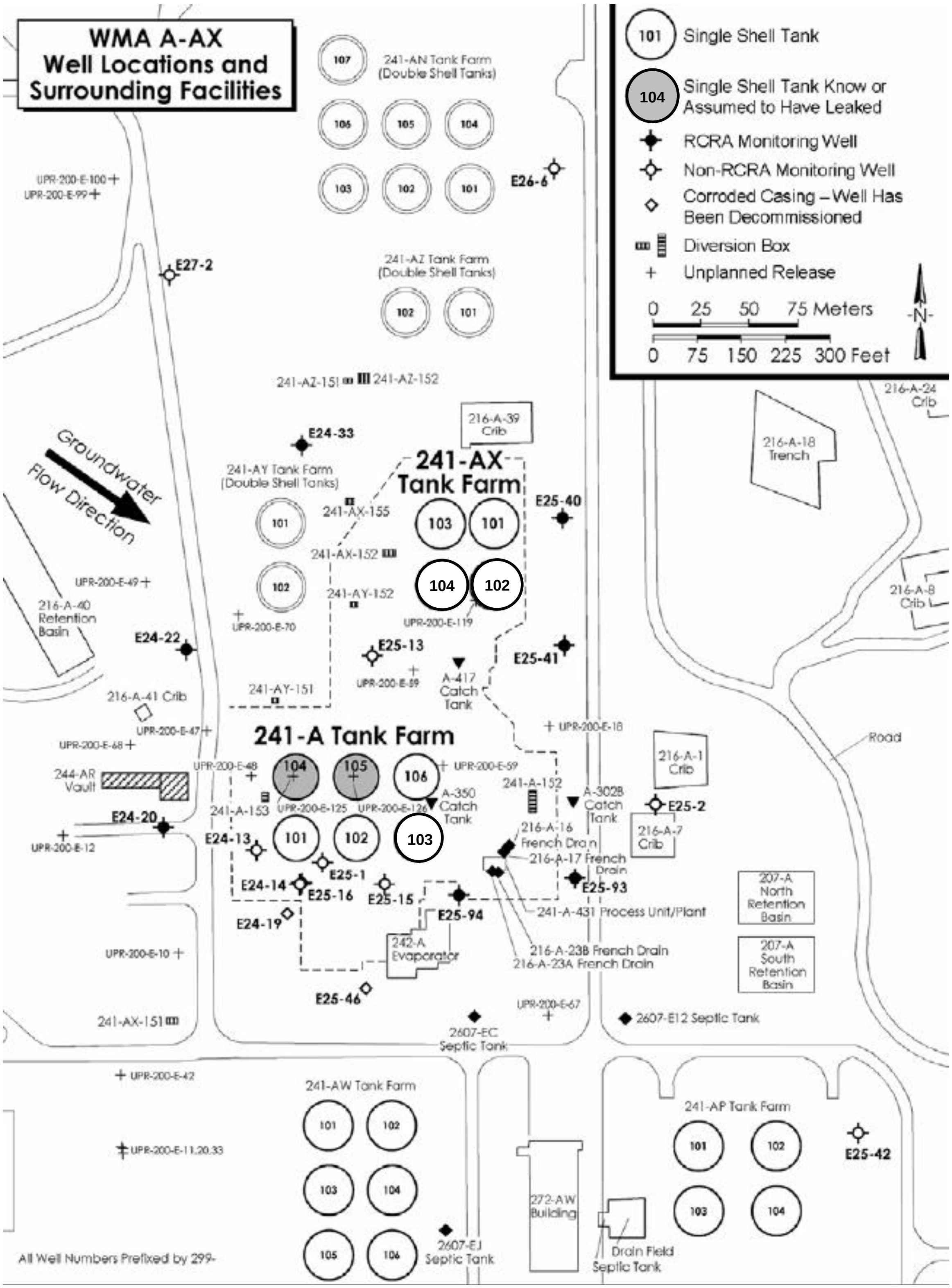
The A Farm vapor header connects to underground condensers and de-entrainment vessels and then enters the 241-A-431 fan house and de-entrainment building. The 241-A and 241-AX Tank Farm Process Condensate was removed from the A and AX Farm off-gases and collected in the catch tank 241-A-417. The off-gas was filtered and discharged through an exhaust stack. Initially, the condensate collected in the catch tank 241-A-417 was either returned to one of the A or AX Farm SSTs or discharged to cribs.

Figure 2-1. Location Map of Waste Management Area A-AX in the 200 East Area of the Hanford Site



PUREX = Plutonium Uranium Extraction (facility) WMA = Waste Management Area

Figure 2-2. Location Map of Waste Management Area A-AX and Surrounding Area



Note: Dashed lines show perceived WMA A-AX boundary (fence line).

RCRA = *Resource Conservation and Recovery Act of 1976*

WMA = Waste Management Area

2.1.1 241-A Farm Tanks

The 241-A Tank Farm contains six nominally 1,000,000-gal capacity SSTs, as shown in Figure 2-3 (H-2-31880, *241-A Tank Farm Leak Detection System Plan-Section-Detail*). The A Farm tanks consist of a 75-ft diameter, carbon steel liner inside a concrete tank. The tank steel bottoms intersect the sidewalls orthogonally, rather than the dished bottoms of earlier designed tank farms. The concrete thickness is 0.5 ft on the tank bottom, 2 ft to 1.25 ft on the side walls, and 1.25 ft for the tank dome. The concrete tank dome thickness increases to ~3.5 ft along the sidewalls. Each tank was originally equipped with 9 to 11 risers and a 20-in.-diameter vapor exhaust pipeline that penetrated the tank dome, and 4 airlift circulators that were operated to suspend solids, mix the tank contents, and dissipate heat.

The tanks in A Farm were originally designed to contain liquid and solid wastes at a maximum temperature of 280 °F (RPP-10435, pp. A-42). After installation of airlift circulators, the operating temperature limit was revised to a maximum of 300 °F at the tank bottom (RPP-10435, pp. A-54). Wastes at higher temperatures could cause buckling of the steel liner and/or structural damage to the concrete shell.

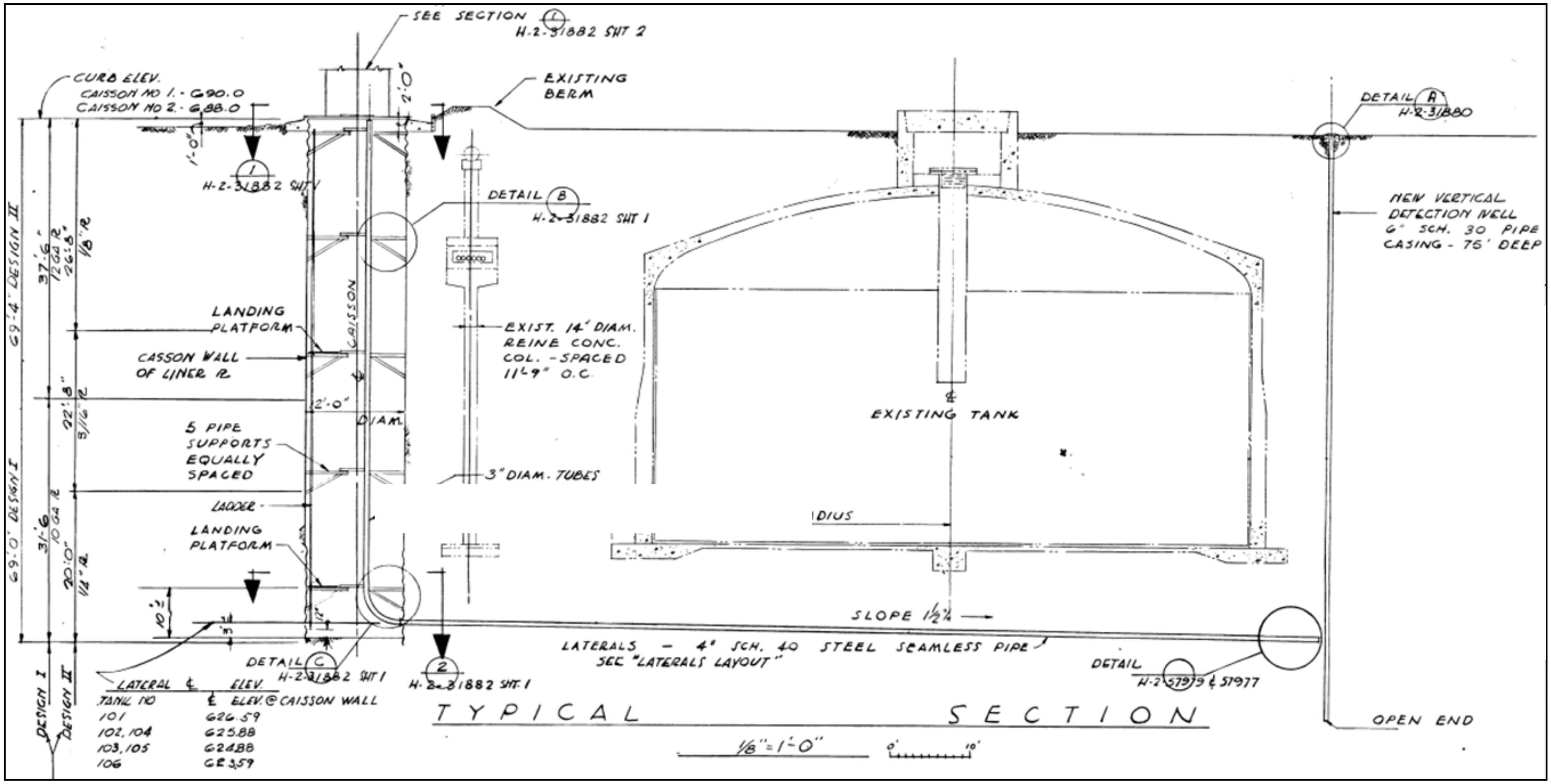
The tanks in A Farm were vented to an underground vessel ventilation header that connected to AX Farm and later to the 241-AY Tank Farm (AY Farm). The purpose of this ventilation header was to remove off-gas and water vapor from these tanks, which were often operated with the wastes at boiling conditions. Section 4.5.2 includes further discussion on the vessel ventilation header and analyses of samples of condensate collected from this system. The A Farm tanks were isolated from this ventilation header in the early 1980s.

The design of this ventilation header included a baffled, 20-in.-diameter pipe inside each tank. The 20-in.-diameter pipe that exits the tank is connected to a 24-in.-diameter, stainless steel pipe header that is buried a minimum of 4 ft below grade. The 24-in. header ran between the tanks to the 241-A-431 ventilation building. Dresser couplings provide a compression seal on the outer surface of vapor header piping segments that are ~25 ft in length. A Dresser coupling is also used to seal the 20-in.-diameter pipe from each tank to the 24-in. main vapor header. The couplings provide for expansion and contraction of the vapor header pipe segments.

2.1.2 241-AX Farm Tanks

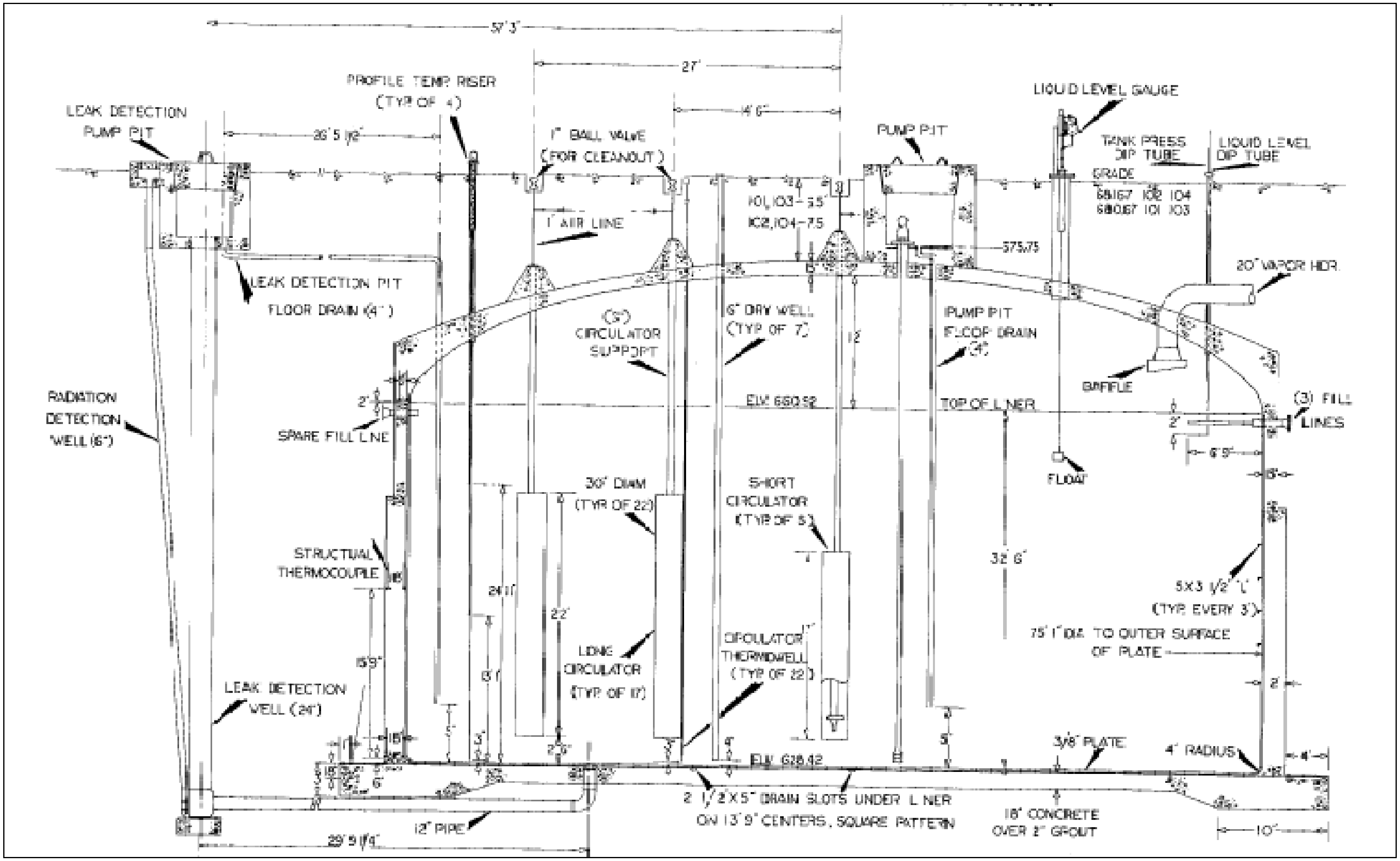
The 241-AX Tank Farm contains four 1,000,000-gal capacity SSTs. A cross section of an AX Farm tank is shown in RL-SEP-9, *PUREX 241-AX Tank Farm and Waste Routing System Information Manual* and Figure 2-4. The AX Farm tanks consist of a 75-ft-diameter carbon steel liner inside a concrete tank. The tank steel bottoms intersect the sidewalls orthogonally (similar to A Farm tanks and 241-SX Farm tanks), rather than the dished bottoms of earlier designed tank farms. The concrete thickness is 1.5 ft on the tank bottom, 2 ft to 1.25 ft on the side walls, and 1.25 ft for the tank dome. The concrete tank dome thickness increases to ~5 ft along the sidewalls. Each tank was originally equipped with 54 risers that penetrated the tank dome and 22 airlift circulators that were operated to suspend solids, mix the tank contents, and dissipate heat (see Figure 2-4).

Figure 2-3. Single-Shell Tanks and Laterals in 241-A Tank Farm



Source: H-2-31880, *241-A Tank Farm Leak Detection System Plan-Section-Detail*.

Figure 2-4. Single-Shell Tanks and Leak Detection Pits in 241-AX Tank Farm



The tanks in AX Farm were vented to an underground vessel ventilation header that connected to A Farm and later to the 241-AY Tank Farm. The purpose of this ventilation header was to remove off-gas and water vapor from these tanks, which were often operated with the wastes at boiling conditions. Section 4.5.2 includes further discussion on the vessel ventilation header and analyses of samples of condensate collected from this system.

The AX Farm tanks were isolated from this ventilation header in the early 1980s. The design of this ventilation header included a baffled, 20-in.-diameter pipe inside each AX Farm tank. The 20-in.-diameter pipe exiting the tank is connected to a 24-in.-diameter, stainless steel pipe header that is buried a minimum of 4 ft below grade. The 24-in. header ran between the tanks to the 241-AX-152 diverter station and then to A Farm to tie in to that farm's ventilation header. The 241-AX ventilation header slopes upward toward the A Farm tie-in. Dresser couplings provide a compression seal on the outer surface of vapor header piping segments that are ~25 ft in length. A Dresser coupling is also used to seal the 20-in.-diameter pipe from each tank to the 24-in. main vapor header. The couplings provide for expansion and contraction of the vapor header pipe segments.

2.1.3 Facilities in and Near Waste Management Area A-AX

Waste Management Area A-AX is part of the PUREX Source Management Area. Figure 2-2 shows facilities in and near WMA A-AX. Facilities and operations in WMA A-AX are summarized in this section. More detailed descriptions and discussion of WMA A-X facilities and operations are provided in the following:

- DOE/RL-92-04, *PUREX Source Aggregate Area Management Study Report,*
- RPP-7494, *Historical Vadose Zone Contamination from A, AX, and C Tank Farm Operations,*
- RPP-35484, *Field Investigation Report for Waste Management Areas C and A-AX* and
- Waste Information Data System.

Operations at PUREX went through two phases: the first phase began in 1956 and continued until 1972 and the second phase occurred from 1983 to 1985. During these phases, waste discharges to the environment, to cribs and other facilities located around WMA A-AX were large and frequent.

2.1.3.1 Cribs, Trenches, and Retention Basins. Initially, cold start-up wastes from PUREX were discharged into four cribs located just north and east of A Farm (216-A-1, 216-A-7, 216-A-18, 216-A-19, and 216-A-20). Approximately 1.6E+06 L of waste, containing ~2,600 kg of uranium, were disposed in these cribs between November 1955 and January 1956. Shortly thereafter, full-scale PUREX operations began, and several liquid discharge facilities began to receive a variety of wastes. In this same time frame, small amounts of overflow waste from diversion box 241-A-152 were discharged into crib 216-A-7 (8E+04 L in 1955 and 1956).

The 216-A-1 and 216-A-7 cribs are located within the same radiologically posted area. They are marked and posted with Underground Radioactive Material signs and are located inside the 200 East Area perimeter fence extension, east of A Farm, along Canton Avenue. These cribs received the depleted uranium waste from the cold startup run in the 202-A Building during November and December 1955 via an overground pipeline.

The 216-A-18 trench is located outside of the 200 East Area perimeter fence, east of AX Farm, along Canton Avenue. The trench received waste via an aboveground pipeline. The site was an excavation with a side slope of 1:2. No crib structure was built. The 216-A-18 trench received the depleted uranium waste from the cold start-up run at 202-A Building. The site was deactivated by removing the overground piping and backfilling the excavation when the specific retention capacity was reached. The trench was removed from service in December 1955 and surface stabilized in September 1990. The site is marked and posted with Underground Radioactive Material signs. In February 2001, a narrow area posted with Soil Contamination Area signs extended between the 216-A-19 southern site boundary and northern boundary of 216-A-34.

The 216-A-19 trench is located east of the 200 East Area perimeter fence, north of the 216-A-8 crib. The site received PUREX start-up waste during November and December 1955. The site was deactivated by removing the overground piping and backfilling the excavation when the specific retention capacity was reached. The site was surface stabilized in September 1990. The Soil Contamination Area extending between 216-A-19 and 216-A-34 was stabilized and downposted to Underground Radioactive Material in October 2001.

The 216-A-20 trench is located east of the 200 East Area perimeter fence, north of the 216-A-8 crib. The 216-A-20 trench was originally a test hole excavated with a drag line and used for PUREX start-up waste. The site received the 241-A-431 Building contact condenser cooling water via the 216-A-34 Ditch and the depleted uranium waste from the cold start-up run at the 202-A Building. The site was deactivated in 1955 when the specific retention capacity was reached by removing the overground piping and backfilling the excavation. The site was surface stabilized in 1990. In April 2007, more surface contamination was backfilled with clean dirt. HW-60807, *Unconfined Underground Radioactive Waste and Contamination in the 200 Areas–1959* notes that the 216-A-20 trench overflowed, covering an area measuring ~30 meters (100 ft) north and 60 meters (200 ft) east of the crib site. The site is marked and posted with Underground Radioactive Material signs.

After PUREX startup, the largest volume of waste discharges into nearby cribs was generated by tank condenser operations. Both condensate and condenser cooling water were intentionally discharged, and the majority of the discharges occurred in facilities east of WMA A-AX. The first facility to receive this waste was the 216-A-8 crib, which was built in 1955 and is located east of A Farm. This crib received 9.3E+08 L of tank condensate and condenser cooling water through May 1958, when the crib had reached its radionuclide capacity. At that point, crib 216-A-24, also located just north of crib 216-A-8, began receiving this waste. The waste is low in salt, neutral to basic and has a record of organic content.

In 1960, an order of magnitude reduction in annual receipt volume was achieved (from ~3E+08 L/yr to < 3E+07 L/yr), when a more efficient condenser system was installed that permitted diversion of the condenser cooling water to Gable Mountain Pond. By 1967, ~8.2E+08 L of fluid had been discharged into this crib. In 1966, condensate discharge reverted back to crib 216-A-8, which received another 2E+08 L through 1976. Subsequently, at crib 216-A-8, additional condensate was received in 1978 (600 L) and from 1983 through 1985, ~1.5E+06 L because of PUREX restart.

The 216-A-8 crib overflow was accomplished through a 16-in.-diameter pipe exiting to the north at the east end of the crib. The pipe emptied into a narrow ditch that flowed northward. A small overflow pond was excavated at the northeast end of the ditch to receive the excess waste water from the crib. The crib was surface stabilized in September 1990.

The 216-A-24 crib was built with four sections, each 107 meters (350 ft) long, separated by soil berms. The sections were installed at increasingly lower elevations, to allow the effluent to cascade from one section to the next. The 216-A-24 crib was believed to have been deactivated in 1966 by valving out the pipeline at the 216-A-508 diversion box (adjacent to the 216-A-8 crib), but in 1979 when excess moisture and radioactive contamination were encountered the valve was discovered to be open and allowing fluid to migrate to crib 216-A-24. The volume of waste released from 1967 through 1979 is unknown. A corrective action backfill was done in 1981 following the contamination spread. The entire crib was surface stabilized in 1988.

The 216-A-8 and 216-A-24 cribs were isolated in 1995 by filling the distribution box with concrete and removing the control structure filter and crib vent filters. The cribs and overflow area are surrounded by chain and concrete AC-540 markers and posted with Underground Radioactive Material signs.

The 216-A-9 crib located 500 ft west of the A Farm, received acid fractionator condensate and cooling water from PUREX between 1956 and 1958 (9.8E+08 L). The crib surpassed its capacity in 1958 and was taken out of service. The crib was approved to receive contamination waste from N reactor in 1966 (2E+06 L) and was again inactive until August 1969, when PUREX acid fractionator waste was transported to the crib in tanker trucks.

The site contains a 10-in. Schedule 30 steel perforated pipe, placed horizontally, 9 ft below grade. The site has 65,000 ft^3 of gravel fill and has been backfilled. The side slope is 2:1. The site was deactivated by blanking the effluent pipeline (200-E-238-PL) to the unit after replacing 100 ft of the pipeline that had failed. The truck unloading station at this site was interim stabilized in 1991. In 1993, filters were removed from the crib risers, surveyed, and disposed of as nonradioactive waste. The crib surface was covered with 18 to 24 in. of uncontaminated backfill. In July 2000, the vent risers were sealed as a preventative measure for potential passive radioactive emissions. The crib is a surface stabilized area, marked with light post and chain. It is posted as an Underground Radioactive Material area.

The 216-A-40 retention basin is located about 500 ft west of AX Farm and consists of a trench 400 ft long by 20 ft wide. The basin received 9.5E+05 L of steam condensate and cooling water from the 244-AR Vault in 1968. The site was originally an open, rubber-lined trench that was divided into three sections. A 12-in.-diameter Schedule 40 distribution pipe ran horizontally through the south end of the unit, 12 ft below grade. Collapsible rubber bladders were utilized to contain the contaminated cooling water and steam condensate. Contaminated cooling water and steam condensate from the 244-AR Vault were diverted to the 216-A-40 Retention Basin when the effluent was above standard release limits for the water to be sent to the 216-B-3 or 216-A-25 Ponds. The retention basin bladders failed in 1979 and the unit was removed from service.

Although it was not being used, it remained an open basin until 1994. Contaminated soil and the bladders were consolidated into the east end of the trench. Contaminated soil from the adjacent Soil Contamination Area (UPR-200-E-143 and remnants of UPR-200-E-100) was also scraped into the east end of the basin. The basin was backfilled with clean material. This eastern end was posted as an Underground Radioactive Material Area. The remaining portion was released from radiological control.

The 216-A-39 crib is located near the southeast corner of the 241-AZ Tank Farm (AZ Farm), inside the tank farm fence. The site consists of a crib and two trenches dug from the north door of the 241-AX-801-A Building. The trenches extended to the brow of the north hill, then over the hill to the flat ground below. The trenches continued eastward 90 ft. Later, a pipeline was added that connected the 241-AX-801-B building to the 216-A-39 crib.

The 216-A-39 crib received liquid from a spill of radioactive material which was washed out a hole in the back of the 241-AX-801-A building in June 1966 (RHO-CD-673, *Handbook 200 Areas Waste Sites*). The spill was washed down using a fire hose. The maximum dose rate from this release was 5 rad per hour at a distance of 3 meters (10 ft). Later, a pipeline was connected and the crib received floor drainage via a pipeline from the 241-AX-801-B Building. Based on RHO-CD-673, the Waste Information Data System shows the total volume of waste released was 20 L. The volume of water used is unknown.

The 216-A-34 crib is located east of the 200 East Area perimeter fence and north of the 216-A-8 crib. The site received cooling water from the contact condenser in the 241-A-431 Building. A 15-in.-diameter clay pipe fed the 216-A-34 crib and was connected to the headwall. Ditch effluent was routed to the 216-A-19 and 216-A-20 trenches. The site consists of two ditches, one ditch measuring 280 ft long and 30 ft wide and a second ditch measuring 130 ft long and 30 ft wide. The headwall structure had 1:2 side slopes. The headwall structure tapered off into an open ditch which terminated at the 216-A-20 crib.

Disposal at this site was terminated due to the potential for release of contamination to the environment. The pipeline to the ditch was valved out and the effluent was rerouted to the 216-A-8 crib. The ditch was backfilled. This site was surface stabilized in September 1990.

The 207-A South retention basin is located east of the 242-A Evaporator Building and consists of three unlined concrete cells that are coated with a white polyurethane sealant. The cells were fed from the pump pit, located between the 207-A South and 207-A North basins. A 4-in. fill line entered each cell inside the basin structure. A 3-in. drain line exits the bottom of each cell. The

200-E-236-PL basin distribution pipelines were consolidated into the 207-A South basin waste site.

When operating, the three cells of the 207-A South basin were filled alternately, sampled, and discharged to the 216-A-37-1 crib after meeting release specifications. The 242-A Evaporator could retrieve the liquid waste for reprocessing or storage in the tank farm, via line 300, if discharge specifications were not met. After the 207-A North and South basins ceased to operate, the effluent was diverted to the 200 Area Treated Effluent Disposal Facility (TEDF). The 207-A South basin received waste between March 1977 and April 12, 1989.

Operation of the 207-A South basin was discontinued in April 1989. The basins were pumped out and radiologically surveyed. The basins initially remained posted as a Contamination Area due to low levels of fixed contamination in the sump areas. The radiological postings were removed in May 2003.

The 207-A North basin is located east of 242-A Evaporator building and consists of three Hypalon-lined, concrete basins. Each of the three basins is 55 ft long, 10 ft wide at the bottom, and 7 ft deep with a total capacity of 210,000 gal. A 4-in. fill line enters each basin, ~2 ft long (inside basin structure) and a 3-in. drain line exits.

The basins were alternately filled, sampled, and emptied when meeting specifications. The basins received steam condensate from the 242-A Evaporator since 1977. Effluent was originally sent to the 216-A-25 (Gable) Pond and later to the B Pond system. When the B Ponds became inactive, effluent was diverted to TEDF. The basins discharged via pipeline to the 216-B-3C pond. Discharge to the 216-B-3C pond was discontinued in early 1997 and the basin effluent was diverted to the 200 Area TEDF.

The 207-A North basins were physically isolated and ceased to operate in November 1999. The basins are surrounded with posts and chain. There is no radiological posting on the north basins.

2.1.3.2 Ancillary Equipment. The 241-A-350 catch tank is an underground reinforced concrete pump pit, with a cover block. The pump pit drains any releases from the pump through the pump pit floor drain to an 800-gal (3,000-L) stainless steel tank below. The tank is located inside the A Farm fence, southeast of tank 241-A-106 (A-106). It is designed to receive drainage from the 241-A-A and 241-A-B valve pits, 241-A service pit, 241-A&B flush pits, 241-A clean out boxes, 241-A-431 ventilation equipment, and out of specification 241-A-207 retention basin solution.

The 241-A-417 catch tank is an underground cylindrical concrete vault lined with an all-welded steel liner. Two overflow lines near the top of the vault prevent overflow of the tank. Above the tank are two rectangular pits, a pump pit and a valve pit. The floor of both pits slope to drains that empty to the tank. The tank is located inside the A Farm fence, east of the 241-A-702 Building. The tank collects condensate from the 241-A-401 Condenser House, 241-A-702, and from 241-AZ-154. Condensate may be pumped back to the AX Farms or overflow to the 216-A-24 crib. On March 25, 1980, a routine pressure test of the underground F-100 condensate return pipeline from the AX-501 Valve Pit to the 241-A-417 condensate catch tank failed. An April 3, 1980 investigation found a leak at the flange connection. An excavation at the pipeline leak was done. Two barrels of contaminated soil, reading 10,000 counts per minute, was taken to a burial ground.

The 241-A-302B catch tank was used for transfer of waste solutions from processing and decontamination operations to the tank farms and is buried outside the tank farm perimeter fence, east of A Farm, adjacent to Canton Avenue. Shotcrete surrounds the area where the 241-A-302B catch tank is located. A riser and electrical box are visible. A staircase has been installed to provide access to the tank surface. The underground tank is positioned horizontally.

The 241-A-302B catch tank is marked and radiologically posted. The tank received liquid effluents from the 241-A-151 diversion box, located south of PUREX, and the 241-A-152 diversion box, outside the A Farm fence. The tank was isolated in 1985 and interim stabilized in 1990. The volume of waste reported to be remaining in the tank is not consistent in all documents. HNF-EP-0182, *Waste Tank Summary Report for Month Ending December 31, 2014* states there is a total of 18,685 L (4,943 gal) of waste remaining in the tank.

The 241-AX-152 catch tank and diverter station are located in the western portion of AX Farm. The catch tank is located under the diverter station. It is constructed of 0.76-meter (2.5-ft)-thick concrete walls. The tank walls and floor are lined with stainless steel. The tank was constructed in 1962 and declared a “leaker” in March 2001. The tank was stabilized by removing all liquid and isolated using both administrative and engineering controls.

The 241-AX-151 diversion box is an underground reinforced concrete structure located near the corner of 4th Street and Buffalo Avenue, south of the 244-AR Vault facility. There are four diverter tanks (tanks 241-AX-151-D, 241-AX-151-E, 241-AX-151-F and 241-AX-151-G) in individual cells and a catch tank (241-A-151CT) in a pump pit. Each cell has a stainless steel liner on the floor that extends approximately one foot up the wall. The cells and pump pit drain into the catch tank below. The structure is surrounded with posts and chain. It is posted with radiological and Inactive Miscellaneous Underground Storage Tank signs.

The unit routed waste from the 202-A Plant to the 244-AR Vault and to the AY and AZ Farms. This unit was isolated by the B-231 project. The last documented waste transfer for this site was in 1977. Gravel was placed on the east and south side slopes in April 2005, to prevent soil erosion.

The 241-AX-152 diverter station, diversion box is a reinforced concrete structure with the top at ground level. There are two diverter tanks in a common cell with a stainless steel liner on the floor that extends ~1 ft up the cell wall. There is also a pump pit that does not have a stainless steel liner. The cell and pump pit drain to a catch tank below.

The 241-AX-152 diverter station is located in the western portion of AX Farm and was used to transfer mixed waste solutions from processing and decontamination operations. The unit was pumped out on August 29, 1992 and declared isolated in March 2002.

The 241-A-152 diversion box is a reinforced concrete structure containing four stainless steel transfer pipes and adequate space to allow for jumper replacement activities. The major portion of the diversion box is below grade with concrete cover blocks and lifting hooks. The diversion box is located inside the A Farm fence, east of tank A-106.

The 241-A-152 diversion box routes waste from 241-A-151 diversion box to 241-CR-151 diversion box through a pipe encasement containing four stainless steel lines. Waste transferred through the diversion box includes fuel decladding waste, organic wash waste (OWW), sump waste, and laboratory waste. Lead shielding may also be contained inside the diversion box. The last documented waste transfer for this diversion box was May 1980.

The 241-A-153 diversion box is a reinforced concrete structure sized to accommodate the pipes and provide space for jumper replacement. The 241-A-153 is one type of diversion box, known as a transfer box. It connects one common pipe to several others, one at a time, uses only one jumper and has the several nozzles arranged in a circle about the common nozzle. The 241-A-153 diversion box is located inside the A Farm fence, southwest of tank 241-A-104 (A-104).

The 241-A-153 diversion box routes waste from A Farm to the 244-AR Vault and contains PUREX high-level waste (HLW) and PUREX OWW. Lead shielding may also be contained inside the diversion box. The last documented waste transfer for this site was July 1985. The diversion box has been stabilized with plastic foam to prevent surface infiltration into the unit.

The 241-A-A and 241-A-B valve pits were built in 1974 and are underground structures with reinforced concrete walls, floor, and cover blocks located inside the A Farm complex, south of tanks 241-A-101 (A-101) and 241-A-102. The A Farm valve pits were used to route wastes to and from the 242-A Evaporator; 241-AN, 241-AW, 241-AY, and 241-AZ Tank Farms, PUREX and the 244-A Double-Contained Receiver Tank. The 204-AR Facility was connected to 241-A-A valve pit, but waste was re-routed to 241-AW-A valve pit in 2003 when line LIQW-702 was tied into line SN-220. Transfers from 244-A may have included cross-site, 244-CR, and 221-B Plant (B Plant) wastes.

The 241-AX-A and 241-AX-B valve pits were built in 1965 and are underground reinforced concrete structures with 1-ft-thick walls and floor located inside AX Farm, southwest of tank AX-104. The 241-AX-A and 241-AX-B valve pits were used to direct slurry into tanks or supernate out of tanks and to route waste solutions from processing and decontamination operations.

The 241-AX-501 valve pit is a reinforced concrete structure located inside the north end of A Farm that contains a valve that routes AX Farm condensate to the 241-A-417 pump pit and tank.

The 241-AX-IX ion exchange (IX) system, located in the southern portion of AX Farm, consists of an aboveground filter and IX column. The IX column is enclosed in a shielded structure. The IX column sits on top of an 8-ft concrete structure. The 241-AX-IX ion exchanger is comprised of the exchange column and underground piping. The resin column is located inside a shielded structure that is open at the top. It was installed in 1967 and operated from 1973 to 1976 to remove cesium from the 702-A tank vapor condensate, collected in the 241-A-417 tank. Condensate was pumped from the 241-A-417 tank through the filter and into the top of the IX column. The condensate would gravity flow through the column and normally be discharged to the 218-A-8 crib. During the summer of 2003, field work was performed to isolate the 241-A-417 tank. The drain line from the 241-A-417 tank to the IX column was sealed. The floor drain was covered with foam.

2.1.3.3 Tank Farm Drainage Systems. The 216-A-16 French drain is composed of a bell-end concrete pipe, 1.8 meters (6 ft) long, placed vertically 3.4 meters (11 ft) below grade. The unit is rock-filled with a 1.9-cm (3/4-in.) carbon- steel cover. A 5-cm (2-in.) steel vent riser extends 0.9 meters (3 ft) from the top. There is a carbon steel inlet pipe, ~0.6 meters (2 ft) long coming from the 216-A-17 French Drain. The French drain is located in the southeast corner of A Farm, inside the tank farm fence.

The site received the floor drainage and the 296-A-11 Stack drainage from the 241-A-431 Building. The waste is low in salt, neutral to basic, and contains less than 10 Ci total beta activity. This unit receives the overflow from the 216-A-17 French Drain. The piping was water-sealed when the 296-A-11 Stack exhaust system was deactivated.

The 216-A-17 French drain is composed of a bell-end concrete pipe, 1.8 meters (6 ft) long, placed vertically 3.3 meters (11 ft) below grade. The unit is rock-filled with a carbon steel cover. The side slope of the excavation is assumed to have been 1:1. The French drain is in the southeast corner of A Farm, inside the tank farm fence.

The 216-A-17 French drain received 60,000 L of contaminated water from floor drainage and 296-A-11 Stack drainage from the 241-A-431 Building. The waste is low in salt, neutral to basic, and contains less than 1 Ci total beta activity. Overflow from the 216-A-17 French drain is routed to the 216-A-16 French drain.

The 241-A-702-WS-1 French drain received steam condensate from the 241-A-702 Ventilation Building. The unit is located inside the A Farm fence, west of the 241-A-702 Ventilation Building. The process steam was used in steam heaters during normal and reduced operating conditions to raise the temperature of vent gases from the AY and AZ Farm tanks to prevent wetting of filters. The drain was used in conjunction with a steam trap for the system. The drain was isolated October 26, 1995.

The 216-A-23A and 216-A-23B French drains are 1.07-meter (3.5-ft)-diameter, 1.8-meter (6-ft)-long bell-end concrete pipes, placed vertically 1.98 meters (6.5 ft) below grade. The concrete pipes are filled with 0.9 meters (3 ft) of rock and have a carbon steel cover. These French drains are located in the southeast corner of A Farm, just south of the 241-A-431 Fan House building.

The 216-A-23A and 216-A-23B drains received the de-entrainer tank condensate and the back flush waste from the 241-A-431 Building. The waste is low in salt, neutral to basic and contains less than 50 Ci total beta activity. The total amount discharged by this waste stream, 6,000 L

(1,580 gal), applies to both the 216-A-23A and 216-A-23B French drains. The 216-A-23A French drain is connected to the 216-A-23B French drain, located 3 meters (10 ft) to the west, by an underground overflow pipe. The sites were deactivated by water-sealing the piping leading to the drains.

Septic tank 2607-EC includes a tank and dry well and is located in the northeast corner of A Farm, near the fence. This septic tank is associated with 241-AR-271 and was abandoned in 1999 or 2000. During operation, the tanks received sanitary wastewater and sewage at a rate of ~0.45 m^3 per day. Due to the surface contamination zone surrounding the facility and various other obstructions, the exact location of the septic tank could not be determined.

The 2607-ED Septic Tank receives sanitary wastewater and sewage from the 2707-AX Building and drains to the drain field. The drain field has a capacity of 973 L (257 gal) per day. This tank lies south of tank AX-102, inside the tank farm fence.

The 2607-ED Septic Tank receives sanitary wastewater and sewage from the 2707-AX Building at an estimated rate of 0.28 m^3 (10 ft^3) per day. This site is in a radiation zone and was abandoned in 1998.

2.1.3.4 204-AR. The 204-AR Unloading Facility is northwest of the 241-AX-151 diversion box and south of the 244-AR Vault and is a reinforced concrete structure. The structure includes a shielded railcar unloading room, floor drains, a 1,500-gal capacity catch tank, transfer pumps and four chemical storage tanks. The chemical tanks contain caustic, nitrite and pH buffer solutions.

The 204-AR Facility received railroad tank cars of liquid radioactive waste to be remotely unloaded inside a fully enclosed, heated, and ventilated building. The rail cars were pumped, sampled, and sluiced as needed. When sample results showed the contents of the railroad car or the catch tank did not meet tank farm specifications, chemical adjustments were made inside the rail car or catch tank. Liquids in the catch tank were periodically sent to the tank farm on a batch basis. Liquid in excess of the catch tank capacity overflows into the sump pit, from which it can be pumped to the 241-A-A valve pit. The unit also received wastes generated from decontamination and regeneration operations in the 100 and 200 Areas; from recovery, fuels fabrication, and laboratory operations in the 200 and 300 Areas; and from decontamination operations in the 400 Area. The waste is chemically adjusted in-line during pump-out to double-shell underground storage tanks to meet corrosion specifications.

2.1.3.5 244-AR. The 244-AR Vault was built in 1966 and is located west of A Farm. Facilities include a canyon building, a service building, two concrete housings, and a change room. The canyon building is a reinforced concrete, two-level, multi-cell structure. The lower process cells contain four tanks and a failed equipment cell, while the upper cells contain the associated piping and equipment. The upper and lower cells are separated by cover blocks with recessed lifting bails.

The unit received waste sluiced from A and AX Farms. Processing took place, then the waste was shipped to B Plant. The facility was the focal point for reprocessing and routing of

PUREX-generated waste between the tank farms and B Plant facilities in the late 1960s and between the tank farms and the Waste Encapsulation Storage Facility in the late 1970s. In 1984, a decision was made to upgrade the 244-AR Vault for use as a waste transfer facility. The extensive upgrading effort provided improved features for the safe and efficient transferring of PUREX-generated waste between the tank farms and B Plant. The waste consisted of cladding removal waste en route to B Plant and transuranic waste from B Plant/Waste Encapsulation Storage Facility to the tank farms.

The vault was placed in a standby mode in 1978. The last documented waste transfer for this site was in 1978. The facility was isolated from steam and water in 1996. In June 2003, ~18,000 gal of liquid waste were pumped from the vault to the Double-Shell Tank (DST) System. In April and May of 2003, all the pumpable liquid in the facility was consolidated into tank 001 and sampled. In June 2003, ~66,880 L (17,600 gal) of waste and flush water were pumped out of tank 001 and transferred to tank 241-AY-102. Facility isolation and intrusion prevention was done in August 2003.

There are an estimated 660 gal of sludge and up to 194 gal of liquid in the tank in tank 001 cell 1 (RPP-12051, *244-AR Vault Interim Stabilization Completion Report*, pp. 3-2). In tank 002 cell 2, there are an estimated 2,080 gal of sludge and up to 194 gal of liquid (RPP-12051, pp. 3-3). The facility is posted with multiple radiological postings including Internally Contaminated Systems, Radiation Area, Underground Radioactive Material Area, Radiological Buffer Area, Radioactive Material Area, Contamination Area, High Contamination Area, and Fixed Contamination Area.

2.1.3.6 241-A-431. The 241-A-431 ventilation building, located southeast of tank A-103 inside the A Farm fence, is a concrete structure with the lower portion below grade. The unit is divided into two sections. One section houses the ventilation equipment. The other section houses the de-entrainment equipment. The building is 25 ft high, with the lower 16 ft below grade.

This structure is a tank farm ventilation building that provided off gas de-entrainment for A Farm and also received the 296-A-11 Stack drainage. The unit contains radioactively contaminated equipment and concrete.

2.1.3.7 242-A Evaporator. The 242-A Building is located adjacent to the south side of A Farm, outside the tank farm. It contains the evaporator vessel, supporting process equipment, and the principal process components of the evaporator-crystallizer system. The building comprises two adjoining, structurally independent structures, designated A and B. Structure A houses the processing and service areas while structure B houses operating and personnel support areas.

The 242-A Evaporator is used to treat mixed waste from the DST System by removing water and most volatile organics. Two waste streams leave the 242-A Evaporator following the treatment process. The first waste stream, the concentrated slurry, is pumped back into the DST System (Tank Farms 241-AN, 241-AW, and/or 241-AP). The second waste stream, process condensate, is routed through condensate filters for treatment before release to the Liquid Effluent Retention Facility and receives final treatment at the Effluent Treatment Facility. Waste types include:

dilute non-complexed radioactive waste, PUREX dilute miscellaneous waste, PUREX cladding removal waste, and complexed radioactive waste. Hazardous chemicals used include: sodium nitrate used to regenerate IX column, sodium hydroxide used for decontamination applications, and the antifoam agent used in the evaporator vessel.

2.2 HISTORY OF WASTE MANAGEMENT AREA A-AX

Waste Management Area A-AX tanks were constructed from 1953 to 1955 for A Farm and from 1963 to 1965 for AX Farm. The tanks are constructed of a reinforced concrete shell with a steel liner on the bottom and sides. Both tank farms consist of the ten 100-series million-gallon flat bottom tanks, four catch tanks, four diversion boxes, five valve pits, a vapor condensate IX system, and interconnecting pipelines. Waste Management Area A-AX was originally designated to hold boiling (i.e., self-concentrating) waste. The stored wastes were allowed to boil for one to five years at fluid temperature of 250 °F. The dome of each tank is penetrated by risers varying in diameter from 2.5 to 42 in. for A Farm and from 4 to 42 in. for AX Farm. All of the tanks have at least six feet of earth cover.

The A Farm tanks were constructed at different elevations with connecting overflow lines that allowed waste to cascade from tank to tank. There were two cascade sequences, both ending in tank A-106. One cascade is from tank A-101 through 241-A-102 and A-103 to A-106. The other is from tank A-104 through 241-A-105 (A-105) to A-106. The tanks in AX Farm do not have connecting overflow lines to cascade waste between tanks.

The tanks in A Farm entered service from 1956 to 1962. The tanks in AX Farm entered service from 1965 to 1966. The dates the tank entered service are based on when the tank first received waste or test water. Tanks A-104 and A-105 are categorized as “assumed leakers;” the rest of WMA A-AX 100-series tanks are categorized as “sound.”

Additional facilities were constructed in WMA A-AX in 1966 and are also discussed in Sections 2.2.1 and 2.2.2.

The WMA A-AX tanks were used to store a wide variety of waste types as indicated by Table 2-1.

Plutonium Uranium Extraction Plant waste was received by all of the WMA A-AX tanks starting in 1956 through the first campaign to 1972. All the tanks continued to receive cladding waste (CW) from the PUREX Plant and some received waste from the thorium recovery process conducted at the PUREX Plant in 1966. Waste from washing the solvent in the PUREX Plant (OWW) was generally received into tanks A-101 and A-105 and tanks 241-AX-101 and AX-102. The OWW contained normal paraffin hydrocarbon, tributyl phosphate, monobutyl phosphate, and dibutyl phosphate organic compounds. The supernate fraction of the CW and OWW wastes were transferred for evaporation in the In-Tank Solidification system. Settled solids from the CW and OWW wastes accumulated in the WMA A-AX- tanks.

Table 2-1. Waste Types Received into Waste Management Area A-AX 100-Series Tanks (1956 through 1981)

<table>
<tr><th>Year</th><th>241-A-101</th><th>241-A-102</th><th>241-A-103</th><th>241-A-104</th><th>241-A-105</th><th>241-A-106</th><th>241-AX-101</th><th>241-AX-102</th><th>241-AX-103</th><th>241-AX-104</th></tr>
<tr><td>1956</td><td rowspan="13">P
OWW</td><td rowspan="15">P</td><td rowspan="13">P</td><td rowspan="14">P</td><td rowspan="4">P
OWW</td><td rowspan="14">P</td><td colspan="4" rowspan="9"></td></tr>
<tr><td>1957</td></tr>
<tr><td>1958</td></tr>
<tr><td>1959</td></tr>
<tr><td>1960</td><td rowspan="3">P</td></tr>
<tr><td>1961</td></tr>
<tr><td>1962</td></tr>
<tr><td>1963</td><td>Sluiced</td></tr>
<tr><td>1964</td><td></td></tr>
<tr><td>1965</td><td>OWW</td><td>P - OWW</td><td rowspan="3">P - OWW</td><td rowspan="8">P</td><td rowspan="8">P</td></tr>
<tr><td>1966</td><td>Sluiced</td><td>FP</td></tr>
<tr><td>1967</td><td rowspan="3">OWW</td><td>P - OWW</td></tr>
<tr><td>1968</td><td rowspan="5">B</td><td rowspan="7">B</td></tr>
<tr><td>1969</td><td>Sluiced</td><td rowspan="5">P-IX</td></tr>
<tr><td>1970</td><td rowspan="2">P</td><td>Sluiced</td><td rowspan="4">P-IX</td><td>Sluiced</td></tr>
<tr><td>1971</td><td rowspan="2">PSS</td><td>Water</td><td rowspan="3">P</td></tr>
<tr><td>1972</td><td>Sluiced</td><td rowspan="3">AR
CSP</td></tr>
<tr><td>1973</td><td>B</td><td>Sluiced</td><td rowspan="3">PSS</td><td rowspan="3">PSS</td><td rowspan="3">PSS</td></tr>
<tr><td>1974</td><td>B</td><td>B</td><td>Sluiced</td><td>Sluiced</td><td rowspan="4">SltCk</td></tr>
<tr><td>1975</td><td>Sluiced</td><td>SltCk</td><td>SltCk</td><td>Sluiced</td><td>SltCk</td><td rowspan="3">SltCk</td></tr>
<tr><td>1976</td><td rowspan="2">SltCk</td><td>Sluiced</td><td>SltCk</td><td></td><td>Sluiced</td><td rowspan="6">CPLX DSSF
NCPLX</td><td rowspan="2">SltCk</td><td rowspan="2">SltCk</td></tr>
<tr><td>1977</td><td>SltCk</td><td>Sluiced</td><td></td><td></td></tr>
<tr><td>1978</td><td rowspan="4">CPLX
DSSF
NCPLX</td><td rowspan="4">CPLX
DSSF
NCPLX</td><td rowspan="4">CPLX
DSSF
NCPLX</td><td></td><td></td><td>Sluiced</td><td rowspan="4">CCPLX
CPLX</td><td rowspan="4">CCPLX
CPLX DSSF
NCPLX</td><td rowspan="4">NCPLX</td></tr>
<tr><td>1979</td><td></td><td></td><td rowspan="3">CPLX
NCPLX</td></tr>
<tr><td>1980</td><td></td><td></td></tr>
<tr><td>1981</td><td></td><td></td></tr>
</table>

Definitions:
Colors in table are used to highlight each waste type
AR = Water washed Plutonium Uranium Extraction (PUREX) sludge
B = 221-B Plant high-activity waste
CCPLX = Concentrated complexed waste
CPLX = complexed waste
CSP = Cesium Product (221-B Plant fission product recovery campaign) via the AR vault
DSSF = double-shell slurry feed
FP = fission product waste
NCPLX = non-complexed waste
OWW = Organic Wash Waste from PUREX Plant
P = PUREX high-level waste
P-IX = PUREX Plant Ion Exchange waste
PSS = PUREX Sludge Supernate
SltCk = Saltcake from the 242-A Evaporator

1

The PUREX HLW supernate (PSN) from A and AX Farm tanks and also PUREX sludge wash supernate (PSS) wastes were transferred to 241-C Tank Farm (C Farm) tanks in the late 1950s and 1960s up until 1970. The PSN and PSS wastes were transferred to B Plant for IX processing to separate cesium. Tanks 241-AX-101 and AX-102 received waste from the B Plant IX process in 1968 through 1974 and tanks A-101 and 241-A-102 received B Plant high-activity waste in 1973 and 1974.

Several other miscellaneous streams, such as salt-cake waste from the 242-A Evaporator, were routed to the WMA A-AX tanks starting in 1974 until all the WMA A-AX tanks were inactive and interim stabilized.

2.2.1 Process Operations

Several processes were conducted at the Hanford Site that generated wastes transferred to the A and AX Farms. These processes and the waste types generated are discussed in HNF-SD-WM-TI-740, *Standard Inventories of Chemicals and Radionuclides in Hanford Tank Wastes*. The initial process operations conducted in WMA A-AX mostly were to support the PUREX operations. Other process operations were also conducted, such as PUREX acidified sludge (PAS) processing and cesium recovery.

The sludges stored in A and AX Farms contained high concentrations of ^{90}Sr that required removal to reduce the heat load in these tanks. The sludges in these tanks were sluiced from 1968 through 1978 (SD-WM-TI-302, *Hanford Waste Tank Sluicing History*, section 3), with the sludge collected in the 244-AR Vault. The ^{90}Sr-bearing sludge was washed to remove soluble salts and ^{137}Cs, then dissolved in nitric acid in the 244-AR Vault. The dissolved sludge, designated as PAS solution, was transferred to the 244-CR Vault. From the 244-CR Vault, the PAS solution was transferred to B Plant for centrifugation and ^{90}Sr processing using solvent extraction (ARH-CD-691, *Strontium Recovery from PUREX Acidified Sludge*).

2.2.2 Interim Stabilization

Uncertainties associated with both the primary and secondary leak detection systems for all SSTs led to a number of decisions. By the early 1960s, decisions were made to move from an SST design to a DST design for construction of new tanks. The double-shell design provided both secondary containment and reliable leak detection systems between the two liners. A decision was also made to pump liquids stored in the SSTs into the DSTs. This process was referred to as interim stabilization of the SSTs.

A Consent Decree (*Washington v. DOE*, Case No. CT-99-5076-EFS [September 9, 2003]) was established that set a timetable and specified criteria to complete interim stabilization, and by 2003 all of the SSTs were interim stabilized except two that went directly to retrieval without undergoing interim stabilization (HNF-EP-0182). A tank was considered interim stabilized when it contained less than 50,000 gal of drainable interstitial liquid and less than 5,000 gal of supernate. If the tank was jet pumped to achieve interim stabilization, then the jet pump flow or saltwell screen inflow must have been at or below 0.05 gpm. Due to equipment failure in some jet pumps, tanks were administratively stabilized before reaching the 0.05 gpm criteria (see HNF-EP-0182).

Although some tanks met interim stabilization administrative procedure at the time they were stabilized, they no longer meet the updated administrative procedure. In 2005, it was determined that tank A-103 no longer met the Interim Stabilization Drainable Interstitial Liquid criterion. Also, in February 2001, tank A-104 was determined to be missing original interim stabilization data (see HNF-EP-0182).

2.2.3 Waste Retrieval

Waste Management Area A-AX will be the next series of tanks at Hanford to undergo waste retrieval operations, planned to start as early as March 2017.

2.2.4 Groundwater under Waste Management Area A-AX

Information for this section was summarized from RPP-ENV-37956. The primary contaminants observed in groundwater monitoring wells at WMA A-AX are nitrate and ^{99}Tc. In 2013, nitrate exceeded the drinking water standard (DWS) in 299-E24-20 and 299-E25-93. Since RCRA assessment monitoring began in 2006, these are the only two wells that have exhibited nitrate concentrations above the DWS. The nitrate concentrations in well 299-E25-93 have been detected above the DWS since 2006. Although nitrate is increasing regionally as displayed in wells 299-E24-22 (up-gradient well), 299-E25-2 (down-gradient well), and 299-E25-40 (down-gradient well), concentrations remain below the DWS. Thus, the elevated nitrate at well 299-E25-93, a down-gradient WMA A-AX well, indicates a local source of nitrate contributions to groundwater in the vicinity of WMA A-AX. Note that nitrate concentrations in well 299-E24-20 also exceeded the DWS once in 2008, and again throughout 2013. A relatively large regional nitrate plume above the DWS is located south of the WMA A-AX.

In 2013, ^{99}Tc was detected above the DWS in three WMA A-AX wells: 299-E24-22, 299-E25-236, and 299-E25-93. Technetium-99 in well 299-E24-22, an upgradient WMA A-AX well, has been detected above the DWS since June 2013. The ^{99}Tc at well 299-E24-22 appears to be associated with sources to the north because of the regional southeast groundwater flow direction and location of this well with respect to WMA A-AX. However, ^{99}Tc activity at well 299-E25-93, located downgradient of WMA A-AX, has historically greater activity as compared to the upgradient wells including well 299-E24-22, indicating a source in the vicinity of WMA A-AX.

It is worth noting that ^{99}Tc also exceeded the DWS in well 299-E25-236, starting in 2012. In November 2012, review of a television survey completed within well 299-E25-236 revealed accelerated corrosion. The corrosion was identified between 80.2 and 81.4 meters (263 and 267 ft) below ground surface. Black staining from the corroded casing extended downward ~8.5 to 9.8 meters (28 to 32 ft) to groundwater at 89.9 meters (295 ft) below ground surface. The surface of the groundwater was covered with various particles. The increase in ^{99}Tc activity at this well may be associated with liquid from the perched zone seeping through the corroded casing and migrating down the inside of the casing to the groundwater within the well because

^{99}Tc was found to be associated with two nearby wells with similar casing corrosion (i.e., 299-E24-19 and 299-E25-46; PNNL-15141, *Investigation of Accelerated Casing Corrosion in Two Wells at Waste Management Area A-AX*). Well 299-E25-236 was decommissioned in June 2013. From PNNL-15141:

> "[T]he sidewall core samples from well 299-E24-19 were elevated with respect to water extractable sodium, while the sidewall core samples from well 299-E25-46 contained significantly elevated concentrations of water extractable nitrate. Since both sodium and nitrate are common components in Hanford waste streams, the water extract samples were further analyzed for technetium-99. Surprisingly, the sidewall core samples from both failed wells contained measurable quantities of technetium-99 (ranging from 0.984 to 21.9 pCi/g). These findings, when coupled with groundwater monitoring data, clearly demonstrate that the vadose zone/groundwater chemistry in the vicinity of the two failed wells has been affected/compromised by a Hanford waste stream."

Because of the accelerated casing corrosion found at well 299-E25-236, the recent increase of elevated metals (e.g., chromium, iron, manganese, and nickel) appears to be associated with the 304 L stainless steel casing, which contains these same constituents. With respect to these metals associated with the stainless steel well casing, between May and June of 2011 the unfiltered chromium increased from non-detect to 23 μg/L. In December 2011, filtered chromium levels began to be continuously detected just above detection limits. Filtered manganese detections lagged temporally behind the chromium results, but increased substantially in September 2012. Filtered and unfiltered nickel were present since the well was installed, though the concentrations of nickel detected in groundwater samples increased substantially in September 2012.

2.3 LEAK DETECTION MONITORING OF TANKS

Historically, SSTs were monitored by two independent methods: in-tank and ex-tank monitoring. From the beginning of Hanford Site tank farm operations, the primary leak detection system was routine monitoring of static liquid-surface levels within each tank. Routine monitoring of gross gamma activity in drywells near the SSTs provided the second leak detection method. The majority of the drywells in A Farm were drilled in the early 1960s to depths of ~75 ft and many of the drywells were deepened in the late 1970s to depths of ~125 ft. The drywells in AX Farm were drilled in 1974 and 1975 and are mostly ~100 ft deep. After the SSTs were pumped and interim stabilized, gross gamma monitoring was no longer required except as specified in tank waste retrieval work plans (RPP-9937, *Single-Shell Tank System Leak Detection and Monitoring Functions and Requirements Document*).

In addition to drywells, beneath each of the tanks in A Farm, three horizontal lateral pipes were installed in 1962 and 1963. These laterals were installed after waste leakage from tank 241-SX-113 was suspected in 1958 and confirmed in 1962. Each lateral is ~10 ft beneath the tank concrete foundation. These laterals are 4-in. outer diameter, schedule 40 seamless steel pipe. The horizontal lateral pipes enter a caisson, transition to vertical orientation, and extend to an instrument enclosure at ground elevation. Probes can be inserted into each lateral to monitor for gamma radiation that could indicate waste leakage from a tank or pipeline.

Each AX Farm tank has its own internal leak detection pit consisting of a network of drain slots in the concrete base immediately below the carbon steel liner. A 12-in. carbon steel pipe connects the drain network with a leak detection well. The 60-ft deep well consists of a 24-in., schedule 20 carbon steel pipe, surmounted by a concrete pump pit. A waste transfer line connects the leak detection pit with a pump pit atop the AX Farm tank. The leak detection well is vented to the main vent header through a water-filled seal pot. The leak detection pump pits drain into their respective storage tanks through a 4-in. line that extends 5 ft from the tank bottom. Each leak detection pit has a separate 6-in. "radiation detection well" that intersects the soil adjacent to the bottom of the leak detection pit. The radiation well is used as a cost-effective and non-invasive method to monitor changes in gamma activity within the leak detection pit.

2.4 WASTE MANAGEMENT AREA A-AX VADOSE ZONE CHARACTERIZATION

Vadose zone characterization provided additional information about WMA A-AX used in this report. Vadose zone characterization activities and results for WMA A-AX are described in RPP-ENV-37956 and will be described in an assessment context report similar to RPP-RPT-41918, *Assessment Context for Performance Assessment for Waste in C Tank Farm Facilities after Closure*. Specific vadose zone characterization results and applications to soil release inventory estimates are described in Appendix A.

2.5 REASSESSMENT OF TANK FARM LEAKS

There have been numerous studies and investigations in an attempt to estimate the inventory of contaminants in the tank farms vadose zone. Most effort to date has focused on leak volume estimates. Vadose zone inventories are estimated based on process knowledge of the composition of waste in the tank at the time the release occurred. For some major tank leaks and UPRs, historical records confirm the waste loss event and provide a strong technical basis for leak volume and inventory estimates. However, for many tank leaks and UPRs little data is available. Not only is there little data on many releases, but existing data is often ambiguous and incomplete.

The *Waste Tank Summary Report* (HNF-EP-0182) provides the commonly accepted basis for tank leak volume estimates, but it does not provide associated inventory estimates or UPR volumes.

A process was developed between the U.S. Department of Energy (DOE) Office of River Protection and State of Washington Department of Ecology (Ecology) to reassess selected tank leak estimates (volumes and inventories), and to update tank leak and other UPR volumes and inventory estimates as emergent field data is obtained (RPP-32681, 2007, *Process to Assess Tank Farm Leaks in Support of Retrieval and Closure Planning*). As stated in RPP-32681, this process will be used to assess the source of tank farm leaks when necessary to help meet the need to justify tank waste retrieval technology selections (independent of tank integrity designation), reassess volume estimates and inventories for previously identified tank leaks, and update tank leak and UPR volume and inventory estimates as emergent field data is obtained.

The DOE will request Ecology review and concurrence on this process document. The DOE will also request Ecology input, review, and concurrence on tank leak assessments at various points when the process is invoked. Ecology concurrence on tank waste leak inventory estimates is necessary to support Ecology approval of tank waste retrieval actions, vadose zone corrective actions, and tank farm closure actions as described in the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) Appendix I.

RPP-ENV-37956 documents inventory assessments for all of the SSTs in WMA A-AX, as well as designated UPRs and other releases within the WMA. Inventory estimates in this report are based on these assessments.

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3.0 CONTAMINANTS OF POTENTIAL CONCERN

The COPCs listed in Table 3-1 are those contaminants identified as COPCs in RPP-23403, supplemented by those regulatory-required COPCs identified in RPP-RPT-38152. RPP-23403 identified 249 COPCs, of which 131 are primary COPCs and 118 are secondary. The RPP-23403 COPC list was expanded in RPP-RPT-38152 to 276 analytes. The primary constituents would be analyzed with a specified level of quality control, which means they would be included in the calibration of the gas chromatographs and method detection limits would be determined for each constituent. If a primary analyte is detected, a numerical value is reported; if not detected, the analyte is reported with a less than minimum detection limit. For secondary organic analytes, if detected, a numerical value is reported as an estimate; if not detected, the analyte is not reported. These COPCs consist of 30 primary radionuclides, 33 primary and 34 secondary inorganics, 29 primary and 32 secondary semi-volatile organic compounds, 32 primary and 52 secondary volatile organic compounds and 7 primary aroclors. Polychlorinated biphenyls (PCBs) are being managed by a DQO (RPP-7614, *Data Quality Objectives to Support PCB Management in the Double-Shell Tank System*).

Table 3-1. Contaminants of Potential Concern for Tank and Tank Farm Closure (9 sheets)

Constituent Name	Inventory Estimate in this report
1,1,1-Trichloroethane	No
1,1,2,2-Tetrachloroethene	No
1,1,2,2-Tetrachloroethane	No
1,1,2-Trichloro1,2,2-trifluoroethane	No
1,1,2-Trichoroethane	No
1,1,2-Trichloroethylene	No
1,1-Dichloroethene	No
1,2-Dichloroethane	No
Aroclor 1016	No
Aroclor 1221	No
Aroclor 1232	No
Aroclor 1242	No
Aroclor 1248	No
Aroclor 1254	No
Aroclor 1260	No
Polychlorinated biphenyl congeners	No
Chloroethene (vinyl chloride)	No
2-Butanone (MEK)	No
2-Nitropropane	No

Table 3-1. Contaminants of Potential Concern for Tank and Tank Farm Closure (9 sheets)

Constituent Name	Inventory Estimate in this report
2-Propanone (Acetone)	No
4-Methyl-2-pentanone (MIBK)	No
Benzene	No
Carbon disulfide	No
Carbon tetrachloride	Yes
Chlorobenzene	No
Chloroform	No
Dichloromethane (Methylene chloride)	No
Ethyl Acetate	No
Ethylbenzene	No
Diethyl ether	No
Isobutanol	No
Methanol	No
n-Butyl alcohol (1-butanol)	No
Trans-1,3-dichloropropene	No
Trichloroflouoromethane	No
Xylenes	No
o-Xylene	No
m-Xylene	No
p-Xylene	No
Cis-1,2-dichlorobenzene	No
Trans-1,2-dichlorobenzene	No
1,2,4-Trichlorobenzene	No
2,4-Dinitrotoluene	No
2,4,5-Trichlorophenol	No
2,4,6-Trichlorophenol	No
2,6-Bis (tert-butyl)-4-methylphenol	No
2-Chlorophenol	No
2-Ethoxyethanol	No
2-Methylphenol (o-cresol)	No
4-Methylphenol (p-cresol)	No
Acenaphthene	No
Butylbenzylphthalate	No

Table 3-1. Contaminants of Potential Concern for Tank and Tank Farm Closure (9 sheets)

Constituent Name	Inventory Estimate in this report
Cresylic acid (cresol, mixed isomers)	No
Cyclohexanone	No
Di-n-butylphthalate	No
Di-n-octylphthalate	No
N-nitroso-di-n-propylamine	No
Ethylene glycol	No
Fluoranthene	No
Hexachlorobutadiene	No
Hexachloroethane	No
m-Cresol (3-Methylphenol)	No
Naphthalene	No
Nitrobenzene	No
n-Nitrosomorpholine	No
o-Dichlorobenzene	No
o-Nitrophenol	No
p-Chloro-m-cresol (4-Chloro-3- methylphenol)	No
Pyrene	No
Pyridine	No
Tributyl phosphate	Yes
Benzo(a) anthracene	No
Benzo(b)fluoranthene	No
Benzo(k)fluoranthene	No
Benzo(a)pyrene	No
Chrysene	No
Indeno (1,2,3-cd) pyrene	No
Dibenz(a,h)anthracene	No
Dibutyl phosphate	No
Monobutyl phosphate	No
Bis(2-ethylhexyl)phthalate	No
cis-1,3-Dichloropropene	No
p-Nitrochlorobenzene	No
Ethylene dibromide (1,2, Dibromoethane)	No
1,4-Dinitrobenzene	No

Table 3-1. Contaminants of Potential Concern for Tank and Tank Farm Closure (9 sheets)

Constituent Name	Inventory Estimate in this report
1,4-Dichlorobenzene	No
Butane	No
1,3-Butadiene	No
Phenol	No
Acrolein (propenal)	No
Hexachlorobenzene	No
3-Chloropropene (Allyl chloride)	No
N,N-Diphenylamine	No
Propionitrile (Ethyl cyanide)	No
Pentachloronaphthalene	No
Acrylonitrile	No
Hexachloronaphtahlene	No
2-Pentanone	No
Tetrachloronaphthalene	No
Methylcyclohexane	No
Octachloronaphthalene	No
n-Pentane	No
Isodrin	No
5-Methyl-2-hexanone	No
Benzo[a]pyrene	No
2-Heptanone	No
Dibenz[a,h]anthracen	No
n-Hexane	No
1,3-Dichlorobenzene	No
Cyclohexane	No
3-Methyl-2-butanone	No
n-Octane	No
N-Nitroso-N,N-dimethylamine	No
4-Heptanone	No
Hexafluoroacetone	No
Acetic acid, n-butylester	No
Pentachloronitrobenzene (PCNB)	No
1,4-Dioxane	No

Table 3-1. Contaminants of Potential Concern for Tank and Tank Farm Closure (9 sheets)

Constituent Name	Inventory Estimate in this report
Pentachloropheno	No
n-Heptane	No
2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	No
Cyclopentane	No
1,1'-Bipheny	No
Ethyl alcohol	No
Acetophenon	No
2-Propyl alcohol	No
Toxaphene	No
n-propyl alcohol (1-propanol)	No
Nitric acid, propyl ester	No
Bromomethane	No
Aldrin	No
Chloroethane	No
alpha-BHC	No
Acetonitrile	No
1,1 Dichloroethane beta-BHC	No
gamma-BHC (Lindane)	No
Dichlorofluromethane	No
Dieldrin	No
Chlorodifluoromethane	No
Endrin	No
3-Methy-2-butanone	No
1,1-Dimethylhydrazine	No
Hexafluoroacetone	No
Methylhydrazine	No
2-Butenaldehyde (2-Butenal)	No
n-Nitrosomethylethylamine	No
Methyl isocyanate	No
n-Nitrosodi-n-butylamine	No
n-Propionaldehyde	No
3-Heptanone	No
Chloromethane	No

Table 3-1. Contaminants of Potential Concern for Tank and Tank Farm Closure (9 sheets)

Constituent Name	Inventory Estimate in this report
n-Nonane	No
Styrene	No
Tetrahydrofuran	No
Cyclohexene	No
2-Methyl-2-propenenitrile	No
2-Hexanone	No
Triethylamine	No
Oxirane	No
2-Methyl-2-propanol	No
Dichlorodifluoromethane	No
1,2-Dichloro-1,1,2,2-tetrafluoroethane	No
Heptachlor	No
1,2-Dichloropropane	No
1-Methylpropyl alcohol	No
3-Pentanone	No
Benzene hexachloride (including lindane)	No
Chlordane	No
DDT/DDD/DDE (total)	No
Dieldrin	No
Endrin	No
Hexachlorobenzene	No
Heptachlor/heptachlor epoxide (total)	No
Pentachlorophenol	No
PETROLEUM	No
Gasoline	No
Diesel	No
Acetate	No
Aluminum	Yes
Americium-241	Yes
Ammonium	Yes
Antimony	No
Antimony-125	Yes
Arsenic	No

Table 3-1. Contaminants of Potential Concern for Tank and Tank Farm Closure (9 sheets)

Constituent Name	Inventory Estimate in this report
Barium	No
Benzene	No
Beryllium	No
Bismuth	Yes
Boron	No
Bromide	No
Cadmium	No
Calcium	Yes
Carbon-14	Yes
Cerium	No
Cesium-137	Yes
Chromium	Yes
Chloride	Yes
Cobalt	No
Cobalt-60	Yes
Copper	No
Curium-242	Yes
Curium-243	Yes
Curium-244	Yes
Cyanide	Yes
Europium	No
Europium-152	Yes
Europium-154	Yes
Europium-155	Yes
Fluoride	Yes
Formate	No
Formaldehyde	No
Glycolate	No
Iodine-129	Yes
Iron	Yes
Lanthanum	Yes
Lead	Yes
Lithium	No

Table 3-1. Contaminants of Potential Concern for Tank and Tank Farm Closure (9 sheets)

Constituent Name	Inventory Estimate in this report
Magnesium	Yes
Manganese	Yes
Mercury	Yes
\Molybdenum	No
Neodymium	No
Neptunium-237	Yes
Nickel	Yes
Nickel-63	Yes
Niobium	No
Nitrate	Yes
Nitrite	Yes
Oxalate	No
Palladium	No
pH	No
Phosphorous	No
Phosphate	Yes
Plutonium-238	Yes
Plutonium-239	Yes
Plutonium-240	Yes
Plutonium-241	Yes
Plutonium-242	Yes
Potassium	Yes
Praseodymium	No
Protectinium-231	No
Rhodium	No
Rubidium	No
Ruthenium	No
Samarium	No
Selenium	No
Selenium-79	Yes
Silicon	Yes
Silver	No
Sodium	Yes

Table 3-1. Contaminants of Potential Concern for Tank and Tank Farm Closure (9 sheets)

Constituent Name	Inventory Estimate in this report
Strontium	Yes
Strontium-90	Yes
Sulfur	No
Sulfide	Yes
Sulfate	Yes
Tantalum	No
Technetium-99	Yes
Tellurium	No
Thallium	Yes
Thorium	No
Thorium-228	No
Thorium-230	No
Thorium-232	No
Thorium-234	No
Tin	No
Tin -126	Yes
Titanium	No
Tritium – H^3	Yes
Tungsten	No
Uranium	Yes
Uranium-233	Yes
Uranium-234	Yes
Uranium-235	Yes
Uranium-236	Yes
Uranium-238	Yes
Vanadium	No
Yttrium	No
Yttrium-90	No
Zinc	No
Zirconium	Yes
Zirconium-93	No

The expanded COPC list in RPP-RPT-38152 for the WMA A-AX characterization effort included additional analytes related to ecological risk, as well as analytes identified for the 200-IS-1 operable unit for pipelines and the BP-5 operable unit for groundwater.

As shown in Table 3-1, inventory estimates and supporting analytical information are not available for many of the soil COPCs. Current analytical data from direct push characterization helps confirm the general nature and extent of a waste release and provides actual data of the past release inventory for comparisons. It must be recognized that many of the analytical results were below detection limits. As a result, inventory estimates in this report for contaminated soils are based on HDW model waste type composition estimates and the waste type compositions adjusted appropriately based on tank waste sample data.

4.0 CONTAMINATED SOIL INVENTORY ASSUMPTIONS AND PROCESSES

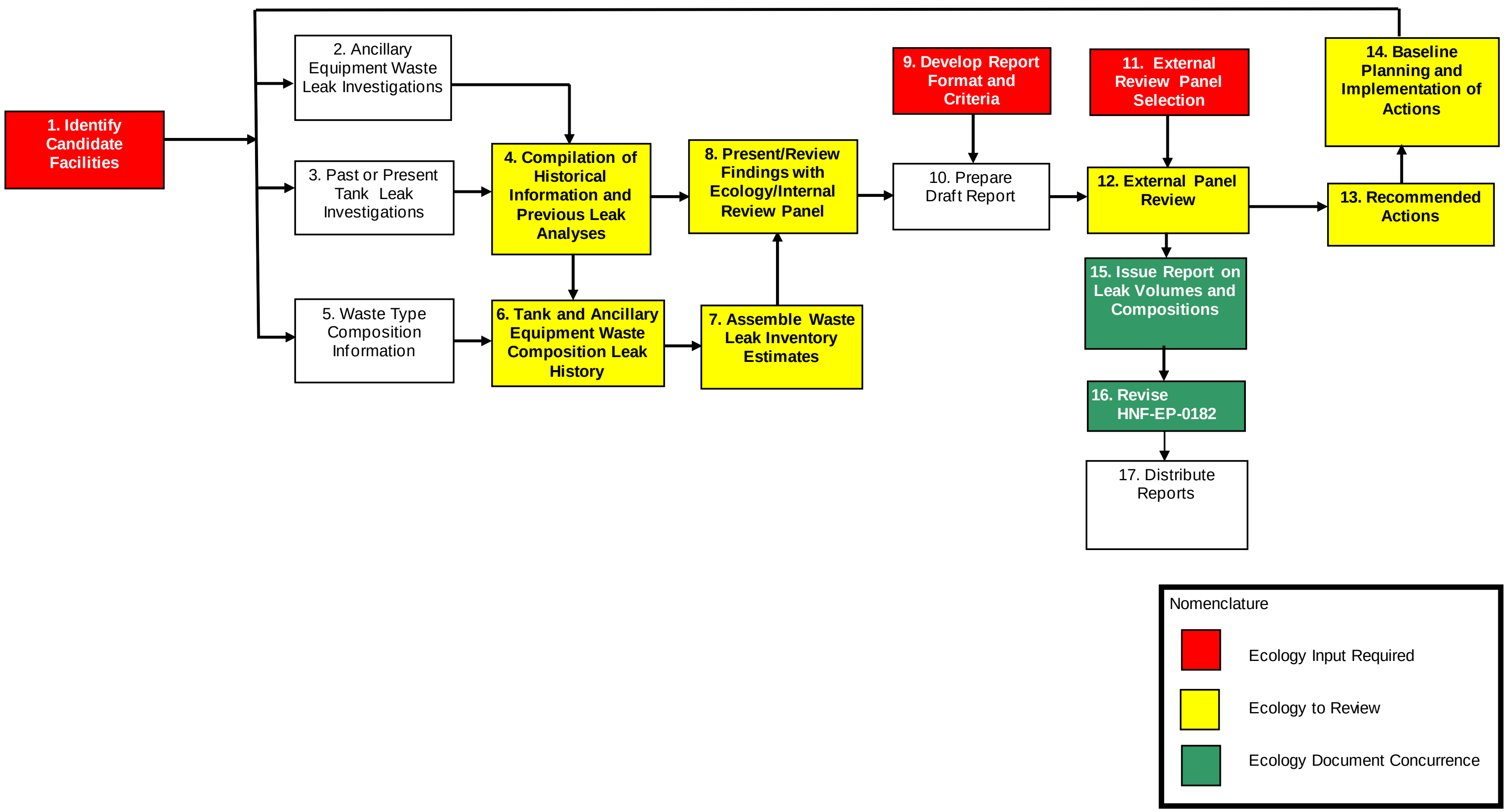
Inventory estimates for WMA A-AX were determined following the approach outlined in RPP-32681. This section describes the process used to provide inventory estimates for C Farm soils. The process is schematically shown in Figure 4-1. The following sections describe the steps in this process, information collected for assessments, key assessment parameters and guidelines, and inventory uncertainties.

4.1 ASSUMPTIONS AND BASIS FOR INVENTORY ESTIMATES

Key enabling assumptions for updated inventory estimates include the following.

- Inventories presented were based on information available as of September 1, 2014.
- Radionuclides were decayed to January 1, 2020.
- Tank farm boundaries are not a physical barrier to waste. Therefore, leaks, spills, UPRs and intentional discharges to the vadose zone to originating River Protection Project facilities are not distinguished from spills to non-River Protection Project facilities, and both are included.
- It is assumed, except where representative sample data is available, that the release estimates provided in Revision 2 of RPP-ENV-37956 adequately represent tank farm process knowledge and provide the best current information for WMA A-AX leak concentrations and inventories, supplemented with HDW information.
- It is assumed that the date of a specific leak or spill is near the time it was first observed based on liquid level decreases in the tanks, radioactivity measurements in soils or operations data confirming the date of a release.
- All releases are liquid waste with supernate compositions. Except for suspended solids in supernate, waste solids were not released.
- No inventory is assigned for airborne particulate releases or vapor releases.
- Future releases are not included. To date, no waste has been removed from the ten tanks that comprise the A and AX Farms. It is recognized that during future retrieval operations should there be any future releases of waste in the farms, such releases would likely originate from the tank ancillary equipment residuals and will be addressed in RPP-RPT-58293, *Hanford A/AX-Farms Tank and Ancillary Equipment Residual Waste Inventory Estimates*.

Figure 4-1. Schematic Diagram of Tank Farm Leak Assessment Process



4.2 SOIL INVENTORY ESTIMATION PROCESS

This section describes the process, shown in Figure 4-1, used to determine inventory estimates for WMA A-AX soils.

4.2.1 Identify Potential Releases

The first step in the assessment process was to determine which tank leaks, UPR events or contaminated areas need to be assessed. Initially, only known or suspected tank leaks and UPR events in A and AX Farms were assessed. Data was then reviewed to determine whether to assess other tank leaks, UPRs, or potential new leaks in A and AX Farms.

4.2.2 Ancillary Equipment Waste Leak Investigations

Data regarding any reported UPRs and waste leaks from ancillary equipment in the area of the facility being reassessed were collected with the information from Section 4.2.3.

4.2.3 Past or Present Tank Leak Investigations

Data regarding past or present waste leaks for tanks assessed were collected and collated with data for any reported ancillary equipment waste leaks from Section 4.2.2. Both of these inputs were fed into the activity of Section 4.2.4.

4.2.4 Collect Historical Information and Previous Leak Analyses

All of the information from previously-reported tank leaks and UPRs was compiled to identify probable leak sources and to estimate the volume of tank waste that leaked to the vadose zone and the time leaks occurred. These estimates were then fed into the next step of the process (Step 4.2.5), which is focused on determining the waste composition at the time of the leak.

4.2.5 Waste Type Composition

Information regarding the waste composition at the time of a leak from the waste tank, ancillary equipment, or UPR were compiled from the available sources, such as waste transfer records, waste stream sample data, the HDW model, and so on, and was applied to the facility being reassessed. See Sections 5.2 and 5.3 for discussion of what is meant by “date of leak” and “waste composition” and how they were determined.

4.2.6 Tank and Ancillary Equipment Waste Composition Leak History

A waste history was prepared to show the waste types in a facility at the estimated time(s) of the specific leak event to determine the composition of the radionuclides and chemicals leaked to the soil.

4.2.7 Assemble Waste Leak Inventory Estimates

After available data was compiled, estimates of the waste volume leaked and the waste composition at the time of the leak were combined to calculate a waste inventory. A leak information report and summary table were prepared, including observations and information collected in Steps 4.2.4, 4.2.6, and 4.2.7.

4.2.8 Present/Review Findings with Ecology and Internal Review Panel

The leak information report and summary table associated with another tank farm (C Farm) were presented and discussed by a panel appointed by the Environmental Programs Lead of the DOE contractor with concurrence from DOE and Ecology. Past waste releases in A/AX-Farms are very similar to those that occurred in C Farm, in that pipeline and tank waste releases have occurred in very similar fashions. The panel included an assessment lead and individuals with the following expertise.

- In-tank data: person or persons with knowledge and experience in reviewing, analyzing, and interpreting in-tank (i.e., surface liquid level and liquid observation well) data.

- Ex-situ tank data: person or persons with knowledge and experience in reviewing, analyzing, and interpreting drywell, lateral survey, and/or high resolution resistivity data.

- Tank operations and processes: person or persons with knowledge and experience with operations of the tank, tank history, tank waste characteristics, and in-tank processes.

- Other personnel as deemed necessary.

4.2.9 Develop Report Format and Criteria

The format and content for the A and AX Farms assessment report and the criteria included in it were developed by the DOE contractor with input from Ecology (RPP-ENV-37956). The leak assessment report included information presented to DOE and Ecology staff and the internal review panel, assessment findings and results, and panel conclusions as to the range of waste volume leaked, composition of the waste, and a basis to calculate inventory estimates.

4.2.10 Prepare Draft Report

A report documenting A and AX Farms assessments (RPP-ENV-37956) was prepared by assessment panel members and reviewed by DOE and Ecology.

4.2.11 External Review Panel Selection

If necessary, based on input received from DOE and Ecology after their review of the reassessment report, an external review panel would be selected with concurrence from DOE and Ecology.

4.2.12 External Panel Review

If necessary, the reassessment report developed in Step 4.2.10 "Prepare Draft Report" would be presented to an external review panel for review. As noted in Section 4.2.11, this was not done for the A and AX Farms assessment report. A decision was made by the DOE Office of River Protection and Ecology assessment panel that an external review panel was not required through the assessment process (RPP-32681).

4.2.13 Recommended Actions

Recommended actions identified in the C Farm assessment report were reviewed by DOE and Ecology.

4.2.14 Baseline Planning and Implementation of Actions

Recommendations from the internal review panel were incorporated into baseline planning for WMA A-AX corrective action sampling and analyses (RPP-PLAN-38777, *Sampling and Analysis Plan for Phase 2 Characterization of Vadose Zone Soil in Waste Management Area C*).

4.2.15 Issue Assessment Report

With review comments resolved, the DOE contractor issued the assessment report for WMA A-AX leaks. Ecology concurred with the A and AX Farms report and recommended reassessing current leak classifications for tanks A-103, AX-102 and AX-104 and updating HNF-EP-0182 consistent with report results.

4.2.16 Revise Tank Farm Vadose Zone Contamination Estimates

The DOE contractor revises waste leak volumes and compositions, as applicable, and updates HNF-EP-0182 on an annual basis or as necessary for consistency with leak assessment reports. Revisions to HNF-EP-0182 will then be concurred on by DOE and Ecology.

Updates of HNF-EP-0182 were completed for the following tank integrity assessments (RPP-ASMT-42278, RPP-ASMT-42628, and RPP-ASMT-57574).

4.2.17 Distribute Reports

When completed, the revised report (HNF-EP-0182) will be issued and distributed to DOE and Ecology. The report will be used to determine appropriate methods for retrieval to be defined in Tank Waste Retrieval Work Plans and to update tank farms performance and risk assessments and other documents, as applicable.

4.3 INFORMATION COLLECTED FOR ASSESSMENTS

The information shown in Table 4-1 and other applicable information was collected by the assessment lead and factored into information discussions by the assessment team.

Table 4-1. Types of Information and Sources Used in Tank Farm Leak Assessments (2 sheets)

Type of Information	Examples
In-tank liquid level measurements	Surveillance Analysis Computer System
	Hanford Works Process records
Waste transfer records	RPP-19822, *Hanford Defined Waste Model – Rev. 5.0*
	WHC-MR-0132, *A History of the 200 Area Tank Farms*
Tank process reports and assessments	HNF-EP-0182, Waste Tank Summary Reports and associated references
	RPP-RPT-29191, *Supplemental Information Hanford Tank Waste Leaks*
	Tank process records
	Occurrence reports
	Letter 8901832B R1, "Single-Shell Tank Leak Volumes"
	HNF-2603, *A Summary and Evaluation of Hanford Site Tank Farm Subsurface Contamination*
	HNF-4872, *Single-Shell Tank Leak History Compilation Volume I of II: Summary*
	SD-WM-TI-356, *Waste Storage Tank Status and Leak Detection Criteria*
	Tank leak assessment reports
	RPP-10435, *Single-Shell Tank Integrity Assessment Report*
	WHC-MR-0132, *A History of the 200 Area Tank Farms*
Vadose Zone Program field investigation results	Farm- and Tank-Specific Grand Junction Reports and Addendums: GJO-98-64-TARA/GJO-HAN-23, *Hanford Tank Farms Vadose Zone Addendum to the A Tank Farm Report* GJO-97-14-TARA/GJO-HAN-12, *Hanford Tank Farms Vadose Zone Addendum to the AX Tank Farm Report* 241-A and AX Farm tank-specific logging reports: GJ-HAN-106, *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank A-101* GJ-HAN-107, *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank A-102* GJ-HAN-108, *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank A-103* GJ-HAN-109, *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank A-104* GJ-HAN-110, *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank A-105* GJ-HAN-111, *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank A-106*

Table 4-1. Types of Information and Sources Used in Tank Farm Leak Assessments (2 sheets)

Type of Information	Examples
Vadose Zone Program field investigation results (continued)	GJ-HAN-49, *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank AX-101* GJ-HAN-50, *Hanford Tank Farms Vadose Zone Tank Summary Data Report for Tank AX-102* GJ-HAN-51, *Hanford Tank Farms Vadose Zone Tank Summary Data Report for Tank AX-103* GJ-HAN-52, *Hanford Tank Farms Vadose Zone Tank Summary Data Report for Tank AX-104*
	RPP-14430, *Subsurface Conditions Description of the C and A-AX Waste Management Areas*
	RPP-7494, *Historical Vadose Zone Contamination from A, AX, and C Tank Farm Operations*
	RPP-35484, *Field Investigation Report for Waste Management Areas C and A-AX*
	RPP-20820, *Waste Retrieval Leak Evaluation Report: Single-Shell Tanks*
	DOE/ORP-2005-01, *Initial Single-Shell Tank System Performance Assessment for the Hanford Site*
	RPP-26744, *Hanford Soil Inventory Model, Rev. 1*
	Tribe and Stakeholder correspondence and related reports
	Annual Monitoring Reports
Groundwater data	Annual and quarterly groundwater reports and Hanford Environmental Information System data
Surface Geophysical Exploration/direct push data	Surface Geophysical Exploration and direct push data for reports for Waste Management Area A-AX

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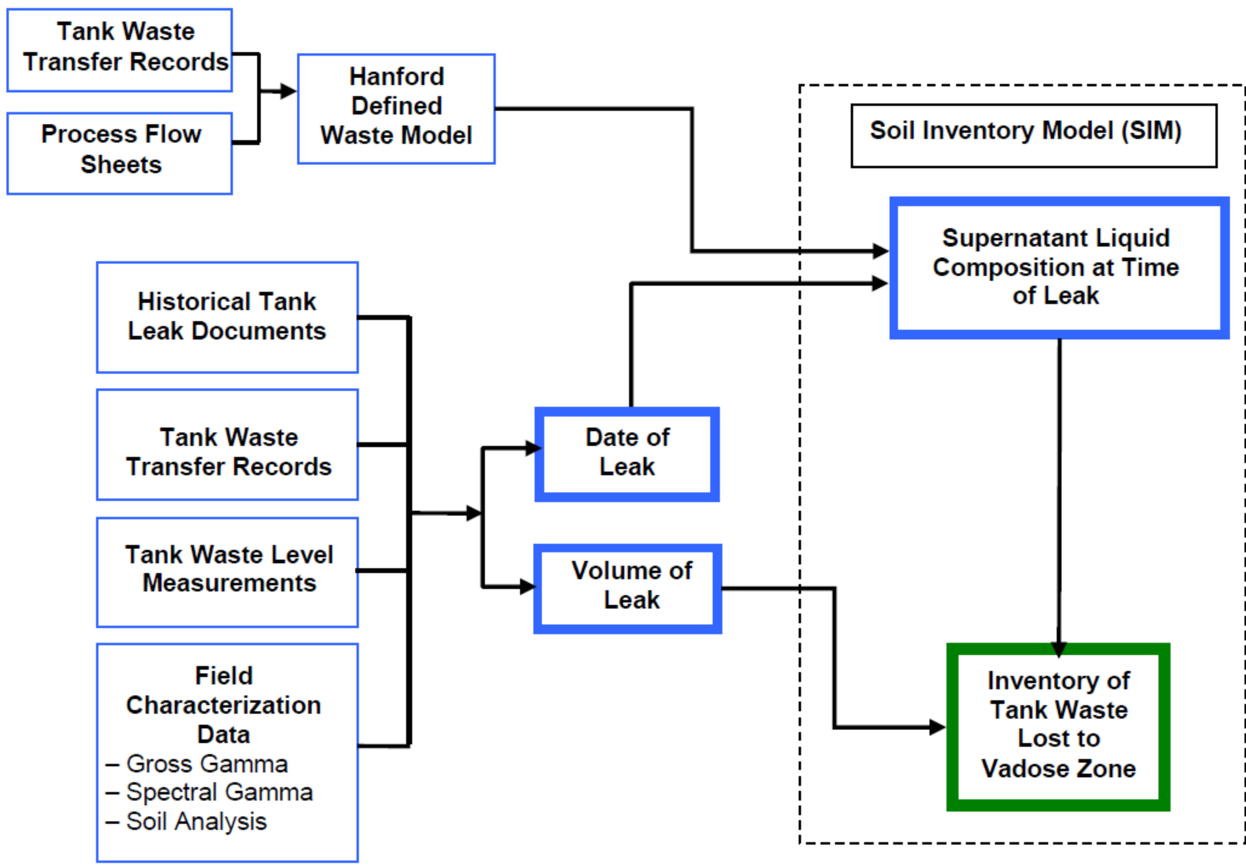
5.0 KEY ASSESSMENT PARAMETERS AND GUIDELINES

The following sections describe key assessment parameters used to determine vadose zone inventory values and guidelines to assess information. The process used to determine tank leak inventories is schematically shown in Figure 5-1.

Figure 5-1. Schematic of Process Used to Determine Vadose Zone Inventory



Note: Uncertainty exists in all these sources.

The key parameters including volume of release, date of release and supernatant liquid composition at the time of the leak are described below.

5.1 RELEASE VOLUME

Tank leak volume estimates for tanks classified as assumed leakers are summarized in HNF-EP-0182. The basis for these estimates and criteria for designating tanks as assumed leakers is documented in SD-WM-TI-356, *Waste Storage Tank Status and Leak Detection Criteria*. After reviewing leak volume estimates and the available documented basis for leaks and releases in WMA A-AX, it was determined that further evaluation was needed.

The process to evaluate leak volume estimates was as follows.

1. Determine the basis used for previous leak volume estimates.

    a. Identify specific information (data, analyses, and/or reports) used as a basis for these leak volume estimates.

    b. Identify how data were used to estimate volumes.

    c. Identify the date and the technology used in the original evaluation and whether that technology is acceptable today or has been either discredited and/or significantly improved.

2. Identify additional information (either generated before but not necessarily used for the tank leak or UPR volume estimates, or subsequently derived information about the leak event) that also relates to leak volume estimates.

3. Examine the collective set of information. Begin with a comparison of waste composition assumptions and volume estimates with spectral gamma data and earlier gross gamma data from nearby drywell/laterals. Table 4-1 identifies data sources and waste volume data types to be examined.

4. Determine the nature and validity of data and previous assessments (e.g., determine which information is unsubstantiated, ambiguous, or irrelevant to estimates of volume losses into the vadose zone).

5. Use the information judged to be valid to estimate leak volumes and uncertainty ranges.

Past releases or tank leak volumes were estimated by one or more combinations of the following three methods: 1) based on process records and mass balance, 2) determined from measured liquid level decreases or 3) calculated based on the estimated mass of ^{137}Cs and concentration of ^{137}Cs in the waste released. All three methods have multiple sources of uncertainty.

The best sources of information were historical process record evaluations that provided a volume and inventory and a technical basis for how the information was determined. A good mass balance for process operations or a combination of liquid level decrease and increased radioactivity in the soils provided the best leak volume estimates.

For liquid level measurements, a decrease or a portion of the decrease was attributed to a leak. Liquid level changes may be attributed to water intrusion, measurement errors, floating or shifting solids, gas releases, spare inlet overflows, and evaporation for static liquid levels in tanks. For tanks during waste transfers, liquid level changes cannot be accurately determined. The liquid level decrease was the primary basis for leak volume estimates in HNF-EP-0182 for tanks A-104 and A-105. Further evaluations summarized in Section 6.0 and described in Appendix A indicated that there were multiple reasons for the liquid level decreases in tanks.

In some cases, no liquid-level measurements were available or a liquid level decrease could not be observed that could be used to estimate release volumes. In these cases, release volumes were estimated from the estimated mass of ^{137}Cs in the soil based on field measurements and the concentration of ^{137}Cs in the waste released. These field measurements included both analysis of soil samples obtained in vicinity of the release and/or gamma radioactivity measurements (pCi/g soil) taken in drywells. The extent of a plume was approximated based on the interpolation of data between drywells with measured radioactivity and tanks or drywells where little or no radioactivity was measured. Given the uncertainties in this estimation, a simplified conservative approach was used. This approach was only applied for the plume near tank A-105 and is described in detail in Appendix A. The mass of ^{137}Cs was used for the plume estimates for several reasons including:

- past analytical data for tank waste is limited, but ^{137}Cs analyses are often available
- total gamma and spectral gamma drywell activity provide ^{137}Cs activity estimates
- because of the general low mobility of ^{137}Cs in Hanford soils, ratio of ^{137}Cs to other chemicals can be calculated knowing the waste types.

Estimated leak volumes using this approach may be misleading because a large leak of diluted waste may result in a very low mass. Therefore, an important factor in estimating the release using this approach is having knowledge of the composition of the waste that is purported to have leaked. RPP-ENV-37956 provides more detail on how the leak volume was estimated for tank A-105 leak loss.

5.2 DATE OF RELEASE

The "date of leak" is when the leak is estimated to have started. The "date of leak" is an important factor because tank waste compositions have changed during decades of tank farm operation, as have waste treatment campaigns as different waste types were routed through the tank farm system. The "date of leak" is less important if waste transfers to a tank were infrequent and the supernate composition was relatively constant. In most cases involving large confirmed leaks, an in-tank liquid-level decrease was typically observed. For small leaks or assumed leaks, based only on detected radioactivity increases in nearby drywells, establishing the "date of leak" is more difficult and associated estimates of the start time for the event may be highly uncertain depending on the frequency of drywell monitoring. It is difficult to detect directly and/or measure small liquid-level decreases associated with small leaks. Small leaks are more difficult to detect because they may not cause an observable liquid level decrease in the tank and the date of the first detection in a drywell may be quite different from the date of release; e.g., a small-volume release may take months to years to reach a drywell, and in the interval, the composition of the supernate in a tank may have changed. Also, the leak may have occurred well before a drywell measurement was obtained and does not provide a valid date of leak.

The "date of leak" is used to assign a waste composition at the time of a leak. In general, the "date of leak" used is just after the last waste transfer into a tank prior to an estimated leak date or when waste status transfer records in the HDW model indicate an unexplained liquid-level decrease. When in doubt, a year has been typically selected during which a tank or UPR had a conservatively high waste composition (i.e., a high radioactivity). Thus, the "date of leak" is not necessarily the year when a leak was declared (as shown in HNF-EP-0182) or when a leak was assumed to have occurred.

5.3 WASTE COMPOSITION

Concise definition of the "waste composition at the time of leak" is complicated by the fact that many different waste streams may have passed through a given tank, as well as by the lack of detailed information showing how different waste streams may have mixed within the tank system before the leak occurred. In addition, limited in-tank supernate data at the estimated time of a leak and limited vadose zone characterization data (gamma radiation and sediment sample results) are available to confirm the composition of past leaks.

In the 1980s, Francis Jungfleisch developed the Track Radioactive Components model (SD-WM-TI-058, *Supplementary Information for the Preliminary Estimation of the Waste Inventories in Hanford Tanks through 1980*). This approach modeled the creation of radionuclides in the production reactors starting with output from the Oak Ridge Isotope Generation and Depletion Code 2 (ORIGEN2) model (RPP-13489, *Activity of Fuel Batches Processed Through Hanford Separations Plants, 1944 Through 1989*) and then followed them as they went through various processing steps. In the 1990s, Steve Agnew of the Los Alamos National Laboratory built on Jungfleisch's efforts to produce the HDW model (WHC-SD-WM-TI-632, *Hanford Defined Wastes: Chemical and Radionuclide Compositions*). He had the advantage of better reactor physics codes, better nuclear data, and more Hanford historical documentation. In 2005, the ORIGEN2 and HDW models were updated and with new data and methods (RPP-19822). Uncertainty and limitations to these models are discussed in Chapter 7.0.

Output from the HDW model, with supporting information from the SIM (RPP-26744), was used to estimate the uncertainty in the composition and volume of leaks and releases to the soil at the Hanford Site. In this report, the HDW model values for waste streams were used for waste composition estimates.

When sample data was identified that was considered representative of a waste release, the HDW values were adjusted based on the ratio of the analytical concentration for a constituent to the HDW concentration for that constituent. Typically, analytical data was only provided for a few constituents and the values for all constituents were adjusted based on the ratio of ^{137}Cs concentrations or other selected analytes.

The predominant waste type released was evaluated based on sample results, waste transfer data and the estimated time of a leak or release. Table 5-1 shows the primary HDW waste streams identified for SSTs within WMA A-AX and Table 5-2 shows constituents which are evaluated in the HDW model. Appendix A identifies the waste types for each release and adjustments to the waste types, if any.

Table 5-1. Waste Streams Currently in Waste Management Area A-AX Single-Shell Tanks

Waste Type	Description	Tanks
A1-Saltcake	Saltcake from the first 242-A Evaporator campaign (1977-1980)	241-A-101, 241-A-102, 241-A-103, 241-A-106, 241-AX-101, 241-AX-102, 241-AX-103
P2	Plutonium Uranium Extraction (PUREX) high level waste generated between 1963 and 1967	241-A-101, 241-A-105, 241-AX-103, 241-AX-104
AR	Water washed PUREX sludge	241-A-104, 241-A-106
SRR	PUREX sludge strontium recovery waste from B Plant	241-A-106, 241-AX-101

Table 5-2. Constituents Evaluated in the Hanford Defined Waste Model

Chemicals		Radionuclides		
Na	NO_3	H-3	Sn-126	U-232
Al	NO_2	C-14	I-129	U-233
Fe	CO_3	Ni-59	Cs-134	U-234
Cr	PO_4	Ni-63	Cs-137	U-235
Bi	SO_4	Co-60	Ba-137m	U-236
La	Si	Se-79	Sm-151	U-238
Hg	F	Sr-90	Eu-152	Np-237
Zr	Cl	Y-90	Eu-154	Pu-238
Pb	CCl_4	Zr-93	Eu-155	Pu-239
Ni	Butanol	Nb-93m	Ra-226	Pu-240
Ag	TBP	Tc-99	Ra-228	Pu-241
Mn	NPH	Ru-106	Ac-227	Pu-242
Ca	NH_3	Cd-113m	Pa-231	Am-241
K	$Fe(CN)_6$	Sb-125	Th-229	Am-243
U-Total			Th-232	Cm-242
				Cm-243
				Cm-244

References: RPP-26744, *Hanford Soil Inventory Model, Rev. 1.*

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6.0 WASTE MANAGEMENT AREA A-AX LEAK INVENTORY ESTIMATES

Inventory estimates for contaminated WMA A-AX soils were developed following the guidelines in Sections 4.0 and 5.0 and were estimated as the product of composition and volume estimates.

Given the limited information available and the uncertainty in release volumes and compositions, a conservative approach was used. RPP-ENV-37956 describes the basis for soil inventory estimates for tank liner leaks and other releases summarized in Table 6-1. Appendix A shows calculated inventories for standard analytes included in the HDW model (Table 5-2).

Table 6-1. Estimated Waste Release Volumes, Inventories for Selected Constituents, and Basis for Estimation in 241-A and 241-AX Tank Farms[1] (2 sheets)

Leak/Release	Waste Volume, gal	^{60}Co, Ci	^{137}Cs, Ci	^{99}Tc, Ci	Basis for Estimation
241-A-103	0	NA	NA	NA	Liquid level decreases were likely due to retained gas release and not a loss of waste. No increase in radioactivity was detected in drywells or laterals.
241-A-104	~2,000	0.008	1,400	0.6	Inventory based on ^{137}Cs radioactivity in tank laterals. P1 supernate was released.
241-A-105	~2,000 to 40,000	0.10	~17,000	7.0	Inventory based on distribution of ^{137}Cs in tank laterals and ^{137}Cs saturation capacity. Volume depends on the relative amounts of P1 and BIX waste released. Range assumes all P1 (2,000 gal) or all BIX (40,000 gal) supernate was released. The measured 1965 ^{137}Cs concentration decayed to 2020 was 8.6 Ci/gal. Values of ^{60}Co and ^{99}Tc based on HDW composition for P1 supernate multiplied by ratio of measured ^{137}Cs concentration to P1 value for ^{137}Cs.
241-AX-102	0	NA	NA	NA	Based on drywell activity, releases were small and appear to be due to Dresser coupling leaks associated with the tank off-gas piping and releases from the ventilation system. 2014 assessment (RPP-ASMT-42628, *Tank 241-AX-102 Integrity Assessment Report*) concluded tank is sound.
241-AX-104	0	NA	NA	NA	Based on ^{106}Ru activity at drywell 11-04-08, releases were small and appear to be due to releases from ventilation lines near the drywell, flush pit leaks or surface runoff and migration. 2014 assessment (RPP-ASMT-57574, *Tank 241-AX-104 Integrity Assessment Report*) concluded tank is sound.

Table 6-1. Estimated Waste Release Volumes, Inventories for Selected Constituents, and Basis for Estimation in 241-A and 241-AX Tank Farms[1] (2 sheets)

Leak/Release	Waste Volume, gal	^{60}Co, Ci	^{137}Cs, Ci	^{99}Tc, Ci	Basis for Estimation
Other 241-A/ 241-AX Farm tanks	0	NA	NA	NA	No change recommended for tanks currently designated as "sound" and no evidence of subsurface releases associated with these tanks.
Near-Surface UPRs in 241-A and 241-AX Tank Farms					Note: Near-surface release estimates based on spectral gamma logging system ^{137}Cs measurements and assumed waste composition and waste type. Waste release volume would be proportionally higher for a more dilute waste stream. Values of ^{60}Co (9.1E-05 Ci/gal) and ^{99}Tc (9.4E-4 Ci/gal) based on predicted composition for A1 Saltcake.
241-A-01B Sluice Pit	~640	0.002	200	0.2	
241-A Tank Farm general	~400	6E-05	10	7E-03	
241-AX-101 surface	~110	1.3E-3	130	0.2	
241-AX Tank Farm general	~1,300	1.9E-04	20	0.02	
Intentional Releases to Cribs, Trenches and Retension Basins near 241-A and 241-AX Tank Farms	~780,000,000	9.9E-03	3,700	0.13	RPP-26744, *Hanford Soil Inventory Model, Rev. 1*, Appendix C. Volume estimates by facility are presented in Section 6.1. As shown, large volumes of waste were released to the cribs, trenches and retention basins near 241-A and 241-AX Tank Farms. Most of the waste was cooling waste water or decontamination water.

[1]Reference: RPP-ENV-37956, *Hanford 241-A and 241-AX Tank Farms Leak Inventory Assessment Report*. Other releases occurred, but inventory estimates for these releases could not be determined. Cesium-137, ^{60}Co, and ^{99}Tc values are approximations decayed to January 1, 2020.

A1 Saltcake = Saltcake from the first 242-A Evaporator campaign (1977-1980)
BIX = Bismuth ion exchange waste from 221-B Plant
HDW = Hanford Defined Waste
P1 = Plutonium Uranium Extraction Plant high-level waste (1956-1962)
UPR = unplanned release

7.0 INVENTORY UNCERTAINTY

This section summarizes the uncertainty of WMA A-AX contaminated soil inventory estimates. A wide range of data with various levels of pedigree are available for different leak/release estimates. Some of the data is inconsistent or ambiguous. Attempts were made to assess the quality of the available data and to achieve a consensus on the source, volume, and composition of the material that leaked to the ground, as well as a justifiable uncertainty range for the values determined. A statistical uncertainty or range for inventory values could not be determined for many releases. Consequently, for most releases only a technically justifiable maximum estimate was determined for contaminants released to the soil. Discussion of data limitations and uncertainties in the data and the technical basis for estimates for each release are provided in RPP-ENV-33418, *Hanford C-Farm Leak Inventory Assessments Report*.

Additional soil sampling is needed to better characterize the nature and extent of contamination in the vadose zone. The RCRA Field Investigation/Corrective Measures Study characterization will be designed to support this objective.

Uncertainties in volume and inventory estimates for past tank leaks and releases to the soil may include the following.

1. Limitations found in tank process reports and assessments that have:

   - incomplete records
   - partial description of the problem
   - incorrect interpretation of data
   - some historical analysis done with incomplete data sets.

2. Difficulties in interpreting in-tank liquid level measurements that:

   - have variations in precision, accuracy, and frequency with instrumentation (manual tape, Food Instrument Corporation gage, or Enraf®[1]) and waste surface (liquid or solid)

   - do not consider evaporation and barometric pressure effects, are sometimes incomplete and often were not available for early tank leaks

   - change in tanks with frequent transfers

   - are not usable for self-boiling tanks and waste operated for evaporation (e.g., in-tank solidification).

[1] Honeywell Enraf® is a registered trademark of Honeywell International Inc., Corporation Delaware, 101 Columbia Road Morristown, New Jersey.

3. Waste transfer records that have:
   - record gaps that are generally rolled up to month or quarterly summaries
   - transfer volumes whose uncertainties were not well defined.
4. Gross gamma logging data that:
   - are collected for a restricted time period (i.e., 1974 to 1994)
   - are partly based on uncalibrated data that does not provide radionuclide-specific identification
   - make use of multiple probe types that provide different results
   - are restricted to available boreholes (i.e., existing drywells)
   - are based on activities that are thought to be only representative of the first 12 to 18 in. from the logged well casing
   - were often collected well after leak events, sometimes by as much as several years.
5. Spectral gamma logging data that are:
   - available for a restricted time period (i.e., 1995 to 2001) with limited logging from 2002 to present
   - restricted to available boreholes (i.e., existing drywells)
   - generally representative of activity within the first 12 to 18 in. from the logged well casing
   - were often collected well after leak events, sometimes by as much as several years
   - only detecting gamma-emitting radionuclides; unable to detect beta emitters such as ^{90}Sr, ^{99}Tc or tritium (bremstrahlung associated with high levels of ^{90}Sr may be detectable)
   - detecting selected radionuclides that include ^{137}Cs, ^{60}Co, ^{154}Eu, ^{152}Eu, ^{126}Sn, ^{125}Sb, ^{238}U (^{234m} Pa), and ^{235}U; ^{106}Ru often decayed below detectable levels
   - capable of quantifying ^{137}Cs up to ~1×10^9 pCi/g when using the high-rate detector
   - likely masking other radionuclides when high levels of ^{137}Cs are detected.

6. Moisture monitoring data that are:

   – based on limited available data with no moisture baseline for tank farms.

7. Vadose zone program reports in which:

   – field investigation reports are limited
   – analysis is generally focused more on tank integrity
   – accuracy is limited by data available and/or reviewed
   – supporting data are unclear or not included.

8. Tank laterals data that:

   – represent limited data available only for 241-A and 241-AX Tank Farm SSTs
   – often post-date leak events, sometimes by as much as several years
   – provides data mostly limited to ^{137}Cs since ^{106}Ru is largely decayed and not detected
   – provide total gamma only.

9. Vadose zone samples and analyses that are based on:

   – limited available data
   – limited sampling and analytical precision and accuracy
   – depth and spatial variability of contaminants in vadose zone.

10. High Resolution Resistivity measurements that:

    – identify resistivity anomalies in the soil, which may likely correlate to areas of high salt content or total dissolved solids in soil moisture that can infer potential areas of vadose contamination

    – generally do not provide depth information (limited to two dimensions)

    – are impacted at some level by the presence of tank farm infrastructure

    – represent indirect measurement that cannot be always correlated to in-situ chemistry or radioactivity.

Given the many potential sources of uncertainty, an objective of this inventory estimate was to determine a reasonable bounding volume for leaks and releases. RPP-ENV-37956 further describes volume uncertainties for individual release estimates.

For composition estimates, waste stream supernatant values estimated in the HDW model provided the most complete set of information from which to estimate inventories. As noted previously, when analytical data representative of a leak or release were available, HDW values were adjusted based on a ratio of the sample concentration to the HDW concentration for ^{137}Cs (or another constituent if ^{137}Cs analyses were not completed). The SIM calculates uncertainty distributions for HDW waste compositions based on uncertainties in the data estimated with ORIGEN2. Appendix A shows standard deviations from SIM for waste type concentrations for individual constituents.

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APPENDIX A

HANFORD WASTE MANAGEMENT AREA A-AX SOIL CONTAMINATION INVENTORY ESTIMATES

From EXCEL Sheet

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RPP-RPT-58291 Rev. 0, Appendix A

HANFORD WASTE MANAGEMENT AREA A/AX SOIL CONTAMINATION INVENTORY ESTIMATES

Spreadsheet Documentation	
Spreadsheet Name	Hanford Waste Management Area C Soil Contamination Inventory Estimates
Spreadsheet Location	\\hanford\data\sitedata\projenveng\
Spreadsheet Owner	J. G. Field, 376-3753
Related Documents	RPP-ENV-37956, *Hanford A/AX-Farm Leak Inventory Assessments Report*
	RPP-RPT-58291, *Hanford Waste Management Area A/AX Soil Contamination Inventory estimates*
Purpose	This spreadsheet was developed to estimate A/AX-Farms contaminated soil inventories for WMA-A/AX Performance Assessments.
Overview	The spreadsheet includes waste type compositions from HDW Rev. 5 (RPP-19822) and calculated inventory estimates based on information presented in RPP-ENV-37956. Radionuclides are decayed to 1/1/2020 for performance assessments.
Worksheet Descriptions	Waste Types worksheet: This worksheet presents waste type compositions for waste types assumed to have been released in the A/AX farms. Chemical values from RPP-19822 in Mole/L are multiplied by molecular weights to calculate concentrations in g/L. Radionuclide values are decayed from 1/1/2001 (the decay date for HDW Rev. 5 values) to 1/1/2020. The worksheet also shows standard deviations for the waste type concentrations presented. Standard deviations are calculated by multiplying mean waste type concentration estimates by SIM ratios for standard deviation over mean concentration.
	Inventory worksheet: This worksheet calculates soil inventory estimates for tank leaks and releases in A and AX-Farms, Surface Releases. The worksheet shows leak/release waste types, volume estimates and sample data from RPP-ENV-37956. Volume estimates are multiplied by waste type composition from the "Waste Type" worksheet and a composition ratio to calculate inventories for each of the leaks/releases. The composition ratio is the Cs-137 composition corresponding to release volume estimates in RPP-ENV-37956, divided by the Cs-137 estimates for the assumed waste type. This ratio is a measure of dilution of the waste compared to waste type composition estimates.

	Decay Factors worksheet: This worksheet calculates decay factors based on the 1/2 life of radionuclides and formulas in SVF-2545, Spreadsheet for Data Entry and Decay Calculation. Start and end decay dates are inputs. SVF-2545 is based on 1/2 life values taken from the 16th edition of chart of the nuclides. Cs-137 decay factors are calculated for sample concentrations and sample dates in the inventory worksheet.
	SIM ratios worksheet: This worksheet shows mean concentration estimates and standard deviations from SIM (RPP-26744) for waste types in C Farm. Radionuclide values are decayed to 1/1/2001. The standard deviations are based on uncertainties provided in the ORIGEN2 model. A ratio of standard deviations over mean concentrations is calculated.
	Cribs worksheet: This worksheet contains inventory estimates for intentional discharges near A and AX-Farms including discharges to cribs, trenches, french drains and a retension basin. Inventory estimates are from RPP-26744. This workshheet also shows bar charts of total volumes, total chemicals, total radionuclides and selected individual chemicals and radionuclides intentionally discharged to waste sites and volumes/inventories released or leaked (unplanned releases) in the A and AX-Farms.
	RPP-RPT-58291 Worksheet: This is a title page for this spreadsheet.
Macros and Add-in software	None
Key Assumptions	None
Units	Inventory units are kg or Ci. Concentration units are Mole/L, g/L and Ci/L. Waste volumes are shown as L and gal. Conversions: 1 gal = 3.785 L
Input Data	HDW Rev 5 (RPP-19822) waste type composition values, SVF-2545 spreadsheet, and Start and end dates for decay values.
Verification	By: L. A. Fort
	Date: May 21, 2015
	Summary: Checked and verified worksheet inputs and formulas

HDW Rev. 5 Waste Type Compositions for Supernate.

		Mean		
pred. su	**Units**	**P1**	**A1Sltck**	**m.w./decay**
Al(OH)4 -	**Mole/L**	0.00E+00	1.75E+00	5.90E+01
Bi	**Mole/L**	0.00E+00	1.93E-04	2.09E+02
butanol	**Mole/L**	0.00E+00	2.75E-02	7.41E+01
Ca	**Mole/L**	3.75E-03	3.75E-03	4.01E+01
Cl-	**Mole/L**	1.45E-02	2.91E-01	3.55E+01
CO3--	**Mole/L**	3.75E-03	5.82E-01	6.00E+01
Cr	**Mole/L**	8.04E-03	5.54E-02	5.20E+01
DBP	**Mole/L**	0.00E+00	2.75E-02	2.10E+02
F-	**Mole/L**	0.00E+00	9.45E-02	1.90E+01
Fe	**Mole/L**	1.88E-03	1.87E-03	5.58E+01
Hg	**Mole/L**	1.62E-06	1.62E-06	2.01E+02
K	**Mole/L**	3.16E-03	8.37E-02	3.91E+01
La	**Mole/L**	0.00E+00	6.78E-09	1.39E+02
Mn	**Mole/L**	0.00E+00	5.55E-04	5.49E+01
Na	**Mole/L**	7.21E-01	1.35E+01	2.30E+01
NH3	**Mole/L**	8.43E-03	9.21E-02	1.70E+01
Ni	**Mole/L**	1.82E-03	1.82E-03	5.87E+01
NO2-	**Mole/L**	2.77E-01	2.72E+00	4.60E+01
NO3-	**Mole/L**	1.75E-01	3.50E+00	6.20E+01
OH-	**Mole/L**	1.84E-01	2.97E+00	8.00E+00
Pb	**Mole/L**	1.12E-04	7.20E-04	2.07E+02
PO4---	**Mole/L**	0.00E+00	6.31E-02	9.50E+01
SiO3--	**Mole/L**	1.05E-02	1.05E-02	7.61E+01
SO4--	**Mole/L**	4.40E-02	1.24E-01	9.61E+01
Sr	**Mole/L**	5.19E-07	5.99E-07	8.76E+01
TOC wt.%C	**wt%C**	0.00E+00	1.99E+00	
U-Total (M)	**Mole/L**	1.30E-04	1.30E-04	2.38E+02
Zr	**Mole/L**	0.00E+00	9.43E-05	9.12E+01
density	**g/cc**	1.032	1.59E+00	
		decayed to 2001		**Decay Factor 2001 to 2020**
H-3 (Ci/L)		3.89E-06	3.04E-05	3.43E-01
C-14 (Ci/L)		2.44E-06	8.58E-06	9.98E-01
Ni-59 (Ci/L)		6.12E-07	1.57E-06	1.00E+00

HDW Rev. 5 Waste Type Compositions for Supernate.

		Mean		
pred. su	**Units**	**P1**	**A1Sltck**	**m.w./decay**
Co-60 (Ci/L)		1.23E-05	2.40E-05	8.22E-02
Ni-63 (Ci/L)		5.70E-05	1.50E-04	8.78E-01
Se-79 (Ci/L)		2.39E-07	7.67E-07	1.00E+00
Sr-90 (Ci/L)		2.48E-03	2.48E-03	6.33E-01
Y-90 (Ci/L)		2.48E-03	2.48E-03	6.33E-01
Zr-93 (Ci/L)		1.43E-05	4.57E-05	1.00E+00
Nb-93m (Ci/L)		1.18E-05	3.69E-05	4.41E-01
Tc-99 (Ci/L)		7.50E-05	2.48E-04	1.00E+00
Ru-106 (Ci/L)		3.76E-12	5.11E-11	2.47E-06
Cd-113m (Ci/L)		1.26E-05	4.30E-05	3.93E-01
Sb-125 (Ci/L)		1.86E-06	7.06E-06	8.44E-03
Sn-126 (Ci/L)		9.89E-07	3.18E-06	1.00E+00
I-129 (Ci/L)		4.47E-09	2.56E-07	1.00E+00
Cs-134 (Ci/L)		7.06E-08	5.04E-07	1.70E-03
Cs-137 (Ci/L)		2.84E-01	3.16E-01	6.45E-01
Ba-137m (Ci/L)		2.68E-01	2.99E-01	6.09E-01
Sm-151 (Ci/L)		7.35E-03	5.32E-03	8.64E-01
Eu-152 (Ci/L)		1.10E-06	1.09E-06	3.78E-01
Eu-154 (Ci/L)		8.16E-05	8.16E-05	2.16E-01
Eu-155 (Ci/L)		3.73E-05	3.80E-05	6.25E-02
Ra-226 (Ci/L)		9.43E-12	6.20E-11	9.92E-01
Ac-227 (Ci/L)		4.20E-11	3.60E-10	5.46E-01
Ra-228 (Ci/L)		5.80E-17	2.93E-08	1.02E-01
Th-229 (Ci/L)		1.57E-13	3.44E-11	9.98E-01
Pa-231 (Ci/L)		5.98E-11	9.41E-08	1.00E+00
Th-232 (Ci/L)		5.98E-17	1.25E-10	1.00E+00
U-232 (Ci/L)		6.91E-13	1.10E-09	8.28E-01
U-233 (Ci/L)		4.86E-12	6.59E-08	1.00E+00
U-234 (Ci/L)		1.01E-08	1.15E-08	1.00E+00
U-235 (Ci/L)		4.32E-10	4.65E-10	1.00E+00
U-236 (Ci/L)		2.23E-10	3.02E-10	1.00E+00
Np-237 (Ci/L)		4.10E-07	4.69E-07	1.00E+00
Pu-238 (Ci/L)		1.26E-07	2.12E-07	8.61E-01

HDW Rev. 5 Waste Type Compositions for Supernate.

pred. su	Units	Mean P1	A1Sltck	m.w./decay
U-238 (Ci/L)		1.03E-08	1.03E-08	1.00E+00
Pu-239 (Ci/L)		5.10E-06	5.05E-06	9.99E-01
Pu-240 (Ci/L)		1.02E-06	1.17E-06	9.98E-01
Am-241 (Ci/L)		6.73E-06	6.73E-06	9.70E-01
Pu-241 (Ci/L)		4.49E-06	1.05E-05	4.01E-01
Cm-242 (Ci/L)		3.70E-08	1.96E-08	9.11E-01
Pu-242 (Ci/L)		3.20E-11	8.72E-11	1.00E+00
Am-243 (Ci/L)		3.09E-09	4.16E-09	9.98E-01
Cm-243 (Ci/L)		7.25E-10	7.83E-10	6.36E-01
Cm-244 (Ci/L)		1.92E-08	1.92E-08	4.83E-01

HDW Rev. 5 Waste Type Compositions for Supernatant. **Standard Deviations**

pred. su	Units	Mean P1	Mean A1Sltck	Standard Deviations (Mean times SIM ratio STD:MEAN) P1	Standard Deviations (Mean times SIM ratio STD:MEAN) A1Sltck
Al(OH)4 -	g/L	0.00E+00	1.03E+02	0.00E+00	2.19E+01
Bi	g/L	0.00E+00	4.03E-02	0.00E+00	8.55E-03
butanol	g/L	0.00E+00	2.04E+00	0.00E+00	4.33E-01
Ca	g/L	1.50E-01	1.50E-01	4.03E-02	3.19E-02
Cl-	g/L	5.15E-01	1.03E+01	1.38E-01	2.19E+00
CO3--	g/L	2.25E-01	3.49E+01	6.03E-02	7.41E+00
Cr	g/L	4.18E-01	2.88E+00	1.12E-01	6.10E-01
DBP	g/L	0.00E+00	5.79E+00	na	na
F-	g/L	0.00E+00	1.80E+00	0.00E+00	3.81E-01
Fe	g/L	1.05E-01	1.05E-01	2.81E-02	2.22E-02
Hg	g/L	3.24E-04	3.24E-04	8.69E-05	6.87E-05
K	g/L	1.23E-01	3.27E+00	3.31E-02	6.94E-01
La	g/L	0.00E+00	9.42E-07	0.00E+00	2.00E-07
Mn	g/L	0.00E+00	3.05E-02	0.00E+00	6.47E-03
Na	g/L	1.66E+01	3.11E+02	4.44E+00	6.60E+01
NH3	g/L	1.43E-01	1.56E+00	3.84E-02	3.32E-01
Ni	g/L	1.07E-01	1.07E-01	2.87E-02	2.27E-02
NO2-	g/L	1.27E+01	1.25E+02	3.41E+00	2.65E+01

HDW Rev. 5 Waste Type Compositions for Supernatant. **Standard Deviations**

		Mean		(Mean times SIM ratio STD:MEAN)	
pred. su	**Units**	**P1**	**A1Sltck**	**P1**	**A1Sltck**
NO3-	**g/L**	1.09E+01	2.17E+02	2.91E+00	4.60E+01
OH-	**g/L**	1.47E+00	2.38E+01	na	na
Pb	**g/L**	2.32E-02	1.49E-01	6.22E-03	3.16E-02
PO4---	**g/L**	0.00E+00	5.99E+00	0.00E+00	1.27E+00
SiO3--	**g/L**	8.02E-01	8.02E-01	2.15E-01	1.70E-01
SO4--	**g/L**	4.22E+00	1.19E+01	1.13E+00	2.52E+00
Sr	**g/L**	4.55E-05	5.25E-05	na	na
TOC	**wt%C**	0.00E+00	0.00E+00	na	na
U total	**g/L**	3.10E-02	3.10E-02	2.21E-01	2.23E+00
Zr	**g/L**	0.00E+00	8.60E-03	0.00E+00	1.82E-03
density					
		decayed to 2020		**decayed to 2020**	
H-3 (Ci/L)	Ci/L	1.33E-06	1.05E-05	1.70E-06	1.52E-04
C-14 (Ci/L)	Ci/L	2.44E-06	8.56E-06	1.00E-05	1.59E-04
Ni-59 (Ci/L)	Ci/L	6.12E-07	1.57E-06	6.67E-07	2.76E-05
Co-60 (Ci/L)	Ci/L	1.01E-06	1.97E-06	1.77E-06	2.83E-05
Ni-63 (Ci/L)	Ci/L	5.00E-05	1.32E-04	5.54E-05	2.31E-03
Se-79 (Ci/L)	Ci/L	2.39E-07	7.67E-07	2.63E-07	1.24E-05
Sr-90 (Ci/L)	Ci/L	1.57E-03	1.57E-03	1.80E-03	2.38E-02
Y-90 (Ci/L)	Ci/L	1.57E-03	1.57E-03	1.80E-03	2.38E-02
Zr-93 (Ci/L)	Ci/L	1.43E-05	4.57E-05	1.56E-05	7.31E-04
Nb-93m (Ci/L)	Ci/L	5.23E-06	1.63E-05	5.59E-06	2.67E-04
Tc-99 (Ci/L)	Ci/L	7.50E-05	2.48E-04	8.21E-05	4.02E-03
Ru-106 (Ci/L)	Ci/L	9.29E-18	1.26E-16	1.04E-16	6.46E-15
Cd-113m (Ci/L)	Ci/L	4.95E-06	1.69E-05	6.59E-06	2.60E-04
Sb-125 (Ci/L)	Ci/L	1.57E-08	5.96E-08	6.15E-08	1.03E-06
Sn-126 (Ci/L)	Ci/L	9.89E-07	3.18E-06	1.15E-06	5.36E-05
I-129 (Ci/L)	Ci/L	4.47E-09	2.56E-07	5.10E-09	4.27E-06
Cs-134 (Ci/L)	Ci/L	1.20E-10	8.57E-10	4.04E-10	2.47E-08
Cs-137 (Ci/L)	Ci/L	1.83E-01	2.04E-01	2.13E-01	3.17E+00
Ba-137m (Ci/L)	Ci/L	1.63E-01	1.82E-01	1.90E-01	2.83E+00
Sm-151 (Ci/L)	Ci/L	6.35E-03	4.60E-03	6.77E-03	7.61E-02
Eu-152 (Ci/L)	Ci/L	4.15E-07	4.13E-07	7.78E-07	6.82E-06

HDW Rev. 5 Waste Type Compositions for Supernatant. **Standard Deviations**

		Mean		(Mean times SIM ratio STD:MEAN)	
pred. su	**Units**	**P1**	**A1Sltck**	**P1**	**A1Sltck**
Eu-154 (Ci/L)	Ci/L	1.76E-05	1.76E-05	3.13E-05	2.67E-04
Eu-155 (Ci/L)	Ci/L	2.33E-06	2.37E-06	4.93E-06	3.66E-05
Ra-226 (Ci/L)	Ci/L	9.35E-12	6.15E-11	2.47E-11	8.38E-10
Ac-227 (Ci/L)	Ci/L	2.29E-11	1.97E-10	6.81E-11	2.71E-09
Ra-228 (Ci/L)	Ci/L	5.90E-18	2.97E-09	1.52E-17	3.90E-08
Th-229 (Ci/L)	Ci/L	1.57E-13	3.44E-11	4.71E-13	5.53E-10
Pa-231 (Ci/L)	Ci/L	5.98E-11	9.40E-08	1.87E-10	1.26E-06
Th-232 (Ci/L)	Ci/L	5.98E-17	1.25E-10	1.63E-16	1.63E-09
U-232 (Ci/L)	Ci/L	5.72E-13	9.07E-10	3.04E-12	3.40E-08
U-233 (Ci/L)	Ci/L	4.86E-12	6.59E-08	1.72E-11	1.10E-06
U-234 (Ci/L)	Ci/L	1.01E-08	1.15E-08	7.26E-08	6.81E-07
U-235 (Ci/L)	Ci/L	4.32E-10	4.65E-10	3.29E-09	2.84E-08
U-236 (Ci/L)	Ci/L	2.23E-10	3.02E-10	1.65E-09	1.06E-08
Np-237 (Ci/L)	Ci/L	4.10E-07	4.69E-07	1.57E-06	7.39E-06
Pu-238 (Ci/L)	Ci/L	1.08E-07	1.83E-07	2.59E-07	6.58E-06
U-238 (Ci/L)	Ci/L	1.03E-08	1.03E-08	7.39E-08	7.45E-07
Pu-239 (Ci/L)	Ci/L	5.09E-06	5.05E-06	2.76E-05	9.83E-05
Pu-240 (Ci/L)	Ci/L	1.02E-06	1.17E-06	5.41E-06	3.34E-05
Am-241 (Ci/L)	Ci/L	6.53E-06	6.53E-06	1.60E-05	2.70E-04
Pu-241 (Ci/L)	Ci/L	1.80E-06	4.22E-06	9.79E-06	2.02E-04
Cm-242 (Ci/L)	Ci/L	3.37E-08	1.79E-08	9.01E-08	1.05E-06
Pu-242 (Ci/L)	Ci/L	3.20E-11	8.72E-11	2.41E-10	5.32E-09
Am-243 (Ci/L)	Ci/L	3.09E-09	4.15E-09	8.58E-09	3.45E-07
Cm-243 (Ci/L)	Ci/L	4.61E-10	4.98E-10	1.59E-09	3.80E-08
Cm-244 (Ci/L)	Ci/L	9.27E-09	9.27E-09	3.35E-08	8.82E-07

A/AX Farms Soils Inventory Calculations

	Units	A-104	A-105	A-01B	A General	AX-101 Surf	AX General	Total	
		Leak or Release							
		release	release	leak/release	release	release	release		
Waste Type	N/A	P1	P1	A1Sltck	A1Sltck	A1Sltck	A1Sltck		
sample yr		na	1965	na	na	na	na		
137Cs Conc (Ci/L)		na	2.28	0.07	0.004	0.32	0.004	(values from RPP-ENV-37956 corresponding with volume estimate)	
Cs ratio		na	12	0.34	0.02	1.57	0.02		
Volume	L	7570	7570	2422.4	1514	416.35	4920.5	2.44E+04	
Constituents	gal	2000	2000	640	400	110	1300	(values from RPP-ENV-37956)	
Al(OH)4 -	kg	0.00E+00	0.00E+00	8.57E+01	3.06E+00	6.74E+01	9.95E+00	1.66E+02	Total Chemicals
Bi	kg	0.00E+00	0.00E+00	3.35E-02	1.20E-03	2.63E-02	3.88E-03	6.48E-02	6.33E+03
butanol	kg	0.00E+00	0.00E+00	1.69E+00	6.05E-02	1.33E+00	1.97E-01	3.28E+00	
Ca	kg	1.14E+00	1.42E+01	1.25E-01	4.46E-03	9.80E-02	1.45E-02	1.55E+01	
Cl-	kg	3.90E+00	4.85E+01	8.57E+00	3.06E-01	6.74E+00	9.95E-01	6.90E+01	
CO3--	kg	1.70E+00	2.12E+01	2.90E+01	1.04E+00	2.28E+01	3.37E+00	7.91E+01	
Cr	kg	3.17E+00	3.94E+01	2.39E+00	8.54E-02	1.88E+00	2.78E-01	4.72E+01	
DBP	kg	0.00E+00	0.00E+00	4.81E+00	1.72E-01	3.78E+00	5.58E-01	9.31E+00	
F-	kg	0.00E+00	0.00E+00	1.49E+00	5.32E-02	1.17E+00	1.73E-01	2.89E+00	
Fe	kg	7.93E-01	9.87E+00	8.69E-02	3.10E-03	6.83E-02	1.01E-02	1.08E+01	
Hg	kg	2.46E-03	3.06E-02	2.69E-04	9.62E-06	2.12E-04	3.13E-05	3.35E-02	
K	kg	9.34E-01	1.16E+01	2.72E+00	9.70E-02	2.13E+00	3.15E-01	1.78E+01	
La	kg	0.00E+00	0.00E+00	7.82E-07	2.79E-08	6.14E-07	9.08E-08	1.51E-06	
Mn	kg	0.00E+00	0.00E+00	2.53E-02	9.05E-04	1.99E-02	2.94E-03	4.91E-02	
Na	kg	1.26E+02	1.56E+03	2.58E+02	9.23E+00	2.03E+02	3.00E+01	2.19E+03	
NH3	kg	1.08E+00	1.35E+01	1.30E+00	4.64E-02	1.02E+00	1.51E-01	1.71E+01	
Ni	kg	8.10E-01	1.01E+01	8.88E-02	3.17E-03	6.98E-02	1.03E-02	1.11E+01	
NO2-	kg	9.63E+01	1.20E+03	1.04E+02	3.71E+00	8.15E+01	1.20E+01	1.50E+03	
NO3-	kg	8.23E+01	1.02E+03	1.80E+02	6.44E+00	1.42E+02	2.09E+01	1.46E+03	
OH-	kg	1.11E+01	1.38E+02	1.97E+01	7.05E-01	1.55E+01	2.29E+00	1.88E+02	
Pb	kg	1.76E-01	2.19E+00	1.24E-01	4.42E-03	9.73E-02	1.44E-02	2.60E+00	
PO4---	kg	0.00E+00	0.00E+00	4.98E+00	1.78E-01	3.91E+00	5.78E-01	9.64E+00	
SiO3--	kg	6.07E+00	7.56E+01	6.66E-01	2.38E-02	5.23E-01	7.73E-02	8.29E+01	
SO4--	kg	3.20E+01	3.98E+02	9.89E+00	3.53E-01	7.77E+00	1.15E+00	4.49E+02	
Sr	kg	3.44E-04	4.29E-03	4.36E-05	1.56E-06	3.42E-05	5.06E-06	4.72E-03	
TOC (total C)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
U total	kg	2.35E-01	2.92E+00	2.57E-02	9.19E-04	2.02E-02	2.99E-03	3.21E+00	
Zr	kg	0.00E+00	0.00E+00	7.14E-03	2.55E-04	5.61E-03	8.29E-04	1.38E-02	
H-3	Ci	1.01E-02	1.26E-01	8.68E-03	3.10E-04	6.82E-03	1.01E-03	1.53E-01	Total Radionuclides
C-14	Ci	1.85E-02	2.30E-01	7.10E-03	2.54E-04	5.58E-03	8.25E-04	2.62E-01	3.69E+04
Ni-59	Ci	4.64E-03	5.77E-02	1.31E-03	4.67E-05	1.03E-03	1.52E-04	6.49E-02	
Co-60	Ci	7.68E-03	9.56E-02	1.64E-03	5.85E-05	1.29E-03	1.90E-04	1.06E-01	
Ni-63	Ci	3.79E-01	4.71E+00	1.09E-01	3.91E-03	8.59E-02	1.27E-02	5.31E+00	
Se-79	Ci	1.81E-03	2.25E-02	6.37E-04	2.28E-05	5.01E-04	7.40E-05	2.56E-02	
Sr-90	Ci	1.19E+01	1.48E+02	1.30E+00	4.65E-02	1.02E+00	1.51E-01	1.62E+02	
Y-90	Ci	1.19E+01	1.48E+02	1.30E+00	4.65E-02	1.02E+00	1.51E-01	1.62E+02	
Zr-93	Ci	1.08E-01	1.34E+00	3.79E-02	1.35E-03	2.98E-02	4.40E-03	1.52E+00	

A/AX Farms Soils Inventory Calculations

	Units	Leak or Release A-104	A-105	A-01B	A General	AX-101 Surf	AX General	Total
		release	release	leak/release	release	release	release	
Waste Type	N/A	P1	P1	A1Sltck	A1Sltck	A1Sltck	A1Sltck	
Nb-93m	Ci	3.96E-02	4.93E-01	1.35E-02	4.83E-04	1.06E-02	1.57E-03	5.58E-01
Tc-99	Ci	5.68E-01	7.07E+00	2.06E-01	7.36E-03	1.62E-01	2.39E-02	8.04E+00
Ru-106	Ci	7.03E-14	8.75E-13	1.05E-13	3.75E-15	8.24E-14	1.22E-14	1.15E-12
Cd-113m	Ci	3.75E-02	4.67E-01	1.40E-02	5.02E-04	1.10E-02	1.63E-03	5.31E-01
Sb-125	Ci	1.19E-04	1.48E-03	4.95E-05	1.77E-06	3.89E-05	5.74E-06	1.70E-03
Sn-126	Ci	7.48E-03	9.32E-02	2.64E-03	9.44E-05	2.08E-03	3.07E-04	1.06E-01
I-129	Ci	3.39E-05	4.22E-04	2.12E-04	7.59E-06	1.67E-04	2.47E-05	8.67E-04
Cs-134	Ci	9.09E-07	1.13E-05	7.12E-07	2.54E-08	5.59E-07	8.26E-08	1.36E-05
Cs-137	Ci	1.39E+03	1.73E+04	1.70E+02	6.06E+00	1.33E+02	1.97E+01	1.90E+04
Ba-137m	Ci	1.24E+03	1.54E+04	1.51E+02	5.40E+00	1.19E+02	1.75E+01	1.69E+04
Sm-151	Ci	4.81E+01	5.99E+02	3.82E+00	1.36E-01	3.00E+00	4.43E-01	6.54E+02
Eu-152	Ci	3.14E-03	3.91E-02	3.43E-04	1.22E-05	2.69E-04	3.98E-05	4.29E-02
Eu-154	Ci	1.33E-01	1.66E+00	1.46E-02	5.23E-04	1.15E-02	1.70E-03	1.82E+00
Eu-155	Ci	1.76E-02	2.20E-01	1.97E-03	7.04E-05	1.55E-03	2.29E-04	2.41E-01
Ra-226	Ci	7.08E-08	8.81E-07	5.11E-08	1.82E-09	4.01E-08	5.93E-09	1.05E-06
Ac-227	Ci	1.74E-07	2.16E-06	1.63E-07	5.83E-09	1.28E-07	1.89E-08	2.65E-06
Ra-228	Ci	4.46E-14	5.56E-13	2.47E-06	8.82E-08	1.94E-06	2.87E-07	4.79E-06
Th-229	Ci	1.19E-09	1.48E-08	2.85E-08	1.02E-09	2.24E-08	3.31E-09	7.12E-08
Pa-231	Ci	4.53E-07	5.63E-06	7.81E-05	2.79E-06	6.13E-05	9.06E-06	1.57E-04
Th-232	Ci	4.53E-13	5.64E-12	1.04E-07	3.70E-09	8.14E-08	1.20E-08	2.01E-07
U-232	Ci	4.33E-09	5.40E-08	7.53E-07	2.69E-08	5.92E-07	8.74E-08	1.52E-06
U-233	Ci	3.68E-08	4.59E-07	5.47E-05	1.95E-06	4.30E-05	6.35E-06	1.06E-04
U-234	Ci	7.64E-05	9.51E-04	9.54E-06	3.41E-07	7.50E-06	1.11E-06	1.05E-03
U-235	Ci	3.27E-06	4.07E-05	3.86E-07	1.38E-08	3.03E-07	4.48E-08	4.47E-05
U-236	Ci	1.69E-06	2.10E-05	2.51E-07	8.95E-09	1.97E-07	2.91E-08	2.32E-05
Np-237	Ci	3.10E-03	3.87E-02	3.89E-04	1.39E-05	3.06E-04	4.52E-05	4.25E-02
Pu-238	Ci	8.21E-04	1.02E-02	1.52E-04	5.41E-06	1.19E-04	1.76E-05	1.13E-02
U-238	Ci	7.83E-05	9.75E-04	8.58E-06	3.07E-07	6.74E-06	9.96E-07	1.07E-03
Pu-239	Ci	3.86E-02	4.80E-01	4.19E-03	1.50E-04	3.29E-03	4.86E-04	5.27E-01
Pu-240	Ci	7.74E-03	9.64E-02	9.71E-04	3.47E-05	7.63E-04	1.13E-04	1.06E-01
Am-241	Ci	4.94E-02	6.15E-01	5.42E-03	1.94E-04	4.26E-03	6.29E-04	6.75E-01
Pu-241	Ci	1.36E-02	1.70E-01	3.50E-03	1.25E-04	2.75E-03	4.07E-04	1.90E-01
Cm-242	Ci	2.55E-04	3.18E-03	1.48E-05	5.30E-07	1.17E-05	1.72E-06	3.46E-03
Pu-242	Ci	2.42E-07	3.02E-06	7.24E-08	2.59E-09	5.69E-08	8.41E-09	3.40E-06
Am-243	Ci	2.34E-05	2.91E-04	3.45E-06	1.23E-07	2.71E-06	4.00E-07	3.21E-04
Cm-243	Ci	3.49E-06	4.35E-05	4.14E-07	1.48E-08	3.25E-07	4.80E-08	4.77E-05
Cm-244	Ci	7.02E-05	8.74E-04	7.70E-06	2.75E-07	6.05E-06	8.94E-07	9.59E-04

Releases and Intentional Discharges near A and AX Farms

	Site	A-AX Releases	216-A-1	216-A-7	216-A-8	216-A-9	216-A-16	216-A-17	216-A-18	216-A-19	216-A-20	216-A-23A	216-A-23B	216-A-24
			Crib	Crib	Crib	Crib	Drain	Drain	Trench	Trench	Trench	Drain	Drain	Crib
	Dates		1955	1955-66	1955-58, 66-78, 83-85	1956-58, 66	1956-69	1956-69	1955-56	1955-56	1955	1957-69	1957-69	1958-66
	Volume (L)	2.44E+04	9.84E+04	3.27E+05	1.15E+09	9.81E+08	1.22E+05	6.00E+04	4.88E+05	1.10E+06	9.61E+05	2.76E+03	3.22E+03	8.20E+08
	Volume (gal)	6.45E+03	2.60E+04	8.64E+04	3.04E+08	2.59E+08	3.22E+04	1.59E+04	1.29E+05	2.91E+05	2.54E+05	7.29E+02	8.51E+02	2.17E+08
	Volume (L)		0.0984	0.3268	1150.401	980.81	0.121996	0.060004	0.488	1.1	0.961	0.0276	0.0322	820.54
Constituents	Units		(Inventory estimates from Soil Inventory Model RPP-26744, Appendix C)											
Ag	kg		0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E-10	5.96E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Al	kg	1.02E+02	0.00E+00	0.00E+00	1.07E+02	4.16E+00	2.63E-05	1.30E-05	0.00E+00	0.00E+00	0.00E+00	7.79E-04	7.79E-04	3.77E+01
Bi	kg		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Butanol	kg		0.00E+00	1.02E-01	1.36E+03	3.60E+02	1.34E-06	6.57E-07	0.00E+00	0.00E+00	1.04E+00	3.74E-03	3.74E-03	1.03E+03
Ca	kg	1.51E+01	2.48E+01	1.72E+00	2.18E+04	1.39E+04	2.43E+00	1.19E+00	1.23E+02	3.40E+03	8.23E+01	5.82E-02	5.83E-02	1.60E+04
CCl4	kg		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cl	kg	6.90E+01	5.06E+01	4.42E-01	1.22E+03	1.29E+03	9.01E-02	4.43E-02	2.51E+02	5.65E+02	7.04E+01	2.89E-03	2.89E-03	8.91E+02
CO3	kg	1.91E+01	3.72E+01	2.13E-01	4.98E+03	5.24E+04	2.67E-05	1.31E-05	1.84E+02	5.10E+03	9.90E+01	0.00E+00	0.00E+00	2.87E-02
Cr	kg	4.72E+01	4.11E+01	4.84E-03	3.90E-03	8.36E+02	3.17E-03	1.56E-03	2.04E+02	4.59E+02	5.65E+01	0.00E+00	0.00E+00	6.49E-04
F	kg		0.00E+00	1.05E-02	1.52E+02	1.32E+02	6.81E-02	3.35E-02	0.00E+00	0.00E+00	1.07E-01	4.06E-04	4.06E-04	1.08E+02
Fe	kg	1.08E+01	6.68E+01	7.02E-02	2.37E+02	2.71E+02	5.54E-03	2.73E-03	3.31E+02	1.83E+04	2.72E+02	1.29E-03	1.29E-03	1.20E+02
Fe(CN)6	kg		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg	kg		1.17E-01	8.49E-06	4.54E+00	3.20E-02	6.08E-10	2.99E-10	5.82E-01	2.79E+01	4.34E-01	3.27E-05	3.27E-05	1.65E+00
K	kg		1.21E+01	6.23E-02	1.13E+03	7.89E+02	4.48E+01	2.21E+01	6.02E+01	1.36E+02	1.73E+01	4.09E-03	4.09E-03	7.19E+02
La	kg		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mn	kg		0.00E+00	1.16E-03	2.49E+01	8.60E+00	4.62E-08	2.27E-08	0.00E+00	0.00E+00	1.19E-02	1.08E-04	1.08E-04	1.49E+01
Na	kg	2.19E+03	1.66E+03	1.03E+01	2.55E+03	2.05E+04	8.75E-02	4.30E-02	8.24E+03	2.77E+04	2.37E+03	6.58E-03	6.58E-03	1.82E+03
NH3	kg	1.71E+01	1.50E+01	1.97E-01	1.59E-01	0.00E+00	5.60E-06	2.76E-06	7.45E+01	4.57E+02	2.36E+01	0.00E+00	0.00E+00	2.64E-02
Ni	kg	1.11E+01	1.28E+01	7.33E-04	5.91E-04	6.42E+02	2.65E-03	1.30E-03	6.33E+01	8.41E+02	2.47E+01	0.00E+00	0.00E+00	9.86E-05
NO2	kg	1.50E+03	1.25E+03	0.00E+00	0.00E+00	1.29E+03	6.16E-05	3.03E-05	6.22E+03	1.47E+04	1.73E+03	0.00E+00	0.00E+00	0.00E+00
NO3	kg	1.46E+03	1.07E+03	1.49E+03	1.83E+03	2.01E+04	3.67E+01	1.81E+01	5.29E+03	1.09E+04	1.45E+03	1.61E-03	1.61E-03	6.53E+02
NPH	kg		0.00E+00	6.84E+04	5.51E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.19E+03
Pb	kg		2.29E+00	4.08E-04	1.16E+02	1.54E+00	3.18E-07	1.56E-07	1.13E+01	2.55E+01	3.14E+00	8.20E-04	8.20E-04	4.31E+01
PO4	kg		0.00E+00	0.00E+00	0.00E+00	1.35E+04	1.74E+01	8.55E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Si	kg		4.70E+01	3.16E-01	2.90E+03	2.47E+03	6.44E-07	3.17E-07	2.33E+02	6.09E+03	1.24E+02	7.50E-03	7.50E-03	2.07E+03
SO4	kg	4.49E+02	4.15E+02	8.07E+00	1.23E+04	1.12E+04	8.41E+00	4.14E+00	2.06E+03	4.64E+03	5.79E+02	3.20E-02	3.20E-02	8.75E+03
TBP	kg		0.00E+00	1.60E+05	1.29E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.14E+04
Zr	kg		0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.93E-09	4.89E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sum Chemicals		6.33E+03	4.71E+03	2.29E+05	2.34E+05	1.40E+05	1.10E+02	5.41E+01	2.33E+04	9.34E+04	6.91E+03	1.20E-01	1.20E-01	6.29E+04

Releases and Intentional Discharges near A and AX Farms

	Site	**216-A-40**	**216-A-41**	**Total**		**241-A-39**	
		Ret Bas	**Crib**			Crib	
	Dates	**1968-79**	**1968-74**				1966
	Volume (L)	9.46E+05	1.00E+04		WIDS/report	20 L waste, washed in with firehose	
	Volume (gal)	2.50E+05	2.64E+03		7.81E+08	not in SIM	
	Volume (L)	0.9456	0.01001		SIM vol. check		
Constituents	Units				total chemicals		
Ag	kg	0.00E+00	7.11E-12	1.88E-10	7.95E+05		
Al	kg	7.36E-05	1.54E-06	1.49E+02			
Bi	kg	7.52E-09	0.00E+00	7.52E-09			
Butanol	kg	1.39E-11	7.83E-08	2.76E+03			
Ca	kg	1.80E+01	1.42E-01	5.53E+04			
CCl4	kg	0.00E+00	0.00E+00	0.00E+00			
Cl	kg	8.36E-01	2.94E-01	4.33E+03			
CO3	kg	7.16E+01	1.56E-06	6.29E+04			
Cr	kg	1.17E-05	1.86E-04	1.60E+03			
F	kg	1.26E-01	3.99E-03	3.92E+02			
Fe	kg	3.34E-02	3.56E-03	1.96E+04			
Fe(CN)6	kg	0.00E+00	0.00E+00	0.00E+00			
Hg	kg	2.32E-09	3.56E-11	3.53E+01			
K	kg	7.08E-01	2.63E+00	2.93E+03			
La	kg	0.00E+00	0.00E+00	0.00E+00			
Mn	kg	4.78E-03	2.71E-09	4.84E+01			
Na	kg	1.97E+00	3.43E-02	6.48E+04			
NH3	kg	2.98E-06	3.28E-07	5.71E+02			
Ni	kg	7.83E-07	1.55E-04	1.58E+03			
NO2	kg	2.83E-04	3.61E-06	2.52E+04			
NO3	kg	4.78E-01	4.03E+00	4.28E+04			
NPH	kg	0.00E+00	0.00E+00	1.33E+05			
Pb	kg	5.25E-03	1.86E-08	2.03E+02			
PO4	kg	4.40E-06	1.02E+00	1.35E+04			
Si	kg	2.35E+00	3.78E-08	1.39E+04			
SO4	kg	9.84E+00	5.09E-01	4.00E+04			
TBP	kg	0.00E+00	0.00E+00	3.10E+05			
Zr	kg	9.95E-10	5.82E-10	1.64E-08			
Sum Chemicals		1.06E+02	8.66E+00	7.95E+05			

Releases and Intentional Discharges near A and AX Farms

Constituents	Site Units	A-AX Releases	216-A-1	216-A-7	216-A-8	216-A-9	216-A-16	216-A-17	216-A-18	216-A-19	216-A-20	216-A-23A	216-A-23B	216-A-24
			(Inventory estimates from Soil Inventory Model RPP-26744, Appendix C)											
			Rad values decayed to 1/1/2001								**Rad values decayed to 1/1/2001**			
H-3	Ci		0.00E+00	2.33E-01	2.46E+04	8.07E+02	3.32E-07	1.63E-07	0.00E+00	0.00E+00	2.33E+00	1.55E-01	1.49E-01	8.80E+03
C-14	Ci		0.00E+00	3.15E-03	3.53E+00	1.17E+00	7.60E-09	3.73E-09	0.00E+00	0.00E+00	3.37E-03	5.63E-06	5.63E-06	3.03E+00
Ni-59	Ci		0.00E+00	1.84E-05	1.48E-05	1.21E-03	1.21E-08	5.97E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E-06
Ni-63	Ci		0.00E+00	1.77E-03	1.42E-03	1.17E-01	1.16E-06	5.71E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.37E-04
Co-60	Ci		0.00E+00	1.10E-02	8.83E-03	8.70E-04	6.12E-08	3.01E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.47E-03
Se-79	Ci		0.00E+00	2.05E-04	1.65E-04	5.44E-06	6.44E-10	3.17E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.74E-05
Sr-90	Ci		0.00E+00	1.02E+01	8.65E+00	6.81E+00	6.75E-06	3.32E-06	0.00E+00	0.00E+00	4.15E-04	6.94E-07	6.94E-07	1.75E+00
Y-90	Ci		0.00E+00	1.02E+01	8.66E+00	6.81E+00	6.75E-06	3.32E-06	0.00E+00	0.00E+00	4.15E-04	6.94E-07	6.94E-07	1.75E+00
Zr-93	Ci		0.00E+00	3.54E-01	2.85E-01	3.21E-04	3.83E-08	1.89E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.75E-02
Nb-93m	Ci		0.00E+00	7.71E-02	6.21E-02	2.41E-04	3.05E-08	1.50E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-02
Tc-99	Ci		0.00E+00	6.39E-02	5.15E-02	2.30E-03	2.03E-07	1.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.57E-03
Ru-106	Ci		0.00E+00	1.92E-08	1.55E-08	1.12E-07	6.88E-09	3.38E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.57E-09
Cd-113m	Ci		0.00E+00	1.13E-01	9.09E-02	4.76E-04	4.16E-08	2.05E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.52E-02
Sb-125	Ci		0.00E+00	2.64E-02	2.13E-02	4.23E-04	5.68E-08	2.79E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.57E-03
Sn-126	Ci		0.00E+00	6.85E-03	5.52E-03	2.33E-05	2.68E-09	1.32E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.18E-04
I-129	Ci		0.00E+00	4.19E-05	3.74E-05	1.22E-03	3.90E-10	1.92E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.64E-06
Cs-134	Ci		0.00E+00	4.13E-03	3.33E-03	6.05E-05	6.36E-08	3.13E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.55E-04
Cs-137	Ci		0.00E+00	2.99E+03	2.41E+03	7.84E+00	8.43E-04	4.15E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.01E+02
Ba-137m	Ci		0.00E+00	2.82E+03	2.27E+03	7.41E+00	7.96E-04	3.92E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.78E+02
Sm-151	Ci		0.00E+00	1.72E+01	1.38E+01	2.12E-01	1.25E-05	6.17E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.30E+00
Eu-152	Ci		0.00E+00	3.95E-03	3.19E-03	1.35E-04	2.32E-09	1.14E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.31E-04
Eu-154	Ci		0.00E+00	3.17E-01	2.55E-01	9.73E-03	1.88E-07	9.23E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.26E-02
Eu-155	Ci		0.00E+00	1.75E-01	1.41E-01	3.57E-03	1.01E-07	4.96E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.35E-02
Ra-226	Ci		0.00E+00	7.83E-06	8.45E-06	6.46E-07	3.47E-14	1.71E-14	0.00E+00	0.00E+00	8.58E-12	1.44E-14	1.44E-14	1.41E-06
Ra-228	Ci		0.00E+00	6.41E-11	1.16E-10	4.72E-07	3.45E-11	1.70E-11	0.00E+00	0.00E+00	5.28E-17	8.84E-20	8.84E-20	1.93E-11
Ac-227	Ci		0.00E+00	3.62E-05	4.09E-05	4.12E-06	5.71E-13	2.81E-13	0.00E+00	0.00E+00	3.82E-11	6.40E-14	6.40E-14	6.81E-06
Pa-231	Ci		0.00E+00	5.54E-05	6.67E-05	6.03E-06	8.30E-11	4.08E-11	0.00E+00	0.00E+00	5.44E-11	9.11E-14	9.11E-14	1.11E-05
Th-229	Ci		0.00E+00	4.75E-08	4.08E-08	3.02E-07	7.10E-14	3.49E-14	0.00E+00	0.00E+00	1.43E-13	2.39E-16	2.39E-16	6.75E-09
Th-232	Ci		0.00E+00	6.66E-11	1.22E-10	3.74E-07	2.65E-13	1.31E-13	0.00E+00	0.00E+00	5.44E-17	9.11E-20	9.11E-20	2.03E-11
U-232	Ci		7.41E-07	1.28E-05	4.92E-05	2.12E-01	8.46E-12	4.16E-12	3.67E-06	2.17E-04	3.16E-06	1.62E-14	1.62E-14	8.14E-06
U-233	Ci		5.30E-07	2.33E-05	1.85E-05	1.26E+01	5.19E-10	2.55E-10	2.63E-06	2.19E-05	8.91E-07	1.14E-13	1.14E-13	3.05E-06
U-234	Ci		4.49E-02	1.64E-01	1.73E-01	9.27E-01	6.75E-11	3.32E-11	2.22E-01	1.42E+01	2.02E-01	2.36E-10	2.36E-10	2.86E-02
U-235	Ci		1.99E-03	6.87E-03	7.45E-03	3.58E-02	2.63E-12	1.30E-12	9.85E-03	6.28E-01	8.92E-03	1.01E-11	1.01E-11	1.23E-03
U-236	Ci		6.18E-04	4.22E-03	8.45E-03	4.03E-02	2.75E-12	1.35E-12	3.08E-03	1.93E-01	2.76E-03	5.22E-12	5.22E-12	1.41E-03

Releases and Intentional Discharges near A and AX Farms

	Site	**216-A-40**	**216-A-41**	**Total**		**241-A-39**
Constituents	Units				total radionuclides	
H-3	Ci	1.40E-07	1.04E-01	3.42E+04	4.71E+04	total radionuclides
C-14	Ci	2.69E-08	8.93E-09	7.73E+00		
Ni-59	Ci	5.07E-09	4.51E-09	1.25E-03		
Ni-63	Ci	4.82E-07	4.35E-07	1.21E-01		
Co-60	Ci	3.10E-07	7.18E-08	2.21E-02		
Se-79	Ci	3.20E-09	1.58E-09	4.02E-04		
Sr-90	Ci	1.73E-07	7.44E-06	2.74E+01		
Y-90	Ci	1.74E-07	7.45E-06	2.74E+01		
Zr-93	Ci	1.91E-07	9.43E-08	6.87E-01		
Nb-93m	Ci	1.54E-07	7.43E-08	1.50E-01		
Tc-99	Ci	1.02E-06	4.93E-07	1.26E-01		
Ru-106	Ci	2.92E-13	4.04E-10	1.60E-07		
Cd-113m	Ci	1.99E-07	1.09E-07	2.20E-01		
Sb-125	Ci	4.74E-08	2.82E-08	5.17E-02		
Sn-126	Ci	1.33E-08	6.60E-09	1.33E-02		
I-129	Ci	6.04E-10	1.68E-06	1.31E-03		
Cs-134	Ci	1.07E-10	3.76E-09	8.08E-03		
Cs-137	Ci	1.13E-04	7.01E-05	5.81E+03		
Ba-137m	Ci	1.07E-04	6.62E-05	5.48E+03		
Sm-151	Ci	4.20E-05	1.33E-05	3.35E+01		
Eu-152	Ci	7.84E-09	3.03E-09	7.81E-03		
Eu-154	Ci	5.84E-07	2.43E-07	6.24E-01		
Eu-155	Ci	2.69E-07	1.34E-07	3.44E-01		
Ra-226	Ci	1.49E-13	2.63E-10	1.83E-05		
Ra-228	Ci	6.92E-12	2.03E-12	4.72E-07		
Ac-227	Ci	8.84E-13	1.22E-09	8.81E-05		
Pa-231	Ci	2.42E-12	1.86E-09	1.39E-04		
Th-229	Ci	3.84E-14	1.60E-12	3.97E-07		
Th-232	Ci	1.07E-13	1.78E-14	3.74E-07		
U-232	Ci	1.84E-12	9.57E-12	2.12E-01		
U-233	Ci	1.13E-10	4.68E-11	1.26E+01		
U-234	Ci	7.90E-11	1.16E-07	1.59E+01		
U-235	Ci	3.30E-12	4.85E-09	7.00E-01		
U-236	Ci	2.15E-12	2.98E-09	2.54E-01		

Releases and Intentional Discharges near A and AX Farms

	Site	A-AX Releases	216-A-1	216-A-7	216-A-8		216-A-9	216-A-16	216-A-17	216-A-18	216-A-19	216-A-20	216-A-23A	216-A-23B	216-A-24
Constituents	Units		(Inventory estimates from Soil Inventory Model RPP-26744, Appendix C)												
			Rad values decayed to 1/1/2001									**Rad values decayed to 1/1/2001**			
U-238	Ci		4.59E-02	1.60E-01		1.30E-01	6.28E-01	5.69E-11	2.80E-11	2.27E-01	1.45E+01	2.07E-01	2.42E-10	2.42E-10	2.16E-02
Np-237	Ci		0.00E+00	3.14E-03		3.77E-03	1.30E-03	8.23E-10	4.04E-10	0.00E+00	0.00E+00	2.13E-06	6.35E-09	6.60E-09	2.27E-03
Pu-238	Ci		0.00E+00	2.93E-02		7.01E-02	2.07E+01	1.38E-09	6.80E-10	0.00E+00	0.00E+00	6.67E-06	5.39E-08	4.79E-08	1.67E-02
Pu-239	Ci		0.00E+00	6.10E-01		8.69E-01	1.83E+02	2.77E-08	1.36E-08	0.00E+00	0.00E+00	2.69E-04	1.09E-06	1.09E-06	3.55E-01
Pu-240	Ci		0.00E+00	1.50E-01		2.57E-01	6.43E+01	6.79E-09	3.34E-09	0.00E+00	0.00E+00	5.42E-05	2.67E-07	2.57E-07	8.50E-02
Pu-241	Ci		0.00E+00	1.33E+00		3.91E+00	1.21E+03	8.59E-08	4.22E-08	0.00E+00	0.00E+00	2.38E-04	2.61E-06	2.20E-06	8.22E-01
Pu-242	Ci		0.00E+00	1.08E-05		3.47E-05	1.09E-02	5.48E-13	2.70E-13	0.00E+00	0.00E+00	1.69E-09	2.19E-11	1.80E-11	6.98E-06
Am-241	Ci		0.00E+00	1.85E-01		5.18E-01	1.02E-01	2.39E-08	1.18E-08	0.00E+00	0.00E+00	2.70E-04	1.09E-06	1.09E-06	2.98E-01
Am-243	Ci		0.00E+00	9.82E-05		2.75E-04	5.12E-05	6.76E-12	3.33E-12	0.00E+00	0.00E+00	1.24E-07	6.27E-10	5.88E-10	1.41E-04
Cm-242	Ci		0.00E+00	3.74E-04		6.36E-04	8.67E-05	5.97E-11	2.94E-11	0.00E+00	0.00E+00	2.11E-07	1.07E-09	1.01E-09	2.69E-04
Cm-243	Ci		0.00E+00	2.25E-05		3.28E-05	2.90E-06	1.74E-12	8.58E-13	0.00E+00	0.00E+00	4.13E-09	6.40E-11	5.34E-11	8.45E-06
Cm-244	Ci		0.00E+00	5.25E-04		7.92E-04	7.41E-05	4.44E-11	2.18E-11	0.00E+00	0.00E+00	1.09E-07	1.55E-09	1.29E-09	2.08E-04

Releases and Intentional Discharges near A and AX Farms

	Site	216-A-40	216-A-41	Total		241-A-39
Constituents	Units				total radionuclides	
U-238	Ci	7.40E-11	1.13E-07	1.59E+01		
Np-237	Ci	3.32E-09	2.51E-06	1.05E-02		
Pu-238	Ci	1.55E-09	2.66E-06	2.09E+01		
Pu-239	Ci	3.61E-08	5.53E-05	1.85E+02		
Pu-240	Ci	8.38E-09	1.35E-05	6.48E+01		
Pu-241	Ci	7.06E-08	1.20E-04	1.22E+03		
Pu-242	Ci	5.82E-13	9.84E-10	1.10E-02		
Am-241	Ci	5.08E-08	7.40E-05	1.10E+00		
Am-243	Ci	2.92E-11	3.93E-08	5.66E-04		
Cm-242	Ci	1.79E-10	1.50E-07	1.37E-03		
Cm-243	Ci	5.51E-12	8.98E-09	6.67E-05		
Cm-244	Ci	1.37E-10	2.11E-07	1.60E-03		

Releases and Intentional Discharges near A and AX Farms

	Site	A-AX Releases	216-A-1	216-A-7	216-A-8	216-A-9	216-A-16	216-A-17	216-A-18	216-A-19	216-A-20	216-A-23A	216-A-23B	216-A-24
Constituents	Units		(Inventory estimates from Soil Inventory Model RPP-26744, Appendix C)											
		Rad values Decayed to 2020									**Rad values Decayed to 2020**			
H-3	Ci	1.53E-01	0.00E+00	8.00E-02	8.43E+03	2.77E+02	1.14E-07	5.60E-08	0.00E+00	0.00E+00	8.02E-01	5.32E-02	5.11E-02	3.02E+03
C-14	Ci	2.62E-01	0.00E+00	3.15E-03	3.52E+00	1.16E+00	7.58E-09	3.73E-09	0.00E+00	0.00E+00	3.37E-03	5.62E-06	5.62E-06	3.02E+00
Ni-59	Ci	6.49E-02	0.00E+00	1.84E-05	1.48E-05	1.21E-03	1.21E-08	5.97E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E-06
Ni-63	Ci	5.31E+00	0.00E+00	1.45E-04	1.17E-04	9.64E-03	9.55E-08	4.70E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.95E-05
Co-60	Ci	1.06E-01	0.00E+00	9.62E-03	7.75E-03	7.63E-04	5.37E-08	2.64E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.29E-03
Se-79	Ci	2.56E-02	0.00E+00	2.05E-04	1.65E-04	5.44E-06	6.44E-10	3.17E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.74E-05
Sr-90	Ci	1.62E+02	0.00E+00	6.46E+00	5.47E+00	4.31E+00	4.27E-06	2.10E-06	0.00E+00	0.00E+00	2.63E-04	4.39E-07	4.39E-07	1.10E+00
Y-90	Ci	1.62E+02	0.00E+00	6.45E+00	5.48E+00	4.31E+00	4.27E-06	2.10E-06	0.00E+00	0.00E+00	2.63E-04	4.39E-07	4.39E-07	1.11E+00
Zr-93	Ci	1.52E+00	0.00E+00	3.54E-01	2.85E-01	3.21E-04	3.83E-08	1.89E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.75E-02
Nb-93m	Ci	5.58E-01	0.00E+00	3.40E-02	2.74E-02	1.06E-04	1.35E-08	6.62E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.57E-03
Tc-99	Ci	8.04E+00	0.00E+00	6.39E-02	5.15E-02	2.30E-03	2.03E-07	9.99E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.57E-03
Ru-106	Ci	1.15E-12	0.00E+00	4.76E-14	3.84E-14	2.76E-13	1.70E-14	8.36E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.36E-15
Cd-113m	Ci	5.31E-01	0.00E+00	4.44E-02	3.57E-02	1.87E-04	1.64E-08	8.04E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.97E-03
Sb-125	Ci	1.70E-03	0.00E+00	2.23E-04	1.80E-04	3.57E-06	4.79E-10	2.36E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.01E-05
Sn-126	Ci	1.06E-01	0.00E+00	6.85E-03	5.52E-03	2.33E-05	2.68E-09	1.32E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.18E-04
I-129	Ci	8.67E-04	0.00E+00	4.19E-05	3.74E-05	1.22E-03	3.90E-10	1.92E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.64E-06
Cs-134	Ci	1.36E-05	0.00E+00	7.03E-06	5.66E-06	1.03E-07	1.08E-10	5.32E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.43E-07
Cs-137	Ci	1.90E+04	0.00E+00	1.93E+03	1.56E+03	5.06E+00	5.44E-04	2.68E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.59E+02
Ba-137m	Ci	1.69E+04	0.00E+00	1.72E+03	1.38E+03	4.52E+00	4.85E-04	2.39E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.30E+02
Sm-151	Ci	6.54E+02	0.00E+00	1.48E+01	1.19E+01	1.83E-01	1.08E-05	5.33E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.99E+00
Eu-152	Ci	4.29E-02	0.00E+00	1.50E-03	1.21E-03	5.12E-05	8.76E-10	4.31E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.01E-04
Eu-154	Ci	1.82E+00	0.00E+00	6.84E-02	5.52E-02	2.10E-03	4.05E-08	1.99E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.19E-03
Eu-155	Ci	2.41E-01	0.00E+00	1.10E-02	8.84E-03	2.23E-04	6.30E-09	3.10E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.47E-03
Ra-226	Ci	1.05E-06	0.00E+00	7.77E-06	8.39E-06	6.41E-07	3.44E-14	1.69E-14	0.00E+00	0.00E+00	8.51E-12	1.42E-14	1.42E-14	1.40E-06
Ra-228	Ci	4.79E-06	0.00E+00	6.51E-12	1.18E-11	4.80E-08	3.51E-12	1.73E-12	0.00E+00	0.00E+00	5.37E-18	8.99E-21	8.98E-21	1.97E-12
Ac-227	Ci	2.65E-06	0.00E+00	1.98E-05	2.24E-05	2.25E-06	3.12E-13	1.53E-13	0.00E+00	0.00E+00	2.09E-11	3.49E-14	3.50E-14	3.72E-06
Pa-231	Ci	1.57E-04	0.00E+00	5.53E-05	6.66E-05	6.03E-06	8.30E-11	4.08E-11	0.00E+00	0.00E+00	5.44E-11	9.11E-14	9.11E-14	1.11E-05
Th-229	Ci	7.12E-08	0.00E+00	4.74E-08	4.07E-08	3.02E-07	7.09E-14	3.49E-14	0.00E+00	0.00E+00	1.43E-13	2.38E-16	2.38E-16	6.73E-09
Th-232	Ci	2.01E-07	0.00E+00	6.66E-11	1.22E-10	3.74E-07	2.65E-13	1.31E-13	0.00E+00	0.00E+00	5.44E-17	9.11E-20	9.11E-20	2.03E-11
U-232	Ci	1.52E-06	6.14E-07	1.06E-05	4.08E-05	1.75E-01	7.01E-12	3.45E-12	3.04E-06	1.80E-04	2.62E-06	1.34E-14	1.34E-14	6.74E-06
U-233	Ci	1.06E-04	5.30E-07	2.33E-05	1.85E-05	1.26E+01	5.19E-10	2.55E-10	2.63E-06	2.19E-05	8.90E-07	1.14E-13	1.14E-13	3.05E-06
U-234	Ci	1.05E-03	4.49E-02	1.64E-01	1.73E-01	9.27E-01	6.75E-11	3.32E-11	2.22E-01	1.42E+01	2.02E-01	2.36E-10	2.36E-10	2.86E-02
U-235	Ci	4.47E-05	1.99E-03	6.87E-03	7.45E-03	3.58E-02	2.63E-12	1.30E-12	9.85E-03	6.28E-01	8.92E-03	1.01E-11	1.01E-11	1.23E-03
U-236	Ci	2.32E-05	6.18E-04	4.22E-03	8.45E-03	4.03E-02	2.75E-12	1.35E-12	3.08E-03	1.93E-01	2.76E-03	5.22E-12	5.22E-12	1.41E-03

Releases and Intentional Discharges near A and AX Farms

	Site	**216-A-40**	**216-A-41**	**Total**		**241-A-39**
Constituents	Units				total radionuclides	
H-3	Ci	4.80E-08	3.56E-02			
C-14	Ci	2.68E-08	8.91E-09			
Ni-59	Ci	5.07E-09	4.51E-09			
Ni-63	Ci	3.96E-08	3.58E-08			
Co-60	Ci	2.72E-07	6.30E-08			
Se-79	Ci	3.20E-09	1.58E-09			
Sr-90	Ci	1.10E-07	4.71E-06			
Y-90	Ci	1.10E-07	4.71E-06			
Zr-93	Ci	1.91E-07	9.43E-08			
Nb-93m	Ci	6.79E-08	3.28E-08			
Tc-99	Ci	1.02E-06	4.93E-07			
Ru-106	Ci	7.21E-19	9.99E-16			
Cd-113m	Ci	7.83E-08	4.27E-08			
Sb-125	Ci	4.00E-10	2.38E-10			
Sn-126	Ci	1.33E-08	6.60E-09			
I-129	Ci	6.04E-10	1.68E-06			
Cs-134	Ci	1.82E-13	6.39E-12			
Cs-137	Ci	7.31E-05	4.52E-05			
Ba-137m	Ci	6.52E-05	4.03E-05			
Sm-151	Ci	3.63E-05	1.15E-05			
Eu-152	Ci	2.97E-09	1.15E-09			
Eu-154	Ci	1.26E-07	5.25E-08			
Eu-155	Ci	1.68E-08	8.39E-09			
Ra-226	Ci	1.48E-13	2.61E-10			
Ra-228	Ci	7.03E-13	2.06E-13			
Ac-227	Ci	4.83E-13	6.64E-10			
Pa-231	Ci	2.41E-12	1.86E-09			
Th-229	Ci	3.83E-14	1.59E-12			
Th-232	Ci	1.07E-13	1.78E-14			
U-232	Ci	1.52E-12	7.92E-12			
U-233	Ci	1.13E-10	4.68E-11			
U-234	Ci	7.90E-11	1.16E-07			
U-235	Ci	3.30E-12	4.85E-09			
U-236	Ci	2.15E-12	2.98E-09			

Releases and Intentional Discharges near A and AX Farms

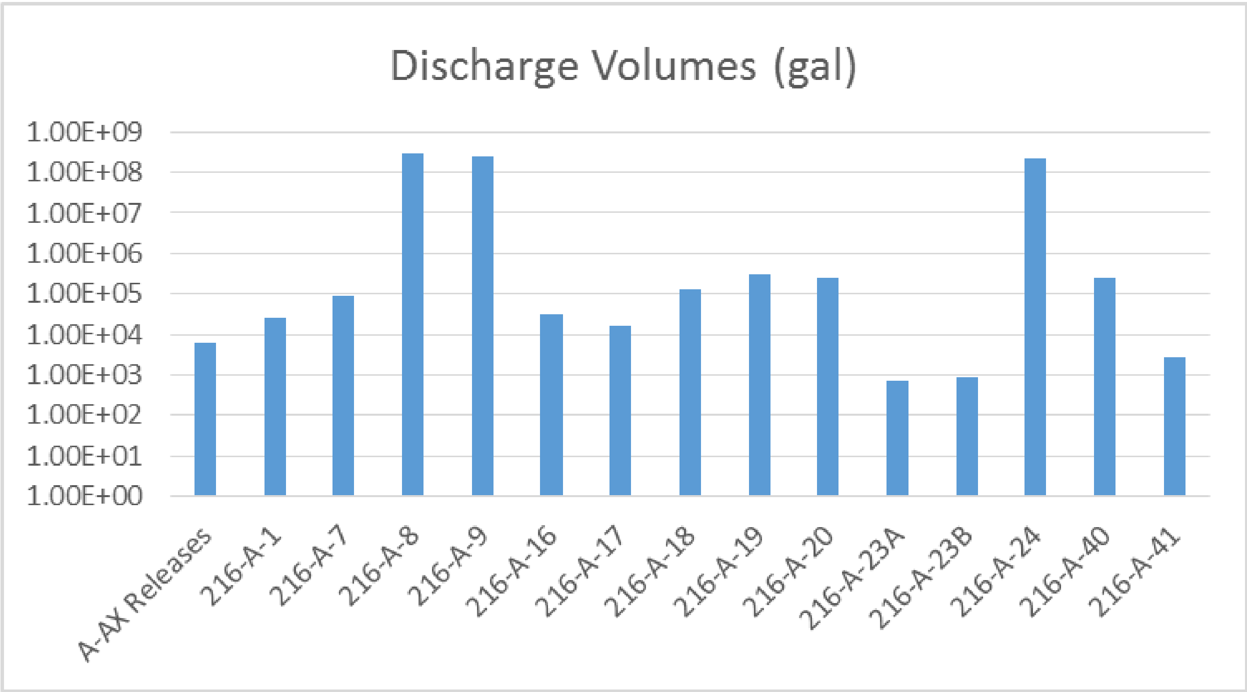
	Site	A-AX Releases	216-A-1	216-A-7	216-A-8	216-A-9	216-A-16	216-A-17	216-A-18	216-A-19	216-A-20	216-A-23A	216-A-23B	216-A-24
Constituents	Units		(Inventory estimates from Soil Inventory Model RPP-26744, Appendix C)											
U-238	Ci	1.07E-03	4.59E-02	1.60E-01	1.30E-01	6.28E-01	5.69E-11	2.80E-11	2.27E-01	1.45E+01	2.07E-01	2.42E-10	2.42E-10	2.16E-02
Np-237	Ci	4.25E-02	0.00E+00	3.14E-03	3.77E-03	1.30E-03	8.23E-10	4.04E-10	0.00E+00	0.00E+00	2.13E-06	6.35E-09	6.60E-09	2.27E-03
Pu-238	Ci	1.13E-02	0.00E+00	2.52E-02	6.03E-02	1.78E+01	1.19E-09	5.85E-10	0.00E+00	0.00E+00	5.74E-06	4.63E-08	4.12E-08	1.44E-02
Pu-239	Ci	5.27E-01	0.00E+00	6.10E-01	8.68E-01	1.83E+02	2.77E-08	1.36E-08	0.00E+00	0.00E+00	2.69E-04	1.09E-06	1.09E-06	3.55E-01
Pu-240	Ci	1.06E-01	0.00E+00	1.49E-01	2.56E-01	6.42E+01	6.78E-09	3.33E-09	0.00E+00	0.00E+00	5.41E-05	2.66E-07	2.57E-07	8.49E-02
Pu-241	Ci	1.90E-01	0.00E+00	5.33E-01	1.57E+00	4.86E+02	3.44E-08	1.69E-08	0.00E+00	0.00E+00	9.52E-05	1.05E-06	8.83E-07	3.29E-01
Pu-242	Ci	3.40E-06	0.00E+00	1.08E-05	3.47E-05	1.09E-02	5.48E-13	2.70E-13	0.00E+00	0.00E+00	1.69E-09	2.19E-11	1.80E-11	6.98E-06
Am-241	Ci	6.75E-01	0.00E+00	1.79E-01	5.03E-01	9.87E-02	2.32E-08	1.14E-08	0.00E+00	0.00E+00	2.61E-04	1.06E-06	1.06E-06	2.89E-01
Am-243	Ci	3.21E-04	0.00E+00	9.80E-05	2.75E-04	5.11E-05	6.75E-12	3.32E-12	0.00E+00	0.00E+00	1.24E-07	6.26E-10	5.87E-10	1.41E-04
Cm-242	Ci	3.46E-03	0.00E+00	3.41E-04	5.79E-04	7.90E-05	5.44E-11	2.67E-11	0.00E+00	0.00E+00	1.92E-07	9.74E-10	9.19E-10	2.45E-04
Cm-243	Ci	4.77E-05	0.00E+00	1.43E-05	2.09E-05	1.84E-06	1.11E-12	5.45E-13	0.00E+00	0.00E+00	2.63E-09	4.07E-11	3.39E-11	5.37E-06
Cm-244	Ci	9.59E-04	0.00E+00	2.54E-04	3.83E-04	3.58E-05	2.14E-11	1.05E-11	0.00E+00	0.00E+00	5.29E-08	7.50E-10	6.22E-10	1.01E-04
SUM	Ci	3.69E+04	9.35E-02	3.68E+03	1.14E+04	1.06E+03	1.05E-03	5.16E-04	4.62E-01	2.95E+01	1.23E+00	5.32E-02	5.11E-02	3.52E+03

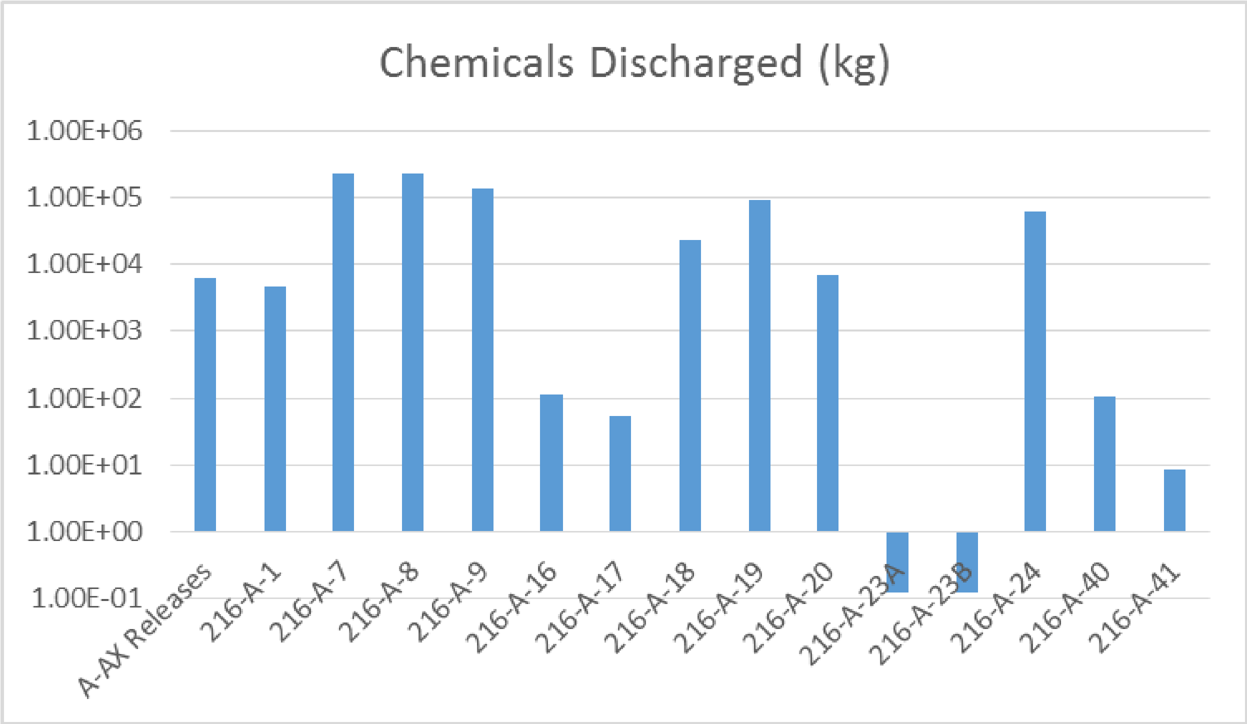
Releases and Intentional Discharges near A and AX Farms

	Site	216-A-40	216-A-41	Total		241-A-39
Constituents	Units				total radionuclides	
U-238	Ci	7.40E-11	1.13E-07			
Np-237	Ci	3.32E-09	2.51E-06			
Pu-238	Ci	1.34E-09	2.29E-06			
Pu-239	Ci	3.61E-08	5.52E-05			
Pu-240	Ci	8.36E-09	1.35E-05			
Pu-241	Ci	2.83E-08	4.81E-05			
Pu-242	Ci	5.82E-13	9.83E-10			
Am-241	Ci	4.93E-08	7.18E-05			
Am-243	Ci	2.92E-11	3.92E-08			
Cm-242	Ci	1.63E-10	1.37E-07			
Cm-243	Ci	3.51E-12	5.71E-09			
Cm-244	Ci	6.64E-11	1.02E-07			
SUM	Ci	1.77E-04	3.59E-02			

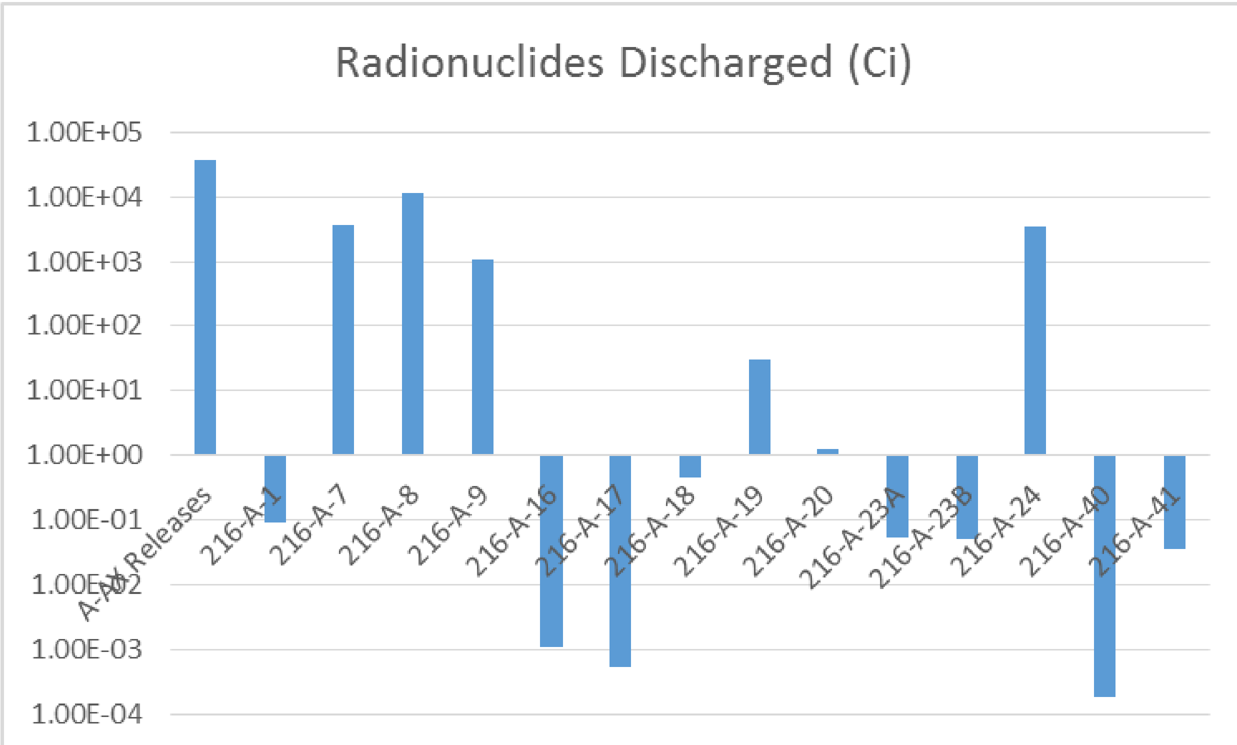
Releases and Intentional Discharges near A and AX Farms

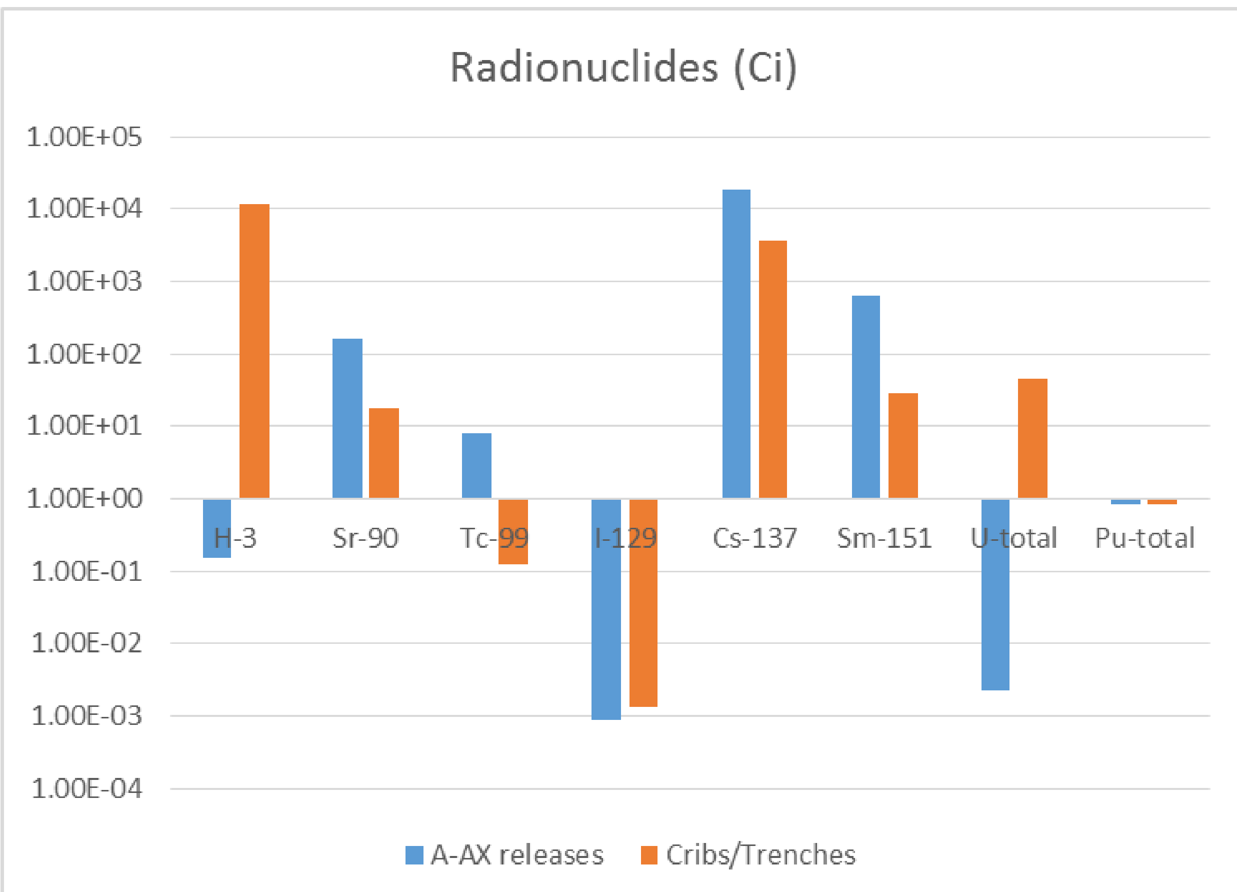
	Site	A-AX releases	216-C-7	216-C-8	216-C-9	216-C-18	216-C-19	216-C-24	Cribs/Trenches
Constituents	Units		(Inventory estimates from Soil Inventory Model RPP-26744, Appendix C)						
H-3	Ci	1.53E-01							1.17E+04
Sr-90	Ci	1.62E+02							1.73E+01
Tc-99	Ci	8.04E+00							1.26E-01
I-129	Ci	8.67E-04							1.31E-03
Cs-137	Ci	1.90E+04							3.75E+03
Sm-151	Ci	6.54E+02							2.89E+01
U-total	Ci	2.29E-03							4.56E+01
Pu-total	Ci	8.23E-01							8.23E-01
Al		1.02E+02	0.00E+00	1.07E+02	4.16E+00	0.00E+00	0.00E+00	3.77E+01	1.49E+02
Butanol			1.02E-01	1.36E+03	3.60E+02	0.00E+00	0.00E+00	1.03E+03	2.76E+03
Cr		4.72E+01	4.84E-03	3.90E-03	8.36E+02	2.04E+02	4.59E+02	6.49E-04	1.50E+03
Fe		1.08E+01	7.02E-02	2.37E+02	2.71E+02	3.31E+02	1.83E+04	1.20E+02	1.93E+04
K			6.23E-02	1.13E+03	7.89E+02	6.02E+01	1.36E+02	7.19E+02	2.83E+03
Na		2.19E+03	1.03E+01	2.55E+03	2.05E+04	8.24E+03	2.77E+04	1.82E+03	6.08E+04
Ni		1.11E+01	7.33E-04	5.91E-04	6.42E+02	6.33E+01	8.41E+02	9.86E-05	1.55E+03
NO3		1.46E+03	1.49E+03	1.83E+03	2.01E+04	5.29E+03	1.09E+04	6.53E+02	4.03E+04
NPH			6.84E+04	5.51E+04	0.00E+00	0.00E+00	0.00E+00	9.19E+03	1.33E+05
PO4			0.00E+00	0.00E+00	1.35E+04	0.00E+00	0.00E+00	0.00E+00	1.35E+04
Si			3.16E-01	2.90E+03	2.47E+03	2.33E+02	6.09E+03	2.07E+03	1.38E+04
SO4		4.49E+02	8.07E+00	1.23E+04	1.12E+04	2.06E+03	4.64E+03	8.75E+03	3.90E+04
TBP			1.60E+05	1.29E+05	0.00E+00	0.00E+00	0.00E+00	2.14E+04	3.10E+05

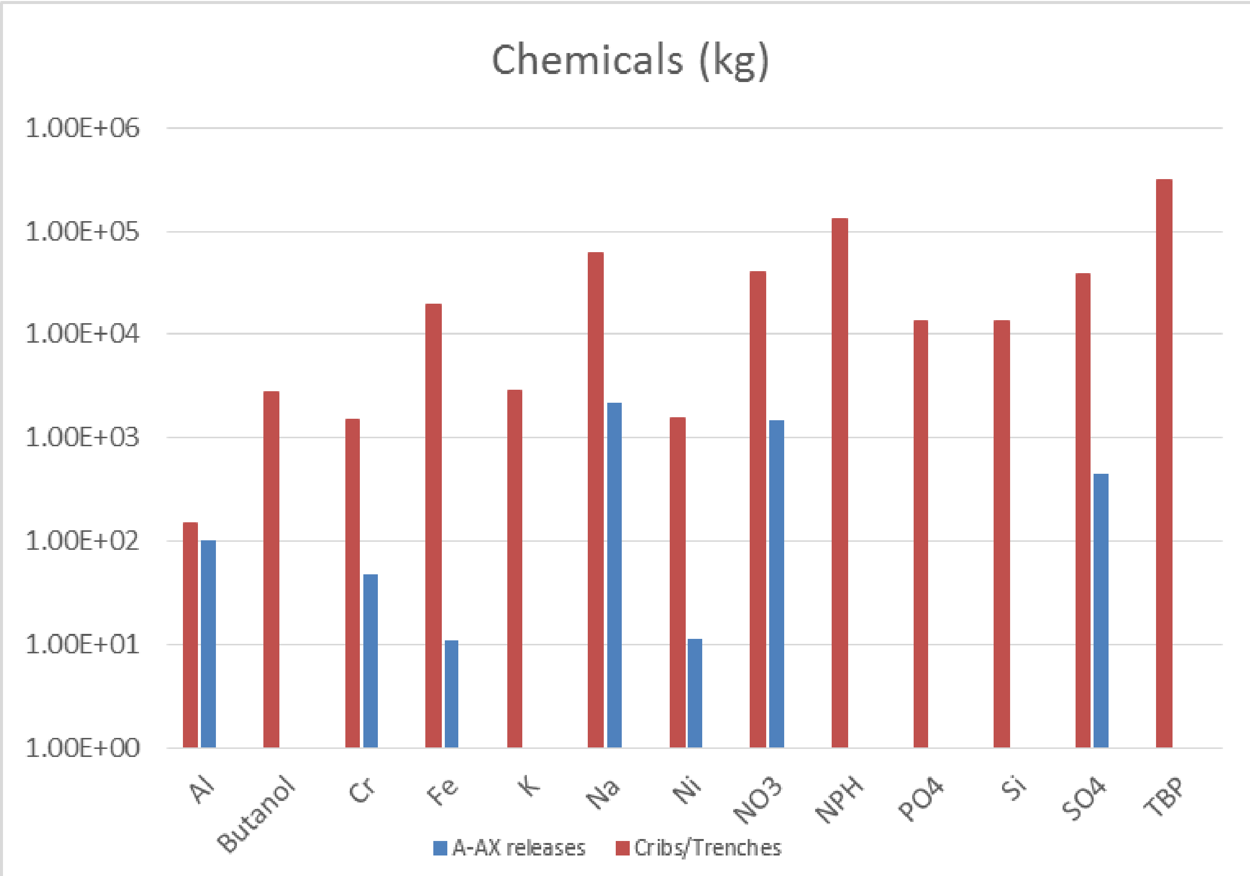

Discharge Volumes (gal)
1.00E+09
1.00E+08
1.00E+07
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
A-AX Releases
216-A-1
216-A-7
216-A-8
216-A-9
216-A-16
216-A-17
216-A-18
216-A-19
216-A-20
216-A-23A
216-A-23B
216-A-24
216-A-40
216-A-41

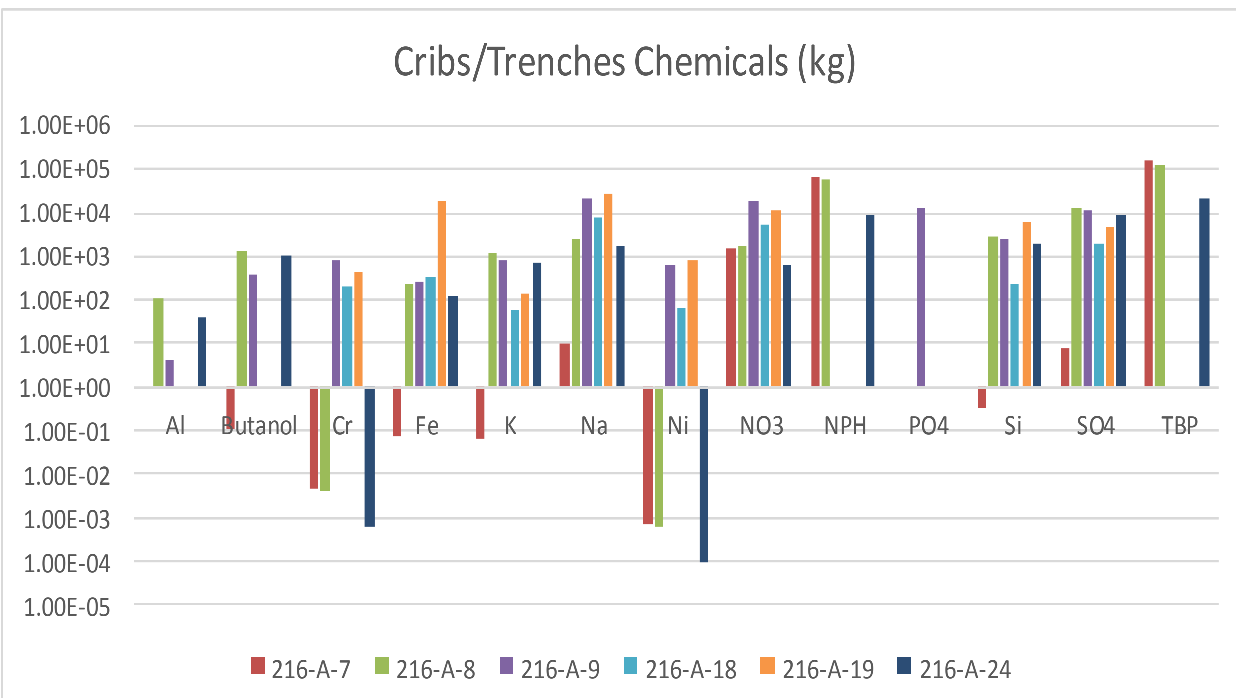

Chemicals Discharged (kg)
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
1.00E-01
A-AX Releases
216-A-1
216-A-7
216-A-8
216-A-9
216-A-16
216-A-17
216-A-18
216-A-19
216-A-20
216-A-23A
216-A-23B
216-A-24
216-A-40
216-A-41

Decay factors (2001 to 2020)		**Rads decayed to 2020**	Total Rads
3H	0.3434	1.173E+04	1.969E+04
14C	0.9977	7.715E+00	
59Ni	0.9998	1.250E-03	
60Co	0.0822	9.919E-03	
63Ni	0.8778	1.942E-02	
79Se	1.0000	4.023E-04	
90Sr	0.6328	1.734E+01	
90Y	0.6328	1.735E+01	
93Zr	1.0000	6.872E-01	
93mNb	0.4414	6.612E-02	
99Tc	0.9999	1.263E-01	
106Ru	0.0000	3.948E-13	
113mCd	0.3930	8.629E-02	
125Sb	0.0084	4.367E-04	
126Sn	0.9999	1.331E-02	
129I	1.0000	1.306E-03	
134Cs	0.0017	1.374E-05	
137Cs	0.6454	3.748E+03	
137mBa	0.6092	3.337E+03	
151Sm	0.8639	2.894E+01	
152Eu	0.3781	2.953E-03	
154Eu	0.2160	1.348E-01	
155Eu	0.0625	2.150E-02	
226Ra	0.9918	1.819E-05	
228Ra	0.1017	4.798E-08	
227Ac	0.5462	4.810E-05	
231Pa	0.9996	1.391E-04	
229Th	0.9982	3.966E-07	
232Th	1.0000	3.743E-07	
232U	0.8281	1.756E-01	
233U	0.9999	1.257E+01	
234U	0.9999	1.594E+01	
235U	1.0000	6.997E-01	
236U	1.0000	2.537E-01	
238U	1.0000	1.594E+01	
237Np	1.0000	1.048E-02	
238Pu	0.8606	1.795E+01	
239Pu	0.9995	1.852E+02	
240Pu	0.9980	6.465E+01	
241Pu	0.4007	4.880E+02	
242Pu	1.0000	1.099E-02	
241Am	0.9700	1.070E+00	
243Am	0.9982	5.651E-04	
242Cm	0.9108	1.244E-03	
243Cm	0.6360	4.240E-05	
244Cm	0.4831	7.730E-04	


Radionuclides Discharged (Ci)
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
A-AX Releases
216-A-1
216-A-7
216-A-8
216-A-9
216-A-16
216-A-17
216-A-18
216-A-19
216-A-20
216-A-23A
216-A-23B
216-A-24
216-A-40
216-A-41


Radionuclides (Ci)
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
H-3
Sr-90
Tc-99
I-129
Cs-137
Sm-151
U-total
Pu-total
A-AX releases
Cribs/Trenches


Chemicals (kg)
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
Al
Butanol
Cr
Fe
K
Na
Ni
NO3
NPH
PO4
Si
SO4
TBP
A-AX releases
Cribs/Trenches


Cribs/Trenches Chemicals (kg)
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
Al
Butanol
Cr
Fe
K
Na
Ni
NO3
NPH
PO4
Si
SO4
TBP
216-A-7
216-A-8
216-A-9
216-A-18
216-A-19
216-A-24

SPREADSHEET FOR DATA ENTRY AND DECAY CALCULATION (SVF-2545)

Decay from	1/1/2001	1/1/1965
Decay to	1/1/2020	1/1/2020
Days of Decay	6939	20088

Radionuclide		Half Life	Lambda		
Name		(years)	(1/day)		
Tritium	3H	12.32	1.540E-04	0.3434	
Carbon-14	14C	5715	3.321E-07	0.9977	
Nickel-59	59Ni	7.6E+04	2.497E-08	0.9998	
Cobalt-60	60Co	5.271	3.600E-04	0.0822	
Nickel-63	63Ni	101	1.879E-05	0.8778	
Selenium-79	79Se	2.9E+05	6.544E-09	1.0000	
Strontium-90	90Sr	28.78	6.594E-05	0.6328	
Yttrium-90	90Y	7.31E-03	2.596E-01	0.6328	
Zirconium-93	93Zr	1.5E+06	1.265E-09	1.0000	
Niobium-93m	93mNb	16.1	1.179E-04	0.4414	
Technetium-99	99Tc	2.13E+05	8.910E-09	0.9999	
Ruthenium-106	106Ru	1.020	1.861E-03	0.0000	
Cadmium-113m	113mCd	14.1	1.346E-04	0.3930	
Antimony-125	125Sb	2.758	6.881E-04	0.0084	
Tin-126	126Sn	2.3E+05	8.251E-09	0.9999	
Iodine-129	129I	1.57E+07	1.209E-10	1.0000	
Cesium-134	134Cs	2.065	9.190E-04	0.0017	
Cesium-137 + Daughters	137Cs	30.07	6.311E-05	0.6454	0.2815
Barium-137m	137mBa	4.852E-06	3.911E+02	0.6092	
Samarium-151	151Sm	90	2.109E-05	0.8639	
Europium-152	152Eu	13.54	1.402E-04	0.3781	
Europium-154	154Eu	8.593	2.208E-04	0.2160	
Europium-155	155Eu	4.75	3.995E-04	0.0625	
Radium-226	226Ra	1599	1.187E-06	0.9918	
Actinium-227	227Ac	21.772	8.716E-05	0.5462	
Radium-228	228Ra	5.76	3.295E-04	0.1017	
Thorium-229	229Th	7.3E+03	2.600E-07	0.9982	

Radionuclide		Half Life	Lambda	
Name		(years)	(1/day)	
Protactinium-231	231Pa	3.28E+04	5.786E-08	0.9996
Thorium-232	232Th	1.40E+10	1.356E-13	1.0000
Uranium-232	232U	69.8	2.719E-05	0.8281
Uranium-233	233U	1.592E+05	1.192E-08	0.9999
Uranium-234	234U	2.46E+05	7.714E-09	0.9999
Uranium-235 + D	235U	7.04E+08	2.696E-12	1.0000
Uranium-236	236U	2.342E+07	8.103E-11	1.0000
Neptunium-237 + D	237Np	2.14E+06	8.868E-10	1.0000
Plutonium-238	238Pu	87.7	2.164E-05	0.8606
Uranium-238 + D	238U	4.47E+09	4.245E-13	1.0000
Plutonium-239	239Pu	2.410E+04	7.874E-08	0.9995
Plutonium-240	240Pu	6.56E+03	2.893E-07	0.9980
Americium-241	241Am	432.7	4.386E-06	0.9700
Plutonium-241 + D	241Pu	14.4	1.318E-04	0.4007
Curium-242	242Cm	4.46E-01		0.9108
Plutonium-242	242Pu	3.75E+05	5.061E-09	1.0000
Americium-243	243Am	7.37E+03	2.575E-07	0.9982
Curium-243	243Cm	29.1	6.521E-05	0.6360
Curium-244	244Cm	18.1	1.048E-04	0.4831

Cerium/Proaseodymium-144		7.78E-01	2.439E-03	1.000000
Curium-243/244		2.85E+01	6.659E-05	1.0000
Niobium-94		2.03E+04	9.348E-08	1.0000
Plutonium-239/240		2.41E+04	7.874E-08	1.0000
Ruthenium/Rubidium-106		1.02E+00	1.861E-03	1.0000
Thorium-228 + D		1.91E+00	9.936E-04	1.0000
Thorium-230		7.54E+04	2.517E-08	1.0000

Half Lives from the 16th Edition of Chart of the Nuclides

Half lifes for radionuclides highlighed are consistent with the Decision Management Tool (DMT) approach used in DOE/ORP-2005-01, *Initial Single-Shell Tank System Performance Assessment for the Hanford Site.*

SIM **RPP-26744**

		P1			A1 SaltCake		
Analyte	Units	Mean	Std	Std/Mean	Mean	Std	Std/Mean
Al	µg/g	0.00E+00	0.00E+00	0.00E+00	2.98E+04	6.31E+03	2.12E-01
Bi	µg/g	0.00E+00	0.00E+00	0.00E+00	2.50E+01	5.30E+00	2.12E-01
Butanol	µg/g	0.00E+00	0.00E+00	0.00E+00	1.03E+03	2.18E+02	2.12E-01
Ca	µg/g	1.46E+02	3.90E+01	2.68E-01	9.46E+01	2.01E+01	2.12E-01
Cl	µg/g	4.99E+02	1.34E+02	2.68E-01	6.45E+03	1.37E+03	2.12E-01
CO3	µg/g	2.18E+02	5.85E+01	2.68E-01	2.18E+04	4.61E+03	2.12E-01
Cr	µg/g	4.05E+02	1.09E+02	2.68E-01	1.81E+03	3.84E+02	2.12E-01
DBP	µg/g	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F	µg/g	0.00E+00	0.00E+00	0.00E+00	1.15E+03	2.45E+02	2.12E-01
Fe	µg/g	1.01E+02	2.72E+01	2.68E-01	6.59E+01	1.40E+01	2.12E-01
Hg	µg/g	3.14E-01	8.42E-02	2.68E-01	2.04E-01	4.33E-02	2.12E-01
K	µg/g	1.20E+02	3.21E+01	2.68E-01	2.04E+03	4.33E+02	2.12E-01
La	µg/g	0.00E+00	0.00E+00	0.00E+00	5.81E-04	1.23E-04	2.12E-01
Mn	µg/g	0.00E+00	0.00E+00	0.00E+00	1.92E+01	4.07E+00	2.12E-01
Na	µg/g	1.61E+04	4.31E+03	2.68E-01	1.95E+05	4.14E+04	2.12E-01
NH3	µg/g	1.39E+02	3.72E+01	2.68E-01	9.80E+02	2.08E+02	2.12E-01
Ni	µg/g	1.04E+02	2.78E+01	2.68E-01	6.73E+01	1.43E+01	2.12E-01
NO2	µg/g	1.23E+04	3.30E+03	2.68E-01	7.82E+04	1.66E+04	2.12E-01
NO3	µg/g	1.05E+04	2.82E+03	2.68E-01	1.37E+05	2.89E+04	2.12E-01
Pb	µg/g	2.25E+01	6.03E+00	2.68E-01	9.38E+01	1.99E+01	2.12E-01
PO4	µg/g	0.00E+00	0.00E+00	0.00E+00	3.72E+03	7.89E+02	2.12E-01
Si	µg/g	2.87E+02	7.69E+01	2.68E-01	1.86E+02	3.95E+01	2.12E-01
SO4	µg/g	4.09E+03	1.10E+03	2.68E-01	7.49E+03	1.59E+03	2.12E-01
U-Total	µg/g	1.07E+00	7.65E+00	7.14E+00	2.07E-01	1.49E+01	7.21E+01

SIM **RPP-26744**

		P1			A1 SaltCake		
Analyte	Units	Mean	Std	Std/Mean	Mean	Std	Std/Mean
Zr	µg/g	0.00E+00	0.00E+00	0.00E+00	5.40E+00	1.14E+00	2.12E-01
H-3	µCi/g	1.44E+00	1.84E+00	1.28E+00	4.71E-01	6.88E+00	1.46E+01
C-14	µCi/g	2.02E+00	8.27E+00	4.10E+00	3.21E-01	5.96E+00	1.86E+01
Ni-59	µCi/g	1.80E+00	1.96E+00	1.09E+00	3.63E-01	6.38E+00	1.76E+01
Co-60	µCi/g	1.20E+00	2.09E+00	1.74E+00	4.89E-01	7.00E+00	1.43E+01
Ni-63	µCi/g	1.75E+00	1.94E+00	1.11E+00	3.60E-01	6.33E+00	1.75E+01
Se-79	µCi/g	1.79E+00	1.97E+00	1.10E+00	4.24E-01	6.86E+00	1.62E+01
Sr-90	µCi/g	1.64E+00	1.89E+00	1.15E+00	4.45E-01	6.76E+00	1.52E+01
Y-90	µCi/g	1.64E+00	1.89E+00	1.15E+00	4.45E-01	6.76E+00	1.52E+01
Zr-93	µCi/g	1.80E+00	1.96E+00	1.09E+00	4.25E-01	6.80E+00	1.60E+01
Nb-93m	µCi/g	1.85E+00	1.98E+00	1.07E+00	4.13E-01	6.77E+00	1.64E+01
Tc-99	µCi/g	1.79E+00	1.96E+00	1.09E+00	4.15E-01	6.73E+00	1.62E+01
Ru-106	µCi/g	3.95E-01	4.42E+00	1.12E+01	1.51E-01	7.74E+00	5.12E+01
Cd-113m	µCi/g	1.46E+00	1.94E+00	1.33E+00	4.77E-01	7.33E+00	1.54E+01
Sb-125	µCi/g	1.01E+00	3.97E+00	3.91E+00	5.47E-01	9.49E+00	1.74E+01
Sn-126	µCi/g	1.76E+00	2.04E+00	1.16E+00	4.29E-01	7.23E+00	1.68E+01
I-129	µCi/g	1.78E+00	2.03E+00	1.14E+00	4.21E-01	7.04E+00	1.67E+01
Cs-134	µCi/g	6.26E-01	2.11E+00	3.36E+00	3.17E-01	9.12E+00	2.88E+01
Cs-137	µCi/g	1.64E+00	1.91E+00	1.16E+00	4.42E-01	6.87E+00	1.55E+01
Ba-137m	µCi/g	1.64E+00	1.91E+00	1.16E+00	4.42E-01	6.87E+00	1.55E+01
Sm-151	µCi/g	1.78E+00	1.90E+00	1.07E+00	3.83E-01	6.34E+00	1.66E+01
Eu-152	µCi/g	1.24E+00	2.32E+00	1.88E+00	5.25E-01	8.67E+00	1.65E+01
Eu-154	µCi/g	1.21E+00	2.16E+00	1.78E+00	5.10E-01	7.72E+00	1.51E+01
Eu-155	µCi/g	1.30E+00	2.75E+00	2.12E+00	4.63E-01	7.13E+00	1.54E+01
Ra-226	µCi/g	3.98E+00	1.05E+01	2.65E+00	5.32E-01	7.25E+00	1.36E+01

SIM **RPP-26744**

		P1			A1 SaltCake		
Analyte	Units	Mean	Std	Std/Mean	Mean	Std	Std/Mean
Ac-227	µCi/g	3.91E+00	1.16E+01	2.97E+00	5.48E-01	7.55E+00	1.38E+01
Ra-228	µCi/g	2.52E+00	6.48E+00	2.57E+00	7.32E-01	9.60E+00	1.31E+01
Th-229	µCi/g	2.00E+00	6.04E+00	3.01E+00	4.60E-01	7.40E+00	1.61E+01
Pa-231	µCi/g	3.88E+00	1.21E+01	3.13E+00	5.56E-01	7.42E+00	1.34E+01
Th-232	µCi/g	2.60E+00	7.10E+00	2.73E+00	7.34E-01	9.60E+00	1.31E+01
U-232	µCi/g	1.70E+00	9.04E+00	5.32E+00	1.80E-01	6.75E+00	3.75E+01
U-233	µCi/g	1.99E+00	7.05E+00	3.53E+00	4.26E-01	7.09E+00	1.67E+01
U-234	µCi/g	1.07E+00	7.71E+00	7.20E+00	2.89E-01	1.71E+01	5.93E+01
U-235	µCi/g	1.05E+00	7.98E+00	7.61E+00	2.72E-01	1.66E+01	6.11E+01
U-236	µCi/g	1.16E+00	8.63E+00	7.43E+00	4.10E-01	1.44E+01	3.52E+01
Np-237	µCi/g	2.11E+00	8.07E+00	3.82E+00	4.62E-01	7.27E+00	1.58E+01
Pu-238	µCi/g	1.67E+00	3.98E+00	2.39E+00	1.50E-01	5.42E+00	3.61E+01
U-238	µCi/g	1.07E+00	7.65E+00	7.14E+00	2.07E-01	1.49E+01	7.21E+01
Pu-239	µCi/g	2.04E+00	1.11E+01	5.42E+00	4.00E-01	7.79E+00	1.95E+01
Pu-240	µCi/g	1.68E+00	8.87E+00	5.29E+00	2.62E-01	7.48E+00	2.86E+01
Am-241	µCi/g	1.60E+00	3.92E+00	2.46E+00	2.69E-01	1.11E+01	4.13E+01
Pu-241	µCi/g	1.41E+00	7.68E+00	5.44E+00	1.19E-01	5.69E+00	4.80E+01
Cm-242	µCi/g	9.56E-01	2.56E+00	2.67E+00	1.18E-01	6.94E+00	5.87E+01
Pu-242	µCi/g	1.01E+00	7.61E+00	7.52E+00	8.82E-02	5.38E+00	6.10E+01
Am-243	µCi/g	9.21E-01	2.56E+00	2.78E+00	9.04E-02	7.52E+00	8.32E+01
Cm-243	µCi/g	7.30E-01	2.52E+00	3.45E+00	5.92E-02	4.51E+00	7.62E+01
Cm-244	µCi/g	7.20E-01	2.60E+00	3.61E+00	5.44E-02	5.18E+00	9.51E+01

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