Historical Vadose Zone Contamination from A, AX, and C Tank Farm Operations

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Abstract: This report compiles information on liquid waste discharged to the soil vadose zone in and around the A, AX and C Tank Farms. Planned discharges (i.e., transfers to cribs) and unplanned releases (spills or tank leaks) are considered. Discharges are presented chronologically and placed in the context of tank farm operations.

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ABBREVIATIONS/ACRONYMS

B	High-level waste generated by B Plant from 1967 to 1978
BL	Intermediate-level waste generated by B Plant from 1967 to 1978.
CWP	PUREX coating waste
DCRT	Double-contained receiver tank
DST	Double-shell tank
FP	Waste generated by B Plant from 1963 to 1967
HS	Waste generated by Strontium Semiworks from 1961 to 1967
ITS	In-tank solidification
LERF	Liquid Effluent Retention Facility
MW	Metal waste
OWW	Organic Wash Waste
PAW	PUREX acid waste (same as P, CAW, HAW, or IWW)
PSN	PUREX supernatant waste
PUREX	Plutonium-Uranium Extraction (Plant)
SNAP	Space Nuclear Applications Program
SST	Single-shell tank
TBP	Tri-butyl phosphate
UNH	Uranyl nitrate hexahydrate
UPR	Unplanned release
WESF	Waste Encapsulation and Storage Facility
WIDS	Waste information data system
1C	Bismuth Phosphate first-cycle waste
2C	Bismuth Phosphate second-cycle waste
224	Plutonium concentrator waste
5-6	B Plant cell drainage waste

GLOSSARY

Crib: An underground liquid waste disposal site filled with soil and/or crushed gravel utilizing the ion exchange properties to remove radioactive contamination. Typically, cribs were operated until contamination was observed in the groundwater beneath the crib.

Double-Contained Receiver Tank (DCRT): A reinforced concrete structure containing a receiver tank for radioactive liquid waste, a pump pit, and a filter pit.

French Drain: A buried horizontal pipe filled with rock, open-ended or perforated, for disposal of liquid waste by seepage into the ground.

Interim Isolation: The process of establishing at least one physical barrier to any credible source of liquid addition to a single-shell tank or other facility, such as a diversion box, and separating the tank atmosphere from the outside air by a filtered ventilation system.

Interim Stabilization: The process of pumping all supernatant waste and as much drainable interstitial liquid as possible from a single-shell tank, typically using a saltwell pump, to minimize the volume of liquid available to leak into the ground.

Reverse Well: A buried vertical pipe with the lower end open or perforated to allow seepage of liquid waste into the ground. Also called *dry well.*

Specific Retention Trench: An unlined excavation used for the disposal of a designated volume of low-level or intermediate-level radioactive waste. Liquid is retained in the trench soil and does not migrate to the groundwater.

Supernate: The supernatant liquid in a tank when all suspended solids have settled.

Tank Bump: A sudden release of a steam bubble from stratified waste in a tank, caused by radiolytic heating of the waste.

Vadose Zone: The portion of the soil below the surface but above the groundwater.

WIDS: The waste information data system (WIDS) comprises the official summary of the history and status of the Hanford waste sites. A general summary report is maintained for each site.

HISTORICAL VADOSE ZONE CONTAMINATION FROM A, AX, AND C TANK FARM OPERATIONS

1.0 INTRODUCTION

This document is a collection of historical information regarding radioactive contamination of the soil surface and vadose zone in the vicinity of the 241-A, 241-AX, and 241-C Tank Farms. Specifically, the information is compiled for the tank farms, all known liquid waste disposal sites (cribs), and all known unplanned releases (UPRs) in the vicinity. The area of interest is shown in Figure 1 (all figures are in Appendix D). Releases are included from initial construction in 1944 to the present. Tables showing disposal sites and UPRs are contained in Appendix A.

Four UPRs have been remediated and are not included in this report:

- On October 15, 1974, contaminated soil was discovered in 241-A Farm (UPR-200-E-47). The contaminated soil was removed and the area released for normal service.
- On November 22, 1974, the 241-A-106 pump pit contaminated the 241-A Farm parking lot (UPR-200-E-48). The area was cleaned and returned to normal service the same day.
- On May 23, 1979, contaminated mud was found in swallow nests at the 244-AR vault, and contaminated tumbleweeds and mud were found outside the containment bag in the 216-A-40 retention basin (UPR-200-E-59). The nests and tumbleweeds were removed, and the basin was decontaminated. The basin was backfilled and the surface stabilized in 1994.
- The soil around the 244-CR vault became contaminated from the numerous piping modifications (UPR-200-E-99). The site was decontaminated in 1981 and released from radiological controls.

Nonradioactive releases (such as fuel spills and septic tanks) and buried radioactive solid waste are excluded from this report. Water discharges to the soil, from precipitation, water line leaks, or decontamination activities, are addressed in Gaddis (1999).

A timeline of events is shown in Appendix B. Crib discharge histories are in Appendix C.

The primary focus of this report is on tank farm operations, which includes spills, tank leaks, and crib discharges. Crib discharges are the largest contributor of vadose zone contamination. Crib disposal outlets are typically located 3 to 10 meters below grade, while most spills occur above ground level and contaminate only the surface. Many spill sites were quickly cleaned up and decontaminated. Additionally, the sitewide volume of waste discharged to cribs is more than 100 times the volume of waste leaked from the tanks (Consort 1994).

The groundwater beneath the A/AX/C Tank Farm complex is approximately 80 meters under ground with a very small (2E-04) hydraulic gradient. The flatness makes it difficult to ascertain the flow direction. Generally, groundwater under A/AX Farms moves to the east, and groundwater under C Farm moves to the southwest, at about 1 meter per day. The groundwater level beneath 200-East Area has been decreasing gradually since B pond was decommissioned in 1995 (Hartman 2001).

The topography of C Farm and of A and AX Farms is such that precipitation can run onto the farm and develop into standing water. Provisions for controlling run-on contamination are described in Gaddis (1999).

2.0 SUMMARY AND CONCLUSIONS

A number of significant discharges of radioactive contamination to the surface soil and vadose zone occurred throughout the operating history of the Hanford Site. The most significant discharges to the area of interest around the A/AX/C Farm complex are summarized as follows:

- Cribs 216-A-8 and 216-A-24 received a total of 1.97E+09 L of single-shell tank (SST) condensate.
- Crib 216-A-9 received 9.81E+08 L of PUREX acid fractionator condensate.
- Cribs 216-A-1, 216-A-18, 216-A-19, and 216-A-20 received a total of 2.65E+06 L of PUREX cold startup waste.
- The largest spill was UPR-200-E-81 (1.36E+05 L). The largest tank leaks were from 241-C-101 (9.10E+04 L) and 241-AX-104 (3.0E+04 L).

Other cribs in the 200-East Area are outside the scope of this report but are mentioned here for comparison. Cribs 216-A-6, 216-A-30, and 216-A-37-2 received 7.7E+09 L of PUREX plant steam condensate. Cribs 216-A-5, 216-A-10, and 216-A-45 received 5E+09 L of PUREX process condensate. Crib 216-A-37-1 received 3.8E+08 L of 242-A evaporator condensate. The BC cribs and trenches received 1.10E+08 L of scavenged tributyl phosphate (TBP) waste.

This report supports previous work on discharges to the cribs associated with the B/BX/BY and T/TX/TY Tank Farm complexes (Williams 1999; Williams 2000). Unlike the B/BX/BY and T/TX/TY Tank Farms, the A/AX/C Tank Farm complex is not completely deactivated. Interim stabilization operations will continue for several more years, and the possibility exists that future contamination events could occur.

3.0 FACILITIES HISTORICAL BACKGROUND

The 241-C Tank Farm contains 12 first-generation, reinforced concrete tanks with carbon steel liners covering the sides and bottoms. The tanks are 23 m (75 ft) in diameter and 4.9 m (16 ft) deep, with a capacity of 2 million liters (530,000 gallons). The tanks are arranged in four rows of three tanks. The tanks in each row are piped together so that when the first tank fills, it overflows (cascades) into the second tank, and the second into the third. Four diversion boxes were originally provided in C Farm; another three diversion boxes, the 244-CR process vault, the 271-CR control house, 271-CRL laboratory, and the 241-C-801 cesium loadout facility were built later. The farm also contains four smaller "200-series" tanks that are 6.1 m (20 ft) in diameter and hold 0.2 million liters (55,000 gallons). These four tanks are piped to diversion box 241-C-252.

The 241-A Tank Farm contains six third-generation tanks similar to C Farm tanks but are 9.1 m (30 ft) deep with a 3.8 million liter (1 million gallon) capacity. The tanks are filled individually and do not cascade. Tanks were connected to each other by overflow lines (which had a water-filled seal loop to isolate individual tanks) and a common vapor header, also with water-filled seal loops. A Farm contains two diversion boxes and no 200-series tanks. A Farm also contains the 241-A-431 vent building, the 241-A-271 control building, and the 241-A-701 compressor building. The 241-A-401 condenser building, the 241-A-417 catch tank, the 241-A-702 filter building, and the 241-A-350 drainage lift station were constructed later. Since A Farm was designed to store boiling waste, it was equipped with leak detection caissons and laterals (see Section 4.0) (Anderson 1990).

The 241-AX Tank Farm contains four, fifth-generation tanks. These tanks are identical to the tanks in A Farm, but with a grid of drain slots beneath the steel liner bottom. The grids collect potential tank leakage, which is diverted to a leak detection well. The grids also provide an escape route for free water formed as it is released from the concrete grout during initial heating of the tank. AX Farm contains the 241-AX-152 diverter station and the 2707-AX change house, but no 200-series tanks. AX Farm has no leak detection caissons (Anderson 1990).

Other facilities located in and around the A/AX/C Farm complex are:

- 244-AR vault
- 241-AX-151 diverter station
- 204-AR unloading station
- 244-A lift station

The A/AX/C complex operations can be separated into six operational phases:

- Construction and bismuth phosphate operations, 1944-1952
- Uranium recovery operations, 1952-1957
- PUREX operations 1956-1972, 1983-1988
- Waste fractionation operations 1961-1978
- Tank farm interim stabilization and isolation began in 1975

Sanitary water was provided to the 271-CR control building in C Farm. Sanitary water was provided to the 241-A-271 control building in A Farm. Later, sanitary water was provided to the 2707-AX change house in AX Farm, the 244-AR vault, and the 242-A evaporator.

3.1 Construction and Bismuth Phosphate Operations (1944-1952)

The Hanford Site was constructed as part of the Manhattan Project to produce plutonium by chemical separation from irradiated fuel slugs using the bismuth phosphate process. Preliminary design (1943) called for four separations plants (B, C, T, and U) and their associated tank farms, but later development reduced that number to three. C Plant construction was cancelled, but by that time, 241-C Tank Farm had already been built. Figure 2 shows facilities constructed during that time.

The bismuth phosphate process produced five waste streams:

- Metal waste (MW) was the byproduct from the plutonium separation phase of the bismuth phosphate process. MW contained unfissioned uranium and approximately 90% of the fission products of the irradiated fuel.
- First-cycle waste (1C) was the byproduct from the first plutonium decontamination cycle of the bismuth phosphate process. This waste contained about 10% of the fission products of the irradiated fuel. This waste also contained coating-removal waste.
- Second-cycle waste (2C) was the byproduct from the second and last plutonium decontamination cycle of the bismuth phosphate process. This waste contained less than 0.1% of the fission products of the irradiated fuel. C Farm did not store 2C.
- The 224 waste was low-level liquid waste from the 224-B plutonium concentrator building. This waste stream was the primary contributor to plutonium contamination of the soil. This waste was discharged to the 216-B-5 reverse well, which is outside the scope of this report but is described in Williams (1995).
- The 5-6 waste was low-level liquid waste from floor drains in individual process cells in B Plant. Drainage from the cells was stored in the 5-6 tank before being discharged to the 216-B-5 reverse well.

During World War II, MW, 1C, and 2C were stored in tanks at B Farm, which is outside the scope of this report but is described in Williams (1999). In December 1946, underground lines were constructed from the 241-B-154 diversion box near B Plant to the 241-C-151 and 241-C-152 diversion boxes in C Farm (see Figure 3). MW from B Plant was stored in the 241-C-101/2/3 and 241-C-104/5/6 cascades, and 1C from B Plant was stored in the 241-C-107/8/9 and 241-C-110/1/2 cascades (Anderson 1990).

Ground disposal of aqueous industrial waste, relying on the ion exchange properties of the soil to decontaminate the water as it percolates to the aquifer, was a commonly accepted method in the 1940s. The ability of Hanford topsoil and substrate to adsorb radioactive material was tested at the Clinton Site in Tennessee (now the Oak Ridge National Laboratory) and at the University of California at Berkeley in 1944. Tests determined that ground disposal of 5-6 and 224 was acceptable, but ground disposal of 1C and 2C was not. Methods to treat 1C and 2C to facilitate ground disposal were investigated at the time, but were unsuccessful (Parker 1944; Patterson 1945; Leader 1945).

In September 1946, the Army Corps of Engineers Manhattan District selected General Electric Company to replace DuPont as the Hanford prime contractor. Pursuant to the McMahon Atomic Energy Act of 1946, control of the Hanford Site passed from the Army to the civilian Atomic Energy Commission (AEC) on January 1, 1947. The AEC opted to maintain Hanford as a permanent facility rather than dismantle it, as happened to many other wartime munitions plants. Wartime production had filled all available tank storage space, so plans were made to increase high-level waste storage capacity and to recover some tank space. These plans included disposing of the relatively low-level 2C waste into the ground, and concentrating the intermediate-level 1C waste in an evaporator. Plans were also made to recover the unfissioned uranium in the MW (by 1947, most of the world's known supply of uranium was in the Hanford Site waste tanks) (Gerber 1991).

From 1947 to 1949, many new facilities were constructed at Hanford. The Hot Semi-Works complex, facilities for the planned uranium recovery mission (see Section 3.2), and other facilities beyond the scope of this report (BX, BY and TX Tank Farms, Z Plant, H Reactor, DR Reactor) were all built during this period (Gerber 1991). Figure 3 shows facilities constructed for post-war bismuth phosphate and uranium recovery operations.

The 242-B and 242-T evaporators were built in 1951 to reduce the volume of stored 1C. C Farm 1C was retrieved from January to March 1952 and evaporated in 242-B. A dedicated underground line (V121) was built for retrieval, and the waste was pumped from 241-C-152 to 241-B-154 to 241-B-152, which connected to evaporator feed tank 241-B-106. B Plant was shut down in 1952 (Anderson 1990; Williams 1999). The operations in 242-B are described in Williams (1999).

Conflicting information exists regarding the piping used for 1C retrieval. Line V121 is shown on drawing H-2-2021, but this drawing has no "as-built" note. The piping encasement from the 241-CR-151 diversion box to the 200-series tanks is shown in the same location as V121 on drawing H-2-41126, which gives an "as-built" date of October 14, 1952. Anderson (1990) says that 1C retrieval was finished on August 15, 1952, and MW retrieval in the 200-series tanks began no earlier than October 1953. This leaves over a year to remove V121 and build the encasement, however drawing H-2-41126 indicates it may have been only two months. Installation of a dedicated line for 1C retrieval was done for T, TX, and U Farms. Most likely, V121 was installed and used, then removed when the encasement was built in September 1952. It is possible that the "as-built" dates on some drawings may be wrong.

No UPRs occurred in C Farm during this time.

3.2 Uranium Recovery Operations (1952-1957)

U Plant was originally constructed during World War II as a bismuth phosphate plant, but was not needed for that purpose, and the facility was used as a simulator. It was modified in 1951 for uranium recovery operations using the TBP process. For this reason, U Plant was frequently referred to as the "TBP Plant." Beginning in October 1952, MW was sluiced from tanks in C Farm, treated in the 244-CR process vault, and transferred to U Plant via the cross-site transfer line. MW in the 200-series tanks was sluiced out in early 1954. MW from B, T and U Farms was also sent to U Plant for uranium recovery. Newly generated MW from T Plant was also sent to U Plant for uranium recovery, until T Plant shutdown in 1956. Uranium recovered by this method was in the form of uranyl nitrate hexahydrate (UNH), which was sent to the 224-U building for conversion to UO_3. 224-U was known as the "UO_3 Plant" (Rodenhizer 1987; Anderson 1990).

The uranium recovery facilities in C Farm include the 271-CR control house, the 244-CR vault, the 241-CR-151, -152, and -153 diversion boxes, and modifications to the underground piping system. Other facilities which are outside the scope of this report, but relevant, include the cross-site transfer line, the 241-ER-151 diversion box near B Plant, the BY cribs, and the BC cribs. Figure 3 shows facilities constructed for uranium recovery.

Uranium recovery operations produced two waste streams: TBP waste and low-level waste. TBP waste, concentrate from the waste concentrator, was returned to the tank farms, including C Farm (all tanks). The design called for the same volume of TBP waste to be produced as the volume of MW processed, but inefficiencies in the process resulted in approximately twice as much TBP waste produced as the MW processed. A total of 215 million liters of TBP waste was produced. Low-level waste included condensate from the feed concentrator, waste concentrator, and HNO_3 fractionator. This waste was sent to various cribs that are outside the scope of this report. Cooling water and cell drainage from the TBP Plant were discharged to U pond, also outside the scope of this report (Waite 1991; DiLorenzo 1994; GE 1951).

Despite additional tank farm construction and ongoing volume reduction efforts, tank space was not sufficient to support both the uranium recovery mission and plutonium production. To reduce the volume of stored waste, TBP waste was concentrated in the 242-T and 242-B evaporators beginning in July 1953 (very little C Farm waste was evaporated – some from 241-C-112 in the third quarter of 1953). Additionally, a ferrocyanide scavenging process was developed to remove the principal long-lived fission products, ^{137}Cs and ^{90}Sr, from the TBP waste to enable disposal of the waste supernate to the cribs. Beginning in September 1954, TBP waste was scavenged in U Plant, instead of being evaporated. The scavenged waste from U Plant was transferred to BY Farm only (see Williams 1999) (Anderson 1990).

The 244-CR vault was modified in 1955 to scavenge TBP waste that was stored in C Farm, and the 241-C-601 chemical makeup building was constructed. Nickel ferrocyanide was added to the TBP waste, which caused the ^{137}Cs to precipitate and join the ^{90}Sr in sludge settling at the bottom of the vault tank. The scavenged waste supernate could then be discharged to cribs. New piping was installed to facilitate TBP retrieval from the 241-C-107/8/9 and 241-C-110/1/2 cascades. TBP could be jetted out of these tanks to the 241-C-104 pump pit and transferred to the 244-CR vault via the existing encasements. Beginning November 1955, TBP waste was retrieved from the C Farm tanks and sent to 244-CR, using the encasements and pump pits. The 244-CR vault received TBP waste from only two tanks outside C Farm: 241-BX-108 and 241-BX-109.

Scavenged TBP waste was transferred from 244-CR via the 241-CR-151, 241-C-151, and 241-C-252 diversion boxes to 241-C-109 and 241-C-112 to settle, and from there to the BC cribs and trenches. Cribbing of scavenged TBP waste began in November 1954. Approximately 155 million liters (41 million gallons) of scavenged TBP waste was discharged into the ground. Of this, approximately 44 million liters (12 million gallons) resulted from in-farm scavenging in the 244-CR vault. The BC cribs and trenches are outside the scope of this report, and are over 2 kilometers from the nearest tank farm. The 241-C-601 building was torn down in August 1973 (Anderson 1990; Waite 1991).

The 241-CR steam cleaning pit was dug in 1954, northwest of 241-C-103. No further information is available about this facility (Baldridge 1959).

Two UPRs occurred in C Farm during this period. Installation of a transfer pump in the 244-CR vault on November 26, 1952, resulted in the spill of liquid waste to the ground (UPR-200-E-107). Airborne contamination spread from 241-C-107 to C Farm and the south bank of the parking lot on April 20, 1957 (UPR-200-E-118).

3.3 PUREX OPERATIONS 1956-1972 (1983-1988)

The PUREX process was the third and final plutonium separation process used at the Hanford Site, and the PUREX plant ultimately processed approximately 72% of the irradiated fuel produced at Hanford. The process recovered both plutonium (in the form of plutonium nitrate) and uranium (in the form of UNH) in a continuous solvent extraction process, and also recovered nitric acid and the TBP organic solvent for reuse. This innovation minimized waste generation and resulted in PUREX waste being more highly concentrated than other Hanford waste streams. The PUREX plant, the 241-A Tank Farm, and various and waste transfer lines and cribs were constructed for PUREX operations (Courtney and Clark 1954; Gerber 1993; Anderson 1990). Figure 4 shows the PUREX facilities constructed in the area of interest.

The use of TBP instead of the more flammable methyl isobutyl ketone (hexone) that had been used in the REDOX plant was also a safety improvement. Plutonium nitrate product generated by the PUREX plant was trucked to the Plutonium Finishing Plant (PFP), and UNH byproduct was trucked to the UO_3 Plant (Gerber 1993).

The PUREX plant produced various low-level waste streams and three high-level waste streams: PUREX coating waste (CWP), PUREX acid waste (PAW), and organic wash waste (OWW), also called "carbonate." PAW, which contained 99% of the fission products, was also known as P, HAW, CAW, and IWW. These waste streams are described in subsections below (Courtney and Clark 1954; Anderson 1990).

PUREX cold startup waste was discharged to 216-A-1 in November 1955 via an overground line from proportional sampler pit 3. When the specific retention capacity was reached, cold startup waste was then discharged to 216-A-18 in November 1955, 216-A-19 in November/December 1955, and 216-A-20, all via an overground line from proportional sampler pit 2 and the 216-A-34 ditch. It is believed that this was the only use of the 216-A-34 ditch (Heid 1956; Baldridge 1959; WIDS). The Hanford Engineer Works monthly report for December 1955 (GE 1956) states that AEC approval to crib the cold startup waste was obtained during that month. Analytical data for these discharges is presented in the following table:

PUREX Cold Startup Waste Disposal		
Crib No.	Waste Volume (L)	U (kg)
216-A-1	1.00E+05	152
216-A-18	8.02E+04	19
216-A-19	4.88E+05	2460
216-A-20	9.61E+05	N/A

3.3.1 PUREX High-Level Waste Streams

Self-boiling PAW and OWW from PUREX were stored in A Farm. The first waste discharges to 241-A-101 and 241-A-102 were not sufficiently concentrated to boil, so OWW was temporarily segregated and sent to 241-C-110. Subsequent waste discharges to A Farm did boil (see Section 3.3.2) (Anderson 1990).

Non-boiling CWP was sent to now-empty tanks in C Farm. Lines V050 from diversion box 241-A-152 to the 241-CR-151 diversion box, and V051 from 241-A-152 to the 244-CR vault, were built for this purpose. As the Uranium Recovery project provided space in B/BX/BY Farms (see Williams 1999), CWP was transferred there from C Farm beginning in 1957. In 1962, tank 241-C-102 was designated as the CWP receiver tank, and all CWP from PUREX went there. From 241-C-102, CWP was pumped to B/BX/BY Farms via the 241-CR-152, 241-CR-151, 241-C-151 and 241-B-154 diversion boxes (Anderson 1990).

New pump discharge line 8107 was built from 241-C-102 to 241-CR-152 in 1966 for CWP transfer to B/BX/BY. When the Waste Fractionization Program got underway in B Plant in 1968 (see Section 3.4), OWW was sent to 241-C-102 along with CWP. Line V843 was built in January 1969 and allowed CWP/OWW to be discharged from 241-CR-151 directly to 241-C-102, bypassing the 241-CR-152 diversion box (this simplified the routing to B/BX/BY). Line V844 was built at the same time, tying into 8107 and allowing 241-C-102 to discharge to 241-CR-151 instead of 241-CR-152. Additionally, line V051 from 241-A-152 to the 244-CR vault was rerouted to 241-CR-151 (Anderson 1990; H-2-33087, Rev 0, 3).

Several months later, in October 1969, CWP leaked from line V051 (UPR-200-E-81). Lines V050 and V051 from diversion box 241-A-152 were modified in November 1969 to bypass the 241-CR-151 diversion box and discharge CWP/OWW directly into 241-C-104 instead of 241-C-102. This waste was transferred from 241-C-104 to B/BX/BY Farms from 1969 to 1973, and from 241-C-104 to 200-West Area from 1973 to 1976 (Anderson 1990; H-2-33087, Rev 5).

There is a discrepancy between drawings H-2-33087 and H-2-44502, sh 7, regarding the piping from the 241-CR-151 and 152 diversion boxes to 241-C-102 and 104. Drawing H-2-44502 shows line 8107 discharging to tank 241-C-102 via a riser along with abandoned line V843, and line V844 connected to V843 and discharging to tank 241-C-104 via a riser. Drawing H-2-33087 shows line V843 discharging to 241-C-102 via a riser, and lines 8107 and V844 connected to the pump discharge line from 241-C-102. It is believed that drawing H-2-44502, sh 7, is wrong.

The overground transfer line from 241-C-105 to 241-C-108 broke sometime between January 1956 and July 1959 and spilled 190 L (50 gallons) of CWP to the ground (UPR-200-E-16). On November 1, 1960, during work in the 244-CR vault, wind spread contaminated particles eastward (UPR-200-E-27).

3.3.2 Tank Farm Ventilation System

PAW was sent to A Farm beginning in January 1956. The more efficient PUREX process was expected to produce highly concentrated waste that was expected to boil. This boiling was regarded as an efficient method of volume reduction. The A Farm tanks were designed to accommodate self-boiling waste, based on experience gained in storage of Redox self-boiling waste in SX Farm. Four airlift circulators were installed in each tank, powered by two air compressors in the 241-A-701 building, and a vapor exhaust system exhausting through the 241-A-431 building (Anderson 1990).

The original tank farm ventilation system consisted of an underground vent header connected to all six A Farm tanks, the TK-401 deentrainment vessel, and direct buried contact condenser E-411 (E-412 was an installed spare condenser). TK-401 drained to 241-A-106, which was initially used only to collect condensate, not to store waste. Condensate/cooling water from the contact condensers drained to the 241-A-08 valve pit, and from there to the 216-A-8 crib. The condensers were vented to the 241-A-431 vent building, where the vapors were routed through another deentrainer to the 241-A-11 stack. Drainage from this stack went to the 216-A-16 and 216-A-17 French drains near the 241-A-431 building. Drainage from the deentrainer went to 216-A-23A and 216-A-23B French drains. A bypass line containing a water-filled seal pot connected the vent header (upstream of TK-401) directly to the 241-A-11 stack. If a tank bump occurred, headspace vapors would blow out the vapor header seal loop and the bypass seal pot and go directly to the stack (O'Neill 1956).

In May 1958, crib 216-A-8 reached its radionuclide capacity and the condensate/cooling water waste stream was diverted to crib 216-A-24 (WIDS).

There is a discrepancy in the description of the waste going to crib 216-A-8. Lundgren (1970) states that from November 1955 to December 1957, tank farm condenser cooling water went to 216-A-34 and condensate went to crib 216-A-8. In December 1957, the two streams both went to 216-A-8, and 216-A-34 was retired from service. This continued until May 1958, when crib 216-A-8 was retired from service and the condensate was rerouted to 216-A-24, and the cooling water rerouted to 216-A-25. However, the condensate and cooling water were commingled in the contact condensers and could not have been separated. Additionally, crib discharge records show little change in discharge volume to 216-A-8 around December 1957 (Bernard 1958 and Baldridge 1958). It is believed that the combined cooling water/condensate waste steam was discharged to 216-A-8 from PUREX startup until May 1958, and that 216-A-34 was used only for disposal of cold startup waste, as described above. This discrepancy is repeated in Maxfield (1979) and WIDS.

Dissatisfaction with the performance of the contact condensers led to their replacement in October 1959 by surface condensers in the 241-A-401 building (project CA-719). The new condensers still vented to the 241-A-431 building. Cooling water went to the newly built 216-A-25 Gable Mountain pond. Condensate drained to the 241-A-417 catch tank, and overflowed to the 216-A-24 crib. This modification reduced the condensate discharge volume to crib 216-A-24 by 95%. Cooling water was supplied by the raw water system. If raw water was unavailable, backup cooling was supplied by a closed-loop system with forced draft cooling towers and makeup water from a well (Wood 1957; GE 1960).

Crib 216-A-24 reached its radionuclide capacity in July 1966, and the condensate was diverted back to crib 216-A-8 until April 1976, when it was diverted to double-shell tanks (DSTs) instead of ground disposal. From 1973 to 1976, the 241-A-417 catch tank condensate was filtered by an ion exchange column prior to discharge to 216-A-8. A small amount (600 L) of condensate was discharged to the crib in 1978 (McMurray 1967; Mirabella 1977; Anderson and Poremba 1979; Stickney and Lipke 1998; WIDS). The crib discharge history for 216-A-8 is shown in Table C-1, and the crib discharge history for 216-A-24 is shown in Table C-2 (see Appendix C).

The 241-AX Tank Farm and the 241-AX-151 and 241-AX-152 diverter stations were built in 1965. The AX Farm vapor header was tied into the 241-A Farm vapor header, upstream of the 241-A-401 condenser building (Doud et al 1962). Later, AY and AZ Farms tied into this system.

The 241-A-702 filter building was added in March 1969 to filter the headspace air. The 241-A-431 vent building was taken out of service at this time and the 216-A-16, 216-A-17, 216-A-23A, and 216-A-23B French drains were decommissioned. Discharge records were not kept for these drains, but estimates of the total discharges are included in Appendix A (WIDS).

In 1959, moisture dripping from a vent pipe bonnet at the 241-A-08 proportional sampler pit contaminated the ground near the 241-A-271 building (UPR-200-E-18).

3.3.3 Other PUREX Low-Level Waste Streams

PUREX process condensate was sent to crib 216-A-5 from startup until contamination broke through to the groundwater in November 1961, then to the 216-A-10 ditch until that broke through in May 1987, then finally to crib 216-A-45 until September 1991. Crib 216-A-38 was built to replace 216-A-10 but it was not used (Maxfield 1979). These cribs are outside the scope of this report.

PUREX steam condensate and drainage went to crib 216-A-6 from startup until January 1961, when 216-A-6 overflowed and caved in. From 1961 until 1992, it was sent to crib 216-A-30. In July 1964, 216-A-30 overflowed and 216-A-6 was reactivated until October 1966, when it overflowed again and was abandoned for good. From PUREX restart in 1983 until final shutdown in 1992, PUREX steam condensate and drainage was sent to the 216-A-37-2 ditch. Cribs 216-A-6 and 216-A-30 operated together from 1964 to 1966, and 216-A-30 and 216-A-37-2 operated together from 1983 to 1992 (Maxfield 1979; WIDS). These cribs are outside the scope of this report.

The 241-A-152 diversion box sump was originally equipped with an automatic siphon that discharged to the 216-A-7 crib in lieu of a catch tank. The crib received drainage from the diversion box sump from January 1956 until July 1959, when the 241-A-302B catch tank was built and piped to the sump drain. The catch tank was set up to overflow to the crib; however, no such overflow is documented. On November 22, 1966, 2.46E+05 L (65,000 gallons) of organic TBP-Soltrol waste was trucked from PUREX and discharged to the crib via the vent riser. In 1985, project B-231 isolated the 241-A-302B catch tank (H-2-57452; Eliason 1967). The crib discharge history for 216-A-7 is shown in Table C-3 in Appendix C.

There is a discrepancy regarding the discharges to crib 216-A-7. Lundgren (1970) states that the crib was still active at the time of publication (January 1970). Eliason (1967) states that the crib was abandoned in July 1959, when the catch tank was installed. Crib discharge records show no discharges after December 1956. It is possible that discharges continued from December 1956 to

July 1959 but were not recorded due to the low volumes involved. After July 1959, the crib was most likely not used, and any catch tank contents were pumped out to the tanks. (GE 1955, Courtney and Cox 1954).

Crib 216-A-9 received PUREX acid fractionator condensate and condenser cooling water from March 1956 to January 1958. This waste stream was then diverted to the 216-A-29 ditch via the PUREX chemical sewer (see Section 3.3.3). From April 1966 through October 1966, the crib received N Reactor decontamination waste via the manhole at the crib site. The crib was inactive but on standby from then until August 1969, when it was decided to discharge the acid fractionator condensate back to the crib. When this was tried, it was discovered that the effluent pipeline had failed, and so the waste was diverted back to ditch 216-A-29 (Lundgren 1970). The crib discharge history for 216-A-9 is shown in Table C-4 in Appendix C.

There is a discrepancy regarding the waste discharged to crib 216-A-9 in 1966-67. Anderson (1976) says that the crib received 1.82E+06 L in 1966 and 1.89E+05 L in 1967 (waste type not specified). McMurray (1967) says there was no discharge in 1966, and Uebelacker (1968) reports a discharge of 1.89E+06 L of N Reactor waste in 1967.

Numerous minor PUREX low-level waste streams went to various cribs around the plant that are outside the scope of this report.

3.3.4 PUREX Cooling Water and Chemical Sewer

PUREX cooling water was first discharged to the old A pond east of PUREX, which was a natural depression at the terminus of the original 200-East Area powerhouse drainage ditch. Powerhouse waste was diverted to the 216-B-2 ditch and B pond when PUREX was built, and the PUREX chemical sewer line was routed to the old drainage ditch outfall structure.

This discharge raised the water table under 200-East Area so much that crib 216-A-8 broke through to groundwater in December 1956. It was decided to send the cooling water elsewhere. Ditch 216-A-29 was built that connected the chemical sewer ditch and the cooling water line outfall. In December 1957, the old A pond was eliminated by tying the chemical sewer and the cooling water lines together at ditch 216-A-29, which emptied into the 216-B-3 pond.

A valve box was built in the cooling water discharge line to allow diversion to either the 216-A-29 ditch and B pond or to the newly built 216-A-25 Gable Mountain pond via an underground line. PUREX cooling water was diverted to the Gable Mountain pond (70%) and B pond (30%). The Gable Mountain pond was taken out of service in 1975 and decommissioned in 1987 (Gerber 1993).

After PUREX restart in 1983, cooling water went to B pond, which was modified for this purpose by the construction of three expansion lobes. B pond was decommissioned in 1995, when the 200-Area Liquid Effluent Retention Facility (LERF) opened. Although cooling water and chemical sewer waste were normally uncontaminated, occasional UPRs contaminated the 216-A-29 ditch. These UPRs are outside the scope of this report.

3.3.5 PUREX Waste in Tank 241-A-105

Tank 241-A-105 received PAW beginning in January 1963, and reached boiling on March 5. An apparent small leak was noticed in November 1963, when the tank was half full. The leak was thought to self-seal. Because experience had indicated that adding waste to a self-boiling tank that had been allowed to settle for a period of time could cause a temperature excursion, the filling continued. Tank 241-A-105 was filled to capacity in December 1964. On January 28, 1965, a sudden steam release occurred in 241-A-105. The earth in the immediate vicinity of the tank was reported to have trembled, and a temporary lead cover on a riser on tank 241-A-103 was dislodged allowing steam to vent from this opening for about 30 minutes. At the time of the bump, construction personnel were preparing to make a final weld in line 4105 connecting tank 241-A-105 with the 241-AX-151 diverter station. Several liters of liquid were ejected onto the ground in the excavation. Radiation dose rates of 4 Sv/hr (400 R/hr) were measured 30 cm (1 ft) from the spill. The 241-A-105 tank instrument enclosure had a dose rate of 5 Sv/hr (500 R/hr) at 30 cm (1 ft), and the liquid level electrode tape was broken. This event differed from previous tank bumps in that it occurred while the airlift circulators were operating (Beard et al. 1967).

An attempt to install an air sparger in a 10-cm (4-in) riser disclosed an obstruction 2.4 m above the normal position of the tank bottom. Additionally, airlift circulator dip tube static pressure readings indicated that either the piping was broken or the circulators had been physically elevated about 1.8 m. Nine holes were drilled through the tank dome and confirmed that the tank bottom was bulged upward by 2.6 m, providing a void volume of 3.03E+05 L underneath the bottom of the tank liner. A description of analyses of tank conditions following the bump is in Beard et al (1967). The tank would not be emptied until it was scheduled for sluicing or until further deterioration was detected. A third leak detection caisson was built near tank 241-A-105 in 1967 (see Section 4.0). The initial leakage amount was between 1.90E+04 L and 5.70E+04 L (Jansen 1965; Beard et al. 1967).

New leakage from the tank was noticed in October 1967 (UPR-200-E-126). The tank was sluiced to the 244-AR vault beginning in August 1968. The sluicing was stopped in November 1970 with a sludge heel remaining in the tank, because readings from the laterals indicated that the sluicing had aggravated the leak. At this time, another 1.90E+04 to 1.14E+05 L leaked from the tank. To cool the remaining sludge, cooling water was added to the tank weekly from November 1970 to December 1978. The total amount of cooling water added was 2.31E+06 L. Pursuant to Washington State law, all cooling water that was not evaporated is included in the leak volume estimate. Allen (1991) estimates the volume of evaporated cooling water at 1.43E+06 to 1.55E+06 L. The final leakage amount is therefore between 7.95E+05 L and 1.05E+06 L (WHC 1991; Hanlon 2001). The 1900-L waste volume given by WIDS for UPR-200-E-126 is incorrect.

3.3.6 PUREX Shutdown and Restart

PUREX was placed in standby in 1972 to allow accumulation of N Reactor spent fuel, and sluicing of A and AX Farms (see Section 3.4). The standby was intended to be 18 months, but various events prevented restart until 1983. PUREX steam condensate went to the 216-A-37-2 ditch. Process condensate went to crib 216-A-45 (Gerber 1993). These ditches are outside the scope of this report.

Crib 216-A-8 was reactivated for the restart, receiving steam condensate from the DSTs in AY and AZ Farms. Unfortunately, the Sr concentration in the tank condensate was too high, so the discharge was rerouted to the DSTs after only 3 days in 1983. This condensate was again discharged to 216-A-8 for a few months in 1984. This waste was rerouted to the DSTs in 1985, and the crib was deactivated permanently. The overflow line from catch tank 241-A-417 was capped at the tank in 1987, and the 216-A-508 distribution box was grouted in April 1995 (Aldrich 1984; Aldrich 1985; Aldrich 1986; WIDS).

Final PUREX shutdown was in 1988, and the closure order came in 1992. Following final PUREX shutdown, cribs 216-A-26, 216-A-30, 216-A-37-2, 216-A-45, and the 216-A-29 ditch received discharges until the 200 Area LERF opened in 1995. These cribs are outside the scope of this report (Gerber 1993; WIDS).

3.4 Fission Product Recovery (1961-1967) and Waste Fractionization Operations (1967-1978)

The concept of recovering fission products with industrial uses (primarily ^{137}Cs) began in the mid-1950s. The country's largest source of fission products was at Hanford. Removal of these isotopes from the PUREX waste stream would also make waste storage cheaper and waste disposal easier. Methods for scavenging Cs and Sr from liquid waste were developed during the Uranium Recovery Mission (see Section 3.2), and reduced storage costs so much that immediate research was begun in the mid-1950s on scavenging REDOX and PUREX waste for similar savings. There was also a growing commercial market for these isotopes. Since the isotope separation process involved precipitation and centrifugation, the first idea was to use B Plant to do this, since it had this equipment and was no longer needed. Plans were made to refurbish B Plant to remove Cs and Sr from PUREX waste (Tomlinson 1956).

An urgent need for ^{90}Sr by the Space Nuclear Applications Program (SNAP) resulted in an acceleration of the fission product recovery project in August 1960. An improvement in the PUREX process allowed modifications to the plant head-end that facilitated recovery. The 244-CR vault was reactivated for the program, and the Hot Semiworks complex would be a pilot plant until B Plant modifications were complete. Hot Semiworks was modified and renamed Strontium Semiworks and production began in July 1961. PAW was pumped via diversion box 241-A-152 and line V051 to 244-CR vault, allowed to age, then sent via line 8900 to Strontium Semiworks for purification. Sr product was loaded into shipping casks at 201-C for offsite shipment to customers (SNAP generators). Sr-depleted PAW waste from Strontium Semiworks (HS) was sent to tanks 241-C-107/8/9 in C Farm. The 271-CRL laboratory was built in C Farm in 1962 (Beard and Swift 1960; Judson 1960; GE 1961; Anderson 1990; Tomlinson 1963). Figure 5 shows facilities constructed in C Farm to support waste fractionization operations.

As well as ^{90}Sr, ^{137}Cs was recovered from PUREX waste during this time. Originally, in 1961, Cs was separated in 212-A. Beginning in 1963, stored PUREX supernate waste (PSN) from 241-C-103 was pumped to the 241-C-801 cesium loadout facility in C Farm and Cs product was loaded into shipping casks for offsite shipment. Newly constructed line V109 from 241-A-101 to 241-C-151 allowed PSN from A Farm to refill 241-C-103. Depleted PSN was returned to 241-C-102 and was eventually transferred (along with CWP) to BY Farm for in-tank solidification (ITS). ITS is described in Williams (1999). Use of the 241-C-801 facility ended in 1969 (Michels 1961; Beard et.al 1964; Anderson 1990; Tomlinson 1963).

B Plant was used for partial Sr recovery work from 1963 to 1967. Beginning in August 1963, PAW was sent from the 244-CR vault to B Plant via line 8902 to 241-C-151, 241-B-154, and 241-BX-154. It was precipitated and concentrated, allowed to age, and later sent to Strontium Semiworks via line V743 for final purification. HS waste was sent to C Farm as before. Process condensate and other waste from B Plant (FP) was sent to B Farm, and was also sent (via tank 241-B-112) to 241-AX-101 in 1965 (Anderson 1990; Caudill and Zahn 1961; GE 1963). Figure 6 shows facilities constructed in A and AX Farms for waste fractionization operations.

Beginning in late 1967, B Plant went into full operation and began isolating Cs (by ion exchange) and Sr. Sr purification was also done in B Plant, and so Strontium Semiworks was no longer needed and was shut down (the facility was retired in 1967 and was decommissioned from 1983-87). Sr was now recovered by solvent extraction in B Plant instead of the previous precipitation method. PAW was now routed to B Plant via 241-AX-151 and the new 244-AR vault for Sr recovery, instead of via the 244-CR vault. In addition, B Plant received PSN from feed tank 241-C-105, via line V130, for Cs recovery by ion exchange. More than 95% of the Sr and Cs in PAW was removed in B Plant. Line V103 from 241-C-151 was modified in 1968 to bypass 241-C-104 and allow PSN transfer from AX Farm to 241-C-105. Redox supernate from SX Farm was also sent to B Plant for fractionization in 1970-'71. OWW was no longer mixed with PAW for storage; it was now mixed with CWP and sent to 241-C-102, and from there to BX Farm for ITS (see Section 3.3.1) (Buckingham 1967; Anderson 1990; Liverman 1975).

In between PAW transfers, sludge was sluiced out of the A/AX tanks for Sr recovery. Tank 241-A-101 was sluiced first in 1968, then 241-A-104 in 1969, and 241-A-106 in 1970. In the 244-AR vault, the sludge, called PUREX sludge waste (PSW), was dissolved in acid. The resulting PUREX acidified sludge (PAS) was pumped to the 244-CR vault via the 241-AX-151 diverter station and line 8656 for lag storage, and from there to B Plant via line 8653. Since PUREX was operating almost constantly, little sluicing was done until PUREX shutdown in 1972 (see Section 3.3.6). Following shutdown, the 244-AR vault was modified for full-time sludge processing and tank sluicing was accelerated. Sr and Cs were encapsulated and stored in the Waste Encapsulation and Storage Facility (WESF) beginning in 1974. Encapsulation was completed in 1985 (Anderson 1990; Rasmussen 1980).

B Plant produced four waste streams. High-level B, Sr-depleted PAW slurry similar to HS, went to AX Farm for storage. Intermediate-level BL (which was primarily ion-exchange waste, but also included waste concentrator concentrate), from PSW and PSN processing, went to B/BX/BY tanks for ITS (which ended in 1974). Process condensate went to the 216-B-12 crib, and organic waste to the 216-B-56 crib. Cooling water was discharged to B pond. Aside from the B waste, these waste streams are outside the scope of this report (Doud and Roddy 1964; Buckingham 1967; Agnew 1994).

Fractionization of stored waste continued until 1978, when the last of the stored waste in A and AX Farms was retrieved. Tank 241-A-102 was sluiced in 1973, 241-A-103 in 1974, 241-AX-101 in 1975, 241-AX-102 in 1976, 241-AX-103 in 1977, and 241-AX-104 in 1978. Following sluicing, the sound tanks (241-A-101, -102, -103, 241-AX-101, and -102) were authorized for saltcake storage, and leakers were stabilized and isolated (see Section 3.5) (Anderson 1990; Rasmussen 1980).

As the tanks were sluiced, the sound tanks were refilled with CWP, OWW, B, and other Hanford waste types, all mixed together. By the mid-70s, every type of waste was being commingled in A/AX/C Farm, primarily in tanks 241-A-103, 241-C-103, and 241-C-104 (Anderson 1990).

In the sluicing operations that occurred from 1969 to 1971, the concentrated slurry layer in the 244-AR vault accumulation tank was washed with water prior to transfer to the acidification tank. After agitation and settling, the wash water was pumped to either tank 241-C-105 or 241-C-106. Some solids were transferred to these tanks. The solids in 241-C-106 contained several megacuries of Sr-90, which caused the waste to approach boiling temperatures. Tank 241-C-106 had not been designed as a boiling waste tank, and Section 3.5 describes efforts to deal with this situation (Walker 1977; Rodenhizer 1987).

The 244-AR vault stack drainage went to crib 216-A-41 from January 1968 to 1974. After that, it was rerouted to the vessel vent seal pot system. Cooling water, if uncontaminated, went to the Gable Mountain pond. Contaminated cooling water was diverted to the 216-A-40 lined retention basin and returned to 244-AR. The 244-AR vault has been inactive since 1978. It was upgraded in the mid-1980s in preparation for the PUREX restart, but by then B Plant was being refitted as a waste vitrification pilot plant, and PUREX waste that was generated after the restart was stored in DSTs and was not fractionized. The 244-AR vault is scheduled for interim stabilization (see Section 3.5) by September 30, 2003 (Maxfield 1979; Laney 2000).

The 216-C-8 French drain received an unknown amount of floor drain waste and ion exchange resin regeneration waste from experiments in the 271-CRL laboratory in C Farm beginning in June 1962. The ion exchange studies were terminated in June 1965 and the equipment removed (Lundgren 1970; H-2-31890). The total volume discharged to the crib is likely to be small, since crib discharge records do not mention 216-C-8.

In June 1966, a radioactive liquid line in the 241-AX-801B building pressurized and spilled 20 L of liquid onto the floor. Dose rates exceeded 50 mSv/hr (5 R/hr) at 3 m. The 216-A-39 crib was constructed to receive the waste. A hole was cut through the back side of 241-AX-801B, and a fire hose was used to flush the contamination out the door and into the crib (WIDS).

Line V122 from tank 241-C-105 to diversion box 241-C-152 (the PSN feed line to B Plant) began leaking in 1970 (UPR-200-E-82) and was replaced with line V115. A leak in line 812 from the 244-AR vault to diversion box 241-C-151 in 1971 contaminated a 36-m^2 area with PSN (UPR-200-E-86).

Three UPRs occurred in AX Farm during this period. Surface contamination occurred around 241-AX-151 in 1972, resulting from an inadvertent pressurization in the 244-AR vault (UPR-200-E-42). A spray leak in the 241-AX-103 pump pit occurred on February 12, 1974 (UPR-200-E-115). Removal of a contaminated electrode cable from 241-AX-104 in 1969 dripped a negligible amount of contamination onto the ground (UPR-200-E-119).

3.5 STABILIZATION AND ISOLATION 1975-PRESENT

Three tanks in A Farm, two tanks in AX Farm, and three tanks in C Farm have leaked. In accordance with Hanford operating policy at the time, liquid waste removal from a tank of questionable integrity was expedited and the tank was removed from service. Interstitial liquid was removed by saltwell jet pumping (Liverman 1975). Figure 7 shows facilities constructed in C Farm for saltwell pumping, and Figure 8 shows facilities constructed in A and AX Farms.

Tank 241-A-104 leaked 9500 L in May 1975 and was pumped down to a sludge heel (UPR-200-E-125). Tank 241-C-101 leaked 91 000 L in 1970 (UPR-200-E-136). Tank 241-C-203 leaked 1500 L in 1976 (UPR-200-E-137). Tank leaks which were not assigned UPR numbers occurred in 241-A-103, 241-AX-102, 241-AX-104, 241-C-110, 241-C-111, and the other three C Farm 200-series tanks. Volume estimates for these leaks are taken from Hanlon (2001). Leakage from tank 241-A-105 (UPR-200-E-126) is discussed in Section 3.3.5. Tank leaks are described in Table 2 of Appendix A.

There is a discrepancy in the reported volume of UPR-200-E-136. WIDS gives a range of 64 000 L to 91 000 L, while Hanlon (2001) reports the volume as 76 000 L. Information is not available to resolve this discrepancy.

Interim stabilization is the process of removing all supernatant liquid and as much drainable liquid as possible; this process began in 1972. The saltwell system for A/AX/C Farms included a pump pit for each tank, the saltwell and jet pump, piping from the pump pits to the receiver tank, and associated instrumentation and controls. Tank 241-C-103 was the receiver tank for C Farm, and 241-A-102 was the receiver tank for A and AX Farms. The 244-A lift station and new encased underground lines were constructed in 1975 that connected C Farm, A Farm, and the cross-site transfer line. The C Farm tanks were interim stabilized beginning in 1976, with the interstitial liquid pumped from 241-C-103 to the 242-S evaporator via line V228 from C Farm to the cross-site transfer line. Transfers to 242-S were discontinued when the 242-A evaporator started operations (Liverman 1975; Smith 1975; H-2-65052).

The 242-A evaporator began operating in March 1977 with saltwell receiver 241-A-102 as the feed tank and 241-AX-101 as the slurry receiver tank. C Farm saltwell waste was pumped from 241-C-103 to 241-A-102 via the 244-A lift station. The evaporator also receives waste from the 241-A-350 drainage lift station, which was built in 1976. Cooling water was discharged to the Gable Mountain pond and condensate went to 216-A-37-1 ditch. When AW Farm was built in 1980, DST 241-AW-102 replaced SST 241-A-102 as the feed tank. In April 1989, after final PUREX shutdown, the 242-A evaporator was shut down. Project B-534 renovated the evaporator, and project W-105 built the 200 Area LERF for evaporator condensate. The evaporator restarted in April 1994 and is still in use (Smith 1975; Maxfield 1979; Luen 1989; Wisness 1994).

Since 1968, all waste tanks constructed have been DSTs, and AEC policy in 1975 was to direct all liquid waste to DSTs. SSTs were removed from service in 1980, and DST 241-AN-101 replaced 241-A-102 as the saltwell waste receiver tank in 1981. Tank 244-CR-003 in the 244-CR vault has been used as a double-contained receiver tank (DCRT) for C Farm since 1979.

A new valve pit was built near tank 241-C-103 that tied into the existing saltwell piping and discharged to 244-CR-003. Waste was transferred from the 244-CR vault to AW Farm for evaporation via the 244-A lift station, the 241-A valve pits, and the 241-AW valve pits. The 244-CR vault has not been used since 1995. It is not yet scheduled for interim stabilization, but no future use has been identified (H-2-73799; Hanson 1980; Parkman 2000).

Following interim stabilization, SSTs were interim isolated by establishing at least one physical barrier between the tank contents and the environment, to preclude inadvertent addition of liquid. Cutting and blanking process piping to and from the tank, blanking all risers, and equipping the tank with a filtered ventilation system accomplished this. In A/AX Farms, the 241-AX-151 diverter station, the 241-A-152 diversion box, and the 241-A-302B catch tank were isolated by project B-231 in 1984-1985. In C Farm, all diversion boxes and the 241-C-301 catch tank were isolated by project B-231 (Liverman 1975; Hanlon 2001; WIDS).

Two leaking tanks in A Farm and two leakers in AX Farm were stabilized and isolated at the end of sluicing activities in 1978. Except for 241-A-101, 241-AX-101, 241-C-103, and 241-C-106, all tanks are interim stabilized. Tanks 241-A-101 and 241-AX-101 are still being saltwell pumped. Tank 241-C-103 has a layer of organic waste floating atop the aqueous supernate that will be removed prior to saltwell pumping. This removal will not use the 244-CR-003 DCRT. The stabilized tanks are also interim isolated, except that isolation is not complete on 241-A-102 and 241-C-105 (Hanlon 2001; Horner 2001).

Water additions to 241-A-105 (see Section 3.3.4) stopped in December 1978 and the 296-P-17 exhauster was installed in January 1979. The tank was interim stabilized in 1979 and interim isolated in 1985. The exhauster was removed from service in October 1991, and the tank is now on passive ventilation (Hanlon 2001; WIDS).

By 1982, the portion of the A Farm vapor header from AX Farm to the 241-A-401 condenser building was in danger of leaking, so project B-419 replaced that section of header. This project also isolated AX Farm from the A-702 ventilation system, and provided an isolation valve for A Farm (following this, the system served only AY and AZ Farms). This was intended to isolate the A Farm tanks; however, a ventilation path to the 241-A-401 condenser building via the old TK-401 deentrainment vessel was inadvertently left open. Project B-222 later isolated individual tanks in A Farm by filling the seal loops in the ventilation header with grout. The 296-P-17 exhauster on 241-A-105 provided ventilation to all A Farm tanks via the overflow lines between the tanks until it was removed (Braun 1982; Prosk and Smith 1986; H-2-62895).

When the waste in tank 241-C-106 reached boiling temperatures in mid-1971, it was connected to an exhauster to cool the waste. Cooling water was also added to the tank. BL waste was added to the tank from 1974 through 1976. The exhauster was replaced twice in 1976 due to excessive contamination. The 296-P-16 exhauster was installed in 1984 (project B-480). Because of continuing high temperature in the tank, the sludge was sluiced to 241-AY-102 in 1999 (project W-320). A special ventilation system, 296-C-006, and a new transfer line to 241-AY-102 were built for the sluicing operation. Following sluicing, the 296-C-006 ventilation system was abandoned in place. The 296-P-16 system will stay in use pending an interim isolation decision (Walker 1977; Anderson 1990; Wang 1994; H-2-93797).

Wind-borne contamination from 241-C-151 in January 1985 (UPR-200-E-68) was either decontaminated to background levels or covered for later decontamination. Following this incident, a radiation survey conducted on April 20, 1985, revealed a contaminated area south of C Farm that indicated the burial of previously undocumented contaminated material (UPR-200-E-72). The contamination was physically fixed in place with Turco Fabri-Film™ and the area posted as a Surface Contamination Area (WIDS).

On December 13, 1993, a project W-049H (200 Area Treated Effluent Disposal Facility) pipeline excavation resulted in the discovery of contaminated soil surrounding the vitrified clay pipeline from 241-A-08 to the 216-A-34 crib (UPR-200-E-145).

On March 23, 2001, the diverter station 241-AX-152 catch tank was declared an "assumed leaker." This leak has not yet been assigned a UPR number (Hanlon 2001).

4.0 MONITORING TEST WELLS

Monitoring test wells were drilled in each tank farm as part of original construction to check for tank leakage. To avoid groundwater contamination, these wells were drilled only to 46 m (150 ft) and did not extend to the upper aquifer (groundwater depth was 76 m [250 ft]). Wells were checked weekly. Test wells were also drilled near cribs as part of original construction to monitor vadose zone contamination. Typically, wells would be drilled to 46 m (150 ft), but major disposal sites had at least one 92 m (300 ft) well to check for nuclide migration to groundwater (Parker 1944; Brown and Ruppert 1950). The test wells are described in Table 4.1 and shown on the figures in Appendix D.

At the time of initial construction, knowledge of the groundwater hydrology of the Hanford area was limited to a few reports from the 1910's and 1920's. These reports were general in scope and limited in content. The continuing need to dispose of 1C and 2C waste into the ground led the AEC to contract with the U.S. Geological Survey to drill a series of test wells in the late 1940's to evaluate the 200 Area plateau soil for waste disposal suitability and for general groundwater research (Brown and Ruppert 1950).

Monitoring wells in other locations were drilled as needed. In the 1970's, additional wells were drilled in all three tank farms to monitor groundwater contamination (see Figure 6a). An extensive discussion of monitoring wells inside the tank farms is included in Gaddis (1999).

In addition to the monitoring wells, two 3.7-m (12-ft) diameter leak detector caissons, extending approximately 21 m below grade, were installed in A Farm during original constructions. Three horizontal leak detection wells (called "laterals") extend radially from each caisson, 2.4 m below the tank bottom. The laterals are approximately 3 m below the base pad elevation. Radiation probes are inserted into each lateral to provide information used to evaluate tank integrity and to determine changing conditions of the tank contents (Anderson 1990).

A third leak detector caisson was built for tank 241-A-105 in 1967 (see Section 3.3.4). This caisson had lateral wells located 0.6 m below the tank bottom, which were equipped with thermocouples to monitor sludge temperature (WHC 1991).

TABLE 4.1: TEST WELLS SURROUNDING A, AX, AND C FARMS

WELL IDENTIFICATION				COORDINATES				DIMENSIONS			NOTES
Location	Hanford Site No.	Washington State No.	Installed Date	Hanford		Lambert		Dia	Depth		
				North	West	North	East	in.	ft	m	
W of A Farm	299-E24-3	A5897	Jun 1956	41010.8	48310.4	135983.2	575165.1	8	333	101.5	1
W of A Farm	299-E24-4	A5898	Jun 1956	41182.9	48482.9	136035.2	575112.4	8	330	100.5	1
W of A Farm	299-E25-5	A5899	Jun 1956	41275.4	48727.2	136063.0	575038.0	8	329	100.3	1
S of A Farm	299-E24-19	A4754	Sep 1989	41075.8	47821.4	136003.8	575317.2	4	301	91.7	None
W of A Farm	299-E24-20	A4756	Mar 1991	41226.0	48038.0	136049.4	575251.1	4	304	92.6	None
W of A Farm	299-E24-63	A5818	Jun 1956	41335.0	48644.0	136081.7	575066.2	8	50	15.2	None
E of A Farm	299-E25-2	A4766	Mar 1955	41265.5	47175.1	136062.2	575514.0	8	375	114.3	1
E of AX Farm	299-E25-4	A4788	Apr 1956	41615.0	46739.0	136168.9	575646.5	8	289	88.1	1
E of AX Farm	299-E25-5	A6025	May 1956	41667.0	46632.0	136184.9	575681.2	8	293	89.3	1
E of AX Farm	299-E25-6	A4796	May 1956	41598.0	46619.0	136163.9	575683.7	8	290	88.4	1
NE of AX Farm	299-E25-10	A4760	Jul 1958	42000.0	46900.0	136268.0	575630.0	8	293	89.3	None
E of AX Farm	299-E25-40	A4789	Sep 1989	41759.6	47334.8	136212.3	575464.6	4	274	83.5	None
SE of AX Farm	299-E25-41	A4790	Sep 1989	41541.8	47330.9	136146.0	575466.3	4	279	85	None
S of A Farm	299-E25-46	A4793	Aug 1992	40944.2	47681.5	135964.0	575359.7	4	310	94.5	None
E of A Farm	299-E25-54	A6043	Mar 1955	41205.0	47169.0	136043.4	545512.4	8	452	46.3	None
E of AX Farm	299-E25-169	A6584	Jan 1966	41675.0	45550.0	136185.2	575696.5	6	85	25.9	1
E of AX Farm	299-E25-170	A6585	Jan 1966	41600.0	46650.0	136134.4	575673.6	6	208	63.3	1
E of AX Farm	299-E25-181	A6591	Jul 1981	41685.0	47040.0	136190.1	575554.8	6	12	3.6	None
S of A Farm	299-E25-184	A6594	Jun 1981	41085.0	47800.0	136006.4	575323.6	6	50	15.2	None

TABLE 4.1: TEST WELLS SURROUNDING A, AX, AND C FARMS

WELL IDENTIFICATION				COORDINATES				DIMENSIONS			NOTES
Location	Hanford Site No.	Washington State No.	Installed Date	Hanford		Lambert		Dia	Depth		
				North	West	North	East	in.	ft	m	
E of AX Farm	299-E25-205	A6609	Feb 1984	41490.0	46680.0	136130.9	575664.6	Unk	25	7.6	2
SE of A Farm	299-E25-209	A6613	Feb 1984	40800.0	46600.0	135920.7	575689.6	Unk	25	7.6	2
NE of C Farm	299-E27-7	A4816	Oct 1982	43097.6	48132.0	136619.6	575220.7	6	281	85.6	None
W of C Farm	299-E27-12	A4810	Oct 1989	42981.4	48678.4	136583.8	575054.3	4	270	82.3	None
SW of C Farm	299-E27-13	A4811	Oct 1989	42671.9	48644.0	136498.5	575065.1	4	275	83.8	None
SE of C Farm	299-E27-14	A4812	Oct 1989	42700.1	48143.6	136498.5	575217.6	4	266	81.1	None
NW of C Farm	299-E27-15	A4813	Oct 1989	43134.7	48543.0	136630.6	575095.5	4	262	79.8	None

Notes: 1 Grouted
2 Backfilled

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5.2 Drawings

5.2.1 A and AX Tank Farm

Drawing No.	Rev.	Title
H-2-33295	3	216-A-39 Crib for Inst Enclosure 241-AX 801-B Plot Plan & Details
H-2-33981	5	Emergency Sluicing in TK-105-A - General Piping Arrangement
H-2-36645	4	Civil - Plan and Profile - Waste Transfer Lines

H-2-38201	2	Civil - Vicinity Plot Plan Steam, Water & Process Lines
H-2-44501	12	Area Map - 200 East, A Plant Facilities (sh 69)
H-2-44551	5	General Area Plan
H-2-44587	2	Structural - Encasement 241-AX-151 to 241-AX-152 - Plans & Profile
H-2-44773	3	Plan & Profile - Process Waste Lines Diverter Station 241-AX-151 to 241-A Tanks
H-2-44778	3	Plan & Profile - Branch Encasement line #8656 from Main Encasement to 244CR Vault
H-2-44820	3	Process Waste Lines - Waste Piping Plan from Diverter 241-AX-151 to 241-A Tank Farm
H-2-55901	4	241-A General Layout
H-2-56000	4	216-A-34 Crib Line from Proportional Samp Pit #2 - Cond Cool H_2O Disposal - Plan & Profile
H-2-56157	5	Crib 216-A-8 & Control Structure 216-A-508, Plan and Details
H-2-56340	1	Plot Plan and Piping Layout
H-2-56780	3	Underground Piping Plan
H-2-56796	2	6" Condensate & 6" Overflow 241-A-417 & 241-A-40 - Plan and Profile
H-2-56797	1	241-A-401 Waste Cooling Water - Plan and Profile
H-2-57452	3	Catch Tank Installation at Diversion Box 241-A-152
H-2-58609	0	Civil - Plan & Profile - Line No. V113 - 241-AX-101 to 241-C-151
H-2-61963	5	Plot Plan - Yard Piping - 244-AR Vault - 241-A Tank Farm
H-2-61964	2	Plot Plan - Yard Piping - 241-AX Tank Farm
H-2-61970	2	Civil - Plan and Profile - Transfer Lines - Line No. 809 and 818
H-2-61979	3	12" CWD Ln #815 to 216-A-40 Trench or Diversion to 30" Powerhouse Ditch 4" SNS Line & Septic Tk
H-2-61984	6	Civil - Plot Plan - 241-A Tank Farm
H-2-65052	0	Key Plan – Phase I Salt Well System, 241-A & 241-AX
H-2-65123	1	Piping Plan
H-2-69183	2	Piping Plan - 242-A Building Area
H-2-69184	5	Piping Plan - 241-A Tank Farm
H-2-69240	2	Piping Plan - 241-A to 241-AX Tank Farm

H-2-69241	2	Piping Plan - 241-AX Tank Farm
H-2-70682	2	Civil/Drawing Index - Site Plan
H-2-73552	1	Piping Plan
H-2-73753	2	Piping & Instrumentation - Plans & Details - 241-A Tank Farm
H-2-73754	2	Piping & Instrumentation - Plans & Details - 241-AX Tank Farm
H-2-73842	3	Piping Plan - 241-AX Tank Farm - System No 5
H-2-73843	3	Piping Plan - 241-AN Tank Farm from 241-AX Tank Farm Sys #5
H-2-90437	1	Civil - Site Preparation Plan - 241-AP Tank FArm

5.2.2 C Tank Farm

Drawing No.	Rev.	Title
M-2904E	9	Outside Lines - Sewers 200E (sh 27)
MAP 2931	1	Outside Lines Key Map 200E (sh 27)
MAP 2931	2	Outside Lines Key Map 200E (sh 28)
HW-72182	1	Tank Farm 241-C - Plot Plan (sh 4)
HW-72183	17	Hanford Works - Diversion Boxes 241-C-151 & 241-C-152 - Arrg't - Piping (sh 4)
H-2-432	6	Piping Between 241B and 241C
H-2-2021	10	Outside Lines - First Cycle Evaporation - 200 East Plot Plan (sh 2)
H-2-2431	2	200 East Area - Process Waste System
H-2-2900	3	4" or 4½" Waste Lines - C & BY Farm to "BC Crib" Area (1st Cycle & TBP Waste Scavenging) - Plot Plan
H-2-2901	1	Plan & Profile - 1st Cycle & TBP Waste Scavenging
H-2-2909	6	Piping Arrangement & Details - 1st Cycle Waste Scavenging - 241-C Tank Farm
H-2-4421	3	2" Waste Line to 241-C Farm - Plan & Profile - Hot Semiworks - Waste Self Concentrator
H-2-4565	1	Plot Plan - Roads Drawing Schedule (Cesium Loadout Facility)
H-2-4566	1	Water & Drain Lines - Plan & Profile (Cesium Loadout Facility)
H-2-4574	3	Process & Service Piping - Tanks to Loadout Station (Cesium Loadout Facility)
H-2-31754	2	Fission Product Transfer - Line 244-CR to 201-C

H-2-31890	2	Mechanical Piping Plans and Details, Addition to 271-CR Bldg
H-2-32371	0	Plot Plan - Waste Transfer Line V109 - 241-A-101 Tank to 241-C-151
H-2-32372	1	Details - Waste Transfer Line V109 - 241-A-101 Tank to 241-C-151
H-2-32373	0	Plan & Profile - Waste Transfer Line V109 - 241-A-101 Tank to 241-C-151
H-2-32484	2	Plan & Profile - Cesium Transfer Line No. V122 - 241-CR-05A to 241-C-152
H-2-33087	7	Ln 8107 (241-CR-152 to 102-C) V843, V844 (241-CR-151 to 102-C) V050, V051 (241-A-152 to 104-C)
H-2-35450	1	Mod Line V101 & New Line V-115 - Plan & Profile
H-2-36642	2	Civil - Plan and Profile - Waste Transfer Lines
H-2-36646	3	Civil - Plan and Profile - Waste Transfer Lines
H-2-38599	1	Salt Well - Pump Pit Installation - Plan 241-C Tank Farm
H-2-41126	4	Arch - Plot Plan - Sheet 1
H-2-41413	5	Piping Underground Process - Plans & Sections - 101 & 104 Cascades
H-2-41414	8	Piping Underground Process - Plans & Sections - 101 & 104 Cascades
H-2-41424	6	Piping Arrangement of Outside Utility Lines
H-2-43037	7	Tie In Details at C Tank Farm - Layout
H-2-43045	4	241-EW Transfer System
H-2-43602	2	Plan & Profile - 3" Connecting Line - 241-C-151 to 244-CR
H-2-44501	7	Area Map - 200 East 'A' Plant Facilities (sh 80)
H-2-44501	8	Area Map - 200 East 'A' Plant Facilities (sh 81)
H-2-44501	2	Area Map - 200 East 'A' Plant Facilities (sh 91)
H-2-44501	14	Area Map - 200 East 'A' Plant Facilities (sh 92)
H-2-44502	7	Flow Diagram - Waste Transfer and Storage Facilities (sh 7)
H-2-44551	5	General Area Plan
H-2-44778	3	Plan & Profile - Branch Encasement - Line #8656 from Main Encasement to 244 CR Vault
H-2-55971	7	Process Tank Vault 244-CR - Piping Layout
H-2-55977	5	Line No V050, V051 - 241-A-152 Div Box to Tank 241-C-104 (sh 2)
H-2-58609	0	Civil - Plan & Profile - Line No. V113 - 241-AX-101 to 241-C-151
H-2-61961	3	Key Plan - Waste Transfer & Storage Facilities - 200 East
H-2-61962	5	Plot Plan - 241-C Tank Farm

H-2-61967	3	Civil - Plan & Profile - 3" PSN Line No. 812
H-2-61981	2	Civil - Plan - 241-C Tank Farm PSN Conn Details
H-2-73338	5	Piping - Waste Tank Isolation - C-Tank Farm - Plot Plan
H-2-73799	8	Engineering Flow Diagram - System No. 4
H-2-73876	3	Piping Plan - 241-C Tank Farm
H-2-73973	3	Piping & Instrumentation - Plan - 241-C Tank Farm
H-2-85604	0	Piping - 241-C-106 - Chiller Installation
H-2-93797	2	Drawing List/HVAC Equipment - Plan & Sections (sh 1)
H-2-140333	1	Civil - Transfer Line - STA 285+00 to STA 307+70.71
H-2-818431	2	Civil - 241-C Tank Farm - Site Plan (sh 1)
H-2-822227	2	Civil - Plan & Profile - STA 270+ to 286+
H-2-822228	3	Civil - Plan & Profile - STA 286+ to 244-A & Yard Piping Plan

APPENDIX A

TABLES

Table 1. Intentional Release Quantities

Table 2. Unintentional Release Quantities

Table 1. Intentional Release Quantities

Crib	Location	Source	Waste Type	Date	Quantity (L)	Comments
216-A-1	Crib E of 241A	202A	Cold startup	11/55-12/55	98400	Capacity reached
216-A-7	Crib E of 241A	241-A-152	Overflow	1/56-11/66	3.26E+05	
216-A-8	Crib E of 241AX	SSTs	SST condensate	11/55-4/95	1.15E+09	
216-A-9	Crib W of 241A	202A	Condensate	3/56-2/58	9.81E+08	
		105N	Decon	4/66-10/66		
		202A	Acid fract con	8/69		
216-A-16	F. drain in 241A	241-A-431	Stack drainage	1/56-3/69	1.22E+05	
216-A-17	F. drain in 241A	241-A-431	Stack drainage	1/56-3/69	6E+05	
216-A-18	Pit E of 241AX	202A	Cold startup	11/55-12/55	4.88E+05	
216-A-19	Pit E of 241AX	202A	Cold startup	11/55-1/56	1.1E+06	
216-A-20	Pit E of 241AX	202A	Cold startup	11/55-1/56	9.6E+05	
216-A-23	2 F. drains in 241A	241-A-431	Deentrainer drainage	9/57-3/69	6000	
216-A-24	Crib NE of 241AX	SSTs	SST condensate	5/58-1/66	8.20E+08	Capacity reached
216-A-25	Gable Mt Pond	202A, 244AR	Cooling water	1957-1987	3E+12	Outside scope
216-A-29	Ditch to B pond	202A	Chem sewer, cond. Clg.wtr. Acid fract con	11/55-9/91		Outside scope
216-A-34	Ditch E of 241AX	202A	Cold startup	11/55-1/56	Unknown	
216-A-39	Pit in 241AX	AX-801B	Spill	6/66	20	
216-A-40	Retention basin W of 241AX	244-AR	Cooling water	1/68-1979	9.46E+05	Not used for disposal
216-A-41	Crib W of 241A	244-AR	Stack drainage	1/68-1974	1E+04	
216-C-8	Fr drain S of 241C	271-CR	IX regen	6/62-6/65	Unknown	

Table 2. Unintentional Release Quantities

UPR Number	Location	Date	Leak Type	Waste Type	Quantity (L)	Comments
UPR-200-E-16	C Farm	Unknown	Overground pipe break	CWP	190	
UPR-200-E-18	241-A-08	1959	Dripping vent	Condensate		
UPR-200-E-27	C Farm	11/1/60	Windblown contamination			
UPR-200-E-42	241-AX-151	11/6/72	Surface contamination			
UPR-200-E-68	241-C-151	1/11/85	Windblown contamination			
UPR-200-E-72	South of C Farm	4/20/85	Buried contamination			
UPR-200-E-81	241-CR-151	10/15/69	Line leak	CWP	136 000	
UPR-200-E-82	241-C-152	12/19/69	Line leak	PSN	10 000	
UPR-200-E-86	C Farm	1971	Line leak	PSN		25,000 Ci Cs
UPR-200-E-107	244-CR	11/26/52	Spill	TBP	18.90	
UPR-200-E-115	241-AX-103	2/12/74	Spray			
UPR-200-E-118	C Farm	4/20/57	Airborne contamination			
UPR-200-E-119	241-AX-104	12/22/69	Surface contamination		Negligible	
UPR-200-E-125	241-A-104	May 1975	Tank leak		9500	Pumped to heel
UPR-200-E-126	241-A-105	Jan 1965	Tank leak		1 049 000	Tank damage
UPR-200-E-136	241-C-101	1970	Tank leak		91000	
UPR-200-E-137	241-C-203	1976	Tank leak	PAW	1500	
UPR-200-E-145	A Farm	1993	Excavation	Uranium oxide		
None	241-A-103	1987	Tank leak		21000	Estimated
None	241-AX-102	1988	Tank leak		11000	Estimated
None	241-AX-104	1977	Tank leak		30000	Estimated
None	241-C-110	1984	Tank leak		7600	Estimated
None	241-C-111	1968	Tank leak		19000	Estimated
None	241-C-201	1988	Tank leak		2100	Estimated
None	241-C-202	1988	Tank leak		1700	Estimated
None	241-C-204	1988	Tank leak		1300	Estimated
None	241-AX-151	3/23/01	Catch tank leak		Unknown	

APPENDIX B

TIMELINE OF EVENTS

1943-44	Hanford construction. C Plant foundation excavated, but plant not built. C Farm constructed.
4/23/45	B Plant begins operations. 5-6 and 224 waste to 216-B-5 crib
8/14/45	World War II ends
3/46	B Plant MW sent to 241-C-101/2/3 tank cascade
4/46	B Plant 1C sent to 241-C-107/8/9 tank cascade
5/46	B Plant 1C sent to 241-C-110/1/2 tank cascade
10/46	B Plant MW sent to C-104/5/6 cascade
1/1/47	GE replaces DuPont as Hanford prime contractor
1/52	1C from C Farm sent to tank 241-B-106 (evaporator feed) via 241-C-152, 241-B-154 diversion boxes
10/52	MW from C Farm sent to U Plant via cross-site transfer line
11/26/52	UPR-200-E-107 (spill at 244-CR vault)
1954	241-CR steam cleaning pit
1955	PUREX and A Farm constructed
1955	244-CR vault modified for in-farm scavenging
11/55	In-farm scavenging begins
11/55	PUREX cold startup waste to cribs 216-A-1, 216-A-18, 216-A-19, 216-A-20 via 216-A-34 ditch
1/56	PUREX begins operations. PAW, OWW to A Farm; CWP to C Farm
1/56	A Farm tank condenser waste to 216-A-8 crib
1/56	Tank Farm stack drainage (241-A-431 to 216-A-16/17 wells)
3/56	PUREX acid fractionator condensate to 216-A-9 crib
12/56	216-A-8 crib waste hits groundwater
1957	244-CR vault scavenging completed
1957	PUREX cooling water to Gable Mountain pond
4/20/57	UPR-200-E-118 (C Farm airborne contamination)
9/57	241-A-431 deentrainer drainage to 216-A-23 drywells
12/57	Gable Mountain pond and 216-A-29 ditch built
1/58	Stop discharges to 216-A-9 crib
5/58	216-A-8 crib (tank condenser waste) replaced by 216-A-24 crib
1959	UPR-200-E-18 (drip at 241-A-08 valve pit)
7/59	241-A-302B catch tank replaces 216-A-7 crib
10/59	Surface condensers installed in A Farm; reduce 216-A-24 crib discharge by 95%
7/59	UPR-200-E-16 (overground CWP line break in C Farm)
11/1/60	UPR-200-E-27 (C Farm airborne contamination)
7/61	Hot Semiworks restarted as Strontium Semiworks
1962	271-CRL and 241-C-801 Cs loadout facility built in C Farm
6/62	271-CRL lab ion exchange regeneration waste to 216-C-8 French drain
1963	PUREX modified to process N Reactor fuel
1963	AX Farm built
1963	Cs recovery begins in 241-C-801
8/63	Sr recovery begins in B Plant
1965	241-AX-151 diverter station constructed
1/65	UPR-200-E-126 (damage to 241-A-105)
6/65	216-C-8 drain out of service

1966	244-AR vault constructed
4/66-10/66	N Reactor decon waste to 216-A-9
7/66	216-A-24 crib hits groundwater; waste diverted to 216-A-8
6/66	Spill in 241-AX-801B flushed to 216-A-39 crib (no UPR)
1967	Third leak detection caisson built in A Farm, near tank 241-A-105
1967	B Plant begins full operations. Strontium Semiworks shut down
1968	241-C-111 tank leak (no UPR)
1/68	244-AR vault stack drainage to 216-A-41 crib
2/22/69	UPR-200-E-119 (surface contamination in AX Farm)
3/69	216-A-23 drains (241-A-431 condensate) out of service
4Q/69	OWW from PUREX segregated from PAW, sent to tank 241-C-104
10/15/69	UPR-200-E-81 (underground CWP line leak near 241-C-151 diversion box)
12/19/69	UPR-200-E-82 (underground line leak near 241-C-152 diversion box)
1970	UPR-200-E-136 (241-C-101 tank leak)
11/70	Final heel removal from 241-A-105 tank; water additions begin
1970-71	REDOX supernate sent to B Plant for Cs recovery
1971	241-C-106 tank temperature reaches 100°C, put on forced ventilation
1971	UPR-200-E-86 (underground PSN line leak in C Farm)
1972	PUREX standby to allow for N Reactor spent fuel accumulation and A/AX Farm sluicing. 244-AR vault modified for full time sludge recovery
11/6/72	UPR-200-E-42 (contamination discovered at 241-AX-151 diverter station)
1973	PUREX restart delayed due to 241-T-106 tank leak
1975	241-ER-152, 241-ER-153 diversion boxes, 244-A lift station constructed
1975	Gable Mountain pond out of service
5/75	UPR-200-E-125 (241-A-104 tank leaks)
1976	UPR-200-E-137 (241-C-203 tank leaks)
1976	241-A-350 lift station built
4/76	Stop discharges to 216-A-8 crib
1977	241-AX-104 tank leaks (no UPR)
3/18/77	242-A Evaporator startup
1978	Sludge recovery complete
1/78-5/78	Resume discharges to 216-A-8 crib
12/78	241-A-105 tank water additions stop; 296-P-17 exhauster installed
1983	PUREX restart
1983-1987	Strontium Semiworks torn down
1984	241-C-110 tank leaks (no UPR)
1985	216-A-8 crib out of service
1/11/85	UPR-200-E-68 (airborne contamination in C Farm)
4/20/85	UPR-200-E-72 (buried contamination south of C Farm)
1987	Gable Mountain pond decommissioned
1987	241-A-103 tank leaks (no UPR)
1988	PUREX shutdown
1988	241-C-201, 202, and 204 tanks leak (no UPR)
1988	241-AX-102 tank leaks (no UPR)
4/12/89	242A shutdown
10/91	296-P-17 exhauster removed from 241-A-105

1992	PUREX closed
12/13/93	UPR-200-E-145 (buried contamination in A Farm)
4/15/94	242A Evaporator restart
1995	All liquid low-level waste discharges to 200 Area TEDF
1999	Tank 241-C-106 sluiced to tank 241-AY-102
3/23/01	241-AX-152 catch tank leak

APPENDIX C

CRIB DISCHARGE HISTORIES

Table C-1. 216-A-8 .... C-1

Table C-2. 216-A-24 .... C-5

Table C-3. 216-A-7 .... C-8

Table C-4. 216-A-9 .... C-9

Table C-1: 216-A-8 Discharge History					
Date	**Volume (L)**	**U (kg)**	**Pu (g)**	**Beta (Ci)**	**Reference**
Nov-55	7.75E+07	N/A	N/A	N/A	HW-44784
Dec-55	1.51E+06	N/A	N/A	N/A	HW-44784
Jan-56	2.45E+07	N/A	N/A	N/A	HW-44784
Feb-56	5.80E+07	47.50	1.70	0.19	HW-44784
Mar-56	6.81E+07	81.70	5.00	2.17	HW-44784
Apr-56	8.17E+06	14.70	5.00	0.39	HW-44784
May-56	3.04E+07	14.00	1.75	19.20	HW-44784
Jun-56	4.00E+07	2.00	0.30	25.00	HW-44784
Jul-56	7.45E+07	43.00	11.00	4.74	HW-48518
Aug-56	5.68E+07	33.00	5.50	1.80	HW-48518
Sep-56	8.70E+07	51.00	5.70	36.00	HW-48518
Oct-56	2.76E+07	33.10	2.00	14.10	HW-48518
Nov-56	1.11E+07	8.63	7.25	1.90	HW-48518
Dec-56	1.98E+07	5.00	1.70	30.00	HW-48518
Jan-57	2.83E+07	34.20	2.00	272.00	HW-53336
Feb-57	2.62E+07	N/A	N/A	360	HW-53336
Mar-57	2.62E+07	N/A	N/A	360	HW-53336
Apr-57	3.29E+07	N/A	N/A	1360	HW-53336
May-57	1.85E+07	N/A	N/A	940	HW-53336
Jun-57	3.05E+07	N/A	N/A	1535	HW-53336
Jul-57	3.15E+07	N/A	N/A	663	HW-55593
Aug-57	3.27E+07	N/A	N/A	459	HW-55593
Sep-57	3.45E+07	N/A	N/A	465	HW-55593
Oct-57	2.80E+07	N/A	N/A	243	HW-55593
Nov-57	2.15E+07	N/A	N/A	423	HW-55593
Dec-57	2.23E+07	N/A	N/A	604	HW-55593
Jan-58	3.25E+07	N/A	N/A	487	HW-57649
Feb-58	2.93E+07	N/A	N/A	411	HW-57649
Mar-58	2.34E+07	N/A	N/A	274	HW-57649
Apr-58	2.65E+07	N/A	N/A	119	HW-57649
1958-1966	0	0	0	0	
Aug-66	3.80E+05	N/A	N/A	0.9	ISO-698
Sep-66	3.80E+05	N/A	N/A	1.4	ISO-698
Oct-66	3.80E+05	N/A	N/A	0.5	ISO-698
Nov-66	1.19E+06	N/A	N/A	2.5	ISO-698
Dec-66	1.33E+06	N/A	N/A	3.19	ISO-698
Jan-67	1.95E+06	0.005	0.002	13.8	ARH-486
Feb-67	1.95E+06	0.005	0.002	3.34	ARH-486
Mar-67	1.85E+06	0.005	0.002	5.13	ARH-486
Apr-67	1.87E+06	0.004	0.005	0.38	ARH-486
May-67	2.32E+06	0.018	0.005	4.62	ARH-486

Table C-1: 216-A-8 Discharge History					
Date	**Volume (L)**	**U (kg)**	**Pu (g)**	**Beta (Ci)**	**Reference**
Jun-67	2.33E+06	0.14	0.002	2.8	ARH-486
Jul-67	1.87E+06	0.003	0.003	3.1	ARH-486
Aug-67	3.25E+06	0.007	0.01	1.8	ARH-486
Sep-67	1.95E+06	0.014	0.009	10.4	ARH-486
Oct-67	2.84E+06	0.001	0.01	11	ARH-486
Nov-67	2.06E+06	0.001	0.09	24	ARH-486
Dec-67	1.09E+06	0.001	0.005	3.9	ARH-486
Jan-68	2.55E+06	0.005	0.12	24	ARH-1159
Feb-68	2.46E+06	0.009	0.12	18	ARH-1159
Mar-68	2.27E+06	0.005	0.1	15	ARH-1159
Apr-68	2.04E+06	0.005	0.1	12	ARH-1159
May-68	4.21E+06	0.005	0.04	125	ARH-1159
Jun-68	2.28E+06	0.009	0.03	162	ARH-1159
Jul-68	1.57E+06	0.027	0.03	95	ARH-1159
Aug-68	1.68E+06	0.032	0.01	323	ARH-1159
Sep-68	1.28E+06	0.009	0.05	37	ARH-1159
Oct-68	2.21E+06	0.014	0.04	128	ARH-1159
Nov-68	2.15E+06	0.005	0.04	8	ARH-1159
Dec-68	1.97E+06	0.014	0.04	16	ARH-1159
Jan-69	1.77E+06	0.010	3.60E-02	100.00	ARH-1608
Feb-69	1.44E+05	0.001	7.40E-05	2.20	ARH-1608
Mar-69	9.42E+05	0.008	8.50E-04	35.10	ARH-1608
Apr-69	1.92E+06	0.000	5.70E-03	38.40	ARH-1608
May-69	3.24E+06	0.017	1.00E-02	66.10	ARH-1608
Jun-69	4.39E+06	0.023	3.00E-03	30.70	ARH-1608
Jul-69	1.11E+06	0.006	6.00E-05	0.78	ARH-1608
Aug-69	1.84E+06	0.010	2.10E-04	1.01	ARH-1608
Sep-69	2.18E+06	0.012	1.50E-04	1.16	ARH-1608
Oct-69	2.43E+06	0.013	2.00E-04	0.43	ARH-1608
Nov-69	2.64E+06	0.014	2.50E-02	0.35	ARH-1608
Dec-69	1.39E+06	0.007	5.00E-05	0.18	ARH-1608
Jan-70	1.71E+06	0.009	8.83E-05	0.475	ARH-2015
Feb-70	6.81E+05	0.004	2.93E-05	472	ARH-2015
Mar-70	1.43E+06	0.008	1.48E-04	0.767	ARH-2015
Apr-70	7.34E+05	0.004	4.12E-05	0.253	ARH-2015
May-70	1.60E+06	0.009	8.99E-05	0.298	ARH-2015
Jun-70	7.57E+05	0.004	6.84E-05	0.134	ARH-2015
Jul-70	6.70E+05	0.004	4.04E-05	0.107	ARH-2015
Aug-70	8.18E+05	0.004	4.66E-05	0.073	ARH-2015
Sep-70	5.19E+05	0.003	5.58E-05	0.051	ARH-2015
Oct-70	8.78E+05	0.005	2.15E-04	0.138	ARH-2015
Nov-70	7.99E+05	0.004	8.26E-05	0.180	ARH-2015
Dec-70	9.39E+05	0.005	8.46E-05	0.250	ARH-2015

Table C-1: 216-A-8 Discharge History					
Date	Volume (L)	U (kg)	Pu (g)	Beta (Ci)	Reference
Jan-71	9.21E+05	0.005	9.10E-05	0.280	ARH-2353
Feb-71	6.14E+05	0.002	7.24E-05	0.162	ARH-2353
Mar-71	9.22E+05	0.013	3.63E-05	0.273	ARH-2353
Apr-71	1.09E+06	0.003	4.10E-04	0.318	ARH-2353
May-71	2.17E+06	0.002	1.75E-04	0.223	ARH-2353
Jun-71	2.25E+06	0.002	1.76E-04	0.282	ARH-2353
Jul-71	1.37E+06	0.001	7.52E-07	0.279	ARH-2353
Aug-71	1.94E+06	0.004	6.57E-06	0.167	ARH-2353
Sep-71	1.62E+06	0.003	4.24E-06	0.145	ARH-2353
Oct-71	3.20E+06	0.002	6.16E-06	0.076	ARH-2353
Nov-71	1.11E+06	0.003	3.53E-06	0.055	ARH-2353
Dec-71	2.19E+06	0.007	5.86E-06	0.068	ARH-2353
Jan-72	1.82E+06	0.011	4.91E-02	0.034	ARH-2757
Feb-72	1.45E+06	0.008	1.37E-04	0.041	ARH-2757
Mar-72	1.22E+06	0.006	1.36E-04	0.061	ARH-2757
Apr-72	1.15E+06	0.006	5.92E-05	0.037	ARH-2757
May-72	1.06E+06	0.006	2.29E-04	0.043	ARH-2757
Jun-72	5.00E+05	0.003	3.87E-05	0.028	ARH-2757
Jul-72	3.18E+05	0.001	2.07E-05	0.057	ARH-2757
Aug-72	1.22E+06	0.004	3.54E-04	0.012	ARH-2757
Sep-72	8.41E+05	0.009	7.78E-06	0.098	ARH-2757
Oct-72	5.84E+05	0.006	5.91E-05	0.088	ARH-2757
Nov-72	3.36E+05	0.004	5.38E-05	0.010	ARH-2757
Dec-72	6.94E+05	0.071	2.97E-05	0.013	ARH-2757
Jan-73	3.32E+05	0.003	8.12E-05	0.163	ARH-2806
Feb-73	2.38E+05	0.003	4.45E-05	0.144	ARH-2806
Mar-73	4.78E+05	0.005	1.90E-04	0.827	ARH-2806
Apr-73	1.94E+05	0.002	3.66E-05	0.156	ARH-2806
May-73	4.37E+05	0.000	5.50E-06	2.470	ARH-2806
Jun-73	8.15E+05	0.008	1.00E-04	0.993	ARH-2806
Jul-73	9.58E+05	0.010	2.66E-04	1.210	ARH-2806
Aug-73	3.28E+05	0.004	8.19E-06	0.586	ARH-2806
Sep-73	5.05E+05	0.005	7.78E-06	0.216	ARH-2806
Oct-73	9.34E+05	0.009	1.04E-05	0.299	ARH-2806
Nov-73	8.55E+05	0.009	5.33E-05	0.191	ARH-2806
Dec-73	9.71E+05	0.010	1.83E-05	0.343	ARH-2806
Jan-74	1.33E+06	0.014	1.09E-04	0.818	ARH-3093
Feb-74	1.79E+06	0.025	6.90E-03	1.360	ARH-3093
Mar-74	9.69E+05	0.010	5.76E-02	0.261	ARH-3093
Apr-74	1.38E+06	0.014	1.45E-05	0.699	ARH-3093
May-74	1.13E+06	0.012	6.88E-04	0.382	ARH-3093
Jun-74	1.06E+06	0.011	6.67E-05	0.331	ARH-3093
Jul-74	9.79E+05	0.010	5.98E-05	0.224	ARH-3093

Table C-1: 216-A-8 Discharge History					
Date	**Volume (L)**	**U (kg)**	**Pu (g)**	**Beta (Ci)**	**Reference**
Aug-74	1.03E+06	0.011	3.95E-05	0.240	ARH-3093
Sep-74	1.25E+06	0.013	3.85E-03	0.212	ARH-3093
Oct-74	1.33E+06	0.014	4.04E-03	0.209	ARH-3093
Nov-74	4.80E+05	0.008	5.81E-04	0.090	ARH-3093
Dec-74	1.01E+06	0.010	4.47E-04	0.100	ARH-3093
Jan-75	1.07E+06	0.011	6.00E-05	0.110	ARH-CD-371
Feb-75	8.54E+05	0.009	5.93E-05	0.082	ARH-CD-371
Mar-75	8.57E+05	0.009	1.55E-04	0.063	ARH-CD-371
Apr-75	6.01E+05	0.006	8.73E-05	0.070	ARH-CD-371
May-75	8.98E+05	0.009	9.06E-05	0.100	ARH-CD-371
Jun-75	7.76E+05	0.008	5.44E-04	0.099	ARH-CD-371
Jul-75	3.38E+05	0.003	1.63E-04	0.066	ARH-CD-371
Aug-75	2.60E+05	0.003	6.38E-06	0.053	ARH-CD-371
Sep-75	2.12E+05	0.002	8.06E-05	0.052	ARH-CD-371
Oct-75	2.27E+05	0.002	1.05E-04	0.050	ARH-CD-371
Nov-75	1.67E+05	0.002	7.96E-05	0.092	ARH-CD-371
Dec-75	2.32E+05	0.002	1.54E-04	0.142	ARH-CD-371
Jan-76	2.69E+05	2.75E-03	1.71E-04	0.178	ARH-CD-743
Feb-76	1.18E+05	1.21E-03	1.44E-04	0.098	ARH-CD-743
Mar-76	4.98E+04	5.06E-04	4.71E-06	0.085	ARH-CD-743
Apr-76	2.31E+04	2.35E-04	3.16E-05	0.065	ARH-CD-743
1977	0	0	0	0	RHO-CD-34
Jan-78	1.51E+02	N/A	6.04E-06	1.04E-04	RHO-CD-78-34
Feb-78	1.51E+02	N/A	6.04E-06	1.04E-04	RHO-CD-78-34
Mar-78	1.51E+02	N/A	6.04E-06	1.04E-04	RHO-CD-78-34
Apr-78	1.51E+02	N/A	6.04E-06	1.04E-04	RHO-CD-78-34
Oct-83	1.33E+05	N/A	N/A	0.0147	RHO-HS-SR-83-3
1984	1.08E+06	N/A	N/A	0.0232	RHO-HS-SR-84-3
Feb-85	2.31E+05	N/A	N/A	0.0397	RHO-HS-SR-85-3
Totals	1.18E+09	3.69E+02	5.00E+01	1.09E+04	

Table C-2: 216-A-24 Discharge History					
Date	**Volume (L)**	**U (kg)**	**Pu (g)**	**Beta (Ci)**	**Reference**
May-58	2.60E+07	N/A	N/A	204	HW-57649
Jun-58	2.38E+07	N/A	N/A	197	HW-57649
Jul-58	4.23E+07	N/A	N/A	507	HW-59359
Aug-58	4.27E+07	N/A	N/A	144	HW-59359
Sep-58	4.16E+07	N/A	N/A	410	HW-59359
Oct-58	4.19E+07	N/A	N/A	198	HW-59359
Nov-58	4.27E+07	N/A	N/A	243	HW-59359
Dec-58	4.23E+07	N/A	N/A	170	HW-59359
Jan-59	4.19E+07	N/A	N/A	182	HW-63646
Feb-59	3.10E+07	N/A	N/A	N/A	HW-63646
Mar-59	3.68E+07	5.902	0	106	HW-63646
Apr-59	3.97E+07	3.632	0	94	HW-63646
May-59	6.24E+07	0	1	694	HW-63646
Jun-59	3.89E+07	37.016	0	53	HW-63646
Jul-59	4.39E+07	2.18	0	124	HW-64375
Aug-59	5.97E+07	0	0	194	HW-64375
Sep-59	2.23E+07	0	0	42	HW-64375
Oct-59	1.51E+06	0	0	0.4	HW-64375
Nov-59	1.63E+06	0	0	318	HW-64375
Dec-59	1.95E+06	0	0	46.2	HW-64375
Jan-60	1.47E+06	0	0	20.7	HW-69071
Feb-60	1.36E+06	0	0	46.3	HW-69071
Mar-60	1.61E+06	8.62E-09	0.32	11.5	HW-69071
Apr-60	1.51E+06	0	0	10.7	HW-69071
May-60	8.70E+05	0	0	4.0	HW-69071
Jun-60	2.27E+06	0	0	6.2	HW-69071
Jul-60	2.69E+06	N/A	0	12.4	HW-69072
Aug-60	3.03E+06	0	0	22.4	HW-69072
Sep-60	2.42E+06	0	0	20.0	HW-69072
Oct-60	1.32E+06	0.454	0	7.2	HW-69072
Nov-60	1.21E+06	0	0	7.5	HW-69072
Dec-60	2.16E+06	0	0	8.9	HW-69072
Jan-61	2.01E+06	N/A	N/A	2.1	HW-71971
Feb-61	1.97E+06	N/A	N/A	22.2	HW-71971
Mar-61	2.66E+06	N/A	N/A	47.2	HW-71971
Apr-61	1.93E+06	N/A	N/A	11.7	HW-71971
May-61	1.89E+06	N/A	N/A	19.2	HW-71971
Jun-61	2.23E+06	N/A	N/A	12.9	HW-71971
Jul-61	1.93E+06	N/A	N/A	37.0	HW-72956
Aug-61	1.50E+05	N/A	N/A	22.6	HW-72956
Sep-61	6.78E+05	N/A	N/A	12.0	HW-72956
Oct-61	4.51E+05	N/A	N/A	4.9	HW-72956

Table C-2: 216-A-24 Discharge History					
Date	**Volume (L)**	**U (kg)**	**Pu (g)**	**Beta (Ci)**	**Reference**
Nov-61	2.89E+05	N/A	N/A	N/A	HW-72956
Dec-61	4.75E+05	N/A	N/A	2.1	HW-72956
Jan-62	2.70E+06	0.01	0	23	HW-76638
Feb-62	1.90E+06	0	0	6	HW-76638
Mar-62	1.80E+06	0	0	4	HW-76638
Apr-62	1.90E+06	0	0	3	HW-76638
May-62	1.50E+06	0	0	3	HW-76638
Jun-62	1.60E+06	0	0	7	HW-76638
Jul-62	1.60E+06	0	0	9	HW-76638
Aug-62	1.40E+06	0	0	9	HW-76638
Sep-62	1.10E+06	0	0	9	HW-76638
Oct-62	1.20E+06	0	0	8	HW-76638
Nov-62	1.00E+06	0	0	8	HW-76638
Dec-62	1.70E+06	0	0	11	HW-76638
Jan-63	1.48E+06	0	0	6	HW-80877
Feb-63	7.60E+05	0	0	0	HW-80877
Mar-63	1.51E+06	0	0	6.3	HW-80877
Apr-63	8.30E+05	0	0	4.3	HW-80877
May-63	1.03E+06	0	0	3.9	HW-80877
Jun-63	1.31E+06	0	0	4.2	HW-80877
Jul-63	2.27E+06	0	0	3.4	HW-80877
Aug-63	3.05E+06	0	0	4.5	HW-80877
Sep-63	3.47E+06	0	0	2.9	HW-80877
Oct-63	1.85E+06	0	0	0.7	HW-80877
Nov-63	1.27E+06	0	0	0.8	HW-80877
Dec-63	1.38E+06	0	0	2.5	HW-80877
Jan-64	1.17E+06	N/A	N/A	4.5	BNWC-91
Feb-64	1.24E+06	N/A	N/A	3.03	BNWC-91
Mar-64	1.63E+06	N/A	N/A	3.64	BNWC-91
Apr-64	7.10E+05	N/A	N/A	2.15	BNWC-91
May-64	1.25E+06	N/A	N/A	2.37	BNWC-91
Jun-64	1.33E+06	N/A	N/A	1.3	BNWC-91
Jul-64	7.80E+05	N/A	N/A	6.6	BNWC-91
Aug-64	7.30E+05	N/A	N/A	4.9	BNWC-91
Sep-64	7.30E+05	N/A	N/A	2.84	BNWC-91
Oct-64	9.90E+05	N/A	N/A	7.2	BNWC-91
Nov-64	7.30E+05	N/A	N/A	4	BNWC-91
Dec-64	2.80E+05	N/A	N/A	1.3	BNWC-91
Jan-65	1.25E+06	N/A	N/A	6.04	ISO-98
Feb-65	2.46E+05	N/A	N/A	N/A	ISO-98
Mar-65	7.04E+05	N/A	N/A	1.75	ISO-98
Apr-65	7.87E+05	N/A	N/A	2	ISO-98
May-65	1.09E+06	N/A	N/A	1.4	ISO-98

Table C-2: 216-A-24 Discharge History					
Date	**Volume (L)**	**U (kg)**	**Pu (g)**	**Beta (Ci)**	**Reference**
Jun-65	8.78E+05	N/A	N/A	1.52	ISO-98
Jul-65	9.88E+05	N/A	N/A	0.86	ISO-98
Aug-65	1.30E+06	N/A	N/A	3.2	ISO-98
Sep-65	1.71E+06	N/A	N/A	1.72	ISO-98
Oct-65	1.40E+06	N/A	N/A	5	ISO-98
Nov-65	1.86E+06	N/A	N/A	5.3	ISO-98
Dec-65	1.98E+00	N/A	N/A	5.84	ISO-98
Jan-66	9.20E+05	N/A	N/A	2.3	ISO-698
Feb-66	1.58E+06	N/A	N/A	3.3	ISO-698
Mar-66	1.70E+06	N/A	N/A	8.9	ISO-698
Apr-66	7.60E+05	N/A	N/A	3.3	ISO-698
May-66	3.30E+05	N/A	N/A	1.3	ISO-698
Jun-66	6.70E+05	N/A	N/A	8.8	ISO-698
Jul-66	6.80E+05	N/A	N/A	8.5	ISO-698
Totals	7.94E+08	49.19	1.32	4552.66	

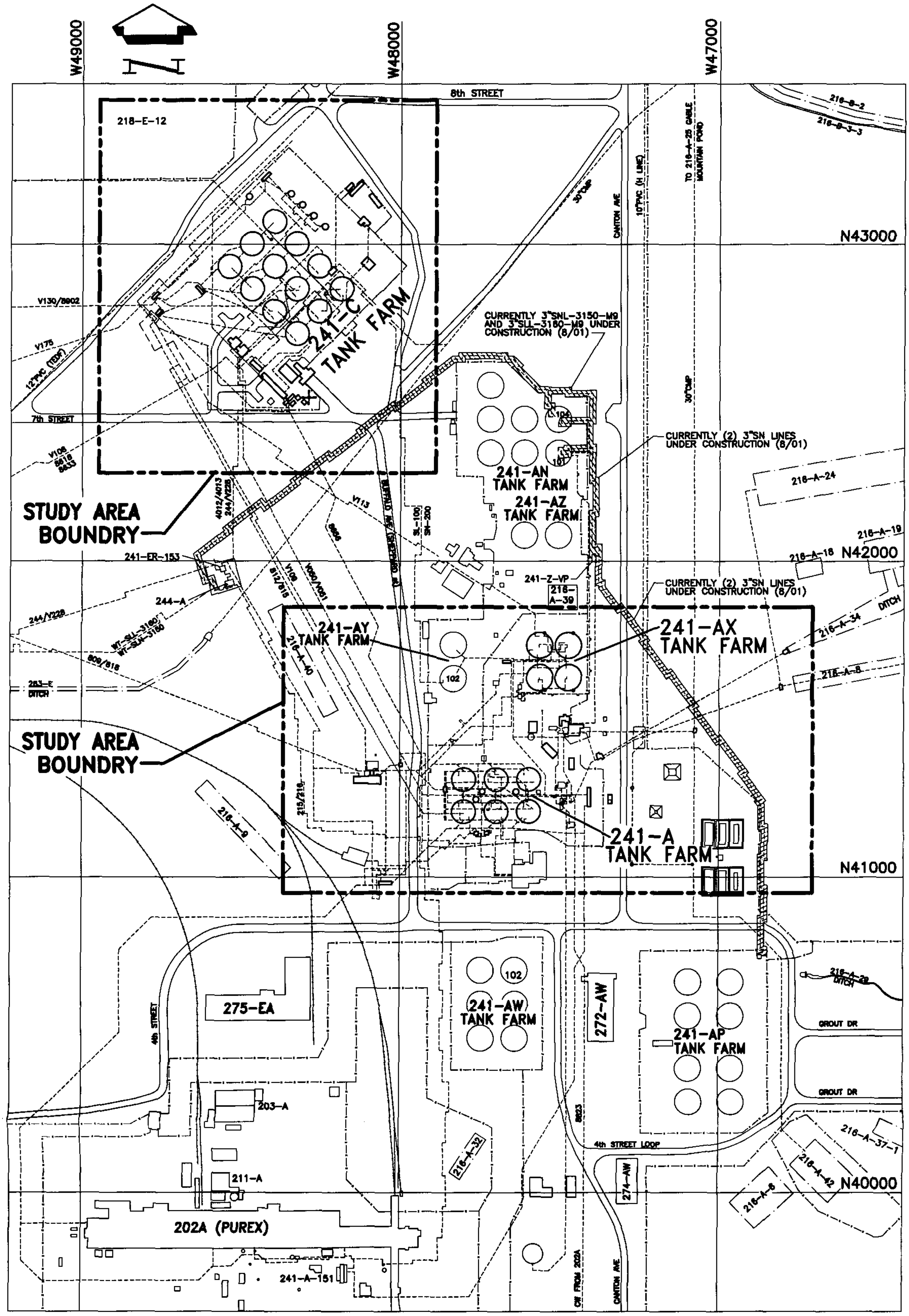
Table C-3: 216-A-7 Discharge History					
Date	**Volume (L)**	**U (kg)**	**Pu (g)**	**Beta (Ci)**	**Reference**
Nov-55	1.00E+04	25	N/A	N/A	HW-44784
Dec-55	1.00E+03	5	N/A	N/A	HW-44784
Jan-56	4.00E+04	N/A	N/A	N/A	HW-44784
Feb-56	4.00E+03	N/A	N/A	N/A	HW-44784
Mar-56	4.00E+03	N/A	N/A	N/A	HW-44784
Apr-56	0	0	0	0	HW-44784
May-56	3.70E+03	N/A	N/A	N/A	HW-44784
Jun-56	3.70E+03	N/A	N/A	N/A	HW-44784
Jul-56	4.00E+03	N/A	N/A	N/A	HW-48518
Aug-56	0	N/A	N/A	N/A	HW-48518
Sep-56	0	N/A	N/A	N/A	HW-48518
Oct-56	5.60E+03	0.953		1.7	HW-48518
Nov-56	0	N/A	N/A	N/A	HW-48518
Dec-56	4.00E+03	N/A	N/A	N/A	HW-48518
Jan-57	N/A	N/A	N/A	N/A	HW-53336
Feb-57	N/A	N/A	N/A	N/A	HW-53336
1966	2.47E+05				ARH-CD-745
Totals	3.27E+05				

Table C-4: 216-A-9 Discharge History					
Date	**Volume (L)**	**U (kg)**	**Pu (g)**	**Beta (Ci)**	**Reference**
Mar-56	3.11E+08	N/A	N/A	0	HW-44784
Apr-56	6.00E+07	N/A	N/A	0	HW-44784
May-56	3.17E+07	N/A	N/A	0	HW-44784
Jun-56	5.30E+06	N/A	N/A	0	HW-44784
Jul-56	8.45E+07	N/A	N/A	0	HW-48518
Aug-56	1.32E+08	N/A	N/A	0	HW-48518
Sep-56	7.60E+07	N/A	N/A	0	HW-48518
Oct-56	0	N/A	N/A	0	HW-48518
Nov-56	0	N/A	N/A	0	HW-48518
Dec-56	0	N/A	N/A	0	HW-48518
Jan-57	2.28E+07	N/A	N/A	0	HW-53336
Feb-57	3.29E+07	N/A	N/A	0	HW-53336
Mar-57	3.29E+07	N/A	N/A	0	HW-53336
Apr-57	4.91E+07	N/A	N/A	3	HW-53336
May-57	5.03E+07	N/A	N/A	0	HW-53336
Jun-57	6.22E+07	N/A	N/A	0.8	HW-53336
Jul-57	4.69E+07	N/A	N/A	8.8	HW-55593
Aug-57	5.56E+07	N/A	N/A	23.3	HW-55593
Sep-57	3.74E+07	N/A	N/A	1.47	HW-55593
Oct-57	7.94E+07	N/A	N/A	4.79	HW-55593
Nov-57	6.12E+07	N/A	N/A	1.9	HW-55593
Dec-57	5.10E+07	N/A	N/A	9.3	HW-55593
Jan-58	2.78E+07	N/A	N/A	0.9	HW-57649
1966	1.82E+06				ARH-CD-745
1967	1.89E+05				ARH-486
Totals	1.31E+09	0	0	54.26	

APPENDIX D

FIGURES

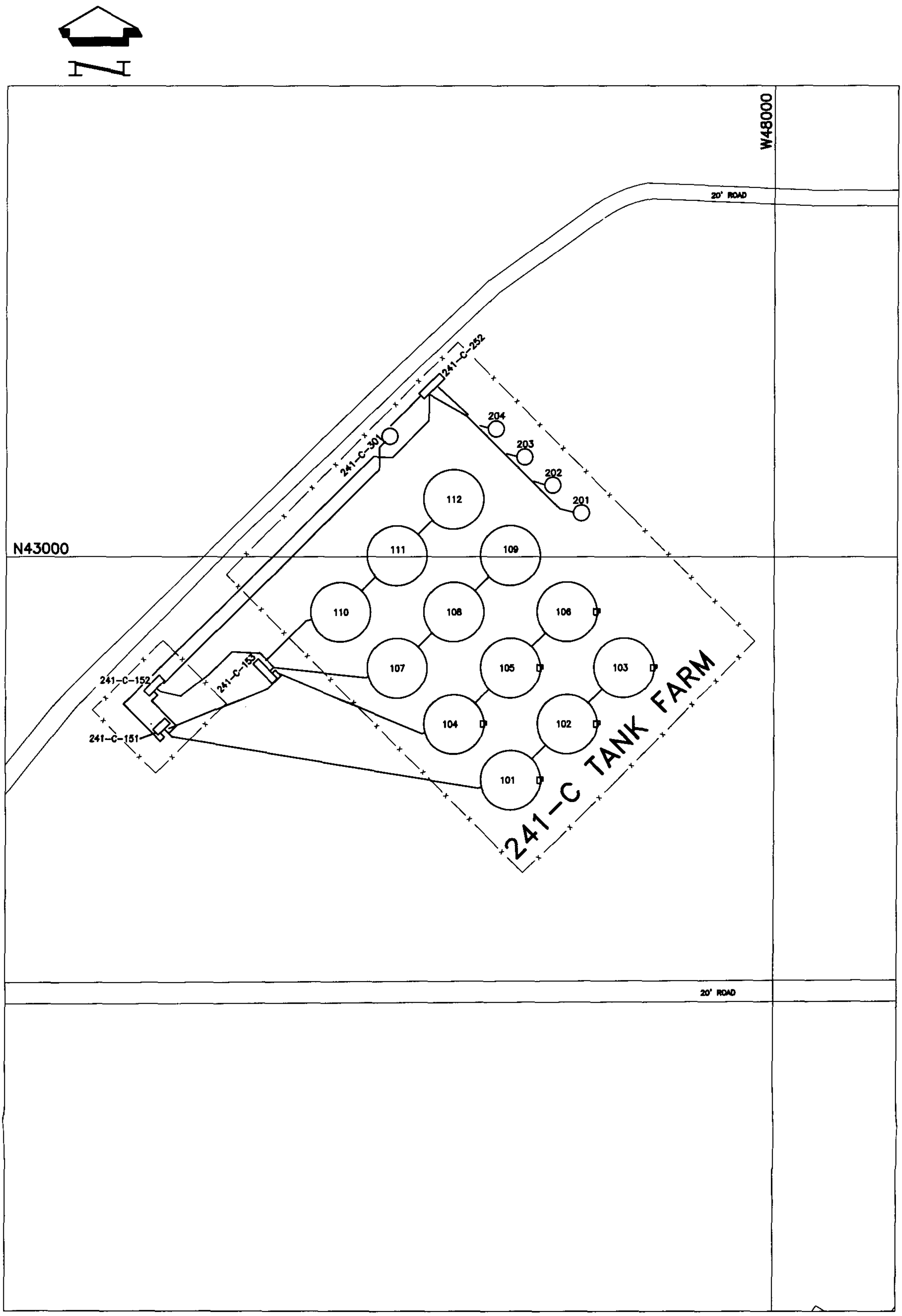
Figure 1:	A, AX, and C Tank Farms, 200 East Area (present)
Figure 2:	Facilities Constructed for the Manhattan Project (1943-1945)
Figure 3:	Facilities Constructed for Postwar Bismuth Phosphate and Uranium Recovery Operations (1946-1957)
Figure 4:	Facilities Constructed for PUREX Operations (1956-1964)
Figure 4a:	Test Wells Constructed for PUREX Operations (1956-1964)
Figure 5:	Facilities Constructed in C Farm for Waste Fractionization Operations (1961-1978)
Figure 6:	Facilities Constructed in A/AX Farms for Waste Fractionization Operations (1965-1978)
Figure 6a:	Test Wells Constructed in A/AX Farms for Waste Fractionization Operations (1965-1978)
Figure 7:	Facilities Constructed in C Farm for Interim Stabilization and Isolation (1975-2001)
Figure 7a:	Test Wells Constructed in C Farm for Interim Stabilization and Isolation, (1975-2001)
Figure 8:	Facilities Constructed in A/AX Farms for Interim Stabilization and Isolation (1975-2001)
Figure 8a:	Test Wells Constructed in A/AX Farms for Interim Stabilization and Isolation (1975-2001)



A, AX, AND C TANK FARMS
200 EAST AREA
(PRESENT)
FIGURE 1

LEGEND

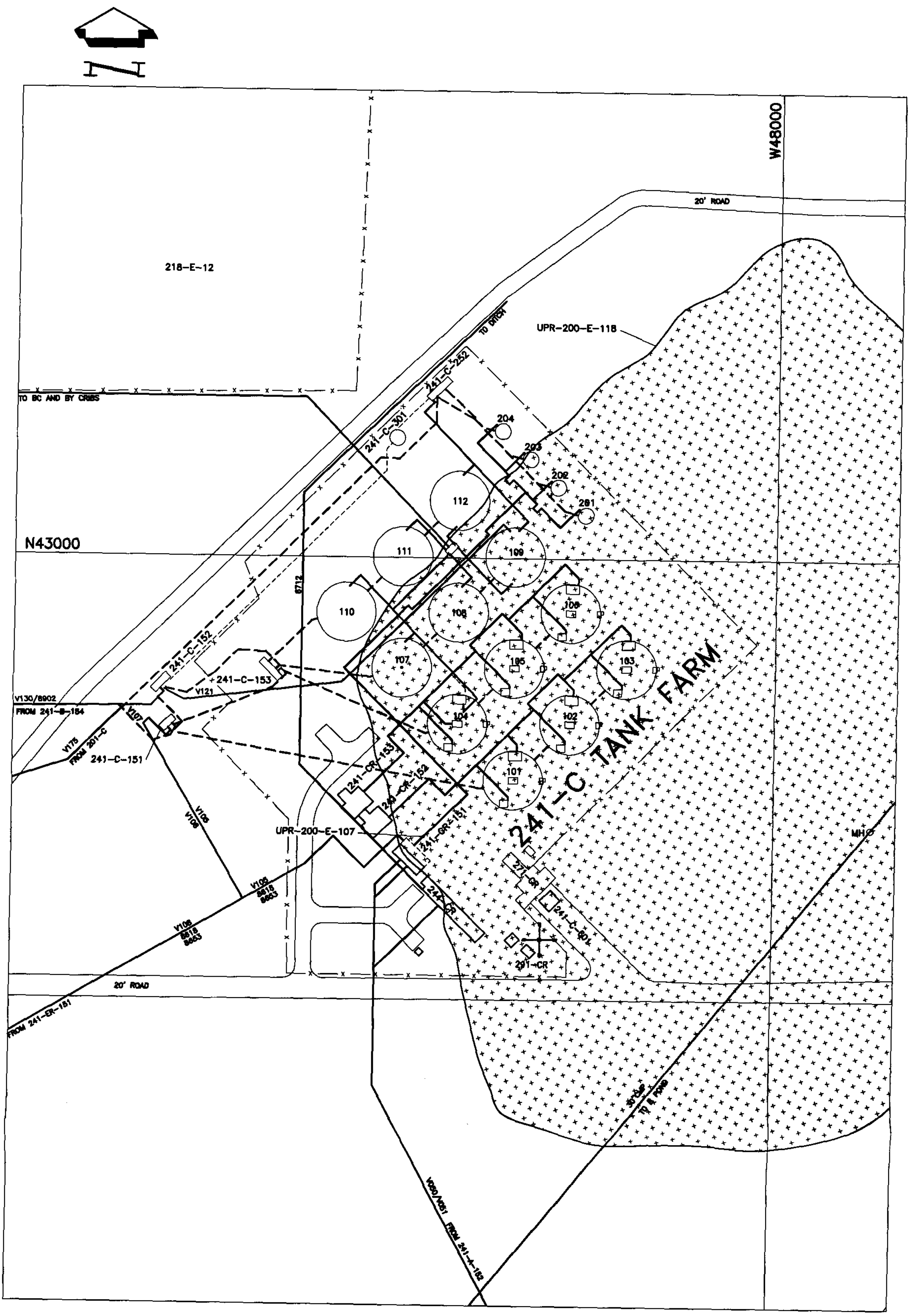
- EXISTING PIPE LINES
- EXISTING FACILITIES
- FENCE
- DITCH



FACILITIES CONSTRUCTED FOR THE MANHATTAN PROJECT (1943–1945)
FIGURE 2

LEGEND

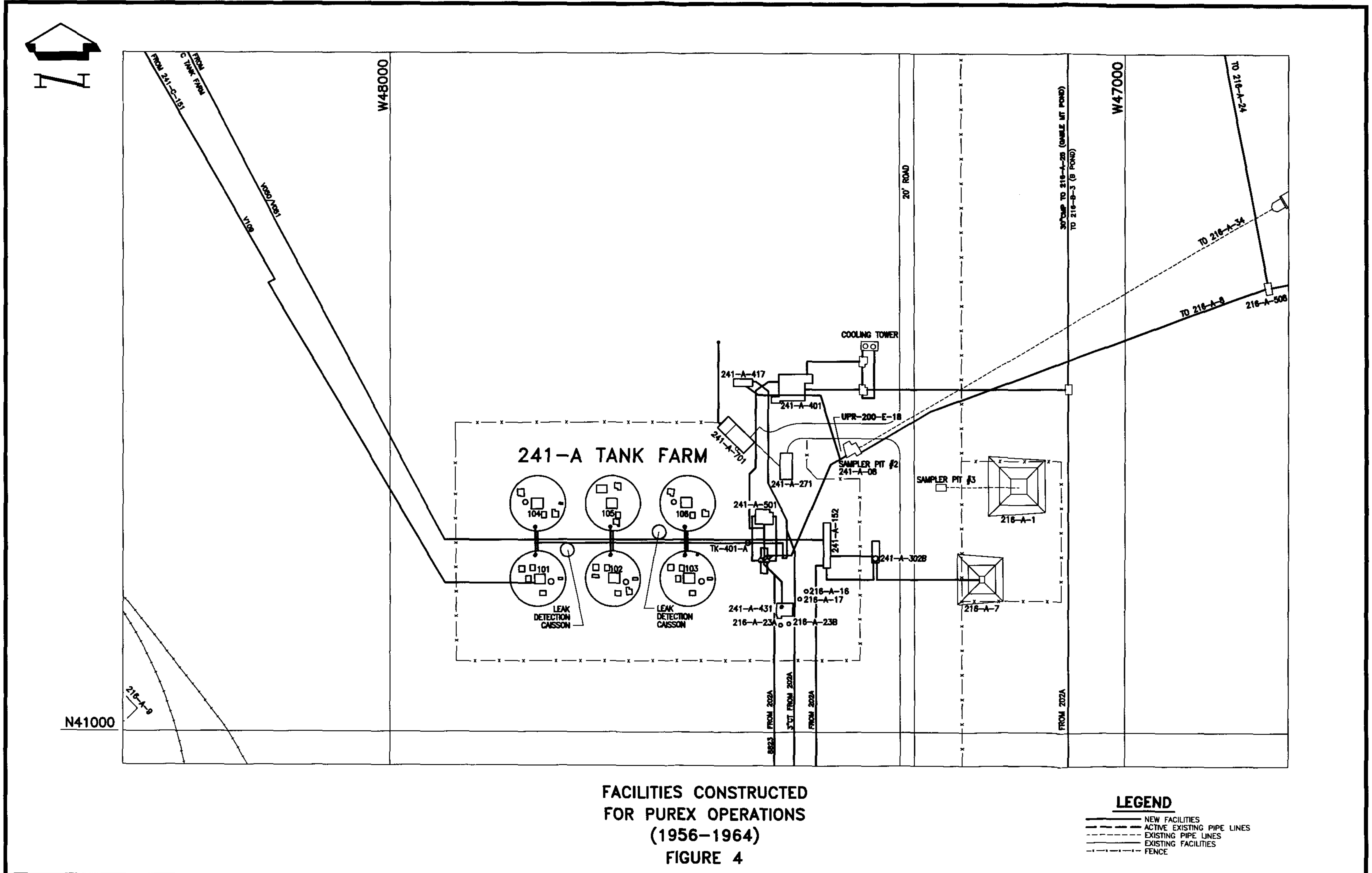
——— NEW FACILITIES
— X — FENCE



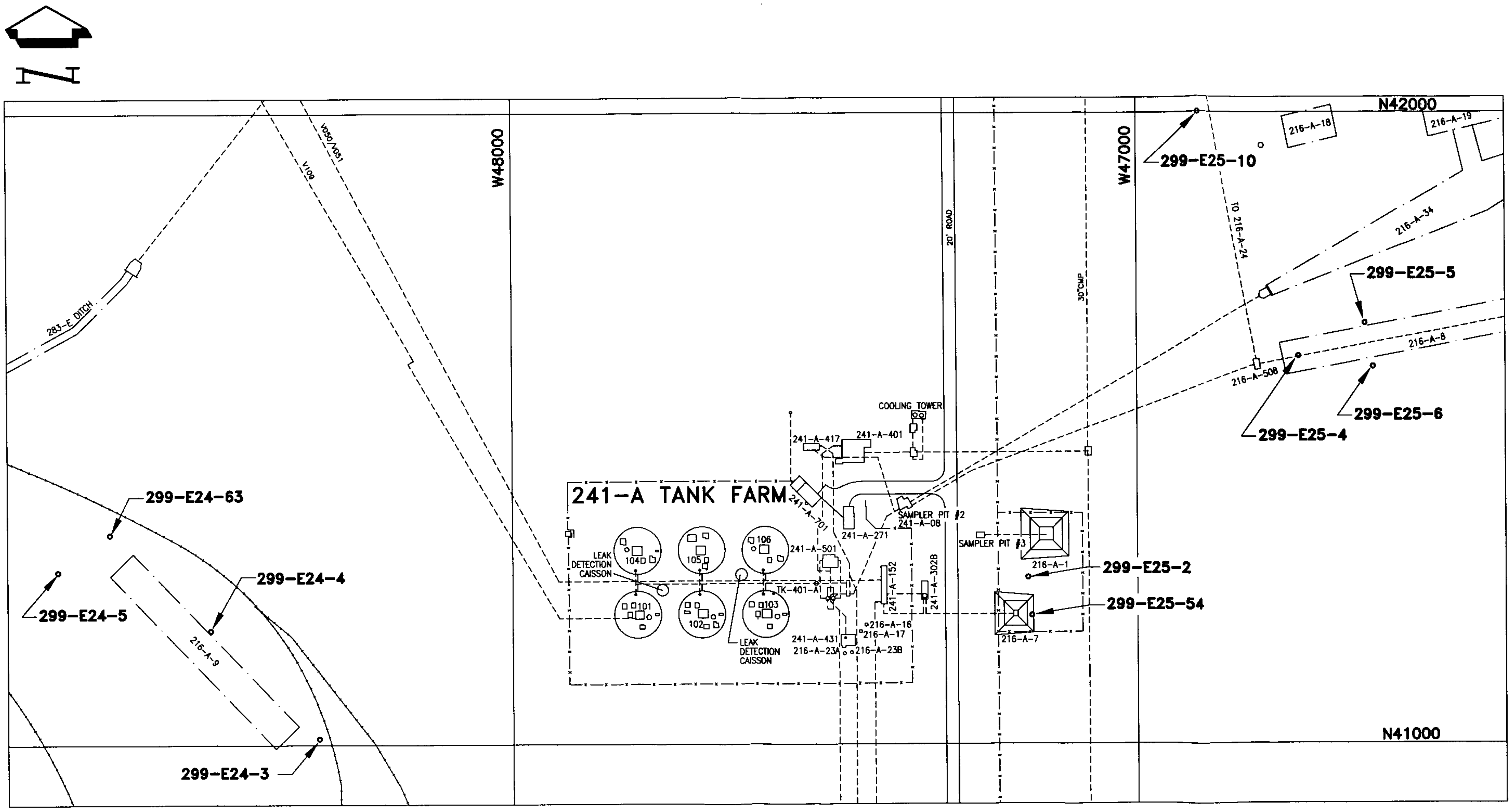
FACILITIES CONSTRUCTED FOR POSTWAR BISMUTH PHOSPHATE AND URANIUM RECOVERY OPERATION (1946–1957)

FIGURE 3

LEGEND
- NEW FACILITIES
- ACTIVE EXISTING PIPE LINES
- EXISTING PIPE LINES
- EXISTING FACILITIES
- FENCE
- UNPLANNED RELEASE



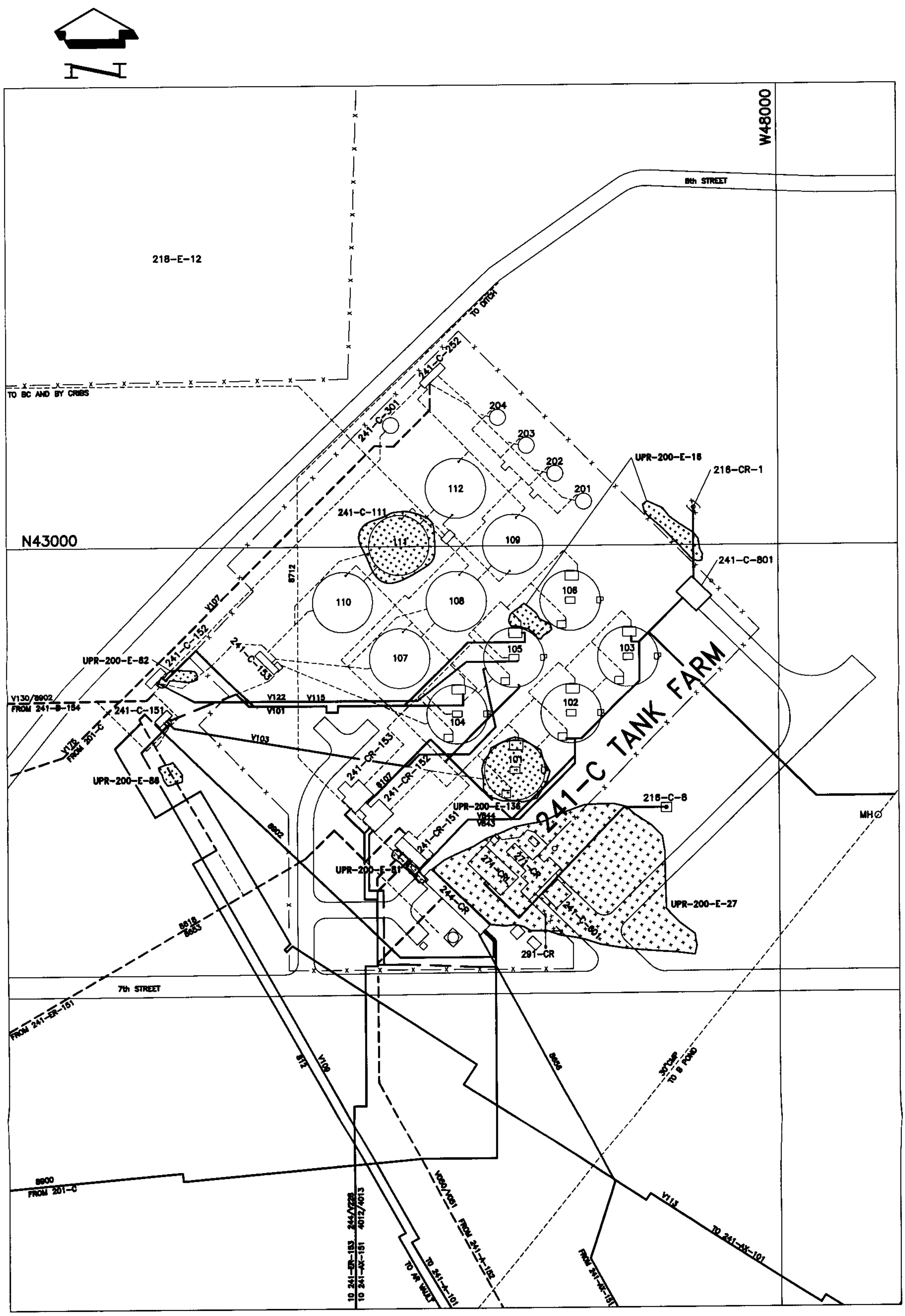
FACILITIES CONSTRUCTED
FOR PUREX OPERATIONS
(1956–1964)
FIGURE 4



TEST WELLS CONSTRUCTED
FOR PUREX OPERATIONS
(1955–1964)
FIGURE 4a

LEGEND

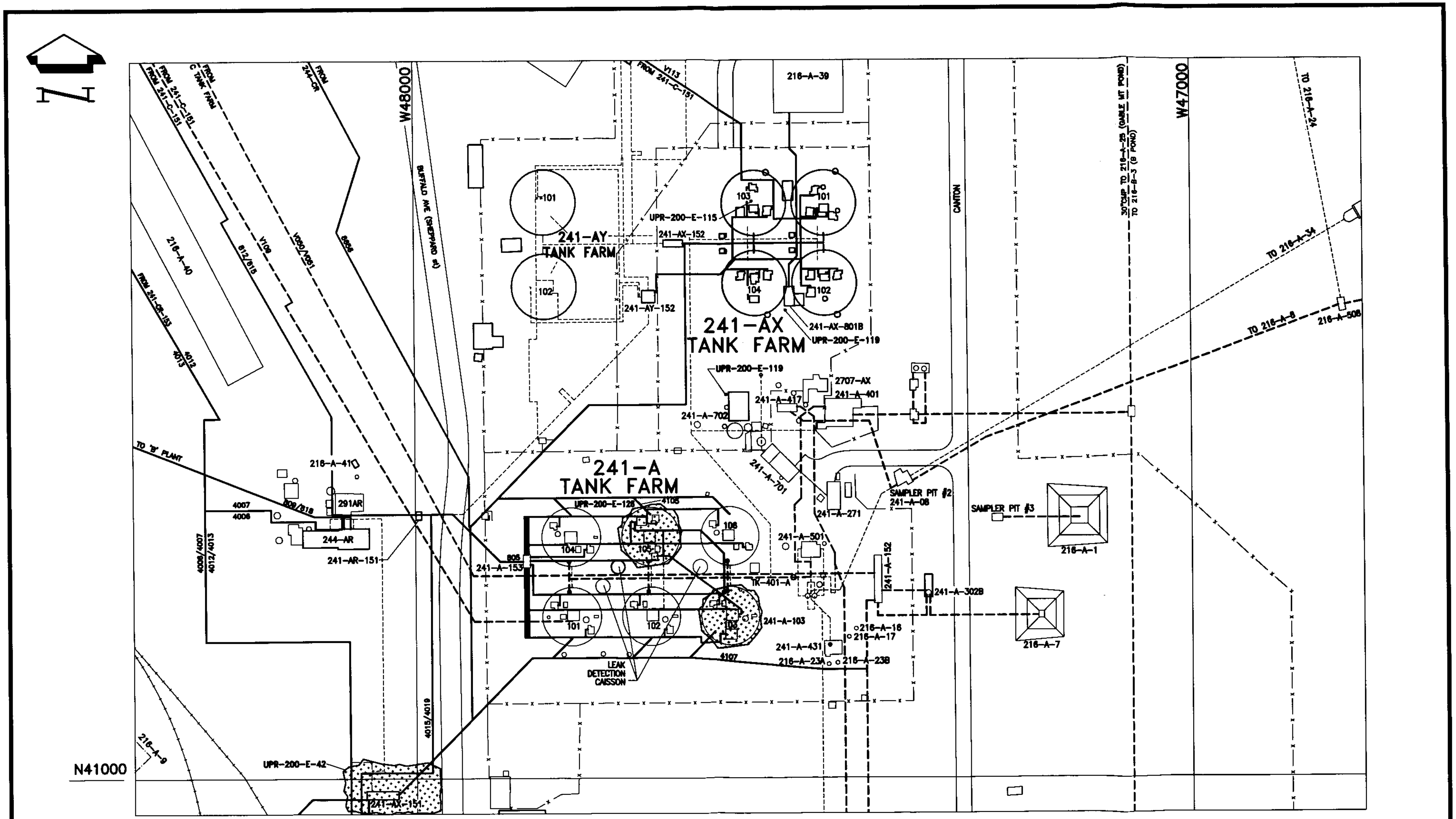
NEW WELLS ARE SHOWN IN "BOLD" TEXT



FACILITIES CONSTRUCTED IN C FARM
FOR WASTE FRACTIONIZATION OPERATIONS
(1961–1978)
FIGURE 5

LEGEND

NEW FACILITIES
ACTIVE EXISTING PIPE LINES
EXISTING PIPE LINES
EXISTING FACILITIES
FENCE
UNPLANNED RELEASE

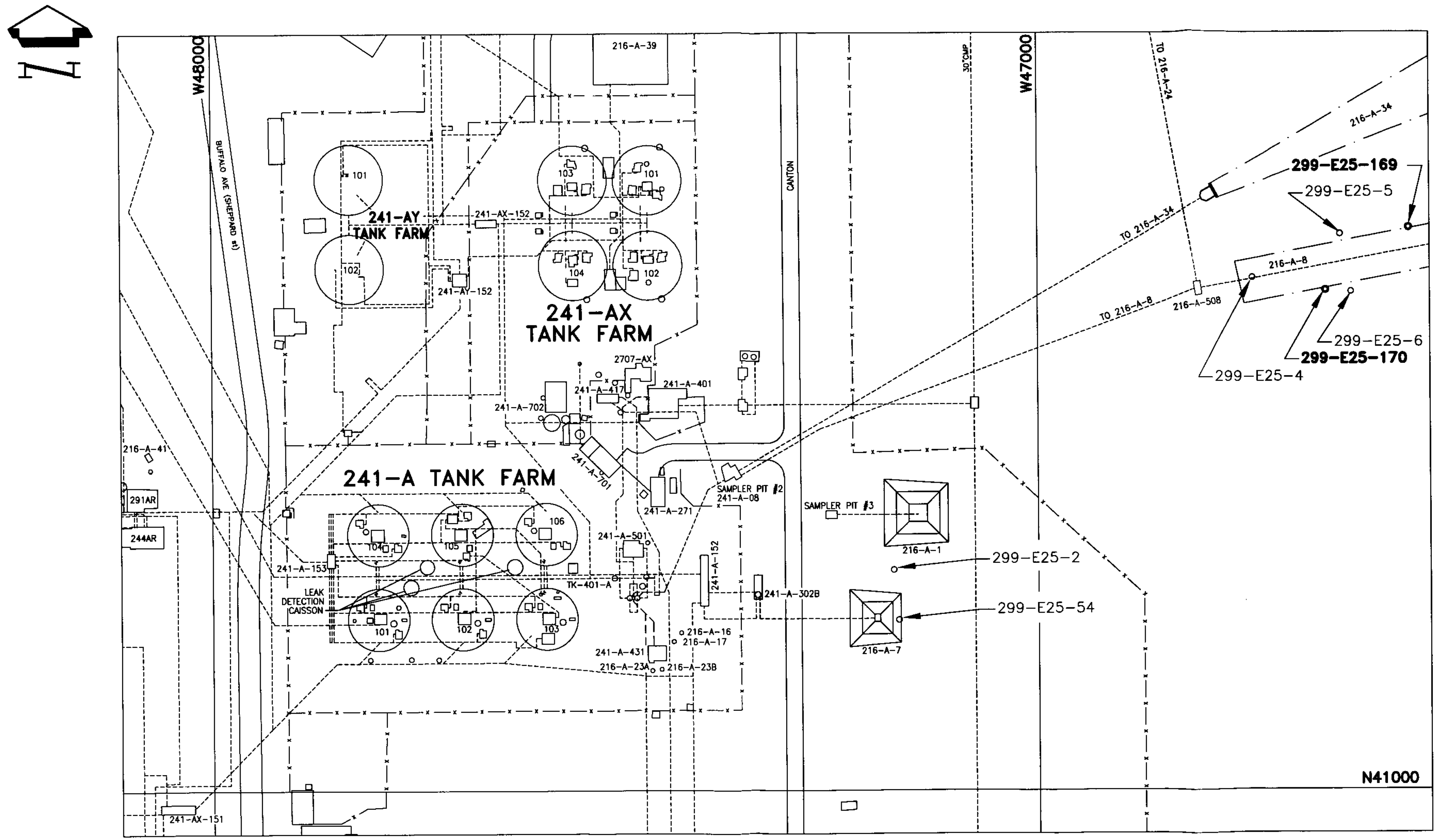


FACILITIES CONSTRUCTED IN A/AX FARMS FOR WASTE FRACTIONIZATION OPERATIONS (1965–1978)

FIGURE 6

LEGEND

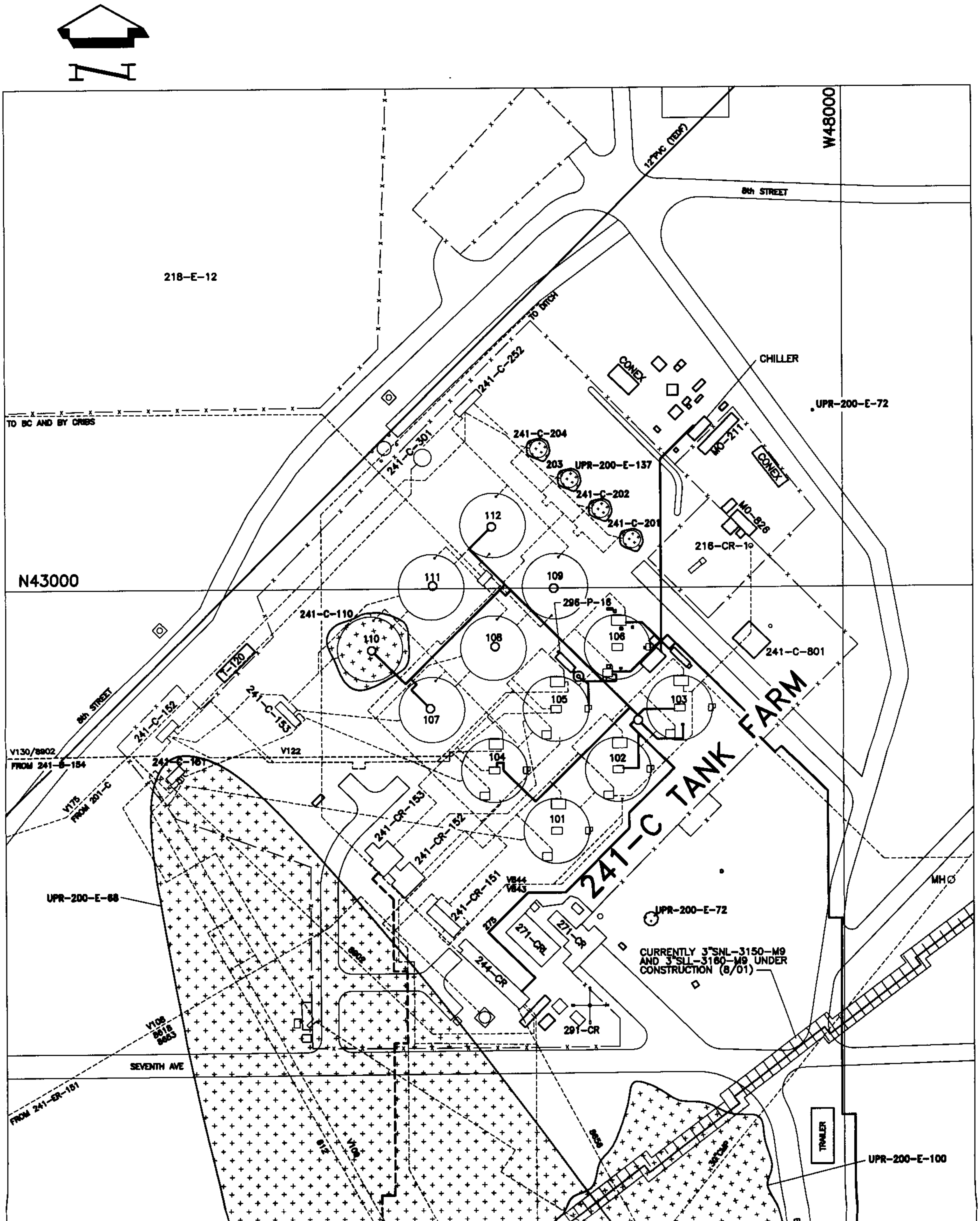
- NEW FACILITIES
- ACTIVE EXISTING PIPE LINES
- EXISTING PIPE LINES
- EXISTING FACILITIES
- FENCE
- UNPLANNED RELEASE



TEST WELLS CONSTRUCTED IN A/AX FARMS
FOR WASTE FRACTIONIZATION OPERATIONS
(1965-1978)
FIGURE 6a

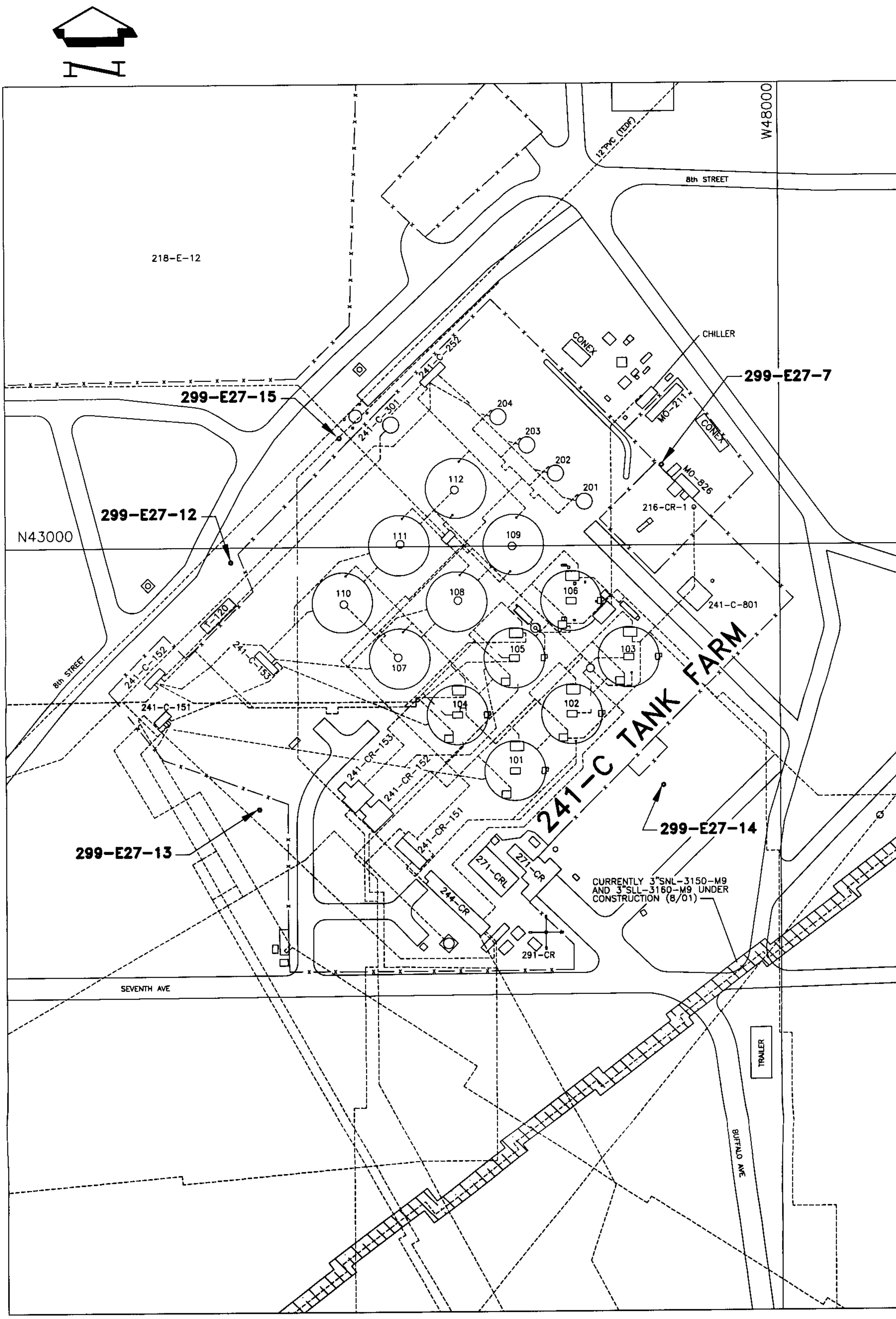
LEGEND

NEW WELLS ARE SHOWN IN "BOLD" TEXT



FACILITIES CONSTRUCTED IN C FARM
FOR INTERIM STABILIZATION AND ISOLATION
(1975–2001)
FIGURE 7

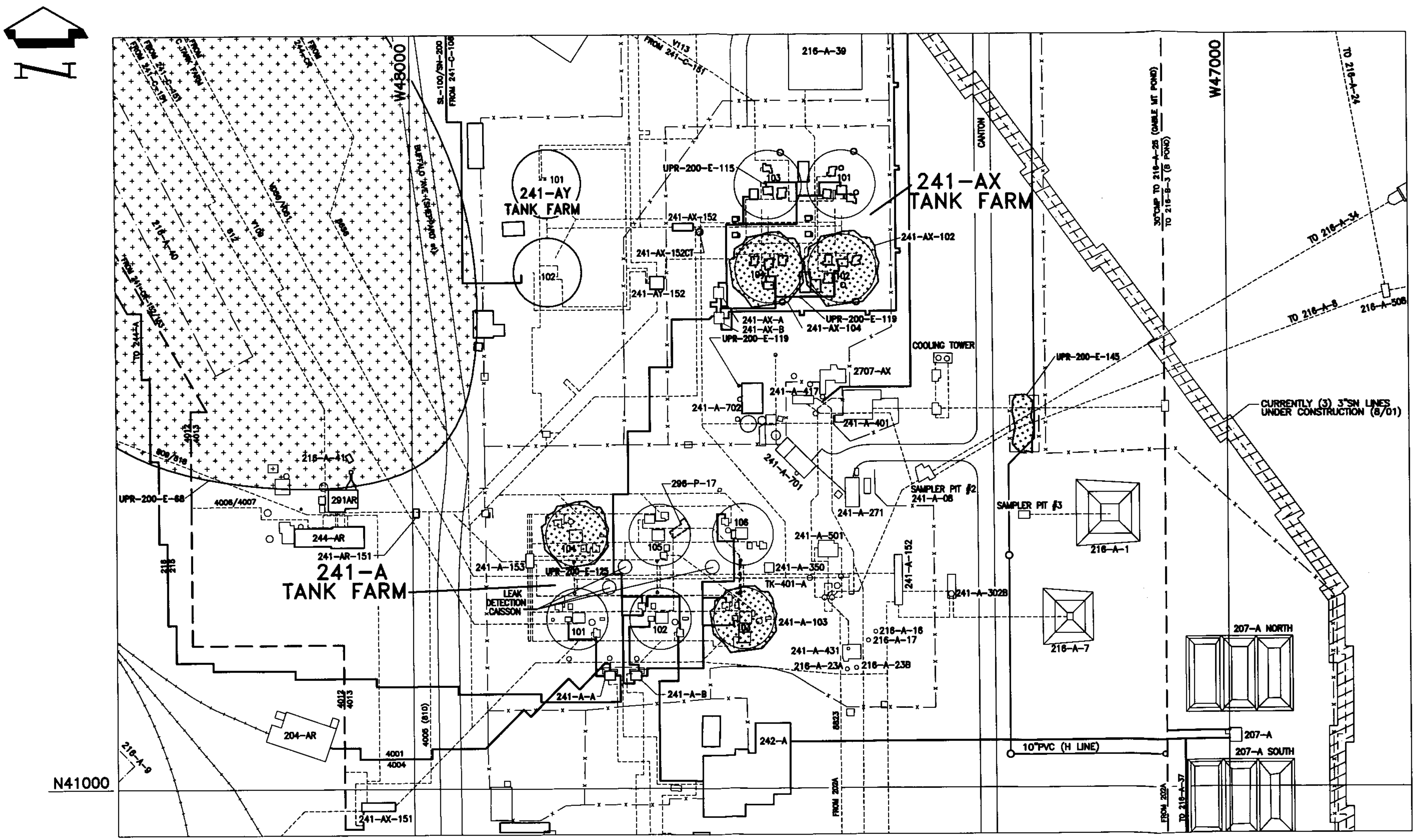
LEGEND
- NEW FACILITIES
- ACTIVE EXISTING PIPE LINES
- EXISTING PIPE LINES
- EXISTING FACILITIES
- FENCE
- UNPLANNED RELEASE



TEST WELLS CONSTRUCTED IN C FARM
FOR INTERIM STABILIZATION AND ISOLATION
(1975–2001)
FIGURE 7a

LEGEND

NEW WELLS ARE SHOWN IN "BOLD" TEXT

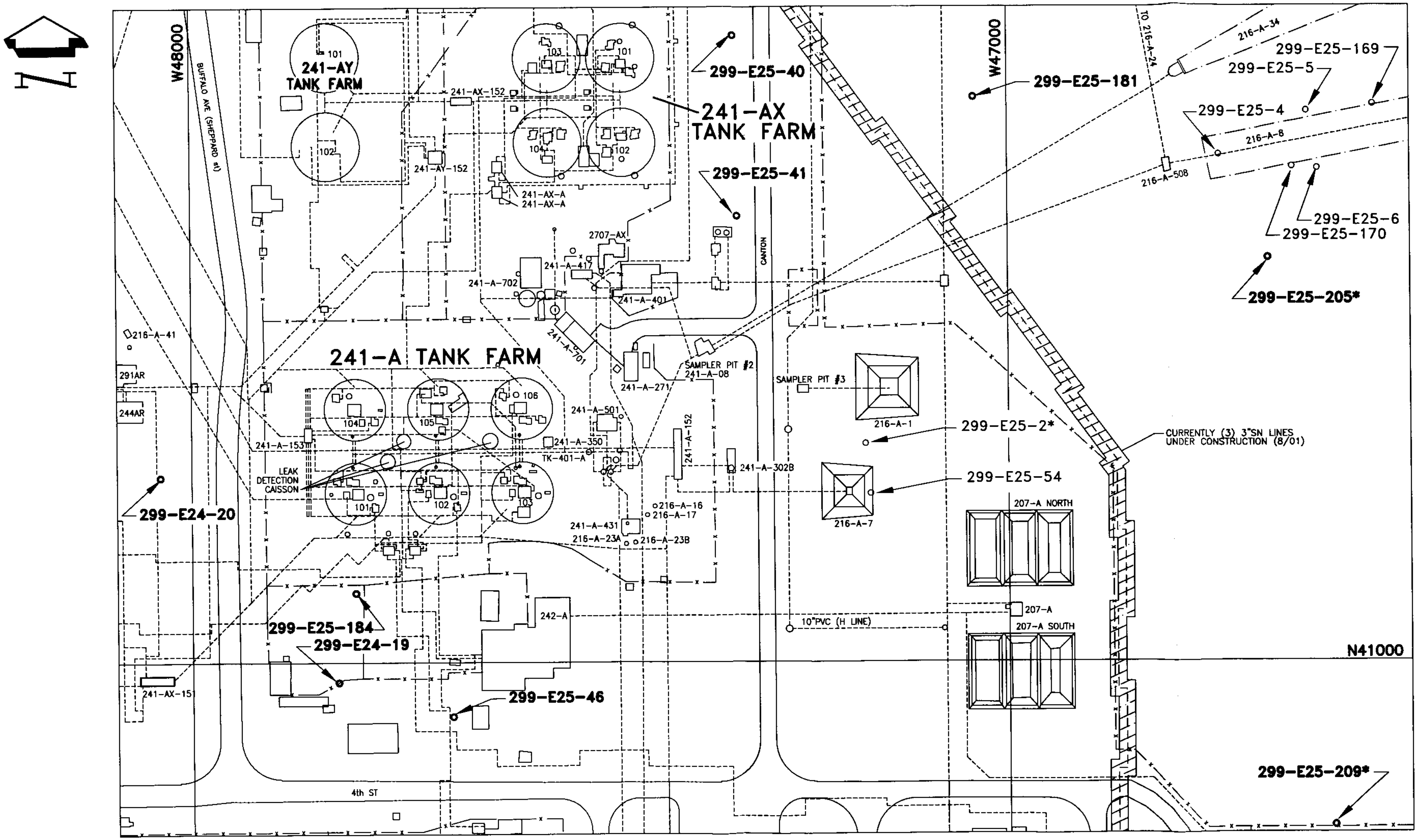


FACILITIES CONSTRUCTED IN A/AX FARMS FOR INTERIM STABILIZATION AND ISOLATION (1975–2001)

FIGURE 8

LEGEND

- NEW FACILITIES
- ACTIVE EXISTING PIPE LINES
- EXISTING PIPE LINES
- EXISTING FACILITIES
- FENCE
- UNPLANNED RELEASE



TEST WELLS CONSTRUCTED IN A/AX FARMS
FOR INTERIM STABILIZATION AND ISOLATION
(1975–2001)
FIGURE 8a

LEGEND

NEW WELLS ARE SHOWN IN "BOLD" TEXT
* = OUT OF SERVICE