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# Data Compilation Task Report for the Source Investigation of the 300-FF-1 Operable Unit Phase I Remedial Investigation

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February 1990

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DATA COMPILATION TASK REPORT  
FOR THE SOURCE INVESTIGATION  
OF THE 300-FF-1 OPERABLE UNIT  
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Richland, Washington 99352

## SUMMARY

This report provides additional information on facility and waste characteristics for the 300-FF-1 operable unit. The additional information gathered and reported includes the following:

- meetings and on-site visits with current and past personnel having knowledge of operations in the operable unit
- a more precise determination of the location of the Process Sewer lines and Retired Radioactive Liquid Waste Sewer
- a better understanding of the phosphoric acid spill at the 340 Complex
- a search for engineering plans and environmental reports related to the operable unit.

As a result of this data-gathering effort, recommendations for further investigation are the following:

- characterization of the 307 Trenches to determine the origin of an underlying uranium plume in the groundwater
- more extensive sampling of near-surface and dike sediments in the North and South Process Ponds to better define the extent of horizontal contamination
- detection of possible leaks in the abandoned Radioactive Waste Sewer by either electromagnetic induction or remote television camera inspection techniques.

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## 1.0 INTRODUCTION

The 300-FF-1 operable unit (Figure 1) has been defined under the direction of U.S. Department of Energy (DOE) orders based on the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and U.S. Environmental Protection Agency (EPA) methodology. Although the process by which inactive waste sites will be remediated has begun, the current operation of many facilities on the Hanford Site is a complicating factor that will continue and must be considered as the CERCLA effort goes forth.

The purpose of this report is to provide additional information on facility and waste characteristics for the 300-FF-1 operable unit that was not available when the draft work plan (DOE 1989a) was written. Specifically, the additional information gathered and reported includes the following:

- meetings and on-site visits with current and past personnel having knowledge of operations in the operable unit
- a more precise determination of the location of the Process Sewer lines and Retired Radioactive Liquid Waste Sewer
- a better understanding of the phosphoric acid spill at the 340 Complex
- a search for other engineering plans and environmental reports related to the operable unit that were not referenced in the draft work plan (DOE 1989a).

### 1.1 PRELIMINARY ASSESSMENT/SITE INSPECTION DATA

Much information on facility and waste characteristics for the 300-FF-1 operable unit is available from the preliminary assessment/site inspection work. At this point, only selected 300-FF-1 waste transfer, storage, and disposal facilities are targeted for direct characterization during the current remedial investigation. Several of the facilities handled only nonhazardous waste, some have no documented releases of hazardous substances, and certain facilities can be effectively combined to focus the investigation.



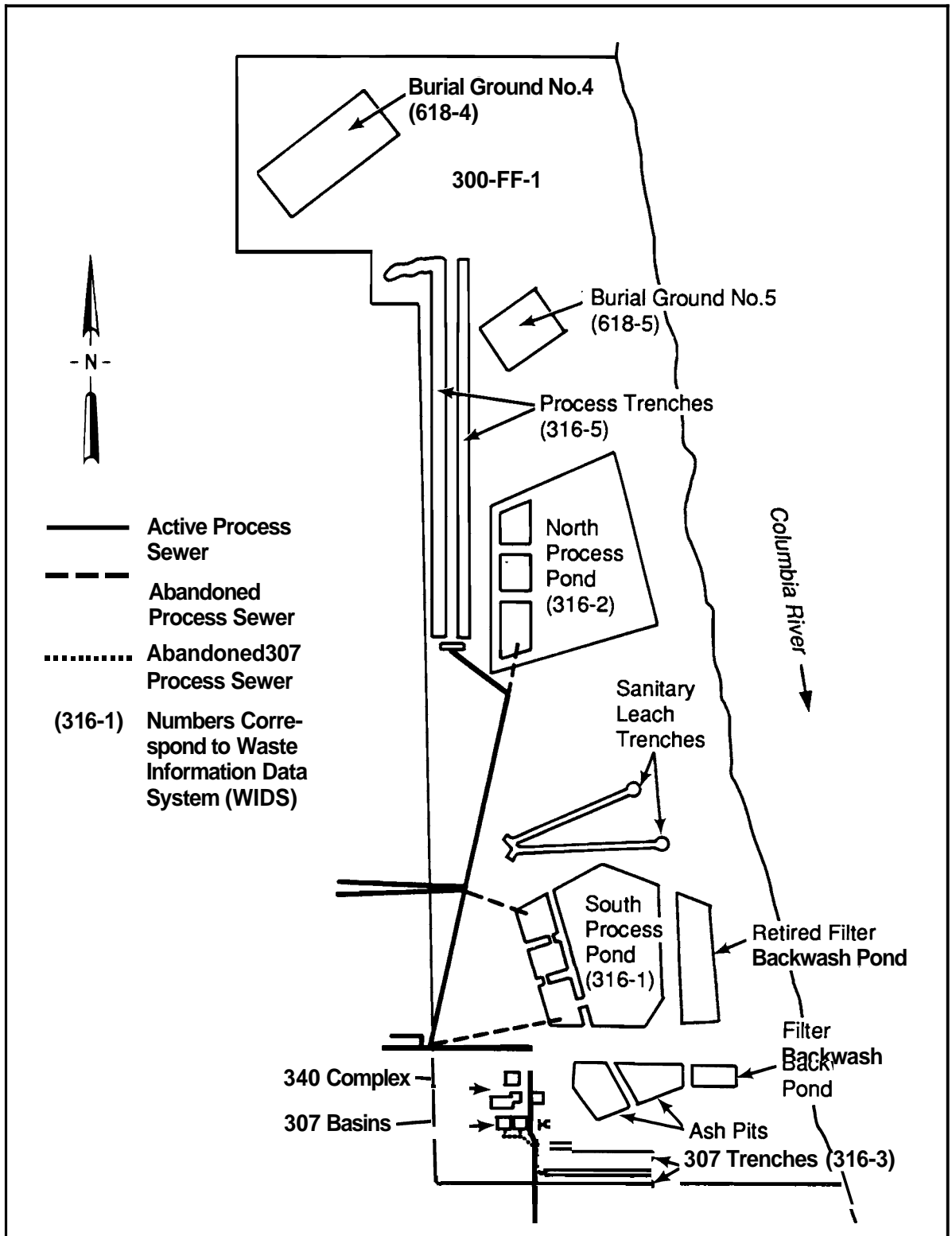


FIGURE 1. The 300-FF-1 Operable Unit

The Hanford Inactive Surveillance System (HISS data base) contains information for all sites within the 300-FF-1 operable unit, except for the Sanitary Sewer, the Retired Filter Backwash Pond, and the Retired and Current Radioactive Liquid Waste Sewers. Stenner et al. (1988) include the same data concerning the 300 Area inactive waste disposal sites. The four liquid effluent disposal sites within the 300 Area [North and South Process Ponds (316-2 and 316-1), 307 Trenches (316-3), and Process Trenches (316-5); see Figure 1] received both radioactive wastes and chemicals from process and Laboratory wastes, along with large volumes of liquids. These are considered to be observed releases as opposed to unplanned releases. Table 1 lists the facilities in the 300-FF-1 operable unit that require further remedial investigation under the remedial investigation/feasibility study work plan (DOE 1989a). Table 2 lists the facilities that have been identified by the work plan (DOE 1989a) as currently not requiring further investigation; this list is subject to change.

TABLE 1. Facilities in the 300-FF-1 Operable Unit That Require Further Remedial Investigation (from DOE 1989a)

	<u>WIDS</u> <sup>(a)</sup>
Retired portions of the Process Sewer and 307 Pipeline systems (active portions will be investigated in the 300 Area treated effluent study)	
South Process Pond (including Retired Filter Backwash Pond)	316-1
North Process Pond (including North Process Pond Scraping Disposal Area)	316-2
307 Trenches	316-3
Process Trenches <sup>(b)</sup>	316-5
307 Basins <sup>(b)</sup>	
Burial Ground No. 4	618-4
Burial Ground No. 5	618-5
Retired Radioactive Liquid Waste Sewer Lines	
340 Complex <sup>(b)</sup>	
Sanitary Sewer System <sup>(b)</sup>	
Ash Pits <sup>(b)</sup>	
Filter Backwash Ponds <sup>(b)</sup>	

(a) From the Waste Information Data System.

(b) Facilities that are active in whole or in part.

TABLE 2. Facilities in the 300-FF-1 Operable Unit That Do Not Require Further Remedial Investigation (from DOE 1989a)

Radioactive Liquid Waste Sewer Lines (leak detection system in place)  
340 Complex Hazardous Waste Staging Area (no documented releases)  
332 Hazardous Waste Staging Area (no documented releases)

Some of the facilities noted in Table 1 are partly or wholly active. For example, the Process Trenches (316-5), the 307 Basins, and the 340 Complex are in current use and are being operated as interim-status Resource Conservation and Recovery Act (RCRA) facilities. Complicating the picture are facilities that have retired portions, such as the Process Sewer system with abandoned lines going to the North and South Process Ponds (316-2 and 316-1), as well as past spills and unplanned releases around active units. This report considers only those facilities or parts of facilities that are inactive, retired, or abandoned.

## 2.0 INTERVIEWS WITH KNOWLEDGEABLE PERSONNEL

Four key people contributed in-depth information to various aspects of this report. Mr. Michael E. Thurman, Westinghouse Hanford Company (Westinghouse Hanford), Defense Waste Management/Solid Waste Management, provided a tour and overview of the 340 Complex. Mr. Roy M. Gale, Pacific Northwest Laboratory (PNL), Engineering and Craft Services, furnished information on the current status of the basic sewer systems in the 300 Area. Mr. Victor H Tarr, Kaiser Engineers Hanford Company, Construction Forces, led an on-site tour of the retired radioactive waste sewer monuments. Mr. Robert B. Hall, PNL, Atmospheric Sciences Department, and formerly Westinghouse Hanford, described many historical aspects of 300 Area operations.

In addition, Mr. Cameron M. Andersen, PNL, described physical controls that prevent the introduction of radioactive and hazardous wastes to the Process Sewer, and Messrs. Lawrence B. Priest, Glenn T. Thornton (both PNL), and Earl E. Gest (Westinghouse Hanford) provided details on photochemicals and some acids released to the Process Sewer.

### 3.0 SOURCE DATA COMPILATION

The following sections present each waste stream in the context of its origin, transfer, and temporary and/or ultimate disposal.

#### 3.1 300 AREA SEWER SYSTEMS

##### 3.1.1 Basic Sewer System

Most buildings in the 300 Area are serviced by one or more of the following sewers: sanitary, process, retention process, and radioactive liquid waste (Figure 2).

The Sanitary Sewer carries waste water from lavatories and kitchens, first to septic tanks and then to two Sanitary Leach Trenches located at the northeast corner of the main 300 Area complex between the North and South Process Ponds (316-2 and 316-1); all within the 300-FF-1 operable unit.

The current Process Sewer, connected to 43 buildings, transfers process liquid wastes that include cooling water, steam condensate, process water from the fuels fabrication operations, and liquids from laboratory sink and

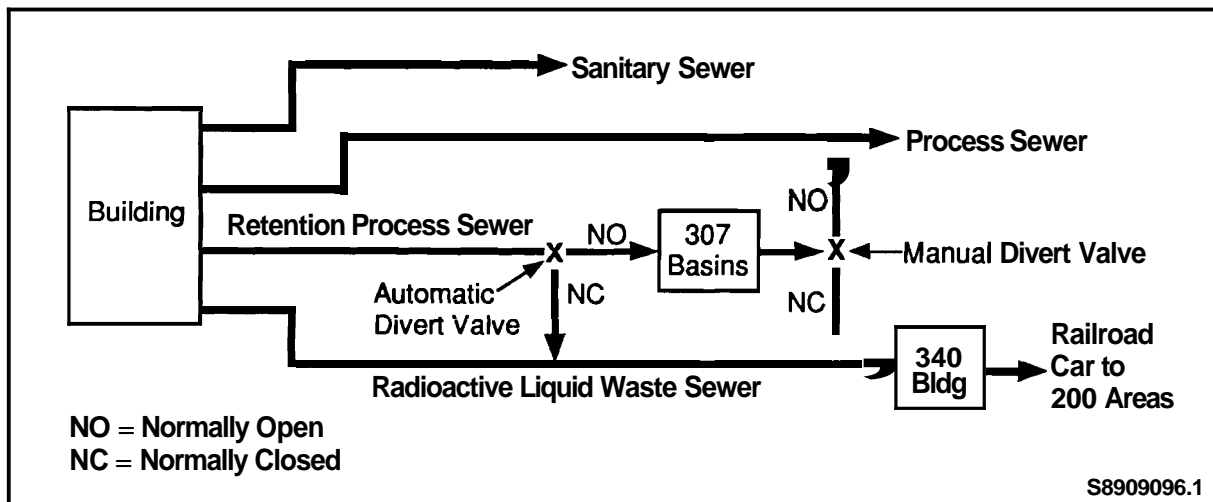


FIGURE 2. Schematic of the 300 Area Basic Sewer System

floor drains to the Process Trenches (316-5) in the northwest portion of 300-FF-1. At present, process wastes are supposed to be free of radioactive materials, although originally they contained radioactive contaminants, especially uranium. Prior to construction of 316-5 in 1975, these wastes were carried to 316-1 and 316-2. From 1943 to 1953, the first ten years the Process Sewer and 316-1 were in use, the only discharge of radioactive waste, other than uranium, came from small analytical laboratories in the 3706 Building. During 1952 and 1953, the 325, 326, 327, and 329 Buildings were constructed, and their wastes were added to the radioactive load. In 1953, a separate laboratory waste transfer and disposal system (the original Radioactive Liquid Waste Sewer and the Retention **Process/307** system) was installed to serve the new laboratory buildings. This removed much of the radioactive burden to the Process Sewer. Potentially contaminated liquid waste from the Retention Process Sewer was directed to four 50,000-gal concrete basins (307 Basins), where it could be retained and monitored for radioactivity. This part of the 307 system is still in use. If radioactivity was below set limits, waste then went to the 307 Trenches (316-3) (Section 3.2.1.3); otherwise it was directed to the 340 Complex. The laboratory system was operated independently of the Process Sewer until 1963, when they were reintegrated after abandonment of 316-3. Retention process waste is now disposed in 316-5; however, the 307 Basins still allow for screening of wastes too high in radioactivity for final disposal in the 300 Area. This radioactive waste is diverted to the 340 Complex (see Figure 2). In addition to radioactive substances, a wide variety of chemicals also entered the Process Sewer in the past.

The Retention Process Sewer now carries potentially radioactive waste from the 324, 325, 326, 327, 329, and 3714 Buildings to either the 307 Basins or the Radioactive Liquid Waste Sewer, depending on whether the waste stream is radioactive. If a level of activity greater than 55,000 pCi/L is detected by a continuous monitor in or near a building, a diverter valve automatically routes the flow to the Radioactive Liquid Waste Sewer. If the waste stream is at or below this level, it is sent to the 307 Basins, where it is again monitored for radioactivity. If the retained waste is found to be

radioactive, it is sent manually to the Radioactive Liquid Waste Sewer and the 340 Complex; otherwise it goes to the Process Sewer.

The current Radioactive Liquid Waste Sewer, a double-walled pipe installed in the late 1970s as an upgrade of the original single-walled system, which was retired and abandoned in 1979, transfers intermediate-level radioactive waste and **potentially** contaminated process water by gravity flow from a limited **number** of sink drains in the 324, 325, 326, 327, and 329 Buildings into underground neutralization tanks in the 340 Complex or stainless steel storage tanks in the 340-B Building. The waste is then transported by railroad tank car to the 200 Areas for disposal.

### 3.1.2 Process Sewer Controls

Administrative controls to prevent the introduction of radioactive and hazardous waste constituents into the Process Sewer are based on DOE orders and applicable federal, state, and local regulations. The DOE orders include 5420.1, **5440.1B**, 5480.1, 5480.2, 5480.4, 5480.5, 5484.1, and 5820.2. These orders and RCRA and state regulations have been incorporated by PNL and Westinghouse Hanford into management manuals.

Releases to the Process Sewer and the Retention Process Sewer are limited to dilute aqueous wastes of miscible nonradioactive chemicals, drain and aquaculture overflows, and small amounts of thermal discharges. Radioactive liquid waste exceeding 1% of DOE Order 5480.1, Chapter XI, Attachment XI-1, Table II, shall not be discharged to the Retention Process Sewer or to the Process Sewer without approval from the PNL Safety Department. If concentrations of radioactive and other hazardous materials in a gaseous or liquid effluent stream exceed the concentration guides, the building manager or another responsible line manager, on being notified, shall promptly begin the necessary actions to reduce the abnormal release to below the concentration guide.

There are physical controls in addition to the administrative controls. All drains from process tanks are locked and tagged. To open them, a researcher must contact the building manager with a letter of approval from PNL Waste Management that documents that the material to be discharged to the Process Sewer is 1) nonhazardous, 2) nonradioactive, and 3) nonregulated.

**It** is the researcher's responsibility to provide the solution's composition, **if** known, or obtain an analysis, **if** unknown. All floor drains are either plugged or have standpipes to prevent an uncontrolled spill to the Process Sewer. All Laboratory sinks and hood drains are posted as nonhazardous disposal sites. Steam or water effluents that are used for heating or cooling process tanks are cleaned before and after their use. These are the only liquids discharged directly to the Process Sewer.

## 3.2 RETIRED SEWER SYSTEMS

### 3.2.1 Retired Process Sewer System

The retired portions of the Process Sewer within the 300-FF-1 operable unit consist of inactive portions of the Process Sewer lines, the North and South Process Ponds (316-2 and **316-1**), and the 307 Trenches (316-3).

#### 3.2.1.1 Retired Process Sewer Lines

The Process Sewer is reviewed in the 300-FF-1 work plan (DOE 1989a). In brief, the Process Sewer was originally constructed in 1943 to carry process liquid wastes from various buildings in the 300 Area to 316-1. The sewer was extended in 1948 to serve the then new 316-2, modified in 1953 to allow the use of both ponds, and extended again in 1975 to transfer wastes to the Process Trenches (316-5). The sewer is constructed primarily of vitreous clay sewer pipe with acidproof, gasketed bell and spigot joints.

When 316-1 and 316-2 were replaced by 316-5, which lie just west of 316-2, most of the sewer lines were retained and only those portions leading to the ponds were sealed and abandoned. The retired Process Sewer line leading into 316-2 begins at Hanford Coordinates N **56053.37**/E 15382.08, where **it** branches, presumably at a manhole, from the line that currently feeds 316-5 (see Figure 1). The as-built drawing (M-3904, Sheet 1, April 28, 1989) does not indicate how **it** is isolated. The line ends in the southeast sediment storage basin.

The Process Sewer pipe that emptied into the northwest corner of 316-1 runs from a diversion box at N **55263**/E 15521.78 to a **wingwall** in the northwest corner of 316-1. This line appears on the as-built drawing (M-3904,



Sheet 2, October 1980) as not having been abandoned; thus, there is no indication that the line is plugged.

The abandoned pipe that fed the southwest corner of 316-1 runs from a manhole just outside the 300-FF-1 operable unit at **N 54628.23/E** 15091.0 to the 316-1 inlet at **N 54730.0/E** 15575.0. The 18-in.-diameter pipe is sealed at the manhole, but has a 6-in. plugged opening.

A system of abandoned 8-in. lines (composition unknown) extends from the 307 Basins to the two retired **316-3** trenches as shown in Figure 1. On the as-built drawing (M-3904, Sheet 3, September 1, **1971**), lines leading from the center of each retention basin join at **N 54339.72/E** 15403.5 to form a single pipe that extends approximately 15 ft south to **N 54323.30**. There, it angles southeast approximately 110 ft to **N 54250/E** 15475, where it splits to feed each of the trenches, one at **N 54250** and the other 50 ft to the south at **N 54200**. In addition to the 8-in. line shown on the as-built drawing, there is a 4-in. line that runs from the 340 Building, between the 307 Basins, to join the 8-in. line near **N 54339.72/E** 15403.5. The composition of this pipe also is not known at this time.

### 3.2.1.2 Retired North and South Process Ponds

The North and South Process Ponds (316-2 and 316-1) are two inactive, unlined surface impoundments in the 300-FF-1 operable unit approximately 300 ft west of the Columbia River (see Figure 1). They were built in 1943 and 1948 (316-1 and 316-2, respectively), and used for disposal of all radioactively and chemically contaminated process waste waters from the 300 Area. After construction of the 307 Basins and 316-3, some radioactive waste was transported to the 200 Areas for disposal. 316-2 was built in response to a 316-1 dike failure in 1948 that released contaminated liquid into the Columbia River. 316-1 was later repaired and the two ponds were operated until 1975, when they were replaced by the Process Trenches (316-5). The east infiltration basin of 316-1, however, remained active for **the disposal** of water treatment filter backwash until late 1986. Both ponds (316-1 and 316-2) are now dry, and portions of the surfaces have been covered for stabilization.

The ponds were operated as a series of basins. The structure of 316-1 changed several times over the years, but its final configuration consisted of three small settling basins on its west side and two larger infiltration basins to the east, each separated by 15-ft-high dikes. The entire series of basins covered eight acres. The dike separating the infiltration ponds is 100 ft wide; other dikes are 16 to 30 ft wide; some have been removed as indicated below. The inlet was located on the southwest corner of 316-1 until 1953, when it was moved to the northwest corner, and the Process Sewer was modified to allow either simultaneous or alternating use of both 316-1 and 316-2. Along with radioactive (primarily uranium) waste, 316-1 received small amounts of organic waste from the 303 area floor drains and 5 to 10 gal per week of bottled organic solutions. These wastes entered the pond via a stainless steel pipe running along the north dike.

316-2 received waste mainly from the Process Sewer, which carried cooling water and low-level radioactive liquid waste from fuel fabrication operations in the 3706 Building with other "incidental" waste from the 3706 and 321 Buildings and wastes from the 313 Building. Prior to 1957, 316-2 received trucked-in liquid wastes. Liquid that entered the pond flowed from basin to basin through flumes located at the tops of the dikes. Suspended solids settled in each of the basins, and since there was no outlet, the liquid either evaporated or entered the soil of the infiltration basins.

After the 1948 dike failure, 316-1 was periodically dredged to improve infiltration. Stenner et al. (1988) reported that in 1949 and 1953 316-1 and 316-2 were dredged and the sludge was removed and buried on the edge of the ponds and dikes. ICF Northwest (1987a) gives the years 1948 and 1952, and adds that the dredging was by dragline. 316-1 was again dredged by earthmover in 1957, 1965, and 1969 (ICF Northwest 1987a). Lack of infiltration was a continuous problem caused by the disposal of sodium aluminate, which was trucked in until 1956, then later carried through the sewer. The sodium aluminate would precipitate solids and restrict infiltration. In 1965, a plan was approved to dispose of 10,000 yd<sup>3</sup> of dredged pond sediments in 316-3, which was no longer used. The estimated chemical inventory of these sediments included 20,000 kg of copper, 10,000 kg of uranium, 3000 kg

of nickel, 1000 kg of chromium VI, and 600 kg of lead, plus other metals and anions (ICF Northwest 1987a). Dredging was discontinued after 1969 when the production of aluminum-clad fuel ceased, ending the disposal of sodium aluminate. After 1975, when both ponds were deactivated, the east infiltration basin was used as a filter backwash pond until 1987. Filter backwash is considered nonhazardous. Some of the dikes separating the settling ponds were excavated and used as cover for the pond sediments. The amount of material removed has not been determined, but the bases of these dikes are still visible in recent aerial photographs.

The North Process Pond (316-2) originally consisted of a single large infiltration basin, but was later subdivided into three small settling basins and one large infiltration basin separated by 15-ft-high and 12-ft-wide dikes at the top. The entire 10-acre pond was surrounded by a 15-ft-wide and 10-ft-high dike. As with 316-1, flumes on top of the dikes allowed the flow of liquid between basins. In approximately 1961 or 1962, the three settling basins were replaced with three new basins just to the east, within the 316-2 boundary, and the original basins were retained for sediment disposal. The inlet for 316-2 was at the southwest corner, but there was no outlet. Water would infiltrate or evaporate from the infiltration basin after sediment was caught in the settling basins.

From 1949 to 1974, the site received low-level radioactive wastes and cooling water from the 3706 Building, aqueous wastes containing unirradiated uranium from the 313 Building, and water from the floor drains of the 303 Building. The wastes flowed through the 307 Basins en route to 316-2 until the site was retired in 1974. 316-2 was reportedly dredged by dragline in 1952, 1954, and 1955 and by earthmover in 1960, 1964, and 1969 to increase the infiltration rate (ICF Northwest 1987a). Some of the subdividing dikes were bulldozed to cover the pond bottom and prevent wind dispersal of contaminated sediments.

The 316-2 scraping disposal area extended approximately 200 ft south of the pond and was used for disposal of uranium-contaminated soil from the bottom of the pond and from beneath the 321 Building during excavation for

hydraulic core mockup. The site has since been backfilled with coal ash (Stenner et al. 1988) and covered with fill.

Total uranium discharged to 316-1 and 316-2 was 40,300 lb by October 1956 (Heid 1956) and 130,000 lb through 1970. Total copper discharged through 1970 was 160,000 to 240,000 lb (DOE 1989a).

In 1970, 316-2 sediments were sampled to a depth of 4 ft and showed a fairly even distribution with depth of copper, uranium, and zirconium (Appendix, Letter 1). In 1974, radiation survey of the floor of 316-1 indicated  $^{60}\text{Co}$  was a significant gamma emitter, and chemical analyses detected fluoride, beryllium, and various heavy metals, including uranium (Appendix, Letter 2). A 1975 study (Appendix, Letter 3) confirmed data for lead, copper, and uranium collected in 1974, but also noted similar values for sediments in the east and west walls of the east basin. These walls consist in part of dredgings removed from the pond bottom. More recent data were adequately reviewed (DOE 1989a), including those covered by Stenner et al. (1988) and Dennison et al. (1989).

Polychlorinated biphenyls (PCBs), particularly Arochlor 1248, were found in sediments of both 316-1 and 316-2 (Dennison et al. 1989). Disposal of PCBs to these facilities was not documented.

### 3.2.1.3 Retired 307 Trenches

The 307 Trenches (316-3) were operated from 1953 to 1963 to dispose of potentially contaminated laboratory retention wastes received by the 300 Area laboratory waste system. There were two parallel trenches (see Figure 1) 600 ft long, 10 ft wide, and 20 ft deep (Hanford Coordinates N 54265/E 16000, N 54185/E 16000, N 54185/E 15475, N 54265/E 15475). The buildings serviced by this system were 325 (radiochemistry), 326 (pile technology), 327 (radio-metallurgy), 329 (biophysics), and 308 (fuels development, which was added in 1960). Wastes were carried via the Retention Process Sewer to one of the four 50,000-gal 307 Basins and held for analysis. If the analysis was below the discharge limits, the wastes were discharged to 316-3; otherwise, they were transferred to the 340 Complex for crib disposal in the 200 Areas. Difficulties in sampling allowed liquid waste that had not been analyzed to

be released to 316-3, perhaps as much as 40% (Haney 1960), possibly resulting in the discharge of radioactive waste in concentrations above DOE guidelines.

In 1963, 316-3 was taken out of service and later backfilled with 10,000 yd<sup>3</sup> of contaminated sediments mostly excavated from 316-1, with some coal ash and other sediments as well. Sediments in 316-1 were contaminated with uranium, copper, and other heavy metals (ICF Northwest 1987b, Dennison et al. 1989). The results of five analyses of visibly contaminated soils from a recent excavation are given in DOE (1989a).

The draft RI work plan for 316-3 (ICF Northwest 1987b) indicates that not enough groundwater monitoring data are available to judge the contribution of uranium from 316-3 to the underlying groundwater, and that not enough wells are close enough to the site for accurate characterization. The plan states that several wells in the vicinity of 316-3 are no longer in use, which, however, is not the case. Dennison et al. (1989), using groundwater data from 1986, show a composite plume of uranium greater than 30 pCi/L originating from 316-5 on the north end of the 300 Area and in the area of 316-3 and leading toward the Columbia River. A review of groundwater data from 1980 to the present adds supporting evidence of elevated uranium in the groundwater near 316-3 in addition to the larger, northern source from 316-5.

If 316-3 is the southern source of the composite uranium plume, the mechanism of the contamination is not clear. Since 316-3 is no longer in use and there is no liquid discharge to it, the only other mode of uranium migration to groundwater is leaching of contaminants associated with disposed 316-1 sediments. The potential for migration along this pathway depends on the leachability of uranium from the sediments and the infiltration of water for leaching. The contaminants are not expected to be very soluble, but the coarse soils and shallow-rooted plants that characterize the 300 Area allow rapid water infiltration and groundwater recharge (Gee 1987).

### 3.3 RETIRED RADIOACTIVE WASTE SEWER LINE

In approximately 1974, the decision was made to upgrade the Radioactive Waste Sewer from a single-walled stainless steel pipe to a double-walled pipe

to provide a greater margin of safety against leakage into the environment. Project V-659 was the construction project for replacement of these sewer lines. Project V-680 made modifications to 300 Area laboratory buildings for replacement of the sewer lines. All reports and documents relevant to these projects are contained in Central Files, 3706 Building, on microfilm cassettes entitled Project V-659 and Project V-680.

The original Radioactive Liquid Waste Sewer was approximately 3600 ft of 2-, 3-, 4-, and 6-in.-diameter single-wall stainless steel pipe that served the 324, 325, 325A, 326, 327, and 329 Buildings (Figure 3). The 308 Building was tied into the sewer system at one time, but was capped off sometime before the line's retirement. The line, buried up to 18 ft deep, was constructed around 1953 and was retired from service in 1979. A separate 3-in. carbon steel transfer line installed in 1960 connected the 309/Plutonium Recycle Test Reactor to the 340 Building to transfer reactor operational liquid waste, such as resin backwash and deionizing solutions. There were no isolation valves, radiation monitors, or other leak-detection capabilities. There were no facilities built into the system that would permit meaningful testing. The lines handled approximately 25,000 gal/mo (the volume varied considerably) of beta-gamma radioactive waste, with an upper radiation level of 20 rem/h.

The old Radioactive Liquid Waste Sewer was replaced by the present sewer, a stainless steel inner pipe surrounded by a fiberglass-reinforced epoxy encasement. The present sewer was built to be independent of the old sewer and follows a different route, although it services the same facilities.

The original sewer was retired by cutting the pipe where it entered a building and sealing the severed end with a welded stainless steel cap. During its construction, cleanouts had been installed at most of the places where the line changed direction. At retirement, the cleanouts that were located (and it is likely that not all were found) were sealed with a gasketed flange and marked with a bronze monument. Each monument has a sketch of the old sewer system, a reference drawing number, a cleanout letter designation (A, B, C, etc.), the words "ABANDONED RLW," a radiation symbol, and

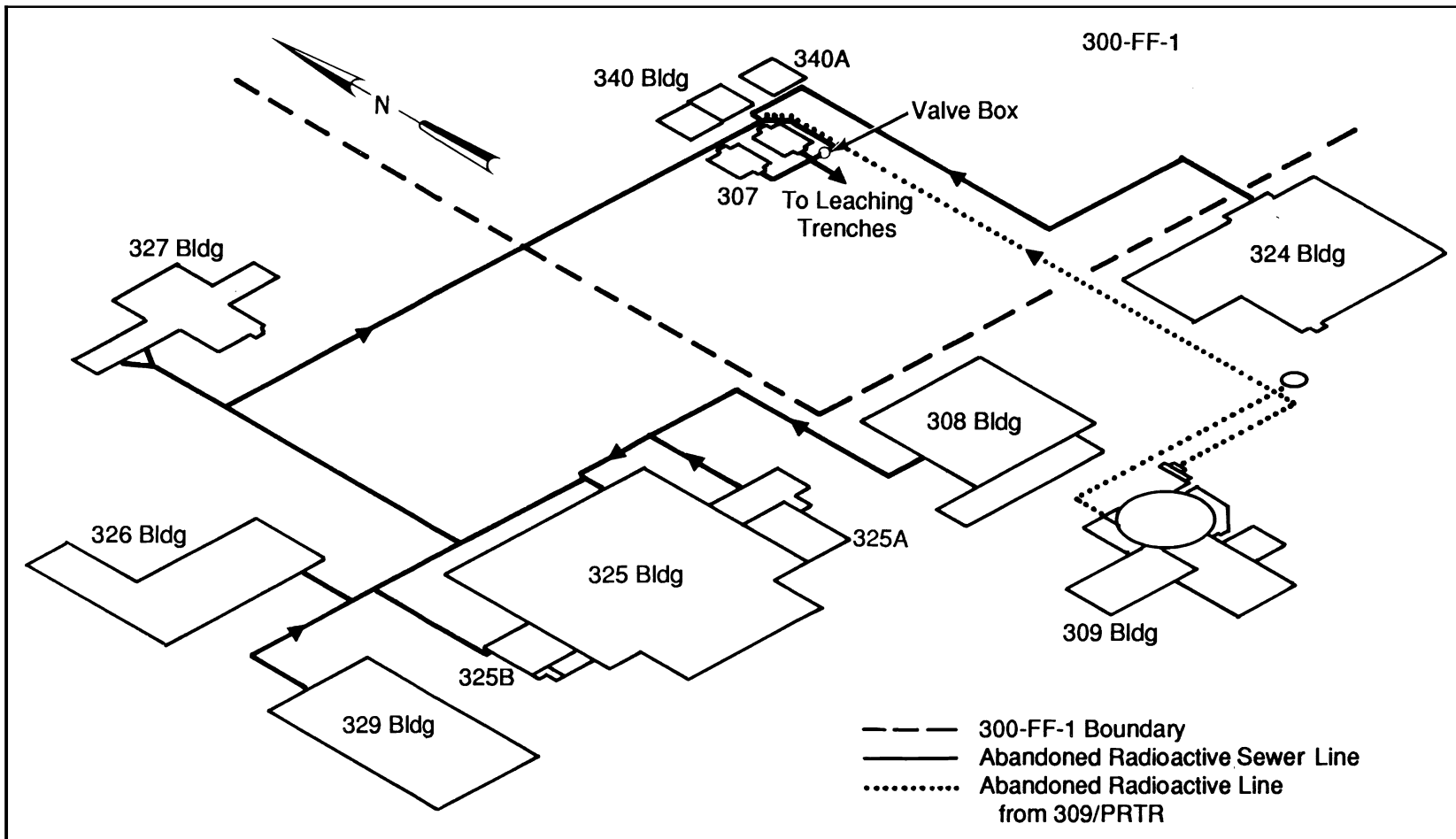


FIGURE 3

ioacti quid Waste Sewer

the Hanford coordinates of the monument location (Figure 4). Eleven monuments were proposed (A through K) at the coordinates listed in Table 3.

The **309/Plutonium** Recycle Test Reactor radioactive waste transfer line was decommissioned in 1983 or 1984. The end of this line at the reactor was cut and capped, but the line did not have a monument. According to Mr. Victor Tarr, the pipe retains residual radioactive contamination. Messrs. Robert Hall and Victor Tarr, who had both participated in the old Radioactive Liquid Waste Sewer retirement, affirmed that prior to isolating the system, radioactive waste was flushed from connecting pipes that led from the buildings into the main part of the underground sewer. The floor drains in the buildings were then sealed, and the sewer lines outside the buildings downstream of the drain connections were cut and capped. This means that the main part of the old sewer still contains radioactive material.

It is the opinion of all who have investigated the old sewer abandonment that pressurizing the line with a tracer gas to detect leaks may force radioactive material from the pipe into the surrounding soil. According to Mr. Robert Hall, cathodic protection for the stainless steel pipe was removed at the time of abandonment, so sections of the pipe may have corroded and weakened. Also, gaskets that sealed the flanges at the cleanouts may have deteriorated with time and would have to be located and replaced before the line could be pressurized. Alternatives to a pressurized tracer gas survey are presented in Section 4.4.

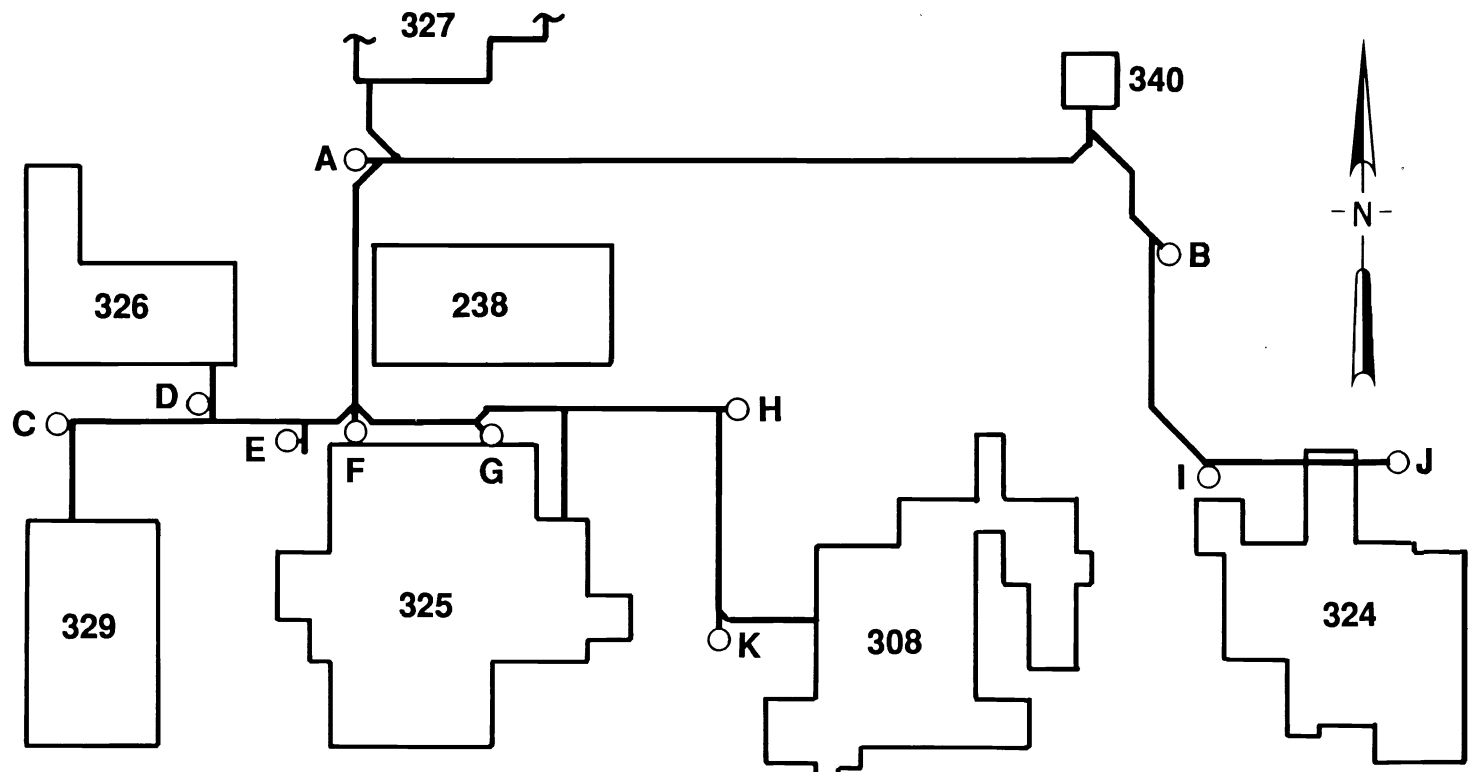
### 3.4 UNPLANNED RELEASES AND SPILLS

#### 3.4.1 UPR-300-1

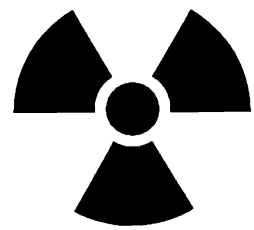
On December 9, 1969, a leak was discovered in the transfer line between the 307 Basins and the 340 Complex waste tanks (Denham Undated). A short, underground, 3-in.-diameter, carbon steel transition pipe that joined the cast iron transfer line from the 307 Basins to the stainless steel Radioactive Liquid Waste Sewer line had corroded so that the bottom portion of the pipe was missing. Retention waste (also called crib waste) had backed up and filled that portion of the line, causing the corrosion. It was estimated



19



**ABANDONED RLW  
C.O. "A"**



**DWG**

**M-3904**

**3 OF 54**

**N54425 E14738**



**RADIOACTIVE**

**FIGURE 4.** The Bronze Monument Marking a Cleanout of the Abandoned Radioactive Liquid Waste Sewer

**TABLE 3.** Approximate Coordinates of Cleanouts A through K of Retired Radioactive Liquid Waste Sewer<sup>(a)</sup>

<u>Cleanout Designation</u>	<u>Hanford Coordinates</u>	
A	N 54425	E 14738
B	N 54344	E 15462
C	N 54143	E 14476
D	N 54155	E 14590
E	N 54138	E 14668
F	N 54152	E 14731
G	N 54132	E 14853
H	N 54149	E 15075
I	N 54138	E 15514
J	N 54140	E 15700
K	N 53969	E 15070

(a) It has been indicated that not all the cleanouts may have been found.

that the pipe had been leaking for at least one year. The radioactive waste leaked into the soil approximately 5 ft below grade, contaminating an area 12 ft in diameter and 25 ft deep. Table 4 gives an estimated inventory of radionuclides and volumes of contaminated soil based on radiochemical separation and direct gamma analysis of core samples and calculations of the mass of soil affected. Groundwater from a test well at the site was not radioactive. The top 2 ft of contaminated soil were placed in drums and removed to burial grounds in the 200 Areas. Further removal of contaminated soil was considered a threat to adjacent structures.

Twenty years have passed since the spill and a good portion of these radionuclides have decayed away, although <sup>90</sup>Sr, <sup>137</sup>Cs, and <sup>241</sup>Am are still abundant. The <sup>147</sup>Pm has passed through more than 7.5 half lives. The Hazard Ranking System (HRS) Migration Score for this unplanned release is 26.604 (Stenner et al. 1988).

### 3.4.2 UPR-300-2

Stenner et al. (1988) described this 1954 unplanned release as approximately 10 mCi of <sup>137</sup>Cs 10 to 20 ft north, east, and south of the 340 Building. There was no mention of any cleanup action; however, contamination was

**TABLE 4.** Inventory of Radionuclides and Volume of Contaminated Soil Beneath the Corroded 307 Basin Transfer Lines

<u>Radio-nuclide</u>	<u>Total Activity (Ci) as of June 1, 1970</u>	<u>Contaminated Soil Volume (yd<sup>3</sup>)</u>
147Pm	800	70
106Ru	20	40
144Ce	20	70
90Sr	10	70
137Cs	10	40
241Am	0.7	20
134Cs	0.4	30
95Zr	0.2	40
103Ru	0.04	40
141Ce	0.03	70
95Nb	0.02	10

not present in 1978 during renovation excavation. This unplanned release has an HRS Migration Score of 18.268.

### 3.4.3 UPR-300-11

In October 1977, during the V-659 Project, radioactive liquid waste was found to have leaked from flanges connecting a tee to the sewer line that enters the 340 Building. The leak had gone undetected until the line was uncovered. Less than 10 Ci of fission products were found in soil samples, and no alpha-emitting radionuclides were detected. Approximately 22 ft<sup>3</sup> of soil were contaminated in the form of a column approximately 1 ft in diameter that extended to approximately 17 ft below the Radioactive Liquid Waste Sewer line. At that depth, contamination spread laterally in an interface between the undisturbed soil and the backfill. Evidence of contamination from a separate event also was found, somewhat blurring contamination boundaries (Hall 1978, HEDL 1977). Physical conditions prevented characterization of the second contaminated soil column. Approximately 90% of the contamination was removed by excavating the soil to approximately 8 ft below grade and transporting it to the 200 Areas for burial. Approximately 1 Ci was left in place. The HRS Migration Score is 17.427 (Stenner et al. 1988).

### 3.4.4 Phosphoric Acid Spill

Several 55-gal plastic drums of phosphoric electrolyte, purchased around 1977, were stored outdoors where weather deteriorated the labels. At some

point, one drum of the phosphoric-chromic acid mixture was mistakenly identified as nitric acid. In mid-1985, this drum (containing approximately 30 gal of phosphoric electrolyte) was shipped to the 340 Building with the presumption that it was nitric acid that could be used in pH adjustment operations. At the 340 Complex, the drum was again stored outdoors. It developed a leak, discovered on June 3, 1986, that discharged the entire contents of high-chromium solution to the soil (PNL 1986). The contaminated soil was allegedly excavated, placed in drums, and removed from the site, but this could not be confirmed.

#### 3.4.5 Other Spills and Releases Near the 340 Complex

Several past spills and leaks around the 340 Complex contributed significant amounts of radioactivity to the soil. Contamination that extends several feet down next to the 340 Building's south wall suggests that the sump (tanker load out) overflowed during the tanker-truck era, before rail transport of waste. Strontium-90 was identified in the soil. Short-lived radionuclides are gone, and the ground surface has been stabilized with clean rock and soil.

In the same vicinity, a tanker-truck valve-maintenance drain was exposed. Minor leakage occurred around the drain pipe. This area also is covered and stabilized, but contamination is known to extend several feet into the soil.

#### 3.4.6 UPR-600-15

During September 1979, 20 depleted uranium fuel elements (0.15% <sup>235</sup>U) were found improperly discarded at Burial Ground No. 4 (618-4). The fuel elements and contaminated soil were removed and buried by November 1979 in the mixed fission product trench in 218-W-3A. This unplanned release has an HRS Migration Score of 26.123 (Stenner et al. 1988).

### 3.5 OTHER FACILITIES

#### 3.5.1 Burial Ground No. 4

Burial Ground No. 4 (618-4) occupied a 570- x 220- x 15-ft-deep area in the northwest corner of the 300-FF-1 operable unit (the southwest corner is

at N 57832/E 14546). This burial ground was used from 1955 to 1961 to dispose of miscellaneous uranium-contaminated materials. No inventory is available.

### 3.5.2 Burial Ground No. 5

Burial Ground No. 5 (618-5) was a 300- x 18- x 15-ft-deep trench at the north end of 300-FF-1 just east of the Process Trenches (316-5) (the southwest corner is at N 57245/E 15429). This burial ground was used from 1945 to 1962 as a burning pit for uranium-contaminated and nonradioactive trash collected from the 300 Area. The burial ground was covered with 4 ft of clean soil.

### 3.5.3 Process Trenches

The two Process Trenches (316-5) are 1500 ft long, 12 ft deep, and are separated by an earthen berm. Constructed in 1975, 316-5 received process wastes from the 300 Area facilities via the Process Sewer Lines. The trenches are located in the northeast part of the 300-FF-1 operable unit near the Columbia River. The trenches received hazardous constituents in low concentrations until February 1, 1985, when administrative controls were instituted to prevent the disposal of dangerous wastes. Estimated chemicals discharged to the trenches prior to February 1, 1985, are summarized in Table 5. The trenches continue to receive approximately 1.5 to 2.0 x 10<sup>6</sup> gal of waste water per day, consisting primarily of cooling water with small quantities of nonhazardous maintenance and process wastes.

There are two general categories of photochemicals generated in the 300 Area, some of which go to 316-5: 1) regulated chemicals in the fixer and hardener solutions and 2) nonregulated chemicals composed of stop bath and activator chemicals. The nonregulated chemicals are transported to the 326 Building, where they are discharged to the Process Sewer.

The stop bath consists of acetic acid plus water; the activator solution consists of potassium hydroxide and potassium sulfite. The fixer and the hardener solutions may be of different compositions, depending on the brand of the product. Typically, these chemicals include acetic acid, gluconic acid, aluminum sulfate, ammonium thiosulfate, sodium thiosulfate, ammonium

**TABLE 5. Estimates of Chemicals Discharged to the Process Trenches  
(adapted from Schalla et al. 1988a)**

<u>Discharges Prior to February 1985</u>		<u>Discharges Between February 1985 and September 1986</u>	
<u>in gram amounts</u>	<u>in kilogram amounts</u>		
Ammonium bifluoride	Benzene	Copper	30 kg/mo <sup>(a)</sup>
Antimony	Carbon tetrachloride	Detergents	≥30 kg/mo <sup>(a)</sup>
Arsenic	Chlorinated benzenes	Ethylene glycol	≥200 L/mo
Barium	Chromium	Heating oil	300 L <sup>(c)</sup>
Cadmium	Degreasing solvents	HCl	100 kg/mo <sup>(a)</sup>
Dioxane	Formaldehyde	Nitrates	≥2000 kg/mo
Dioxin <sup>(b)</sup>	Formic acid	Nitric acid	≥300 L/mo
Hydrocyanic acid	Hexachlorophene	NaOH	≥300 L/mo
Pyridine	Kerosene	Paint solvents	>100 L/mo
Selenium compounds	Lead	Photochemicals	≥700 L/mo <sup>(a)</sup>
Thiourea	Mercury	NaCl	75 ton/yr
Miscellaneous laboratory chemicals	Methyl ethyl ketone	Uranium	20 kg/mo <sup>(a)</sup>
	Naphthalene		
	Nickel		
	Perchloroethylene		
	Phenol		
	Silver		
	Sulfuric acid		
	Toluene		
	Tributyl phosphate		
	1,1,1-Trichloroethane		
	Trichloroethylene		
	Xylene		

(a) Chemicals still being discharged.

(b) Included because of the potential for dioxin to exist as a trace impurity in chlorinated benzenes.

acetate, ammonium sulfite, silver, and cadmium. These materials go to the Process Sewer from PNL Photography in the 3705 Building.

The silver concentrations in used photochemicals vary dramatically, so samples are sent out for analysis. Solutions containing less than 500 ppm silver go to the Process Sewer. If the content is greater than 500 ppm, the photochemicals are processed to recover the silver. After the silver has been recovered, the remaining liquid is discharged to the Process Sewer.

At the same time a sample is analyzed for silver, it is also analyzed for cadmium. If the cadmium content is greater than 1 ppm, the solution is put into containers and transported off the Hanford Site for disposal.

In addition to photographic chemicals, the Metallographic Laboratory in the 326 Building uses oxalic acid, nitric acid, hydrochloric acid, sulfuric acid, and small amounts of hydrofluoric acid. These acids are diluted, neutralized, and discharged to the Process Sewer.

Twenty-two unplanned releases occurred between the initial operation and 1981 of 316-5. They are individually summarized in Stenner et al. (1988, Vol. 3) and are included as part of the total discharge in Table 5. Since then, there have been two unplanned releases of perchloroethylene to 316-5: 1) on November 4, 1982 (approximately 120 gal) and 2) on July 6, 1984 (approximately 20 gal). These are not included in Table 5.

A groundwater monitoring program was begun in June 1985 for 316-5 under compliance orders from the State of Washington Department of Ecology (Ecology). Subsequently, groundwater monitoring has continued, following requirements set forth in RCRA and in Washington Administrative Code 173-303-400. More information concerning 316-5 is contained in Schalla et al. (1988a, 1988b) and in quarterly and annual RCRA progress reports submitted to Ecology and EPA.

By December 1991, 316-5 will be closed under the Tri-Party Agreement (1989) between the EPA, DOE, and Ecology, when a treatment plant designed specifically to handle process wastes will be completed.

#### 4.0 CONCLUSIONS AND RECOMMENDATIONS

Within the 300-FF-1 operable unit, both radioactive wastes and toxic chemicals have been discharged to the ground through four engineered facilities: the South and North Process Ponds (316-1 and 316-2), the Process Trenches (316-5), and the 307 Trenches (316-3). 316-1, 316-2, and 316-5 have the highest HRS Migration Score (79.28; Stenner et al. 1988) of any Hanford facility.

##### 4.1 IDENTIFICATION OF THE SOURCE OF THE URANIUM PLUME IN GROUNDWATER BENEATH THE 300-FF-1 OPERABLE UNIT

Dennison et al. (1989) and DOE (1989b) identified a groundwater plume beneath the 300 Area that contained measurable concentrations of uranium (>10 pCi/L). As this appears to be one of the major environmental impacts of fuel fabrication operations, its source should be determined, if possible. The most obvious potential source for the uranium, based on the operating history of the facilities, would be the abandoned 316-1 or 316-2 or the currently active 316-5. As expected, a peak in groundwater uranium concentrations occurs (>30 pCi/L) below the general area of these facilities. However, another peak in groundwater uranium (also >30 pCi/L) appears to originate near 316-3. As discussed in Section 3.2.1.3, these trenches were backfilled with contaminated sediments dredged from 316-1. Therefore, we propose that additional characterization of 316-3 be undertaken. This characterization should include areal extent and depth, distribution of the uranium, and presence of any water in the trenches. In addition, the isotopic composition of the uranium should be determined in all of the possible sources of uranium (316-1, 316-2, 316-3, 316-5). Because several different grades of enriched uranium, as well as natural and depleted uranium, have been processed at various times and locations in the 300 Area, the isotopic signature of the contamination in the groundwater may help to reveal its source.

Other possible sources of the uranium plume are leaks from the abandoned or current Radioactive Liquid Waste Sewer leading from the 324 Building, or



possibly a contaminated Process Sewer line. These lines should be investigated by the techniques discussed below for surveying the abandoned Radioactive Liquid Waste Sewer. Groundwater investigations will be conducted during the 300-FF-5 operable unit remedial investigation/feasibility study (DOE 1989b).

#### 4.2 SEDIMENT ANALYSES

Further remedial investigations of 316-1 and 316-2 should continue with its primary focus on near-surface and dike sediment sampling to better define the horizontal extent of contamination. Sediment analyses should include uranium, other radionuclides (such as  $^{99}\text{Tc}$  and  $^{232}\text{Th}$ ), and PCBs.

#### 4.3 PHOSPHORIC ACID SPILL

Numerous documented unplanned releases have occurred in the 300-FF-1 operable unit, some of which have been remediated. They have had, in aggregate, a very small impact on the environment compared to those documented from the engineered facilities. As conveyed in Section 3.4.4, the phosphoric acid/chromic acid spill in 1986 involved only 30 gal of waste. The spill was remediated shortly after it occurred; therefore, further investigation of this spill will be limited to perhaps a surface grab sample at the location.

#### 4.4 ALTERNATIVES TO THE TRACER GAS SURVEY OF THE RETIRED RADIOACTIVE LIQUID WASTE SEWER

An unknown impact has occurred from possible undocumented leaks in the various sewer systems in the 300-FF-1 operable unit. Revision 1 of the work plan for this unit suggested the use of a tracer gas to detect any leaks in the abandoned Radioactive Liquid Waste Sewer. This procedure is not recommended for two reasons. The first is the fear that residual radioactivity, which is known to be present in the abandoned sewer, will be forced into the surrounding soil. Because there is no way to isolate the 300-FF-1 portion of the sewer line, this leakage could occur anywhere along the length of the line. The second is the high probability of false negatives caused by the

deep (up to 18 ft) burial of the pipes. Because of the deep burial, **it** is very likely that leaking tracer gas will not reach any of the wells drilled to sample **it**. The large **number** of wells required to overcome this problem would be prohibitively expensive.

Two potential "in-pipe" techniques would appear to lend themselves to investigation of this sewer. One is an electromagnetic induction technique (known as the eddy-current inspection). In this technique, the excitation source and the receiver are both enclosed in a remote probe that is fed into the pipe. Having both units in the pipe greatly reduces interference from other nearby pipes and cables and greatly **simplifies** data interpretation. This technique works well in the presence of murky water and other obstructions to vision. The other is a remote television camera inspection. **If** viewing conditions are good, this method provides the most unambiguous evidence of leaks. Both of these methods require direct access to the sewer pipe, so the practicality of this access will have to be determined.

All of the possible inspection techniques have the problem that they will not be able to differentiate between holes in the piping that occurred before the system was abandoned in 1979 (that actually caused leaks) and those holes that occurred after that time.

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**APPENDIX**

LETTERS

Letter 1.

Operated by  
Westinghouse  
Hanford Company

From: R. B. Hall  
Date: April 8, 1974  
Subject: PROPOSED SAMPLING OF SOUTH  
PROCESS POND

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## Hanford Engineering Development Laboratory

To: G. D. Carpenter  
CC: F. W. GILGEO  
M. A. REES  
W. R. FELTS

### PURPOSES

- To develop analytical techniques which will be used later.
- To evaluate the surface contamination, both chemical and radioactive to permit preliminary planning toward pond decommissioning.
- To confirm and evaluate cobalt-60 contamination revealed by ARMS survey.
- To compare analyses with 1970 sample from North Process Pond.

### SAMPLES

- Obtain a larger number of samples than we expect to analyze (about 50 total).
- Sample 12 to 15 locations geographically well distributed.
- Sample surface and at 1 foot depth intervals as deep as possible with simple digging tools. Post hole digger or spade.
- Each sample should be more than 1 pint but less than 1 quart.
- Label each sample carefully. Location, depth, date, person who took sample and GM reading on sample carton.

### ANALYSES

- Group 1 (Whole Pond Area) - ~ 10 sample sites - ~ 30 samples
  1. Approximate density of samples as received (g/ml) and after drying.
  2. Chemical analysis for copper and uranium (mg/g dry)
  3. Radiochemical analysis for cobalt-60 ( $\mu\text{Ci/g}$  dry) and try to identify other gamma emitters.
- Group 2 (Three Settling Bays) - ~ 5 sample sites - ~ 15 samples
  1. Chemical analysis for fluoride ion and hexavalent chromium.
  2. Radiochemical analysis for uranium nuclides and protactinium-234m.
  3. Possible quantitative measurement of gamma emitters.
- Group 3 (First Bay) - 2 or 3 sample sites - up to 6 samples
  1. Chemical analysis for toxic metals - mercury, beryllium, silver, nickel, lead, cadmium and zinc.

Letter 1. (contd)

G. D. Carpenter

-2-

April 8, 1974

2. Radiochemical analyses

- a) Try to identify alpha emitters, especially plutonium nuclides and thorium nuclides.
- b) Try to identify beta emitters, especially strontium-90 and promethium-147.

Attachment - 1970 analyses from North Pond.

**Letter 1. (contd)**

<b>ANALYSES REPORT</b> <i>DOUGLAS UNITED NUCLEAR, INC.</i> ANALYTICAL LABORATORY						CC: File				
TO: L. F. Reilly 7717 Bldg.						DATE: 3/17/70				
<u>Analyses of Precipitate from Bottom of North Pond</u>										Sampled 9/16/69
Lab. No.	Source	As Received				Ignited				Wt. Loss On Ignition
		Cu	Cr	Fe	U	Cu	Cr	Fe	U	
05828	Bottom, 0-1"	0.8	0.03	1.3	0.50	1.8	0.07	2.9	1.1	55.1
05829	" , 1-2"	0.6	0.02	1.3	0.50	1.5	0.05	3.2	1.2	59.2
05830	" , 2-3"	0.7	1.2	0.02	0.57	1.7	3.0	0.05	1.4	59.6
05831	" , 5-6"	3.0	0.15	2.1	1.53	4.4	0.2	3.1	2.3	32.4
Analyses in %.										
<u>G. B. Hansen</u>										

A-4360-019 (6-64)

<b>ANALYSES REP—T</b> <i>DOUGLAS UNITED NUCLEAR, INC.</i> ANALYTICAL LABORATORY						CC: File <i>G. Hudson</i> <i>J. Stringer</i>				
TO: F. W. Grubb 2703 Bldg.						DATE: 10/7/73				
<u>Analyses of North Pond Crud</u>										Date: 10/29/70
Lab. No.	Source	As Received								
		Cl	Cu	Cr <sup>+++</sup>	Z	Fe	SO <sub>4</sub>	NO <sub>3</sub>	U	Zr
05013	#1, Surface	.014%	3.2%	.8 ppm		0.56%	.44%	.80%	0.56%	1.7%
05014	2, 1/2 ft.		2.1			.19			.18	.74
05015	3, 1		1.7			.19			.21	.82
05016	4, 2	.002	1.6	.2		.28	.08	.06	.14	.35
05017	5, 3		1.3			.60			.22	.69
05018	6, 4 "	.002	1.9	.4		.28	.02	.03	.20	.60
<u>Dried (oven @ 100 C)</u>										
05013			6.9			*20.0%	1.2		1.2	3.6
05014			8.3			.73			.72	2.9
05015			7.1			.81			.87	3.4
05016			6.6		*0.15	1.2			.59	3.5
05017			4.8			2.2			.81	2.5
05018			8.0		*0.12				.84	2.5
* Air dried.										
<u>G. B. Hansen</u>										

A-4360-019 (6-64)



## Letter 2.

Operated by  
Westinghouse  
Hanford Company

**From:** Applied Chemistry and Analysis  
**Date:** July 22, 1974  
**Subject:** SOUTH PROCESS POND SOIL SAMPLE  
ANALYSES AND ESTIMATED FUTURE COSTS

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### Hanford Engineering Development Laboratory

TO: R. B. Hall

cc: **GJ Alkire**  
RL Moore  
**RW Stromatt**  
BP Van der Cook

A **summary** of the methods used and estimated future costs to analyze the South Process Pond Soil Samples and the results of the analyses follow. Attached is a Spark Source Mass Spectrographic analyses of two of the samples.

Now that we have run these samples, we can make a better estimate of costs using the procedures outlined and assuming 10 samples or more. Cost per determination for elements run by flame AAS will be about \$10; for elements by flameless AAS, about \$20; for elements (U specifically) by **spectrophotometry**, about \$20; and F, about \$30. Sample preparation will cost \$25 per sample in units of 10 or \$15 per sample in units of 20.

Leach Procedure. Samples weighing 10 grams excluding rocks were treated with 100 ml 2N HNO<sub>3</sub> at a temperature just below boiling for 4 hours. Samples 2, 3, 4 and 9 did not undergo complete reaction and were treated with an additional 20 ml concentrated HNO<sub>3</sub>. The solutions were diluted back to 100 ml and stored in plastic bottles until analyzed.

TABLE 1. Summary of Analytical Procedures

<u>Constituent</u>	<u>Method</u>	<u>Special Conditions</u>	<u>Spike Recovery, %</u>
Hg	Flameless AAS*	Diluted sample treated with H <sub>2</sub> SO <sub>4</sub> and KMnO <sub>4</sub>	
Cu	Flame AAS	La(NO <sub>3</sub> ) <sub>3</sub> and concentrated HNO <sub>3</sub> added to diluted solution to minimize matrix effects	99-120
Ni	Flame AAS		104-123
Cr(VI)**	Spectrophotometric		0
Total Cr	Flame AAS	Same as for Cu	76-90

Letter 2. (contd)

R. B. Hall

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July 22, 1974

<u>Constituent</u>	<u>Method</u>	<u>Special Conditions</u>	<u>Spike Recovery, %</u>
Zn	Flame AAS	Concentrated $\text{HNO}_3$ added to diluted solution. Background correction required for the instrument.	96-103
Cd	Flameless AAS	Graphite furnace with background correction: 0-50 ppb.	98-101
	Flame AAS	Concentrated $\text{HNO}_3$ added to sample and no background correction: 0-2 ppm.	
Ag	Flame AAS	Concentrated $\text{HNO}_3$ added to diluted sample	98-110
Pb	Flame AAS		91-95
Be	Flameless AAS	Carbon rod atomization	
U	Spectrophotometric***	Separation by solvent extraction with hexone. Thiocyanate reagent used to develop color in organic phase.	
F	Pyrohydrolysis and Specific Ion Electrode Potentiometry	Separation of F from sample by pyrohydrolysis at $1000^\circ\text{C}$ using $\text{WC}_3$ as an accelerator. TISAB buffering solution added to the F catch solution prior to measurement.	
Density	Weight of a Pour Volume	As received samples not dried. Dried samples dried at $105^\circ\text{C}$ overnight.	

\*

AAS is atomic absorption spectrophotometry

\*\* There is apparently a reducing agent in the samples which reacts with Cr(VI) or an agent which destroys the chromogenic reagent.

\*\*\* Excellent agreement with a polarographic method was obtained. The spectrophotometric procedure is faster for large numbers of samples.



R. W. Stromatt, Technical Leader  
General Analytical Chemistry

RWS:sj  
Attachment

TABLE 2. Results of Analysis of South Process Pond Soil Samples

Sample	Density, g/ml		Constituents, µg/g										
	As Received	Dried	Hg	Cu	Ni	Cr	Zn	Cd	Ag	Pb	Be	U	F
Blank	1.36	1.34	<0.5	9	3	20	30	<0.5	~0.3	8	0.27	<50	270
1A	1.36	1.32	4	25000	970	230	320	5	5	170	2.7	3900	2200
2A	0.45	0.37	5	87000	3100	190	420	9	44	230	3.5	6000	16000
2B	0.97	0.94	~0.3	19000	580	8	110	3	36	80	2.1	1500	7200
3A	0.53	0.46	8	79000	2400	410	550	9	74	300	4.9	7200	3700
3B	0.92	0.87	~0.5	20000	580	200	180	3	38	100	2.4	1800	2900
4A	0.4	0.28	16	74000	2300	390	630	12	349	380	6.1	7600	4900
5A	1.06	1.00	6	30000	1200	180	390	6	85	220	2.4	3300	3300
6A	1.16	1.12	8	23000	1100	150	490	6	102	230	2.2	3000	1100
7A	0.47	0.36	14	74000	1000	140	720	10	162	310	5.2	3300	3000
8A	1.31	1.28	<0.5	880	93	20	40	<0.5	13	20	0.25	130	750
9A	0.84	0.76	13	44000	1800	540	770	13	338	390	3.6	5400	1800
10A	1.26	1.24	<0.5	850	170	80	50	1	15	40	0.29	130	560
11A	1.23	1.20	4	12000	380	170	260	5	65	90	3.0	790	560
12A	1.59	1.57	<0.5	250	28	10	30	<0.5	3	10	0.3	50	500
13A	1.45	1.43	1	4000	150	90	120	2	25	30	1.2	230	410
14A	1.75	1.73	<0.5	390	33	10	20	<0.5	2	7	0.22	<50	370
15A	1.69	1.67	<0.5	770	52	10	40	0.6	5	8	0.32	<50	310

Letter 2. (cont'd)

A.6

**Letter 2. (contd)**

SC <u>139,140</u>	WESTINGHOUSE HANFORD COMPANY SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS REPORT	CC: SPEC. LAB
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MATERIAL Soil

SUBMITTED BY		SUBMITTER'S NO.		ANALYZED BY		DATE REPORTED		
<u>B. Van derCock</u>		<u>4A &amp; 7A</u>		<u>JS</u>		<u>6-3-74</u>		
ELE-MENT	4A	7A	ELE-MENT	4A	7A	ELE-MENT	4A	7A
H			Fe	1000	1000	Sb	2	
He			Co	100	100	Te		
Li	100	100	Ni	(2300) 120	80 (1000)	I	1	1
Be	3	1	Cu	(7400) 5000	10,000 (74000)	Xe		
B	100	40	Zn	(630) 70	100 (120)	Cs		1
C	10,000	30,000	Ga	6	3	Ba	3	10
N	10,000	10,000	Ge			La	*	*
O	30,000	30,000	As	5	3	Ce	3	3
F(4900)	1000	100 (3000)	Se			Pr		
Ne			Br			Nd		
Na	3000	30000	Kr			Pm		
Mg	9000	9000	Rb	1	2	Sm	1	2
Al	30,000	30,000	Sr	10	20	Eu		
Si	20,000	20,000	Y			Gd		
P	1000	1000	Zr	200	700	Tb		
S	1000	4000	Nb			Dy		
Cl	400	100	Mo	1	1	Ho		
Ar			Tc			Er		
K	1000	10,000	Ru			Tm		
Ca	10,000	30,000	Rh			Yb		
Sc	*	*	Pd			Lu		
Ti	100	100	Ag	*	*	Hf		
V	30	30	Cd	(12)	(10)	Ta		
Cr(390)	500	100 (140)	In	3		W		
Mn	50	50	Sn	2	7	Re		

TYPE OF ANALYSIS

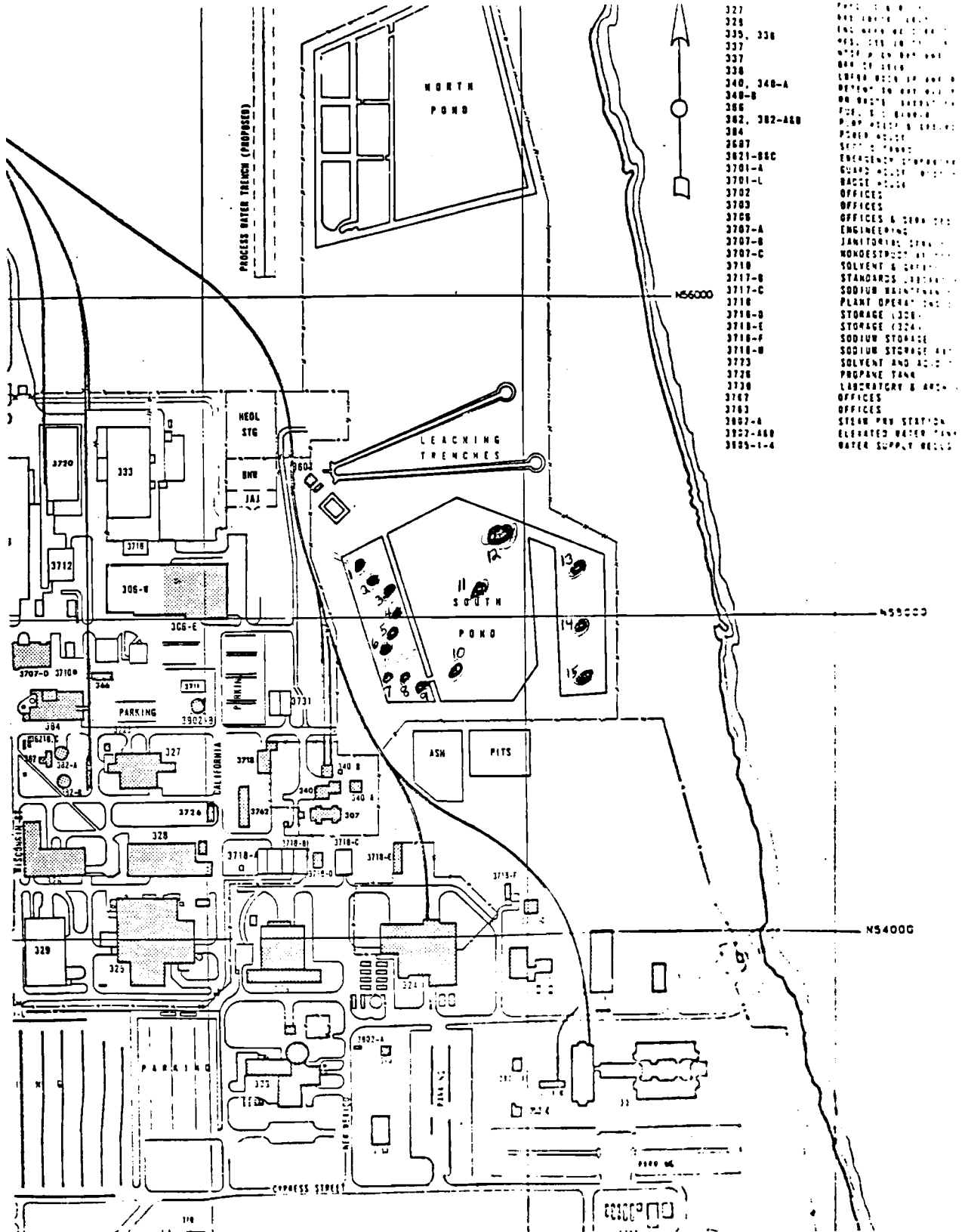
<input type="checkbox"/> QUALITATIVE	<input checked="" type="checkbox"/> SEMIQUANTITATIVE	<input type="checkbox"/> QUANTITATIVE
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APPR'X PRECISION ± FACTOR _____	APPR'X PRECISION ± FACTOR <u>3</u>	APPR'X PRECISION ± _____

REMARKS: RESULTS ARE RELATIVE ONLY. SAMPLES WERE MIXED WITH SILVER POWDER, MADE INTO PELLETS & SPARKED. THOSE NOT REPORTED ARE LESS THAN 100.

INTERFERENCE

REPORT APPROVED J. G. F.

Letter 2. (contd)



Letter 3.

From: Applied Chemistry and Analysis **Hanford Engineering Development Laboratory**  
Phone: 2-3805  
Date: December 31, 1975  
Subject: ANALYTICAL CHEMISTRY RESULTS FOR ACID AND FILTER  
BACKWASH LEACHES OF EAST TRENCH SOUTHPROCESS POND SOIL SAMPLES

To: R. B. Hall ✓

cc: G. J. Alkire  
R. L. Moore  
RWS/File  
/LB

In these analyses 10 gram samples (excluding rocks) were equilibrated with, 100 ml leach solutions 4 hrs. 2M HNO<sub>3</sub>, just below the boiling temperature was used for the acid leach, and a 315 building backwash sample (taken on 12/19/75 from No. 2 filter) was used for the backwash solution leach. The backwash solution was equilibrated with the samples on a mechanical shaker.

The analytical procedures used were the same as used for the South Pond soil samples analyzed in July 1974.

The results are tabulated on the following attachment.

  
R. W. Stromatt

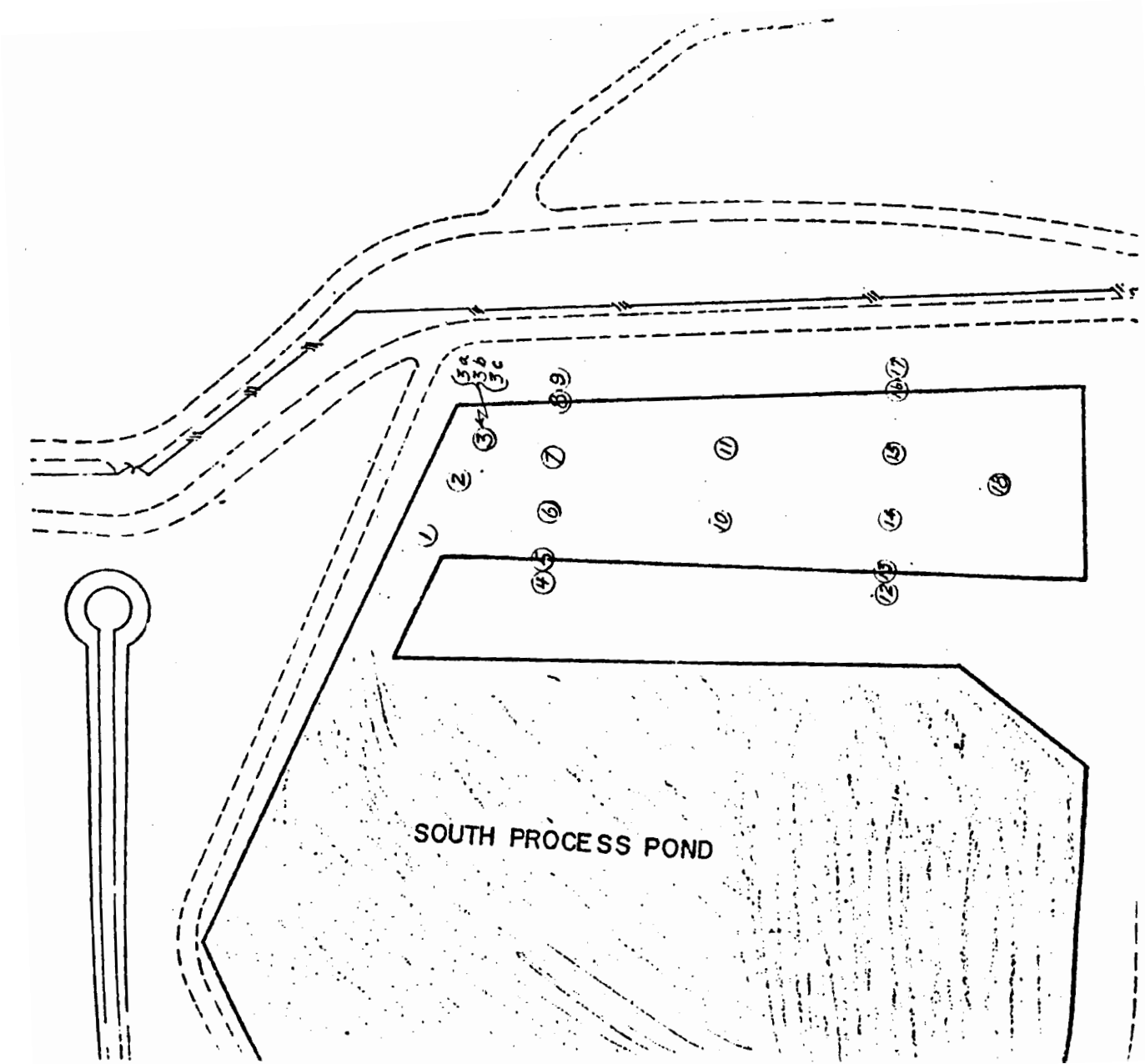
eld

Attachment

Letter 3. (contd)

<u>Lab No.</u>	<u>Sample No.</u>	<u>Leach Solution</u>	<u>Pb</u> <u>μg/g</u>	<u>Cu</u> <u>μg/g</u>	<u>U</u> <u>μg/g</u>	<u>Co-60</u> <u>μCi/g</u>
3344	1	Acid Backwash	26 <2	2900 3.5	280 <100	$4.8 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3345	2	Acid Backwash	4.8 <2	7800 9.7	390 <100	$1.3 \times 10^{-4}$ $<1.7 \times 10^{-5}$
3346	3a	Acid Backwash	45 <2	5200 13	500 <100	$1.3 \times 10^{-4}$ $<1.7 \times 10^{-5}$
3347	3b	Acid Backwash	4.5 <2	36 <1	<100 <100	$<1.7 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3348	3c	Acid Backwash	4.6 <2	43 <1	<100 <100	$<1.7 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3349	4	Acid Backwash	29 <2	1400 5.9	400 <100	$<1.7 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3350	5	Acid Backwash	16 <2	2200 3.2	120 <100	$3.3 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3351	6	Acid Backwash	16 <2	1700 3.0	<100 <100	$4.7 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3352	7	Acid Backwash	63 <2	10100 8.9	530 <100	$1.5 \times 10^{-4}$ $<1.7 \times 10^{-5}$
3353	8	Acid Backwash	16 <2	360 1	120 <100	$<1.7 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3354	9	Acid Backwash	16 <2	530 1	110 <100	$<1.7 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3355	10	Acid Backwash	13 <2	2000 2.0	<100 <100	$4.4 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3356	11	Acid Backwash	17 <2	2300 2.2	110 <100	$4.8 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3357	12	Acid Backwash	18 <2	610 1	180 <100	$<1.7 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3358	13	Acid Backwash	18 <2	920 2.2	120 <100	$<1.7 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3359	14	Acid Backwash	10 <2	1400 1.8	<100 <100	$4.0 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3360	15	Acid Backwash	18 <2	2400 1.1	100 <100	$6.5 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3361	16	Acid backwash	29 <2	2800 2.0	220 <100	$5.9 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3362	17	Acid Backwash	22 <2	750 1.4	220 <100	$<1.7 \times 10^{-5}$ $<1.7 \times 10^{-5}$
3363	18	Acid Backwash	20 <2	2400 <1	100 <100	$7.6 \times 10^{-5}$ $>1.7 \times 10^{-5}$

Letter 3. (contd)





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