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LEVEL 1 REMEDIAL INVESTIGATION WORK PLAN
300 AREA PROCESS PONDS

ICF Northwest
Richland, Washington

June 1987

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1.0 INTRODUCTION

1.1 GENERAL

Pacific Northwest Laboratory (PNL) is undertaking a remedial investigation (RI) for the two inactive process ponds located outside the 300 Area at the U. S. Department of Energy (DOE) Hanford Site. This RI is being conducted as part of implementation of Phase II of the DOE Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Program being conducted under DOE Order 5480.14. The 300 Area Process Ponds were selected for further characterization under Phase II based on the results of the Phase I Installation Assessment (DOE, 1986a). In Phase I, inactive waste disposal sites at Hanford were ranked using the Environmental Protection Agency's Hazard Ranking System (HRS) and DOE's Modified Hazard Ranking System (mHRS). The two ponds each had an HRS/mHRS migration score of 79.28. These scores were above the value of 28.5 used to determine whether further action at a site should be conducted.

This work plan describes the work to be performed for site characterization for the 300 Area Process Ponds. The work described herein will meet the requirements of Phase II of the DOE CERCLA Program as well as comply with the RI requirements given in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The work corresponds to Level I of site characterization, as described in the general RI methodology plan for Hanford. In addition, some Level II sampling and analysis activities are included at this time because of the lack of contaminant data needed to assess the risk associated with the site.

The work plan summarizes an initial evaluation of existing data and background information and defines the scope of the site characterization activities. Sections 2 and 3 summarize the evaluation of existing data. Section 4 identifies the rationale for the proposed approach, which is described in Section 5. Section 6 presents a schedule for performing the work.

1.2 OBJECTIVES

The objectives of the site characterization for the 300 Area Process Ponds are to identify and quantify contamination at the ponds and to estimate their potential impact on human health and the environment. The results of the site characterization will be used to identify any future actions related to contamination at the site and to identify any additional data requirements needed to support selection of a remedial action.

Following completion of the Level I RI, a Work Plan for the Level II RI will be prepared if the results:

- Identify an environmental or health risk needing further characterization.
- Determine the environmental contamination and migration pathways must be characterized in more detail than possible with existing data and those data collected during Level I.
- Determine that additional data are required to support selection of remedial technologies and alternatives.

2.0 BACKGROUND

2.1 PHYSICAL SETTING

2.1.1 Location and Description

The 300 Area Process Ponds are two inactive surface impoundments located at the DOE Hanford Site in Benton County in south central Washington. The two impoundments are known as the South Pond (facility number 316-1) and the North Pond (facility number 316-2). The South Pond covers an area of 8.1 acres and was constructed in 1943. The North Pond covers an area of 10 acres and was constructed in 1948. These ponds are located east and north of the Hanford 300 Area, as shown in Figure 1. The ponds are approximately 300 ft west of the Columbia River and approximately 3 mi north of the city of Richland.

The 300 Area Process Ponds are unlined surface impoundments which were used for the disposal of chemically and radioactively contaminated industrial wastewaters generated in the 300 Area. Wastewater flows to the ponds reportedly ranged from 410,000 to 2,900,000 gal/day. Layouts of the South and North Ponds are shown in Figures 2 and 3, respectively. As shown in these figures, at the time of closure each pond consisted of a series of three small settling basins followed by larger infiltration/ evaporation basins (two at the South Pond and one at the North Pond). The settling basins are located at the pond inlets and were used for removal of suspended and particulate contamination. Some of the dikes separating settling basins have been removed and materials on the pond bottoms have been periodically removed. Discharge of industrial wastewaters to the ponds was halted in 1975. The small infiltration/evaporation basin at the east side of the South Pond continued to receive water treatment filter backwash until recently. Both impoundments are now dry, with grass and other vegetation growing in them.

Both ponds are located within a security fence to prevent unauthorized access. The ponds are also marked with Radiation Zone signs. Access within the signed areas requires conformance with Hanford radiation protection procedures. The adjacent Columbia River is used for

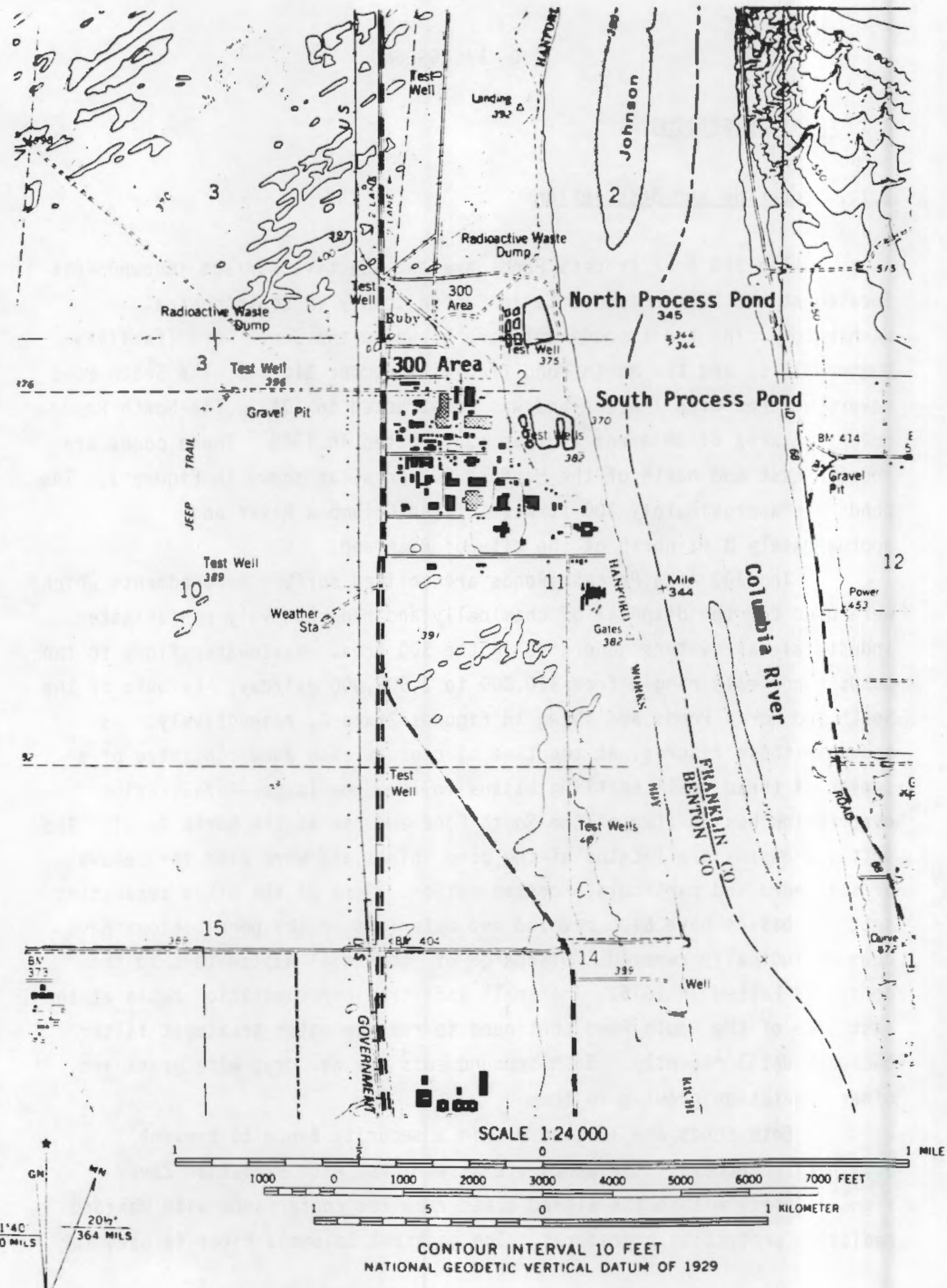
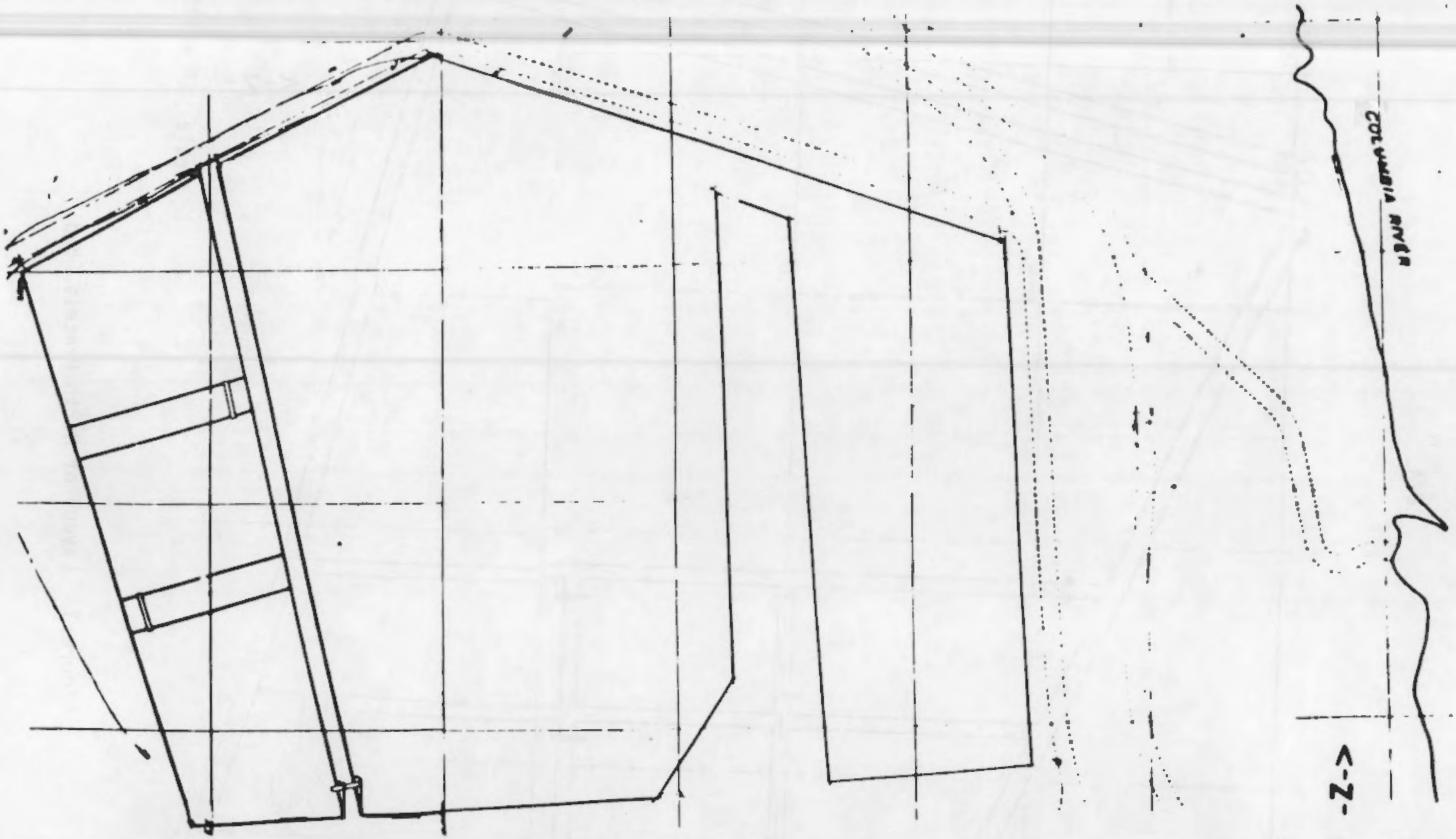


Figure 1. Location of 300 Area Process Ponds



Scale: 1" = 130'

Figure 2. Layout of South Process Pond

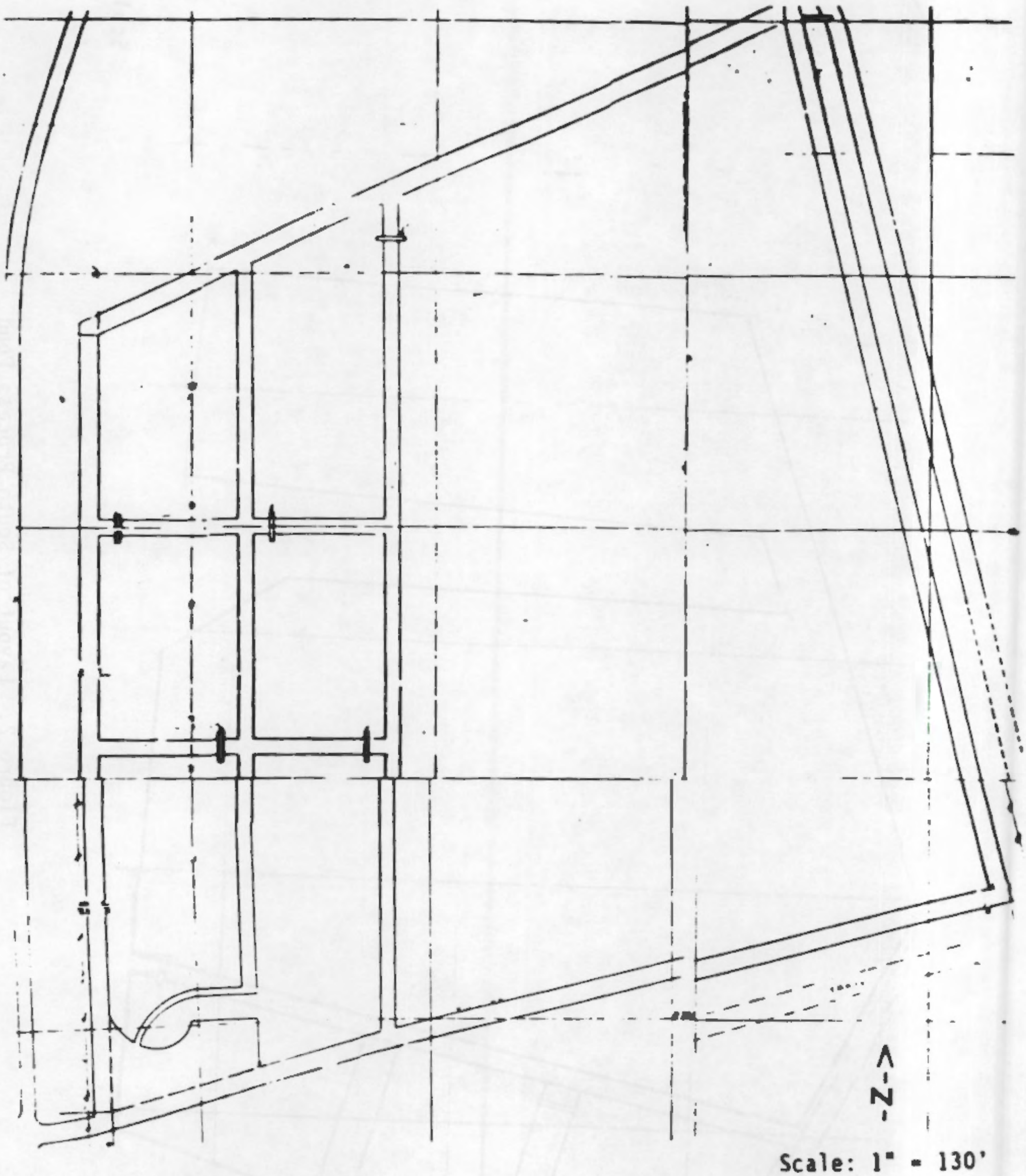


Figure 3. Layout of North Process Pond

recreational purposes including boating, fishing, and swimming. In addition, the River is used as a downstream source of drinking water for the cities of Richland, Kennewick, and Pasco.

2.1.2 Regional Physiography and Surficial Geology

The Hanford Site is located in the Pasco Basin within the Columbia River Basalt Plateau. The Pasco Basin forms the physiographic low of the larger Columbia Basin, with the Hanford Site located over the structural low of the Pasco Basin. The Hanford Site is bordered to the southwest, west, and north by large anticlinal ridges and to the northeast by the cliffs of the White Bluffs. Elevations range from approximately 345 ft above Mean Sea Level (AMSL) in the southeastern portion of the Site to 3,586 ft AMSL at the summit of the Rattlesnake Hills southwest of the Site. The White Bluffs rise to a maximum elevation of 980 ft AMSL (ERDA, 1975).

The Pasco Basin appears to have been formed by slow continuous subsidence coupled with periodic flooding with basaltic lava flows. As the anticlinal ridges to the south of the basin rose, they obstructed the flow of the Columbia River, flattening the gradient and causing deposition of alluvial deposits known as the Ringold Formation. The river then began to incise a channel through the ridge and lowered its base elevation, subsequently eroding the Ringold Formation. Later, catastrophic floods of glacial meltwater flowed through the Pasco Basin depositing glaciofluvial sediments in the basin, including coarse deposits known as the Pasco Gravels. More recently, the site has received eolian deposits, with the formation of dunes at some locations. The geological history of the Pasco Basin is summarized in Table 1.

2.1.3 Site Physiography and Surficial Geology

Surface materials at and near the 300 Area consist of alluvial and eolian deposits. The topography at location of the ponds is generally flat to rolling, but drops off steeply to the east to the Columbia River.

Table 1. Summary of Geologic History of Pasco Basin

ERA	SYSTEM	SERIES	GEOLOGIC UNIT	MATERIAL
CENOZOIC	QUATERNARY	HOLOCENE	DUNES AND EOLIAN SEDIMENTS (0-40 FEET THICK)	SANDS, INCREASINGLY FINER AND QUARTZ-RICH TO THE NORTHEAST
			ALLUVIUM, COLLUVIUM, LANDSLIDES (0-100 FEET THICK)	UNSORTED RUBBLE AND DEBRIS, LOCALLY INTERFINGER WITH RINGOLD FORMATION AND PASCO GRAVELS
			PASCO GRAVELS AND THE TOUCHET BEDS (0-400 FEET THICK)	SANDS AND GRAVELS OCCURRING AS GLACIAL FLOOD DEPOSITS. COMMONLY ROUGHLY GRADED. UNCONSOLIDATED BUT HIGHLY COMPACT.
			PALOUSE SOILS (0-30 FEET THICK)	WIND-TRANSPORTED AND DEPOSITED SILT, LOCALLY WEATHERED TO CLAY
		PLEISTOCENE	RINGOLD FORMATION (0-1200 FEET THICK)	WELL-BEDDED FLUVIAL AND FLOOD-PLAIN SILTS, SANDS AND GRAVEL, POORLY SORTED, COMPACT BUT VARIABLY CEMENTED. BASAL PORTION LARGELY SILT AND CLAY OF HIGHLY VARIABLE THICKNESS. REMAINDER OF FORMATION IS INTERBEDDED GRAVEL, SAND AND SILT. GENTLY DEFORMED.
	TERTIARY	PLIOCENE	ELLENSBURG (20-200 FEET THICK) FORMATION	VOLCANICLASTIC ROCKS AND THEIR WEATHERING PRODUCTS, LARGELY CLAYS. GRADES INTO AND INTERFINGERS WITH RINGOLD FORMATION SEDIMENTS.
		MIOCENE	COLUMBIA RIVER BASALT GROUP PROB. 12 000 FT THICK: YAKIMA BASALT FORMATION (PROB. 2500 FEET THICK)	BASALTIC LAVAS WITH INTERBEDDED STREAM SEDIMENTS IN UPPER PART, LOCALLY FOLDED AND FAULTED.
			PICTURE GORGE FORMATION EQUIVALENT (?) (PROB. 1500 FEET THICK)	BASALTIC LAVAS
		OLIGOCENE	?	BASALTIC LAVAS POSSIBLY COMPARABLE TO THE TEANAWAY BASALTS
		EOCENE		PROBABLY SANDSTONES COMPARABLE TO THE SWAUK AND ROSLYN FORMATIONS
		PALEOCENE	? ?	
MESOZOIC			ROCKS OF UNCERTAIN AGE, TYPE AND STRUCTURE	PROBABLY METASEDIMENTS AND METAVOLCANICS INTRUDED BY GRANITIC ROCKS

Source: ERDA, 1975

The elevation of the top of the pond dikes is approximately 380 ft AMSL. The high water elevation of the Columbia River at the site is approximately 340 ft AMSL.

The surficial geology of the 300 Area is discussed in detail by Lindberg and Bond (1979). Unconsolidated deposits at the 300 Area consist of, in ascending order, the Ringold Formation, glaciofluvial deposits, and eolian deposits. Geologic cross-sections of the 300 Area near the Process Ponds are shown in Figure 4. The location of these cross-sections are shown in Figure 5.

The Ringold Formation consists of gravels, sands, silts, and clays deposited by the ancestral Columbia River. The Ringold Formation is approximately 120 ft thick at the location of the Process Ponds. The lower part of the Formation consists of approximately 40 ft of silt and clay with occasional sand and gravel. These deposits are overlain by a complex association of gravel and sand with occasional silt and clay lenses. As shown in Figure 4, there is an ancient river channel incised in the Ringold Formation beneath the 300 Area. The Process Ponds are located above this channel.

The glaciofluvial deposits at the 300 Area are coarse-grained deposits known as Pasco Gravels, which were deposited in the Pasco Basin by catastrophic floods. The deposits are typically graded, with boulders at the base of each sequence and ranging upward through cobbles, gravels, and sand. Two such sequences of graded deposits are found at the 300 Area. The finer portion of the upper sequence, however, has apparently been eroded away and surface deposits include cobbles and boulders. As shown in Figure 4, the Pasco Gravels at the location of the Process Ponds are approximately 50 to 60 ft thick.

Surface sediments at and near the 300 Area consist of eolian deposits of sand and silt. These deposits have locally formed dunes, especially north and southwest of the 300 Area. In the vicinity of the Process Ponds, these deposits are thin. Other surface materials near the 300 Area Process Ponds include fly ash from coal combustion, which has been disposed of by burial in and around the Ponds.

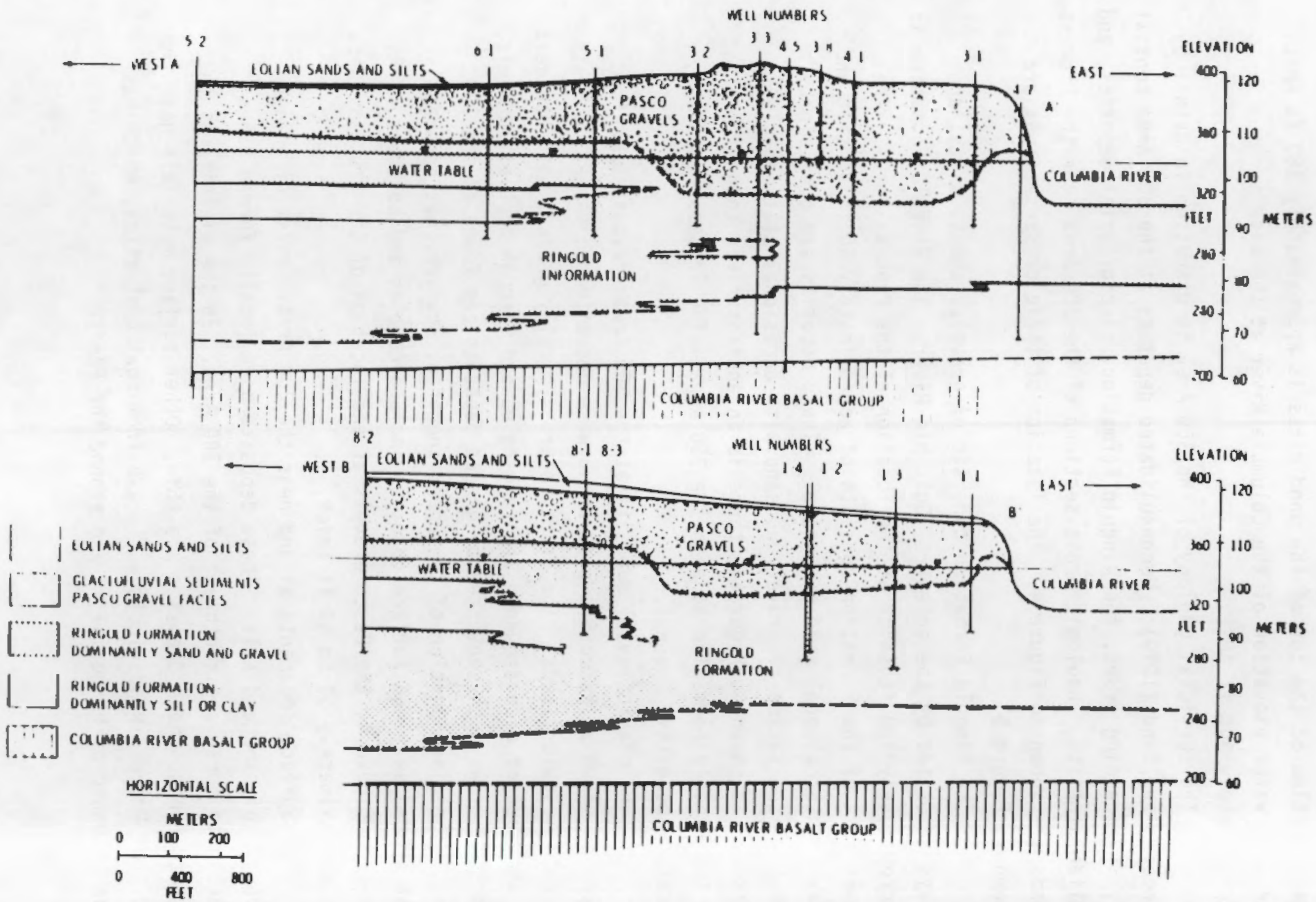


Figure 4. Geologic Cross-Sections Near 300 Area Process Ponds

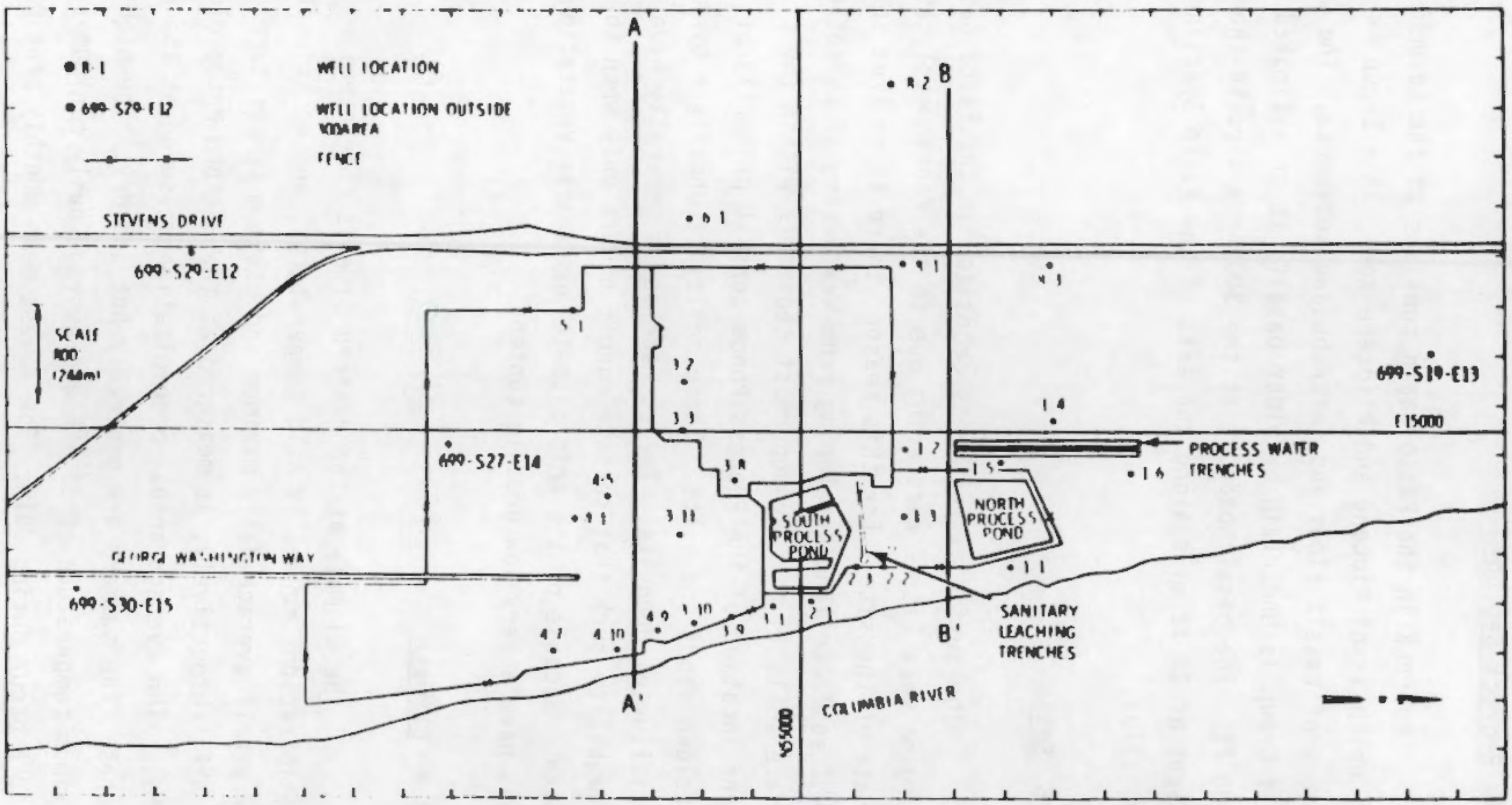


Figure 5. Locations of Cross-Sections Near 300 Process Ponds

2.1.4 Bedrock Geology

Bedrock in the Pasco Basin consists of the Columbia River Basalt Group which is of Miocene and Pliocene age. This Group is comprised of a sequence of basalt flows and inter-bedded sediments. The Columbia River Basalt Group is underlain by older basalts to an estimated depth of over 12,000 ft. The basalt bedrock at the 300 Area dips to the northwest at a gradient of 25 ft/mile along the axis of the Pasco Syncline (Lindberg and Bond, 1979).

2.1.5 Soils

The surficial sediments deposited in the Pasco Basin have undergone very little weathering due to the continuously arid to semi-arid climate of the site. For this reason, there is no true soil profile (i.e., soil horizons developing from weathering of parent material). Surface soils (i.e., the uppermost sediments within the plant root zone) at the location of the Process Ponds consist primarily of thin deposits of windblown sands and silts. These soils are underlain by much coarser glaciofluvial deposits. The surface soils generally have a high permeability such that surface runoff occurs only when the ground is frozen. Because of the arid climate and sparse vegetation, the surface soils have a very low organic content.

2.1.6 Climate

The climate at the Hanford Site is characterized by low precipitation, generally mild temperatures, and occasional high winds. The yearly average daily maximum and minimum temperatures are 64.8^{0}F and 41.4^{0}F, respectively, as measured at the Hanford Meteorological Station (HMS). The average annual precipitation measured at the HMS is 6.25 inches. The summers are generally hot and dry. The high average daily maximum temperature of 91.8^{0}F and average daily minimum temperature of 61.0^{0}F occur during July. The lowest mean monthly precipitation and average monthly relative humidity also occur during July and are 0.14

inches and 31.8 percent, respectively. Winters are mild for the latitude and are somewhat wetter than the summers. The low average daily maximum temperature of 36.7°F and average daily minimum temperature of 22.1°F occurs during January. The highest mean monthly precipitation also occurs during January and is 0.93 inches. The highest average monthly relative humidity occurs during December and is 80.4 percent (ERDA, 1975).

Mean monthly wind speeds range from a low of 6.0 mph in December to a high of 9.2 mph in June with a yearly average of 7.6 mph. The prevailing wind direction is from the northwest to west-northwest, but the strongest winds are from the southwest. Windspeeds are generally the lowest in the midmorning and the highest in the late evening. Average daily variations range from as much as 8 mph in the summer to as little as 1 mph in the winter. The maximum peak gust recorded at the HMS was 72 mph in June, 1957. Peak gusts over 40 mph are observed 26 times per year on the average (ERDA, 1975).

2.1.7 Surface Water

The major surface water feature at the Hanford Site is the Columbia River, which is located approximately 300 ft east of the 300 Area Process Ponds. The Columbia is the largest river in the Pacific Northwest and drains most of the land area in the Northwest. In the Columbia Basin the river is used extensively for irrigation as well as for production of electricity with hydroelectric dams. The river is also used as a source of drinking water by a number of municipalities, including the city of Richland, whose water intakes are approximately three miles downstream from the 300 Area, and the cities of Kennewick and Pasco. A sanitary water intake for the 300 Area is located approximately 1,000 ft downstream of the South Process Pond. The river, including the reach at and downstream of the 300 Area, also sees heavy recreational use for boating, fishing, and swimming.

The river reach from Priest Rapids Dam, which is several miles upstream of the Hanford Site, to the head of the McNary Dam reservoir pool, which is located near the city of Richland, is the last free-flowing reach of the Columbia River within the United States. This reach, which includes the river reach adjacent to the 300 Area, is characterized by islands, submerged rock ledges, and gravel bars. The bed material is typically sands, gravels, and cobbles. The river in this reach varies in width from 1,200 to 1,800 ft and ranges in maximum depth from 10 to 40 ft, with an average maximum depth of 25 ft (ERDA, 1975).

Although the reach at Hanford is free-flowing, its flow is controlled by the upstream Priest Rapids Dam. Flows through this hydroelectric dam can vary widely depending on power demands. During the summer, fall, and winter, the daily flows can range from as low as 36,000 cfs to as much as 160,000 cfs. Flows are higher during the spring when there is heavy runoff. Peak flows during spring runoff have recently ranged from 160,000 cfs to 550,000 cfs. The long-term annual average flow at Hanford is 120,000 cfs. Maximum river velocities range from 3 ft/sec to over 11 ft/sec, depending on cross-section and flow (ERDA, 1975).

2.1.8 Regional Hydrogeology

A number of water-bearing units are present beneath the Hanford Site. The upper-most aquifer is located in the upper Ringold Formation in the western part of the Site and in the Ringold and overlying Pasco Gravels in the eastern part of the Site. This aquifer is generally unconfined, although locally confined zones exist. The bottom of this aquifer is the silts and clays of the middle and lower Ringold Formation or, in some locations, the top of the basalt flows. In some areas, there are also sands and gravels in the lower Ringold which form the uppermost confined aquifer.

Natural recharge of the unconfined aquifer occurs to the southwest at the foot of the Rattlesnake Hills and Yakima Ridge. The major source of artificial recharge is liquid waste disposal in the 200 Areas, where approximately 15,000,000 gal/day of water are discharged to the ground (DOE, 1986b). Lesser amounts of artificial recharge occur in the 100N and 300 Areas.

Flow in the unconfined aquifer is generally toward the Columbia River, which forms a discharge boundary. Both the flow direction and the groundwater gradient have been significantly influenced by the large volumes of wastewater which are disposed of at the 200 Areas. The water table has been raised by as much as 75 ft due to mounding beneath waste disposal sites. Gradients at the mounds are as much as 30 ft/mile. Hydraulic properties of the aquifer material vary substantially with location. Values of hydraulic conductivity measured at Hanford range from 10 to 700 ft/day for the Ringold Formation and from 1,000 to 12,000 ft/day for the Pasco Gravels (ERDA, 1975).

Beneath the Ringold Formation is the series of basalt flows in which are found a number of confined aquifers. Aquifers in the basalt are found in inter-bedded sediments and scoria and breccia zones forming the tops and bottoms of flows. The confined aquifers are generally not well characterized.

2.1.9 Site Hydrogeology

The hydrogeology of the 300 Area is described in detail by Lindberg and Bond (1979). Groundwater is found beneath the Process Ponds in a shallow unconfined aquifer in the Pasco Gravels and Ringold Formation. The depth to the water table beneath the Ponds is less than 40 ft. The flow direction of the water table aquifer at the 300 Area is generally to the east toward the Columbia River. During periods of high river stage, however, gradient reversal and bank storage can occur. The aquifer is recharged locally by discharges to active liquid waste disposal units. The largest source of recharge is the 300 Area Process Trenches, which are located approximately 300 ft west of the North Pond. These trenches receive approximately 1,000,000 gal/day of process wastewaters. There is some slight mounding of groundwater beneath the Process Trenches, the effect of which is to steepen the groundwater gradient toward the Columbia River. An additional source of recharge is the Sanitary Leaching Trenches, which are located just north of the South Pond. These trenches receive several hundred thousand gallons per day of sanitary wastewater.

The transmissivity of the unconfined aquifer, as determined from aquifer tests on a well near the Ponds, is on the order of 100,000 ft^2/day. A groundwater model of the 300 Area used transmissivity values ranging from 20,000 to 2,000,000 ft^2/day for the area near the Process Ponds (Lindberg and Bond, 1979). The model predicted groundwater travel times from the 300 Area to the Columbia River on the order of weeks to months.

2.2 SITE HISTORY AND RESPONSE ACTIONS

The South and North Process Ponds were constructed in 1943 and 1948, respectively, for disposal of radioactively (principally uranium) and chemically contaminated wastewaters from the 300 Area. The North Pond was originally constructed as a replacement to the South Pond following a failure of the dike near the northeast corner of the South Pond and subsequent release of much of the Pond's contents. The South Pond was later repaired and the two Ponds were operated alternately until 1975. A summary of data related to the operation of the ponds is given in Table 2. The ponds were used primarily for disposal of fuel fabrication wastewaters and nonradioactively contaminated process and laboratory wastewaters. Discharges to the pond were reportedly subject to a release limit of 5×10^{-5} uCi/ml (Loe, 1967). Until recently, the small (east) infiltration basin of the South Pond was kept active for the disposal of water treatment filter backwash. Also, the first settling basin of the North Pond was used for disposal of flyash from the 300 Area Power Plant.

The ponds were operated as a series of basins, as shown previously in Figures 2 and 3. The South Pond consisted of three small settling basins followed by two large basins. The North Pond consisted of three small settling basins followed by one large basin. The basins were separated by dikes which were approximately 15 ft high. The inlet to the South Pond was originally located at the southwest corner of the Pond. In 1953, a new process sewer was constructed to serve the expanded 313 Metal Fabrication Building and 306 Fuel Element Pilot Plant. This new sewer was connected to a new inlet at the northwest corner. The inlet for the North Pond is at the southwest corner. Influent would enter the first of the settling basins and flow to the remaining basins by overflowing through flumes constructed in the tops of the dikes. The ponds were operated in this manner so that suspended and particulate contamination would be removed in the settling basins. There was no discharge from the ponds, and all water would either infiltrate or evaporate. The three settling basins on the North Pond were replaced in 1961 or 1962 with the original basins kept for sediment disposal. Since closure, several of the dikes

Table 2. Summary of Operational Data for 300 Area Process Ponds

Characteristics	South Pond (316-1)	North Pond (316-2)
Period of Use	1948-1975	1948-1975
Bottom Area	3.3 ha (8.1 acres)	4.0 ha (10 acres)
Depth to Water Table	10 m (33 ft)	10 m (33 ft)
Rate of Inflow	410,000 to 2,900,000 gal/day	
Total Uranium Received	More than 62,000 kg (130,000 lb)	
Other Radionuclides Received	55 mCi Pu; trace ^{60}Co; trace ^{234}Th	
Unplanned Releases	750 mCi ^{147}Pm 1967; some Pu 1950	
Nonradioactive Constituents Received	Copper (160,000-240,000 lb)	
pH Range of Pond Water	1.8 to 11.4	
Significant Process Changes	(1) Changes in 314 Bldg. in 1953 reduce soluble and insoluble U discharges to ponds (2) New laboratory facilities in 1954 eliminate routine Pu and FP discharges to ponds (3) Copper discharges 1959-1974 from N Reactor fuel fabrication (1000-1500 lb/yr) (4) Thorium fuel fabrication in 1969	

between the basins have been removed, with the material placed on the bottom of the basins to control wind erosion of contaminated sediments.

Sources of wastes discharged to the Process Ponds were uranium fuel fabrication facilities, the 321 Building cold separations laboratory, and miscellaneous other buildings (e.g., floor drains, equipment cooling). Fuel fabrication wastes constituted the major waste stream discharged to the Process Ponds. Fuel fabrication operations conducted in the 300 Area, and their resultant waste streams, varied somewhat over time. Originally, the site was used to fabricate aluminum clad fuel elements. Operations included extrusion, machining, and chemical cleaning of uranium fuel; sealing of fuel elements in aluminum cans; testing of fuel elements; and recovery of failed fuel elements. Typical wastes associated with the fuel fabrication process are given in Table 3. In 1959, process modifidations were made to allow for production of zirconium clad fuel. A major difference with this process was the use of copper jackets to protect the uranium fuel during extrusion. This process resulted in discharge of approximately 1,000 to 1,500 lb/yr of copper to the Ponds.

The 321 Building was used during the late 1940s to mid-1950s for research and development for chemical separations processes. During that time, wastes containing depleted uranium and special depleted uranium were discharged to the Process Ponds (Heid, 1956).

Prior to early 1953 (at which time laboratory operations were consolidated in the Works Laboratory Area in the south part of the 300 Area), the Process Ponds received small amounts of laboratory wastes from the 3706 Building. The South Process Pond was also used to dispose of very small quantities (i.e., bottles) of organic solutions. These wastes, which were immiscible in water and which would pose an explosion hazard in sewers or tanks, were poured into a stainless pipe laid down the dike on the north side of the South Pond. The generation rate of these wastes was estimated to be five to ten gallons per week.

During the time that aluminum clad fuel elements were being fabricated, sodium aluminate wastes were discharged to the ponds. Precipitates from these wastes reduced the permeability of the pond sediments, necessitating periodic dredging. The South Pond was reportedly

Table 3. Typical Wastes Discharged to the 300 Area Process Ponds

$NaOH$
Soap
$NaAlO_2$
Cleaner (Na_2CO_3, Na_2SiO_3, $Na_4P_2O_7$)
Deoxidizer ($NaHSO_4$, CrO_3 or $Na_2Cr_2O_7$, Na_2SiF_6)
$NaNO_3$
Chelating Agent ($NaC_6H_{11}O_7$)
Aluminux ($NaOH$, $NaC_6H_{11}O_7$)
Oxalic Acid
HNO_3
Uranium
Trichloroethylene

dredged by dragline in 1948 and 1952 and by earthmover in 1957, 1965, and 1969. The North Pond was reportedly dredged by dragline in 1952, 1954, and 1955 and by earth mover in 1960, 1964, and 1969. Sediments removed during dredging were disposed of by spreading on the impoundment dikes and by burial.

Post-closure activities have been directed toward minimizing the potential for radioactive sediments in the Ponds to be spread by wind. After closure, some of the materials in the dikes were used to cover the pond bottom. Other stabilization activities include disposal of fly ash in parts of the North Pond. There have been no response activities related to contamination in the Ponds other than sampling of sediments in the Ponds and monitoring of groundwater in the vicinity of the Ponds.

The 300 Area Process Ponds are near several active liquid waste disposal sites. The 300 Area sanitary leaching trenches are located immediately north of the South Pond. These consist of two trenches, each approximately 650 ft long by 30 ft wide used for the disposal of several hundred thousand gallons per day of sanitary wastewater from the 300 Area. The trenches run roughly east-west, with the southern trench as close as 50 ft from the South Pond. Immediately west of the North Pond are the 300 Area Process Trenches. These consist of two parallel trenches each approximately 1,535 ft long by 10 ft wide, which run north-south. These trenches are used to dispose of approximately one million gallons per day of process wastewaters presently generated in the 300 Area. Immediately south of the southwest corner of the South Pond is the 300 Area Ash Disposal Basin. This basin receives ash/water slurry from the 300 Area Power Plant. Immediately south of the southeast corner of the South Pond is a newly constructed basin used to receive water treatment filter backwash.

3.0 INITIAL EVALUATIONS

3.1 THE NATURE AND EXTENT OF SITE PROBLEMS

3.1.1 Types and Apparent Volumes of Wastes Disposed

Information concerning the past disposal of wastes to the 300 Area Process Ponds is somewhat limited. As part of the Phase I Installation Assessment (DOE, 1986a), estimates of the chemical and radiological inventories in each of the inactive waste disposal sites at Hanford were developed for use in ranking the sites using HRS/mHRS. The inventories for the 300 Area Process Ponds were developed based on available waste descriptions and volumes reported in historical documents, interviews with personnel familiar with the sites, and the results past of sampling and analysis of Pond sediments. When assumptions were made, they were conservative so as to maximize the estimated waste inventory. The estimated inventories for the South and North Ponds are given in Tables 4 and 5, respectively.

Slightly enriched uranium was the only radionuclide known to have been disposed of in significant quantities. Anodizing operations in the 306 Building reportedly resulted in wastewaters containing zinc-65, Zirconium-niobium, selenium-46, iron-59, cobalt-58, and cobalt-60 up to several tenths of a microcurie per milliliter (Loe, 1967). Some cobalt-60 has been detected in the pond sediments up to a maximum of 4 nCi/g. A release of 750 mCi of promethium-147 in 1967 was probably the most significant unplanned release.

3.1.2 Extent of Hazardous Substances

Information on the extent of hazardous substances in the Ponds is limited to the results of monitoring. Samples of the sediments in the Ponds were taken in the early 1970s and indicated the presence of many of the chemical contaminants identified in Tables 4 and 5. A recent inspection and radiological survey of the Ponds identified the presence of radioactively contaminated sediments.

Table 4. Estimated Contaminant Inventory for South Process Pond

Chemical	Inventory, kg
Sodium	2,000,000
Sodium Hydroxide	1,000,000
Nitrite	900,000
Mercury	60
Chromium (VI)	5,000
Cadmium	80
Lead	4,000
Fluoride	7,000
Trichloroethylene	100,000
Uranium	40,000
Sodium Aluminate	2,000,000
Nitrate	1,000,000
Sodium Silicate	100,000
Nickel	10,000
Zinc	5,000
Silver	1,000
Beryllium	40
Copper	60,000
Nitric Acid	1,000,000

Source: DOE, 1986a

Table 5. Estimated Contaminant Inventory for North Process Pond

Chemical	Inventory, kg
Sodium	2,000,000
Sodium Hydroxide	800,000
Nitrite	700,000
Mercury	40
Chromium (VI)	3,000
Cadmium	60
Lead	2,000
Fluoride	5,000
Trichloroethylene	100,000
Uranium	30,000
Sodium Aluminate	2,000,000
Nitrate	800,000
Sodium Silicate	90,000
Nickel	8,000
Zinc	3,000
Silver	900
Beryllium	30
Copper	50,000
Nitric Acid	900,000

Source: DOE, 1986a

Less is known of the extent of hazardous substances which may have migrated from the Ponds. Given the high hydraulic conductivity of the glaciofluvial and alluvial sediments beneath the Ponds and the high rate of discharge to the Ponds, migration of soluble contaminants to groundwater is expected. Groundwater monitoring in the vicinity of the Ponds has shown elevated levels of uranium and other soluble inorganic contaminants. The most recent annual monitoring data in the vicinity of the Ponds show uranium concentrations ranging from 0.5 pCi/l to 120 pCi/l (Price, 1986). Elevated levels of hexavalent chromium and fluoride were also observed. With the high transmissivity of the shallow aquifer and the short distance to the Columbia River, it is likely that contaminants present in groundwater have reached the River. A 1957 study identified higher concentrations of uranium in the Columbia River downstream of the Process Ponds than upstream. The most recent annual monitoring data continue to show uranium concentrations downstream of Hanford to be slightly higher than upstream concentrations (Price, 1986). It should be noted, however, that there are other potential sources of these contaminants in the 300 Area and the contribution of the Process Ponds to observed groundwater and surface water contamination has not been characterized.

Contamination of subsurface sediments is expected from infiltration of contaminated wastewater. The vertical and horizontal extent of contaminants in subsurface sediments, however, have not been characterized.

After closure the pond sediments dried out, presenting some potential for airborne contamination through wind erosion and dispersal. As mentioned previously, post-closure activities at the Ponds have included stabilization of the sediments to control such migration. The most recent annual monitoring data for Hanford show atmospheric uranium levels in the 300 Area and near the 300 Area Ponds to be slightly higher than off-site levels (Price, 1986).

3.1.3 Major Contaminant Parameters Identified and Concentrations Detected

Limited information is available concerning the chemical and radiological characteristics of the sediments currently in the Ponds. Fifteen sediment samples, three from each of the five basins, were taken from the South Pond in 1974. These samples were taken along the assumed flow path through the ponds, as shown in Figure 6. Results from analysis of these samples are given in Table 6. One sample location in the North Pond, thought to be in the first settling bay, was sampled in 1970. Samples were taken at depths of 0, 0.5, 1, 2, 3, and 4 ft. Results from analysis of these samples are given in Table 7.

A study was performed in 1975 to evaluate the potential for contaminant leaching associated with the disposal of water treatment filter backwash in the east bay of the South Pond. Eighteen sediment samples were collected, from the bottom of the pond as well as from the dikes, at the locations shown in Figure 7. These samples were leachated with both 2 molar nitric acid and filter backwash solution. The results from this study showed levels of contamination similar to the 1974 study. Levels of contamination found in the samples collected on the dikes above the high water mark were similar to those in samples from the pond bottom, suggesting that the dikes contained spoils dredged from the pond bottom.

There are numerous existing groundwater monitoring data for the 300 Area. In general, these data show elevated levels of uranium, beta emitters, fluoride, chloride, chromium, and nitrate in the vicinity of the Process Ponds. Interpretation of these data with respect to identifying contributions due to the Process Ponds is difficult, however, because of the presence of other possible sources. Detailed review of the extensive groundwater monitoring data base is beyond the scope of the work plan preparation, but is included as one of the tasks of the RI.

Surface water monitoring data are generally indicative of contamination related to the contaminated groundwater. As with the groundwater data, these data will require extensive review which is beyond the scope of the work plan preparation. Review of existing surface water monitoring data will be accomplished as one of the tasks of the RI.

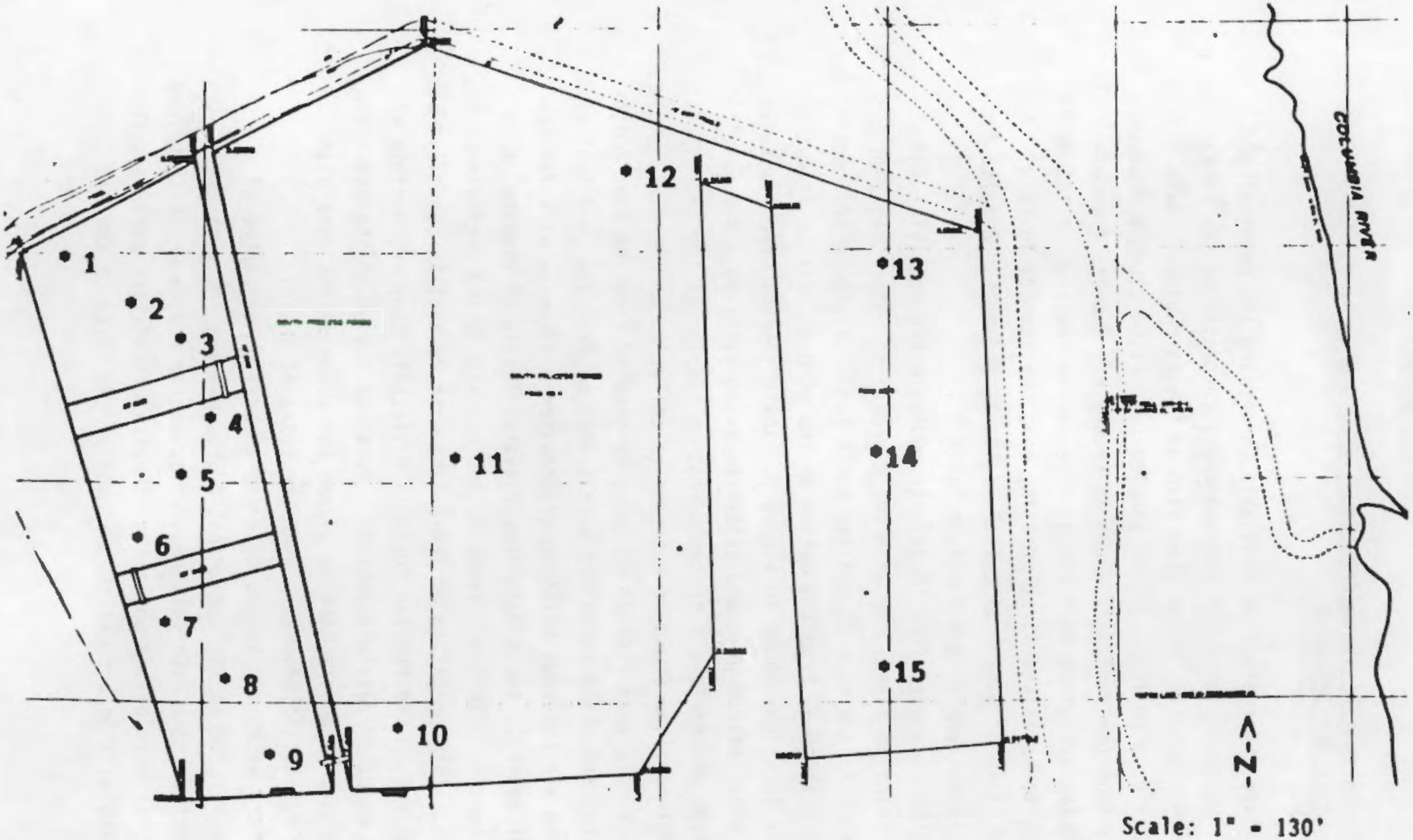


Figure 6. Approximate Locations of Samples Taken From South Pond in 1974

Table 6. Results of Analysis of South Pond Sediment Samples, 1974

	% dry wt		mg/kg dry wt								
Location	Cu	U	Hg	Ni	Cr	Zn	Cd	Ag	Pb	Be	F
1	2.5	0.39	4	970	230	330	5	5	170	2.7	2,200
2	8.7	0.60	5	3,100	190	420	9	44	230	3.5	16,000
3	7.9	0.72	8	2,400	410	550	9	74	300	4.9	3,700
4	7.4	0.76	16	2,300	390	630	12	349	380	6.1	4,900
5	3.0	0.33	6	1,200	180	390	6	85	220	2.4	3,300
6	2.3	0.30	8	1,100	150	490	6	102	230	2.2	1,100
7	7.4	0.33	14	1,000	140	720	10	162	310	5.2	3,000
8	0.09	0.01	<0.5	93	20	40	<0.5	13	20	0.25	750
9	4.4	0.54	13	1,800	540	770	13	338	390	3.6	1,800
10	0.09	0.01	<0.5	170	80	50	1	15	40	0.29	560
11	1.2	0.08	4	380	170	260	5	65	90	3.0	560
12	0.03	<0.01	<0.05	28	10	30	<0.5	3	10	0.3	550
13	0.40	0.02	1	150	90	120	2	25	30	1.2	410
14	0.04	<0.01	<0.05	33	10	20	<0.5	2	7	0.22	370
15	0.08	<0.01	<0.05	52	10	40	0.6	5	8	0.32	310

Table 7. Copper, Uranium, and Zirconium in North Pond Sediment Samples, 1970

Sample Depth, ft	Cu, % dry wt	U, % dry wt	Zr, % dry wt
Surface	6.9	1.2	3.6
0.5	8.3	0.72	2.9
1.0	7.1	0.87	3.4
2.0	6.6	0.59	3.5
3.0	4.8	0.81	2.5
4.0	8.0	0.84	2.5

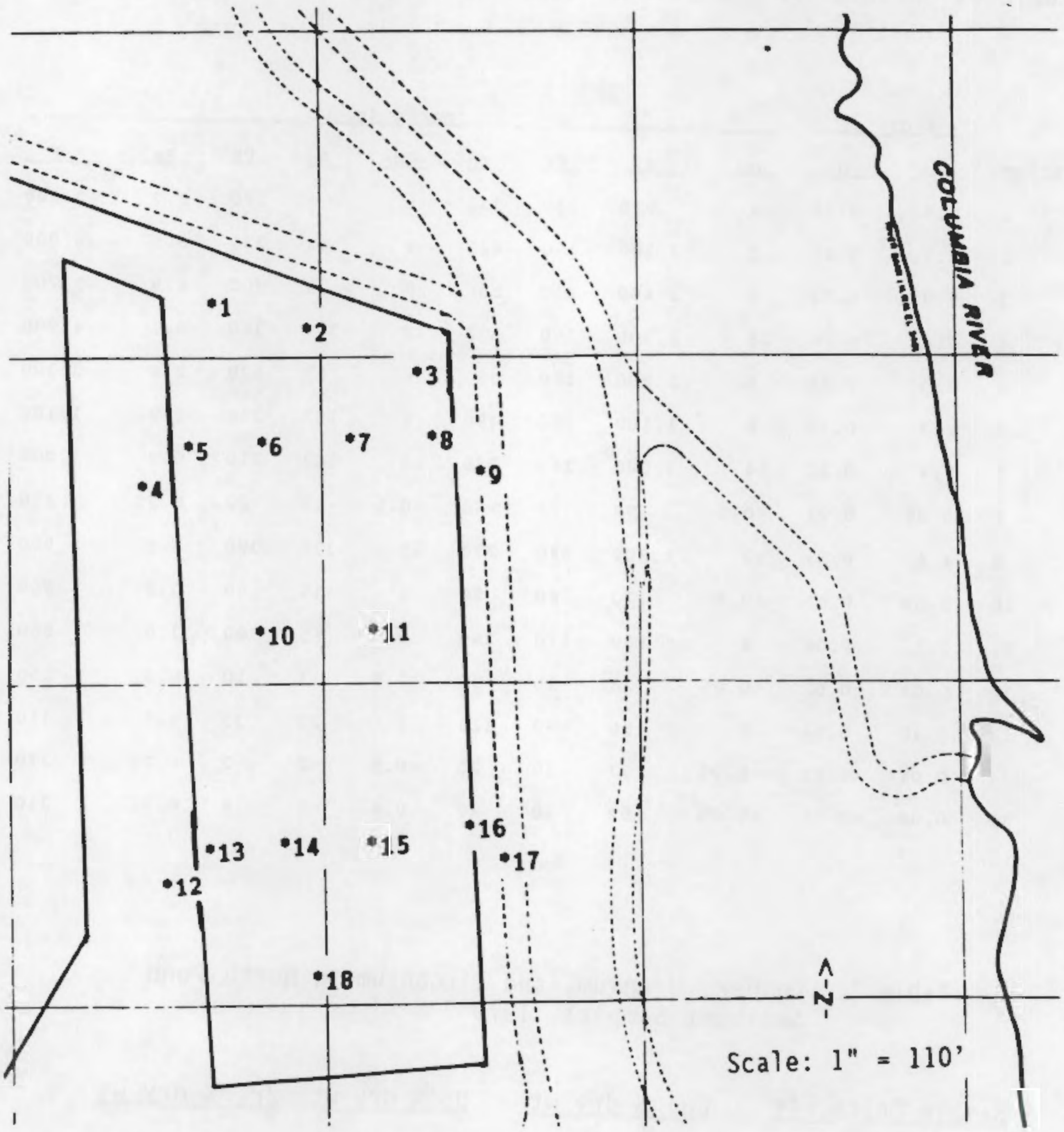


Figure 7. Approximate Location of Samples Taken from East Bay of South Pond in 1975

Air monitoring data show levels of gross alpha and gross beta near the Process Ponds to be higher than off-site. There are numerous possible sources of this contamination in the 300 Area and the contribution of the Process Ponds, if any, has not been characterized. A review of existing air monitoring data is included as one of the tasks of the RI.

3.2 POTENTIAL PATHWAYS OF CONTAMINANT MIGRATION

3.2.1 General

The primary potential migration pathway available is migration in groundwater. Because of the observed groundwater contamination and the large volume of wastes disposed of to the Ponds, this pathway was scored as having an observed release for the HRS/mHRS ranking (DOE, 1986a). A secondary related pathway is migration in surface water following discharge of contaminated groundwater to the Columbia River. Because of the known occurrence of groundwater discharges to surface water, this pathway was also scored as having an observed release for the HRS/mHRS ranking (DOE, 1986a). Airborne migration is a potential pathway, though the results of air monitoring data indicate that such migration has not occurred to any significant extent (Price, 1986). Because there was no documentation of observed releases, this pathway was not scored for the HRS/mHRS ranking (DOE, 1986a). The above potential migration pathways are discussed below.

3.2.2 Groundwater

The importance of the groundwater migration pathway results from the form of waste disposal (i.e., discharge of wastes in aqueous streams) and the ultimate disposition of these liquid wastes (i.e., infiltration). The magnitude of the potential for migration is indicated by the magnitude of disposal operations. Available data on past operations indicate that waste disposal discharges were often greater than a million gallons per day. This volume of water discharged to a 10 acre pond results in a net infiltration of greater than 0.25 ft/day. Given the shallow depth to groundwater (less than 40 ft) and the long period of operation (approximately 30 yrs) it is certain that water discharged to the Ponds reached groundwater and the Columbia River.

While the main groundwater pathway appears to be infiltration to the shallow unconfined aquifer and subsequent migration to the river, downward migration to the lower unconfined and upper confined aquifers is also a possibility. This downward migration, however, has not been well characterized.

While the hydrogeologic aspects of contaminant migration are well characterized (at least for the upper unconfined aquifer) and indicate a high potential for migration, the geochemical aspects of contaminant migration are less well known, though equally important. The geochemical behavior of the contaminants discharged to the Ponds is believed to have a major affect on the potential for migration. For example, soluble contaminants which do not interact with sediments (e.g., nitrate) would have the greatest potential for migration. Such contaminants would be expected to infiltrate readily to groundwater and be transported to the river. Soluble contaminants which interact with sediments (e.g., most of the metals) would be transported to varying degrees depending on the strength of their interactions with the sediments.

While monitoring data strongly indicate that some contaminants have migrated to groundwater, the migration potential of other contaminants (i.e., those associated with sediments) is not well characterized. Characterization of this potential will require a better understanding of the geochemical behavior of the contaminants.

3.2.3 Surface Water

The potential for surface water migration is directly related to the potential for groundwater migration. That is, contaminants must be able to first migrate through the groundwater in order to reach the surface water. As described above, the ability of contaminants to reach surface water will depend strongly on the geochemistry of the contaminants. Once in surface water, the migration potential will also depend on the type and nature of geochemical interactions which occur. For example, contaminants which remain soluble will display a greater potential for migration than those which interact with sediments and become associated with the river bed. While monitoring data suggest that some contaminants discharged to the Process Ponds have reached surface water, the migration potential of other contaminants is not well characterized.

3.2.4 Air

The potential for airborne migration of particulate contaminants (e.g., metals and most radionuclides) depends on several factors. The first of these is the availability for transport. In order for migration to occur, the contaminants must first be located on the surface and exposed to the wind. The second factor is the transportability of the contaminants. The contaminants must be associated with a small enough particle to be able to be eroded and transported by the wind. The migration potential of vapor contaminants (e.g., organic solvents) depends only on the ability of vapors to come in contact with the wind. The above factors are influenced strongly by the degree to which contaminants in the Ponds have been stabilized (i.e., covered with inert, nonerodable material). Some stabilization activities have been performed at the Process Ponds in the past. Available data are insufficient to determine the impacts associated with possible airborne migration.

3.3 POTENTIAL EXPOSURE TO MIGRATING CONTAMINANTS

Exposure to contaminants disposed of to the Process Ponds requires that receptors be present along the migration pathways. At present, there is no use of groundwater in the area known to be contaminated (i.e., the shallow unconfined aquifer between the 300 Area and the Columbia River). The potential for exposure, therefore, is related to the potential for groundwater contamination to extend beyond the shallow unconfined aquifer to other aquifers which are potentially used.

Surface water migration offers the potential for exposure to migrating contaminants. The downstream cities of Richland, Kennewick, and Pasco as well as the 300 Area use the Columbia River for drinking water supplies, creating the potential for direct human exposure. Columbia River water is also used as a downstream source of irrigation water, creating the potential for human exposure through food crops irrigated with contaminated water. Human exposure is also possible through recreational use, either through direct contact with contaminated water, or through consumption of contaminated game fish. Surface water also offers the potential for exposure of aquatic biota to contaminants and for food chain uptake of these contaminants by higher predators. Because receptors are known to be present, the potential for exposure depends on the potential for contaminants to be present in the River.

The potential also exists for exposure to airborne contaminants. Potential receptors include Hanford Staff working in the 300 Area and residents downwind of the disposal sites. The potential for exposure depends on how well contaminant stabilization is maintained.

While not a migration pathway, direct contact is a potential exposure mechanism. Direct contact is not currently of concern because of the restricted access to the Process Ponds. The future importance of this exposure mechanism depends on the future disposition of the Ponds.

3.4 QA/QC REVIEW OF EXISTING DATA BASE

Data reviewed during preparation of the work plan include results of past sediment sampling and Hanford annual monitoring data. Quality assurance/quality control (QA/QC) aspects of these data are discussed below.

3.4.1 Sediment Sampling

The sediment sampling data reviewed were those obtained for the South Pond in 1974 and for the North Pond in 1970. South Pond sampling procedures are described by Hall (1974) and involve collection of shallow samples (i.e., less than 1 ft depth) using simple digging tools. Sample preparation and analysis are described by Stromatt (1974). Sample preparation involved acid leaching of samples. Analytical methods involved flame atomic absorption (AA) spectrophotometry for chromium, copper, lead, nickel, silver, and zinc. Flameless AA was used for beryllium, cadmium, and mercury. Spectrophotometry was used for hexavalent chromium and uranium and potentiometry for fluoride. Spike recoveries were reported and generally ranged from 90 to 110 percent. Specifics of QA/QC methods were not described, but it assumed that the analyses were performed under the general Hanford laboratory QA/QC procedures.

The available documentation indicates no obvious QA/QC concerns with respect to sampling and analysis. The greatest concern over the use of these data is their age. These samples were taken approximately 13 years ago and it is unknown how representative these data are of current conditions.

No documentation was available for sampling or analysis of the North Pond. Regardless of the methods employed to collect or analyze samples, use of these data is of concern because of the long time period since the samples were collected.

3.4.2 Groundwater Sampling

As mentioned previously, there is an extensive existing data base resulting from past monitoring of groundwater at the 300 Area. Review of these data was beyond the scope of work plan preparation, but will be performed as part of the RI. This review will include evaluation of QA/QC concerns. Potential QA/QC concerns with respect to existing groundwater data are expected to relate primarily to well construction methods and materials, and sampling methods.

3.4.3 Surface Water Sampling

As mentioned previously, there is an extensive existing data base resulting from past monitoring of surface water at Hanford. Review of these data was beyond the scope of work plan preparation, but will be performed as part of the RI. This review will include evaluation of QA/QC concerns. Potential QA/QC concerns include the representativeness of sample locations and methods for characterizing contamination associated with the Process Ponds.

3.4.4 Air Monitoring

As mentioned previously, there is an extensive existing data base resulting from past air monitoring at and downwind of the 300 Area. Review of these data was beyond the scope of work plan preparation, but will be performed as part of the RI. This review will include evaluation of QA/QC concerns. Potential QA/QC concerns include the representativeness of sample locations and methods for characterizing contamination associated with the Process Ponds.

4.0 WORK PLAN RATIONALE

4.1 DATA NEEDS

The primary objective of the site characterization is to establish if there are public health and environmental hazards associated with the 300 Area Process Ponds. Data are needed which specifically characterize contamination associated with the Ponds. Past investigations have not focused solely on the Ponds as a source of contamination, nor have they addressed all contaminants potentially of interest or concern. Additional data are also needed to satisfy the objective of supporting both the public health evaluation (risk assessment) and the feasibility study (FS). The data needed to support these activities overlap with the primary objective of the site characterization. Data needs are grouped into three categories, which are:

1) Those data necessary to support the FS which indicate the nature and extent of site contamination sources and potential routes of contaminant release and migration (Section 4.1.1, Problem Identification);
2) Those data which determine the potential impact and risks to human health and the environment from the presence or release of contaminants from the site (Section 4.1.2, Risk Assessment and Environmental Impact);
3) Those data necessary to support the FS which will aid in defining cost-effective remedial measures to reduce the risk or threat posed by the presence or release of contaminants (Section 4.1.3, Remedial Action Screening).

Evaluation of existing data, as summarized in Sections 2 and 3, indicates:

1) Substantial data exist for some media (e.g., groundwater and surface water), but require review to determine whether they are adequate to meet the objectives of the RI; and
2) Existing data for other media (e.g., subsurface sediments) are inadequate to meet the objectives of the RI.

Specific data needs are discussed below.

4.1.1 Problem Identification

Site and Contaminant Characterization. Existing data are inadequate to fully characterize the contamination associated with the Process Ponds. Sampling of the sediments in the South Pond in 1974 indicated the presence of uranium and heavy metals at concentrations above background. These analyses were limited, however, and did not include additional contaminants which may be of concern (i.e., organic contaminants). In addition, samples were collected only at the surface and only within the boundary of the ponds. This limited distribution of samples is inadequate to characterize the extent of contamination.

Specific sediment data needs include:

- Identification and quantification of the inorganic, organic, and radioactive hazardous substances present in the sediments in and beneath the Ponds;
- Characterization of the horizontal and vertical extent of chemical and radiological sediment contamination associated with wastes discharged to the Ponds;

Groundwater contamination at the site also needs additional characterization. Available hydrogeologic data clearly indicate that wastewater discharged to the Ponds has reached groundwater. As discussed in Section 3, there presently exists a significant amount of groundwater monitoring data for the area near the 300 Area Process Ponds. These data were collected as part of the site-wide groundwater monitoring effort at Hanford and, therefore, were collected to satisfy objectives different from those of the RI. It is likely, however, that some of these data will be useful in terms of characterizing contamination at the Ponds. In addition, there are other ongoing groundwater characterization studies in the 300 Area related to active liquid waste disposal facilities (e.g., 300 Area Process Trenches). Ongoing and planned activities may provide useful data for the RI.

Specific groundwater data needs include:

- Evaluation of existing monitoring data and planned monitoring networks in terms of their applicability to site characterization of the Process Ponds.

- Characterization, using those data which are applicable to the site investigation, of the types, distribution, and concentrations of organic, inorganic, and radiological contaminants present in the shallow unconfined and deeper aquifers near the Ponds;
- Evaluation and characterization, using applicable data, of the relationship of the observed groundwater contamination to wastes received by the Ponds; and
- Identification of additional required hydrogeologic investigations and groundwater monitoring, considering the available data and planned monitoring networks,

Existing surface water monitoring data are similar to existing groundwater data. That is, the data were collected to identify contamination in the Columbia River but were not collected to characterize this contamination with respect to its relationship to the 300 Area Process Ponds. As with the groundwater data, it is likely that some existing surface water monitoring data will be useful for the site characterization.

Specific surface water monitoring data needs include:

- Evaluation of existing monitoring data and planned monitoring networks in terms of their applicability to site characterization of the Process Ponds.
- Characterization, using those data which are applicable to the site investigation, of the types, distribution, and concentrations of organic, inorganic, and radiological contaminants present in the Columbia River upstream and downstream of the Ponds;
- Evaluation and characterization, using applicable data, of the relationship of the observed surface water contamination to wastes received by the Ponds; and
- Identification of additional required investigations and surface water monitoring, considering the available data and planned monitoring networks.

Potential for Contaminant Migration. The primary pathway for migration of contaminants from the Ponds is groundwater. With respect to migration of contaminants in groundwater, the hydrogeology (i.e., transport medium) is generally well characterized, particularly the shallow unconfined aquifer. Contaminant migration in other aquifers may also be of concern and may require additional characterization. Specific data needs include:

- Identification of the types, concentrations, and distribution of contaminants in aquifers below the shallow unconfined aquifer; and
- Characterization of the interconnection between the shallow unconfined and deeper aquifers in terms of properties which affect contaminant transport (i.e., hydraulic gradient, hydraulic conductivity, porosity)

One area of groundwater and surface water contaminant migration which is not well characterized is the geochemical aspect of migration. That is, the geochemical interactions affecting the availability of contaminants for leaching and migration are complex and poorly characterized. Such information will be needed in order to determine the migration potential of contaminants associated with sediments in and beneath the pond. These data will also be needed to determine the fate of contaminants following discharge to surface water. Specific data needs include:

- Identification of the minerals and chemical forms of contaminants present in sediments;
- Identification and characterization of the factors controlling the solubility of inorganic contaminants; and
- Characterization of the factors controlling the rate of migration of contaminants in groundwater (e.g., distribution coefficients).

Migration by the air pathway is potentially of concern. As mentioned previously, the potential for migration is primarily related to the availability for contaminants to be eroded by the wind. While existing air monitoring data do not indicate that air contamination is a significant problem, the monitoring data should be reviewed to evaluate how well these data characterize potential releases from the Ponds. In addition, surface contamination at the Ponds should be characterized to determine the potential for atmospheric releases. Specific data needs include:

- Evaluation of existing monitoring data in terms of their applicability to site characterization of the Process Ponds;

- Using those data which are applicable to the site investigation, characterization of the types and concentrations of atmospheric releases; and
- Characterization of surface contamination in the Ponds with respect to the types and distribution of surface contaminants.

4.1.2 Risk Assessment and Environmental Impact

The primary means of contaminant exposure appears to be to surface water, with a lesser potential for groundwater and atmospheric exposure. The data needs described above should better characterize the actual and expected future concentrations of contaminants in these media. To determine risk and impact, additional data will be needed to determine what acceptable levels of contamination are and what receptors are likely to be impacted. The former will first require identification of the contaminants present at the site. Once all contaminants have been identified, applicable or relevant and appropriate requirements (ARARs) can be identified. Major potentially impacted receptors have been identified for surface water, groundwater, and air, respectively as:

- Municipal, agricultural, and recreational users of the Columbia River, and aquatic biota in the River;
- Nearby users of groundwater in the lower unconfined and confined aquifers; and
- Site workers and nearby residents.

Potential receptors, critical habitats, endangered species, archeological areas, and other concerns with respect to environmental impact have been previously characterized (e.g., ERDA, 1975; Price, 1986) and should not require further characterization. Additional specific data needs for risk assessment and environmental impact are identification of ARARs for each contaminant identified at the site.

4.1.3 General Response Action Screening

Potential general response actions were identified and screened as part of the work plan preparation. The early identification of potentially feasible remedial actions allows for definition of site characterization tasks to produce data necessary to assess endangerment and define cost-effective remedial action alternatives. Sufficient data do exist to make an initial assessment of general response actions and to direct certain data gathering activities during the RI which will support more detailed screening efforts to identify and evaluate specific remedial technologies. This initial assessment is based on the assumption that site contamination is of a nature that remediation is necessary. The final determination of the need for remedial action will be based on an assessment of the data collected during the site characterization.

Response Action Identification. There are eight general categories of response actions that include technologies to remediate waste or contaminant sources, contamination migrating along pathways, and exposure of receptors to contaminants. These categories include:

1) No action;
2) Use and access restrictions;
3) Alternate water supplies;
4) Containment technologies applied to contaminant sources (barriers and encapsulation) and contaminant migration pathways (flow barriers and flow modification);
5) Removal of contaminants from contaminant source (usually combined with disposal or treatment technologies) and locations along contaminant transport routes (groundwater recovery, surface water or leachate collection, sediment removal);
6) Disposal of contaminated or treated materials, including waste products (usually to a secure facility), groundwater, surface water, and leachate (usually after treatment), and soil and sediments;
7) Treatment of contaminants (usually after removal or collection) including wastes, contaminated soil and sediment, surface water, leachate, and groundwater (after recovery or at the point of use); and
8) In-situ treatment of wastes, groundwater, and contaminated soils and sediments at the source.

Potentially Applicable General Response Actions. The existing site data indicate that several general response actions exist which could potentially be required. The need for any actions will, of course, depend on the results of the site characterization and assessment of the risk posed by the site. Actions which may potentially be required at the site can be divided into three groups: no action, on-site action (source control), and off-site action (migration control).

No Action. The need for remedial action will depend on the risk associated with contaminants presently in the Process Ponds or formerly disposed of to the Process Ponds. The no-action alternative may be the cost-effective alternative for the Process Ponds if the contamination associated with the Ponds does not exceed levels set by ARARs.

On-Site Actions (Source Control). The need for on-site actions will depend on the hazard posed by the contaminants at the site (i.e., in and beneath the Ponds). In addition, determination of the feasibility of any actions will depend on additional site characterization. Potentially applicable on-site actions include:

1) Containment of Source: This action could be used if it were necessary to control migration of contaminants from the sediments and groundwater in and below the Ponds. Potentially applicable technologies include:
   - Contain contaminated groundwater at the site using either physical or hydraulic barriers; and
   - Isolate contaminated sediments with physical barriers to prevent introduction into migration pathways.
2) Removal of Contaminants: This action could be used if it were necessary to control migration of contaminants from the sediments and groundwater in and below the Ponds. Potentially applicable technologies include:
   - Excavation and removal of contaminated sediments (additional disposal or treatment of contaminated materials would be required); and
   - Withdrawal of contaminated groundwater beneath the site (additional treatment of withdrawn groundwater would be required).
3) Disposal of Contaminated or Treated Materials: This action would apply to excavated materials generated by item 2 above.

4) Treatment of Contaminants: This action would apply to excavated materials or withdrawn groundwater generated by item 2 above.
5) In-Situ Treatment: This action could be used if it were necessary to control migration of contaminants from sediments and groundwater in and below the Ponds. Potentially applicable technologies include:
    - In-situ treatment of contaminated sediments; and
    - In-situ treatment of contaminated groundwater.

Off-Site Actions (Migration Control). The need for off-site actions will depend, in part, on the actual or potential exposure of receptors to contaminants at levels which pose a hazard. The feasibility of any action will, of course, depend on additional site characterization data. Potentially applicable off-site actions include:

1) Use and Access Restrictions: This action could be used to prevent exposure of human receptors to contaminants in the Columbia River and could include restriction of fishing, boating, and swimming access.
2) Alternate Water Supplies: This action could be used to prevent exposure of municipal and agricultural users of contaminated groundwater and/or surface water. Potentially applicable technologies include:
    - Replace water supplies contaminated by the site with uncontaminated sources;
    - Treat individual water supplies to remove contaminants migrating from the site; and
    - Monitor wells and/or intakes for water quality degradation.
3) Removal of Contaminants: This action could be used to control exposure to contaminated sediments or groundwater away from the source. Potentially applicable technologies include:
    - Withdrawal of contaminated groundwater downgradient of the site (would require additional treatment); and
    - Dredging of river sediments contaminated by groundwater discharges (would require additional treatment or disposal).
4) Disposal of Contaminated or Treated Materials: This action would apply to dredged sediments generated in Item 3 above.
5) Treatment of Contaminants: This action would apply to dredged sediments or withdrawn groundwater generated in Item 3 above.

6) In-Situ Treatment: This action could be used to treat contaminants in shallow groundwater away from the site.

Technology Evaluation Data Needs. In order to screen individual technologies and develop feasible remedial alternatives, additional data will be necessary. Specific data needs related to further assessment of remedial technologies include:

1) No Action. Actual and expected contaminant concentrations in various environmental media; acceptable or allowable concentrations.
2) Use and Access Restrictions. Actual and expected contaminant concentrations in media controllable by access restrictions; distributions of receptors in these media.
3) Alternate Water Supplies. Actual or expected contaminant concentrations in groundwater and surface water used as water supplies; chemical and physical properties related to treatment.
4) Contaminant Containment. Horizontal and vertical distribution of contaminants; soil and aquifer properties and subsurface conditions.
5) Contaminant Removal. Horizontal and vertical distribution of contaminants; soil and aquifer properties and subsurface conditions.
6) Disposal of Contaminated or Treated Materials. Chemical and physical properties of treated materials.
7) Treatment of Contaminants. Chemical and physical properties of soils, sediments, and waters affecting treatment.
8) In-Situ Treatment. Horizontal and vertical distribution of contaminants; physical and chemical properties of soils and aquifers.

4.2 WORK PLAN APPROACH

Most of the data needs identified in Section 4.1 can be satisfied by performance of a site characterization program which incorporates hazard identification, endangerment, and remedial technology needs into the following objectives:

- Maximize the use of existing data and monitoring structures.
- Characterize inorganic, organic, and radiological contamination of sediments, groundwater, and surface water to determine if a hazard exists and to evaluate feasibility of various treatment technologies.

- Characterize the vertical and horizontal extent of contamination in the different environmental media.
- Determine the influence of neighboring liquid waste disposal facilities on the observed contamination.
- Determine the potential for contaminant migration in the deep unconfined and confined aquifers and in the atmosphere.
- Characterize geochemical factors affecting contaminant migration potential.

The approach includes appropriate site characterization activities described in the generic Hanford RI plan including Level I data review activities and some Level II data collection activities. Specific activities to be conducted include:

- Site visit and general reconnaissance.
- Detailed evaluation of existing groundwater and geohydrologic data and planned geohydrologic investigations for adjacent sites.
- Detailed evaluation of existing surface water and hydrologic data and planned investigations for adjacent sites.
- Detailed evaluation of air monitoring data.
- Sampling and analysis of subsurface sediments below the Ponds.
- Sampling and analysis of surface sediments in the Ponds.
- Data evaluation.
- Risk assessment.
- Reporting.

Section 5 presents a detailed outline of proposed RI tasks, including objectives and deliverables to be accomplished during these tasks. The RI schedule is included as Section 6.

5.0 RI TASKS

The RI of the 300 Area Process Ponds is being conducted using a phased approach, as described in the generic Hanford RI Plan. The first phase, referred to as the Level I RI, will focus heavily on review of existing data and evaluation of those data to determine they can be used to meet the objectives of the RI. This approach is necessary because of the large amount of existing data and the related investigations under way at neighboring facilities which may be of use. In addition, Level I will involve limited collection of new environmental contamination data which do not presently exist. These new and existing data will be evaluated to estimate the potential impact of the ponds on human health and the environment and to determine whether additional investigative phases are needed (i.e., existing data are inadequate to meet the objectives of the RI). The tasks associated with the Level I RI are described below.

5.1 TASK 1 - TECHNICAL MANAGEMENT AND SUPPORT

5.1.1 Subtask 1.1 - Project Management

Project management activities will be conducted through PNL's Inactive Waste Site Surveillance (IWSS) Program. Contact will be maintained with PNL Hanford Environmental Program management staff and with DOE Richland Operations (RL) staff during performance of the RI.

Project management activities during Level I will include preparation of monthly reports to keep PNL and RL management staff informed of the technical, financial, and schedule status of the project. Other responsibilities include controlling budgets and schedules; selecting, coordinating, and scheduling staff, subcontractors, and other Hanford contractors for task assignments; maintaining project quality control and assurance programs; and preparation of a work plan for Level II of the RI, if required.

5.1.2 Subtask 1.2 - Field Work Support

Under this subtask, PNL will coordinate the efforts of other Hanford contractors and/or subcontractors involved with field work (e.g., sampling). PNL will also provide required support for field activities. Required field support will include excavation of subsurface sediment sampling locations, subsurface sediment sampling, radiation monitoring, and surveying of the location and elevation of sample locations

5.1.3 Subtask 1.3 - Quality Control

This subtask will involve review of project files and project deliverables, site inspection during the field activities, and inspections and review of laboratory QA/QC procedures. Project deliverables to be reviewed include technical memoranda, the Draft Level I RI Report, and the Final Level I RI Report. This subtask will also involve preparation of field QA/QC samples (e.g., blanks, duplicates, spikes) for laboratory analysis.

5.1.4 Subtask 1.4 - Sample Management

The objective of this subtask is to track the progress of samples delivered to the analytical laboratory and to manage the analytical data received from the laboratory. This subtask will include maintenance of sample chain-of-custody records, receipt of the analytical data from the laboratory, and supervision of entry of the data to the environmental data base.

5.2 TASK 2 - EXISTING DATA REVIEW

5.2.1 Subtask 2.1 - Site Visit and General Reconnaissance

The objective of this subtask, is to visit the site to gain familiarity with site characteristics which may influence conduct of the RI, particularly the field activities. The site visit will be attended by

PNL staff and Hanford contractor and subcontractor staff involved with the RI. Particular emphasis will be placed on identifying potential health and safety concerns related to field activities and identifying site access problems.

5.2.2 Subtask 2.2 - Hydrogeologic and Groundwater Monitoring Data

The objective of this subtask is to review and evaluate existing hydrogeologic and groundwater monitoring data for application to the Level I RI site characterization. Data sources to be evaluated include Hanford groundwater monitoring data collected near the 300 Area Process Ponds from existing monitoring wells, groundwater monitoring data collected for the ongoing RCRA compliance effort at the 300 Area Process Trenches, well logs from existing wells, results of aquifer tests, and any other hydrogeologic investigations conducted in the area. The focus of this evaluation will be on identifying hydrogeologic and groundwater monitoring data which can be used to characterize groundwater contamination at the Process Ponds and to characterize groundwater movement near the Ponds. Evaluation of existing groundwater monitoring data will include consideration of the sampling and analysis methods used to obtain the data. Existing wells near the Ponds will also be evaluated to determine their suitability for collection of additional groundwater samples during Level II, if required. This evaluation will include careful consideration of the construction and maintenance of the wells.

The deliverable for this subtask will be a summary report which identifies the existing geohydrologic and monitoring data near the Ponds, summarizes evaluation of those data with respect to their applicability to the RI, identifies data gaps which must be addressed during Level II of the RI, and presents recommendations for collecting those data during Level II.

5.2.3 Subtask 2.3 - Hydrologic and Surface Water Monitoring Data

The objective of this subtask is to review and evaluate existing hydrologic and surface water monitoring data for application to the Level I RI site characterization. Data sources to be evaluated include Hanford surface water monitoring data collected from the Columbia River near the 300 Area, surface water monitoring data collected near the 300 Area for any other related environmental programs, and results of any other studies related to transport of contaminants in the Columbia River. The focus of this evaluation will be on identifying hydrologic and surface water monitoring data which can be used to characterize any surface water contamination related to the Process Ponds and which can be used to characterize transport of these contaminants in the River. Evaluation of existing surface water monitoring data will include consideration of the sampling and analysis methods used to obtain the data, in particular the locations of samples and the use of vertical and horizontal sample integration.

The deliverable for this subtask will be a summary report which identifies the existing hydrologic and monitoring data near the 300 Area, summarizes evaluation of those data with respect to their applicability to the RI, identifies data gaps which must be addressed during Level II of the RI, and presents recommendations for collecting those data during Level II.

5.2.4 Subtask 2.4 - Meteorologic and Air Monitoring Data

The objective of this subtask is to review and evaluate existing meteorologic and air monitoring data for application to the Level I RI site characterization. Data sources to be evaluated include Hanford air monitoring data collected from the 300 Area and downwind locations, air monitoring data collected near the 300 Area for any other related environmental programs, and results of any other studies related to atmospheric transport of contaminants from similar waste sites. The focus of this evaluation will be on identifying meteorologic and air monitoring data which can be used to characterize actual or potential releases of contaminants from the Process Ponds and which can be used to characterize atmospheric migration of these contaminants. Evaluation of air monitoring data will include consideration of the sampling and analysis methods used to obtain the data, in particular the locations of samples vis-a-vis the location of the Process Ponds and wind direction.

The deliverable for this subtask will be a summary report which identifies the existing relevant meteorologic and air monitoring data near the 300 Area, summarizes evaluation of those data with respect to their applicability to the RI, identifies data gaps which must be addressed during Level II of the RI, and presents recommendations for collecting those data during Level II.

5.3 TASK 3 - FIELD DATA COLLECTION

5.3.1 Subtask 3.1 - Surface Radiation Monitoring

The objective of Subtask 3.1 is to obtain data on the extent and magnitude of current radioactive surface contamination in the Ponds. This information will be used to determine health and safety requirements for work within the Ponds, to assess the potential for atmospheric releases from the Ponds, and to help guide surface sediment sampling by identifying "hot spots". Radiation monitoring will be performed using hand-held survey instruments or more sensitive vehicle mounted instruments, depending on access restrictions.

5.3.2 Subtask 3.2 - Subsurface Sediment Sampling

The objective of subsurface sediment sampling is to determine the vertical distribution of contaminants beneath the 300 Area Process Ponds. These data will be used to help define the contamination problem, to assess the potential for future subsurface migration of contaminants, to assess human health and environmental problems related to the ponds, and to evaluate the feasibility of remedial actions.

Subsurface sampling efforts will involve collection of sediment samples at 16 locations in and adjacent to the ponds. Preliminary sample locations for the South and North Ponds are shown in Figures 8 and 9, respectively. Final sample locations will be developed during field reconnaissance based upon access and other considerations. Final sample collection locations should be map spotted or surveyed to within an accuracy of 10 ft, and coordinates reported in units consistent with the Hanford environmental data base. The rationale for the sampling locations is given below.

The sample locations are designed to gain understanding as to the behavior of the various contaminants following discharge to the Ponds. Those contaminants released to the Ponds as precipitates, or already associated with suspended material, would be expected to settle quickly after discharge. The highest level of these contaminants should be found at the surface and close to the influent point. Contaminants discharged as solutes, but which precipitated out following discharge, would also be expected to be found in the highest concentrations at the surface and near the influent point. Those contaminants discharged as solutes which did not precipitate out in the pond should have infiltrated in approximately the same concentration over the entire pond area. The vertical distribution of these contaminants should depend on the nature of their interactions with the glaciofluvial sediments beneath the ponds. Those contaminants which interacted rapidly and strongly with these sediments should be found in highest concentrations near the surface. Those which interacted less strongly should be more evenly distributed with depth. Those having little interaction with the sediments should have been associated mainly with the dissolved phase and should not be found in high concentrations at any depth.

For the South Pond, sample locations S-1 through S-6 are located along the approximate flow path through the pond basins. Sample S-1 is located at the northwest corner of the pond, near the current pond inlet, and S-2 is at the southwest corner near the original pond inlet. These samples are intended to identify high concentrations associated with the pond inlets. Sample locations S-3, S-4, and S-5 are located in the main pond basin. These samples will provide concentration data representative of the largest potentially contaminated area. Sample location S-6 will

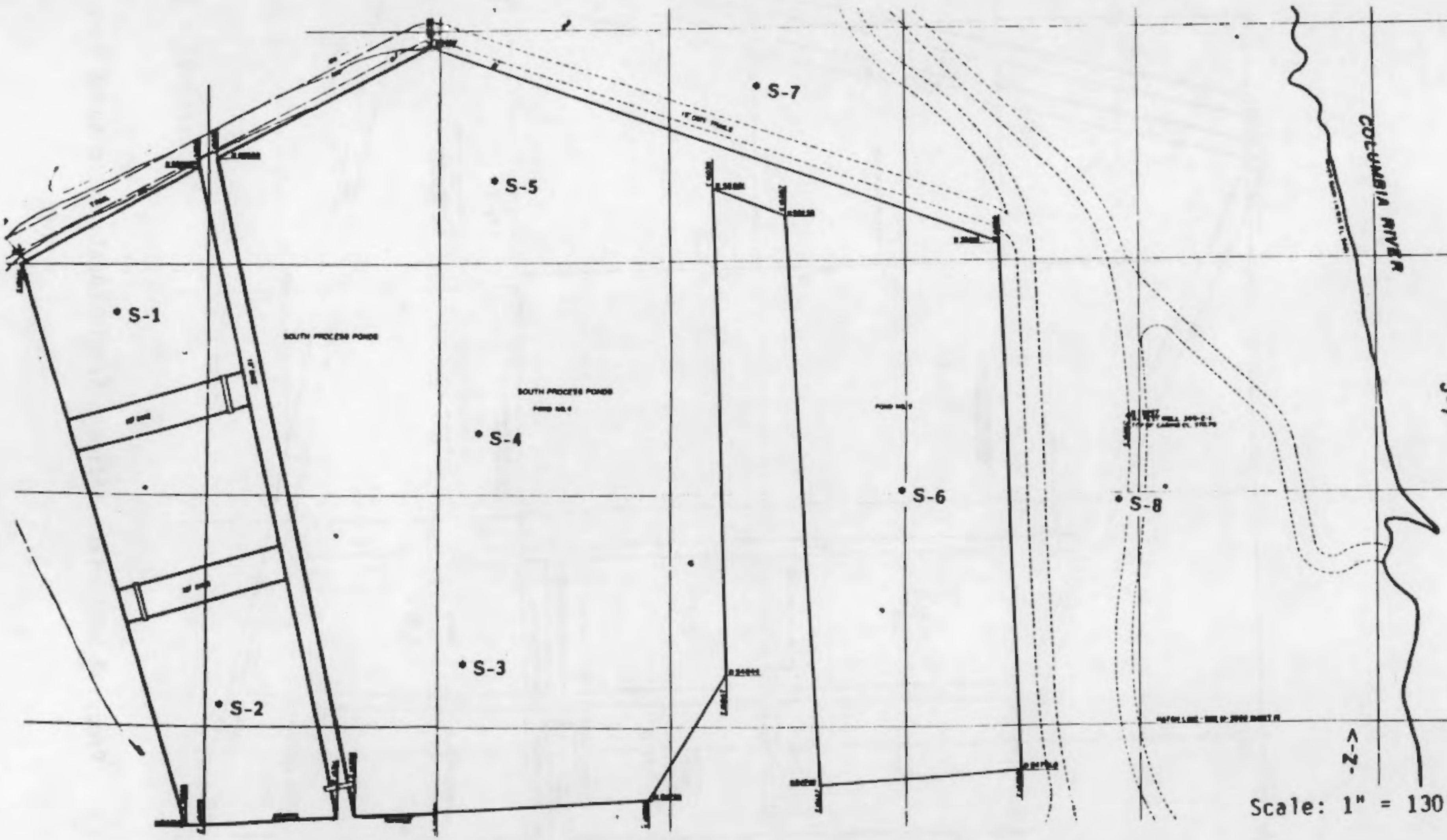


Figure 8. Proposed Subsurface Sediment Sample Locations in South Pond

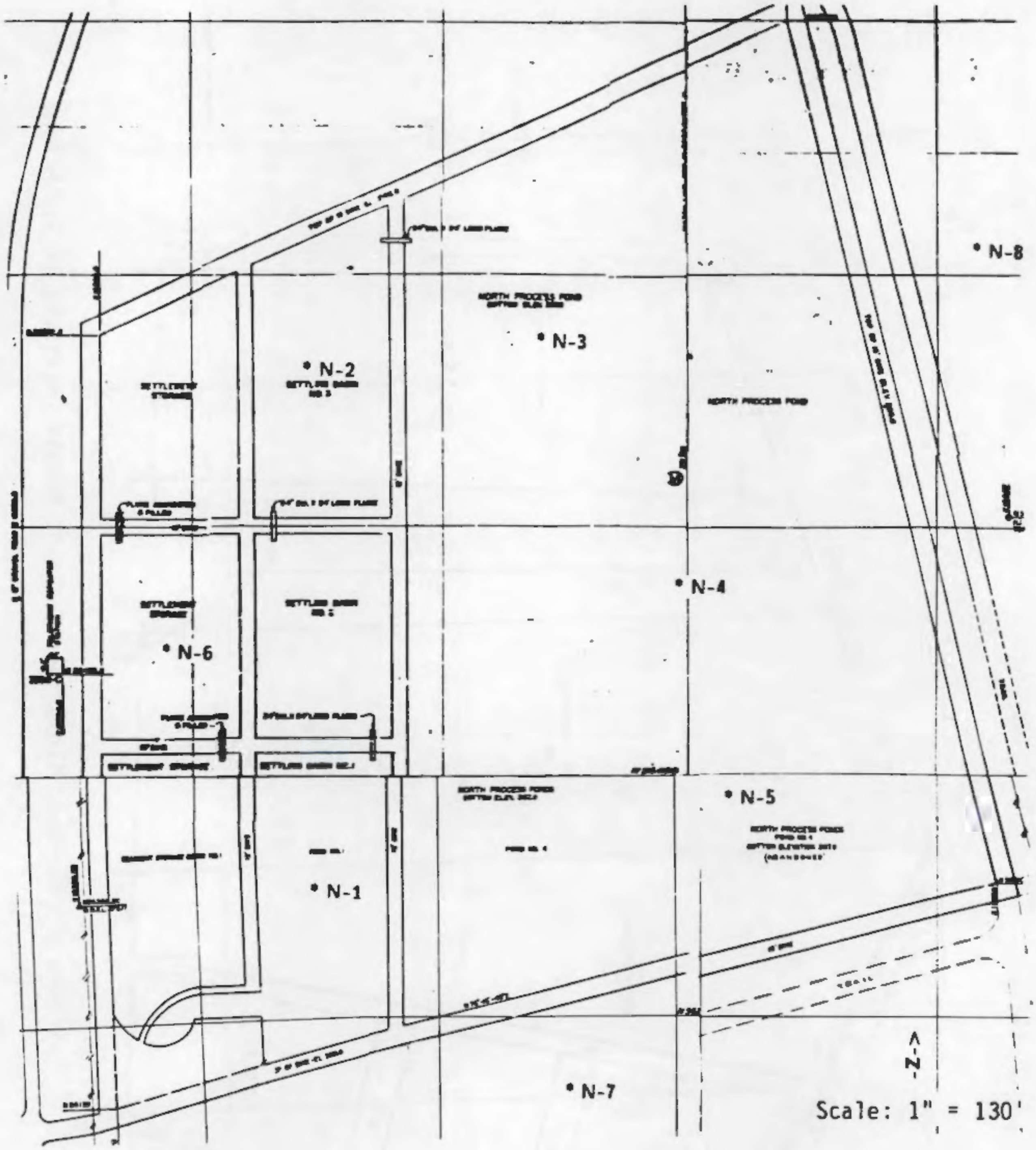


Figure 9. Proposed Subsurface Sediment Sample Locations in North Pond

provide data on the concentrations associated with the final pond basin. Sample locations S-7 is outside the Pond near the area where dike failure occurred. This sample will provide data on any contamination outside the Pond boundary which may be associated with the past dike failure. Sample location S-8 is adjacent to, but outside, the pond boundary. This sample is intended to provide data on the horizontal migration of contaminants which may have occurred during infiltration of contaminated water. This information will also help define the extent of the area potentially contaminated and potentially requiring remediation.

North Pond samples are similarly located, with location N-1 near the influent; location N-2 in the final settling basin to determine possible concentration reductions across the settling basins; and locations N-3, N-4, and N-5 in the main pond area. Location N-6 is in the second of the western-most series of basins. This sample location will identify contamination associated with these basins. Sample N-7 is located outside the pond in the vicinity of the area which reportedly was used to dispose of ash and sediments dredged from the bottom of the North Pond. Sample N-8 is located outside the pond boundary to determine possible horizontal subsurface migration of contaminants.

Five samples will be collected at each of the above locations. These samples will be collected at approximate depths of 0, 2.5, 5, 10, and 15 ft. Final sample depths will be determined in the field by the PNL Sampling Representative of the basis of the observed stratigraphy. Sample depths will be recorded in the field with respect to a temporary reference point. The elevations of the temporary reference points will be surveyed to establish the sample elevations with an accuracy of 0.1 ft.

Samples will be analyzed for the analytes identified in Table 8.

Sample collection methods will generally be those described in Westinghouse Hanford Company (WHC) Procedure A13057, "Inactive Waste Site Soil Sampling Procedure" (Appendix A). Subsurface samples will be collected from a trench excavated using a backhoe, clamshell, or bulldozer, depending on soil conditions. Samples will be collected by hand from the wall of the excavation to prevent cross contamination. In addition to the samples specified in the above Procedure, two additional 1-kg samples will be collected in 1-liter wide-mouth polyethylene bottles for archiving and for possible supplemental analysis by PNL using X-ray

Table 8. Analytical Parameters for 300 Area Process Pond Characterization

Heavy Metals (ICP)
Arsenic (AA)
Mercury (AA)
Selenium (AA)
Thallium (AA)
Lead (AA)
Polychlorinated Biphenyls (GC)
Volatile Organics (GC/MS)
Acid/Base/Neutral Extractable Organics (GC/MS)
Anions (IC)
Gross Alpha
Gross Beta
Gamma Spectometry

diffraction or other methods. An additional 1-kg sample may be collected for microbial characterization to support PNL research activities not related to the RI. Microbiological samples will be collected by a PNL field representative using procedures currently under development.

Samples for chemical and radiological analysis will be collected from a small particle size fraction separated by sieving. This fraction is being separated because of the requirements of the analytical procedures and because most of the contaminants are expected to be associated with the smaller sizes. In assessing the total inventory and distribution of contaminants at the site, however, it is important to account for the presence of large particles which may have little contamination associated with them (e.g., cobbles). For this reason, the on-site PNL sampling representative will maintain a written log of the stratigraphy encountered (i.e., description of the material size fractions encountered).

The PNL field representative will maintain a record of all sampling activities using sample log sheets supplied by PNL. Strict chain-of-custody will be maintained for all samples collected for chemical and radiological analysis. A record of chain-of-custody will be maintained with PNL-supplied chain-of-custody forms. Because of radioactive contamination present at the sites, a Radiation Work Procedure will be developed prior to the start of on-site work. Additional health and safety procedures (e.g., work in excavations) will be developed in conjunction with laboratory safety staff.

5.3.3 Subtask 3.3 - Surface Sediment Sampling

The objective of surface sediment sampling is to characterize the horizontal distribution of contaminants in the 300 Area Process Ponds. These data will be used to help define the contamination problem, to assess the potential for future subsurface migration of contaminants, to assess human health and environmental problems related to the ponds, and to evaluate the feasibility of remedial actions.

Surface sampling will involve collection of surface samples at random locations within the ponds. This random sampling will serve to characterize the variability of the surface contamination within the ponds. A total of five random samples will be collected from within each of the three settling bays in the South Pond and from within each of the six settling basins in the North Pond. Ten random samples each will be collected from within the main bays of the South and North Ponds and eight random samples from within the last bay of the South pond. Random sample locations are shown in Figures 10 and 11 for the South and North Ponds, respectively. These samples will be analyzed for the analytes previously identified in Table 8.

The above samples will serve to generally identify variability of surface contamination in the Ponds. In addition, it may be desired to sample obvious "hot spots" to determine the maximum levels of contamination in the Ponds. Information on maximum levels of contamination that may be encountered may be needed to assess the feasibility of remedial actions. "Hot spots" may be identified during the site reconnaissance or during surface radiation monitoring. Samples will also be collected from spoil piles located in the ponds and on the pond banks. Approximately two surface samples will be collected from each pile to characterize the contamination associated with material dredged from the pond bottoms in the past.

Sample collection methods will generally be those described in Appendix A except that excavation prior to sample collection will not be required. Instead, samples will be collected from approximately the top six inches of sediment (or other surface material) at each sample location. In addition to the samples specified in Appendix A, two additional 1-kg samples will be collected in 1-liter wide-mouth polyethylene bottles for archiving and for possible analysis by PNL using X-ray diffraction or other methods.

Samples for chemical and radiological analysis will be collected from a small particle size fraction separated by sieving. This fraction is being separated because of the requirements of the analytical procedures and because most of the contaminants are expected to be associated with the smaller sizes. In assessing the total inventory and distribution of contaminants at the site, however, it is important to account for the presence of large particles which may have little contamination associated with them (e.g., cobbles). For this reason, the

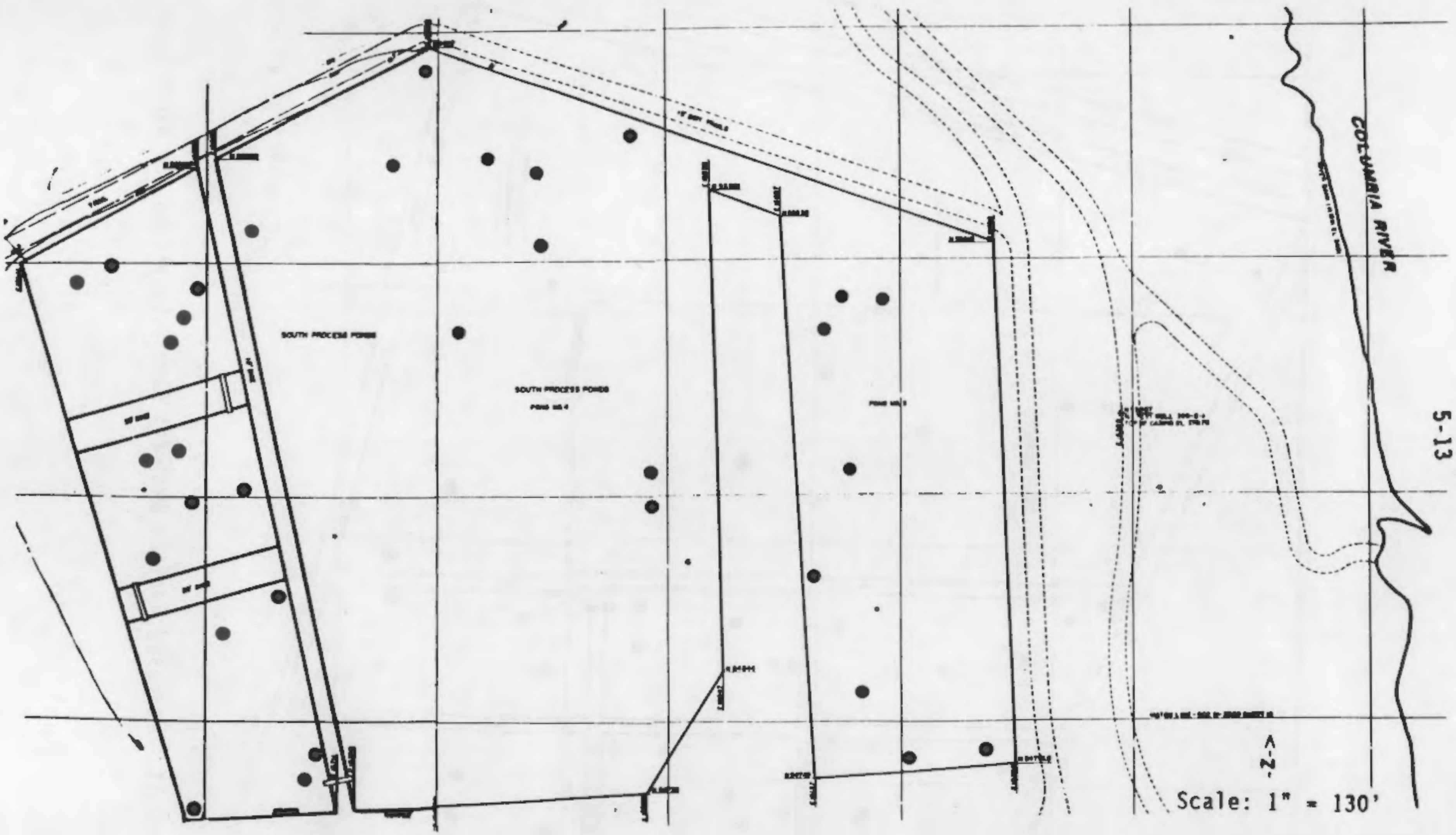


Figure 10. Proposed Surface Sediment Sample Locations for South Pond

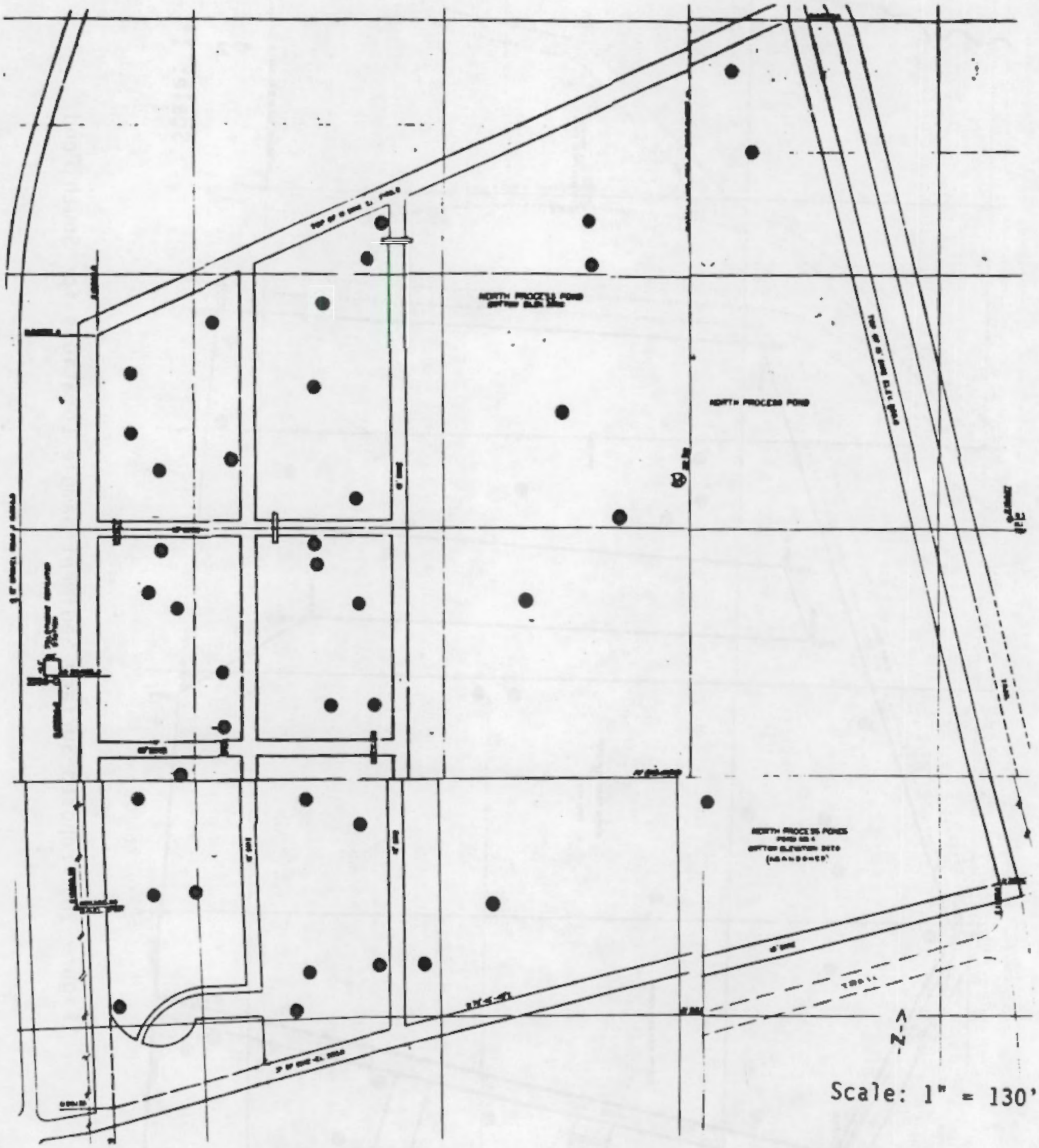


Figure 11. Proposed Surface Sediment Sample Locations for North Pond

on-site PNL sampling representative will maintain a written log describing the size fractions of the surface sediments at the sample location.

The PNL field representative will maintain a record of all sampling activities using sample log sheets supplied by PNL. Strict chain-of-custody will be maintained for all samples collected for chemical and radiological analysis. A record of chain-of-custody will be maintained with PNL-supplied chain-of-custody forms.

Because of radioactive contamination present at the sites, a Radiation Work Procedure will be developed prior to the start of on-site work.

5.4 TASK 4 - LABORATORY ANALYSIS

The objective of this task is to provide laboratory analytical services to support the RI. This effort will be conducted by U. S. Testing Laboratories, under subcontract to PNL.

5.5 TASK 5 - GEOCHEMICAL CHARACTERIZATION OF SEDIMENTS

The objective of this task is to collect data on the geochemistry of contaminated sediments as it relates to the migration potential of contaminants. The specific activities carried out under this task will depend on the results of the sediment sampling and analysis conducted in Tasks 2 and 3. If these results indicate the presence of significant contamination associated with the sediments, Task 4 will be conducted to determine the mobility of these contaminants. This task will involve laboratory analyses (e.g., X-ray diffraction) to characterize the minerology of the sediments and to determine major chemical species present. The task may also involve laboratory leaching tests and/or geochemical modeling to evaluate contaminant solubility.

Specific activities to be conducted under this task will be identified upon review of the sediment sampling and analysis results. At that time, an amended work plan will be prepared describing these activities.

5.6 TASK 6 - DATA EVALUATION

5.6.1 Subtask 6.1 - Validation of Laboratory Data

The objective of this subtask is to review the analytical data associated with the sediment sampling to assure its validity. Laboratory QA/QC records will be reviewed to identify any limitations associated with use of the analytical data.

5.6.2 Subtask 6.2 - Data Evaluation

The objective of this subtask is to evaluate the existing data collected during Task 2, the new field data collected during Task 3, and any additional laboratory data collected during Task 4. The focus of this evaluation will be on characterizing the nature and extent of contamination in the various environmental media at and around the Process Ponds and on characterizing the migration potential of these contaminants.

Specific analyses and evaluations to be performed will include:

- Generation of groundwater contours.
- Identification of hydraulic gradients, flow directions, and flow rates.
- Identification of contaminants present in groundwater and generation of isopleths showing the extent of groundwater contamination.
- Identification of contaminants present in surface water and evaluation of the extent of surface water contamination.
- Evaluation of the relationship of groundwater contamination and surface water contamination.
- Identification of contaminants present in sediments and determination of the horizontal and vertical distribution of contaminants in subsurface sediments.
- Evaluation of the mobility of contaminants present in sediments.
- Evaluation of the extent of surface contamination present in the Ponds.

- Determination of the extent of atmospheric transport of contaminants near the Ponds and the relationship between atmospheric transport and sediment contamination.

5.7 TASK 7 - PUBLIC HEALTH/ENDANGERMENT ASSESSMENT

5.7.1 Subtask 7.1 - Selection of Contaminants of Concern and ARARs

The objective of this subtask is to identify contaminants associated with the Process Ponds which are of concern with respect to public health and environmental endangerment. Initially, all the existing and new monitoring data collected in previous tasks will be reviewed to identify all contaminants present. Contaminants of concern will be selected from these contaminants based on concentration, toxicity, and environmental fate and transport characteristics. Those contaminants selected will be those judged to be most likely to result in endangerment to public health and the environment.

In conjunction with this effort will be identification of applicable or relevant and appropriate requirements (ARARs). ARARs will include environmental standards and criteria related to the contaminants of concern as well as other general requirements related to environmental impact. Establishment of ARARs will be performed in close cooperation with the DOE Richland Operations Office and the Washington Department of Ecology.

The result of this subtask will be an identification of the contaminants of concern and ARARs and a discussion of the rationale used to select these contaminants and ARARs.

5.7.2 Subtask 7.2 - Environmental Fate and Transport

The objective of this task is to assess the environmental fate and transport of each of the contaminants of concern. The physical and chemical properties of each of these chemicals will be discussed, along with relevant properties of the transport medium (e.g., aquifer properties). The results of the geochemical characterization conducted in Task 4 will also be discussed.

The result of this task will be a summary discussion of the environmental fate and transport and migration potential of each of the contaminants of concern.

5.7.3 Subtask 7.3 - Exposure Evaluation

The objective of this subtask is to evaluate actual and potential exposure to contaminants of concern. Evaluation of exposure potential will initially involve characterization of potentially affected receptors vis-a-vis the exposure pathways identified in the previous subtask. This information will then be used to identify all completed exposure pathways (i.e., pathways including a source of contamination, a mechanism for release, an environmental transport medium, a point of potential contact, and a mode of exposure). After exposure pathways have been identified, data collected and evaluated in previous tasks will be used to estimate environmental concentrations for each contaminant of concern at exposure points. This evaluation will incorporate monitoring data and information from the environmental fate and transport subtask and may involve modeling of various environmental media. It is expected that simple analytical models will be sufficient for this evaluation. If more complex modeling is required, it would be performed as part of Level II of the RI.

The result of this subtask will be estimates of exposure for all reasonable pathways for each contaminant of concern in each environmental medium. These exposure estimates will be tabulated for subsequent use in the risk characterization.

5.7.4 Subtask 7.4 - Toxicity Evaluation

The objective of this subtask is to collect any toxicity data needed to support the risk characterization. Toxicity data will be required for those contaminants which do not have exposure standards or criteria as part of ARARs. Reviews of toxicological data will be performed for these contaminants. The result of this subtask will be summaries of toxicological profiles for each contaminant.

5.7.5 Subtask 7.5 - Risk Characterization

The objective of this subtask will be to characterize the risk associated with the contamination related to the Process Ponds. For most contaminants, the risk will be characterized by comparing estimated environmental concentrations with standards and criteria identified in the ARARs. If ARARs do not exist for any route of exposure, quantitative risk assessments will be performed.

The quantitative risk assessment will be based on the estimated exposure levels calculated in Subtask 6.3. For each population at risk, the total intake by each route of exposure will be calculated by adding the intakes from each pathway. For each exposure, a chronic daily intake (DCI) will be calculated. Critical toxicity values (i.e., numerical values derived from dose-response information for individual compounds) will be used in conjunction with the intake determinations to characterize risk. Two different types of critical toxicity values may be used:

- The acceptable daily intake for chronic exposure (AIC); and
- The carcinogenic potency factor (for carcinogens only).

The result of this subtask will be a summary of the risk associated with exposure to each of the contaminants of concern.

5.8 TASK 8 - INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

The objective of this subtask is to perform an initial screening of remedial technologies which may be required at the site. The need for remedial action will be based upon the results of the risk characterization performed in Subtask 6.5. The risk characterization will serve to identify the populations at risk and the contaminant migration routes. The initial screening will be based primarily on suitability and technical feasibility (i.e., the ability to mitigate identified risk and the ability to be implemented at the site). The technology screening will also identify any additional data which must be collected during Level II of the RI to support further remedial alternative evaluation during the FS.

The result of this task will be a summary discussion identifying the remedial technologies considered for the Process Ponds, evaluating the feasibility of each alternative, and identifying additional data needs.

5.9 TASK 9 - REPORTING

The objective of this task is to document the results of the previous tasks. An RI report will be prepared which summarizes Level I activities, results, and conclusions. The report will provide documentation of data obtained for Level I tasks, as well as data evaluation and identification of additional tasks and data needs for the Level II RI. The deliverables for this task will be a draft and final RI Report.

6.0 PROJECT SCHEDULE

The proposed schedule for the RI of the 300 Area Process Ponds is shown in Figure 12.

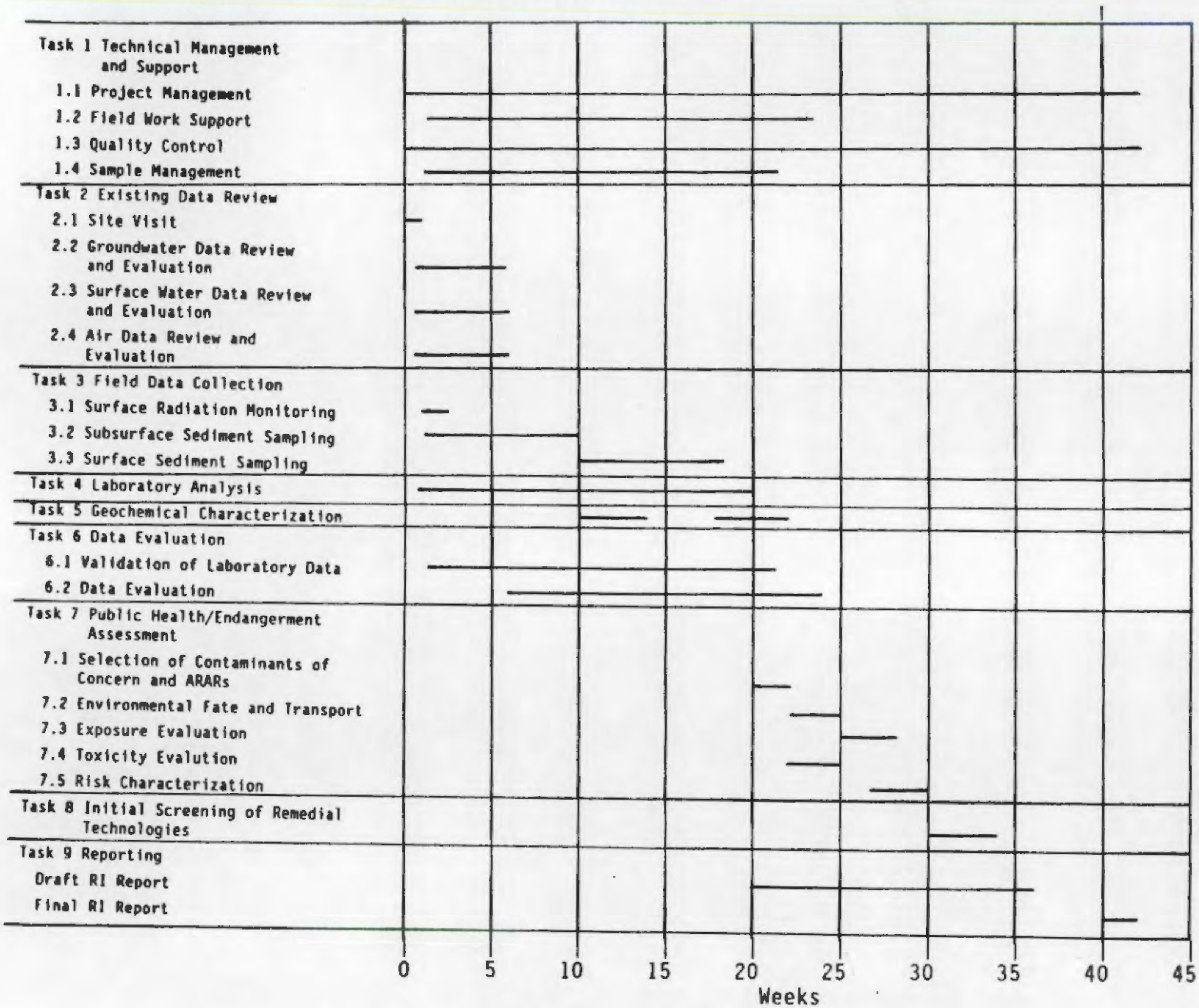


Figure 12. Proposed Schedule for 300 Area Process Ponds Phase I RI

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APPENDIX A

WHC PROCEDURE A13057
INACTIVE WASTE SITE SOIL SAMPLING PROCEDURE

PROCEDURE NUMBER	FACILITY	DATE
A13057	316-1, 316-2 and 316-3	4/30/87
TITLE: Inactive Waste Site Soil Sampling Procedure		REVISION NO. 0
PREPARED BY: D. L. Pursley (signed DL. Pursley)	REVIEWED BY: See EDT A13057	APPROVED BY: See EDT A13057

1.0 Purpose

This procedure defines the methods to be used in obtaining soil samples from the bottom of the 300 Area inactive waste sites and for preparing and handling these samples from the field to the laboratory. All samples must be taken and controlled per EPA Publication SW-846, Second Edition, July 1982, "Test Methods for Evaluating Solid Waste," such that they are compatible with State and Federal Regulatory compliance requirements.

2.0 General

2.1 The inactive waste sites include the South Process Pond (316-1), the North Process Pond (316-2) and the 307 Disposal Trench. These sites will be sampled at specific points determined by PNL. A stake will be placed in the site of each sample excavation. Each sample location will yield samples from several depths as determined by PNL. The sample hole will be excavated to the proper depth keeping in mind personnel safety and then sampled at each of the predetermined elevations starting at the bottom and working up to the surface. Excavations may be completed using hand tools or large excavating equipment.

2.2 Each complete sample will consist of a set of ( ) separate bottles of soil. Each bottle will be filled with soil leaving no head-space and then sealed tightly. Bottle caps must not be interchanged. A seal tape will be placed over each bottle lid and then the bottles will be packed in ice for transport to the laboratory. Each set of bottles will be pre-labeled to include the sample location code and other information as required by

PNL and to indicate laboratory testing requirements. When each sample has been labeled and packed in ice in the transport cooler, a CHAIN-OF-CUSTODY form will be filled out (PNL Form #BC-1200-345 (7-85)). The sample information will then be entered in the "Sample Log" and a "Sample Analysis Request Form" will be filled out. Each sample will have all except one bottle transported to U.S. Testing with one 250 ml sample kept by WHC in refrigeration at the 325 Building. Separate coolers will be used for samples transmitted to U.S. Testing and WHC Storage. For each delivery, the chain-of-custody forms will be signed by both the person relinquishing the samples and the person receiving the samples. See the sample of "Chain-Of-Custody," "Sample Log Form" and "Sample Analysis Request Form" in Appendix A.

2.3 Samples must include only fine materials without stones. If separation of the finer materials from gravel and cobbles becomes a problem screens will be used along with hand brushing of the finer materials from the larger stones. Three U.S. standard screens will be available with screen sizing of Tyler #6, #9 and #16. The sample will be dug and transferred directly to a screen and shaken into a bucket until sufficient material is available for the sample bottles.

Prior to first sampling of the day and between samples the sampling tools will be steam cleansed. This cleaning will stop cross contamination between samples. Equipment required will include shovels, a pick, trowels, U.S. standard screens, brush, steam cleaner, coolers, ice, sample bottles and buckets.

2.4 Personnel present for the sampling shall include a Radiation Protection Technician (RPT), a Waste Systems Operation (WSO) Technician, a PNL IWSS representative and a Waste Systems Engineering (WSE) representative. The PNL IWSS representative will also be a geologist and will examine materials from which the samples are taken and keep a written log of stratigraphy encountered. The backhoe and backhoe operator will be available as required. The Waste Systems Engineering representative will fill out the "chain-of-custody" form, the "Sample Log Form" and the Sample Analysis Request Form. The WSE representative will also keep a log of all unusual happenings or deviations. The PNL IWSS geologist will also complete the third party inspection checklist.

2.5 The U.S. Testing laboratory can handle a maximum fifteen samples per week so field personnel obtaining the samples must be aware of the laboratory status so their limit is not exceeded. U.S. Testing must also be notified each morning that samples will be delivered that day. PNL will make delivery of samples to the back door (North East side of Building) where lab personnel can be signaled by a bell. The cooler full of samples will be left and any empty coolers will be picked up.

2.6 Copies of sampling paperwork will be provided to Waste Systems Engineering and the PNL IWSS representative at the end of the day. This will include copies of the "chain-of-custody" form, "Sample Log Form," "Sample Analysis Request Form," and the geologists log. All paperwork will be completed in black ink.

2.7 All samples shall be transported in their coolers to the U.S. Testing laboratory or to WHC storage by the end of the day the samples are taken.

3.0 Safety

Safety concerns are those typical hazards associated with an outdoor worksite. These include steep sides on the process ponds and excavation sites with loose materials that are potential tripping hazards and extreme weather conditions. Personnel must be aware of the conditions and plan accordingly. The ponds themselves contain uranium, potentially other radioactive or hazardous materials and standard radiological precautions must be observed. All work will be performed under a Radiation Work Procedure (RWP).

4.0 Prerequisites

4.1 The pond area to be sampled must be dry enough to move around in and dig without problems with surface water. Wet conditions will affect the sampling procedure and cause cross contamination of samples.

4.2 Radiological protection gear and clothing shall be available along with a copy of the applicable RWP.
Responsibilities: Radiological Clothing - Waste Systems Operations
RWP Copy: Project Engineering

4.3 All tools and equipment shall be available for locating and staking out the sample sites, digging, preparing the samples and transporting the samples. Pre-labeled sample bottles, trowels, coolers with ice, steam cleaner, sieves, brush, plastic sheet, pen, evidence seal tape, clipboard, field logbook and proper forms.

Responsibilities:

Hand Tools: Project Engineering/Waste System Engineering

Transporting Samples: IWSS Representative to US Testing; WSO to 325 Building.

Backhoe and Operator: Kaiser Engineers Hanford

4.4 Notify the testing laboratory that sampling is proceeding and verify the WHC sample storage area is available.
Responsibility: Waste Systems Engineering.

4.5 Notify the PNL IWSS representative.
Responsibility: Waste Systems Engineering

5.0 Procedure

5.1 Determine the first sample site in the correct waste site. Record the location. Measure and stake the site of the sample excavation.

5.2 At the location of the first sample, select a set of sample bottles for the surface sample. Collect materials from the surface of the ground and transfer to the sieve. Shake the material through the sieve into a bucket until sufficient materials are collected to fill the sample bottles. Fill the bottles completely (no head space). Cap the bottles tightly without interchanging bottle cpas and place the evidence seal tape on each bottle. Place the sample bottles in the proper ice chest and make sure they are packed with ice.

5.3 Register the sample in the "sample log" and provide any necessary or interesting observations. Fillout the "Chain-Of-Custody" form and the "Sample Analysis Request" form for the sample. Steam clean all sampling tools.

5.4 Using the stakes for alignment, use the shovel and pick or the backhoe and dig a hole deep enough to provide samples from the proper lower sample elevations. Using a trowel, scrape some material from the wall and elevation of the lowest sample. This will remove material that might cause cross contamination of the sample. With the trowel, sample the materials at this elevation and transfer the material to a selected sieve. Shake the material through the sieve into a bucket and add more from the same location until enough material is available to fill the sample bottles (approximately 1-1/2 liters). Fill the pre-labeled sample bottles completely (no head space) from the sieved material in the bucket. Cap the bottles tightly as they are filled and place evidence seal tape over the cap. Bottle caps must not be interchanged. Place the sample bottles for U.S. Testing in the proper cooler and place the WHC backup sample in the proper cooler. Make sure all samples bottles are packed in ice.

5.5 Register the sample in the "sample log" and provide any necessary or interesting disruptions or observations. Fill out the "Chain-Of-Custody" forms and a "Sample Analysis Request" form for the sample. Steam clean all tools to prevent cross contamination between samples.

5.6 Select the next set of pre-labeled sample bottles. Scrape a small amount of soil from the side of the hole at the next elevation to remove material that may potentially cross contaminate the sample. Dig out and screen enough material into a clean bucket to provide a sample that will fill the sample bottles. Fill the sample bottles from the bucket, cap them tightly and place evidence seal tape on each cap. Place the bottles in the proper coolers for U.S. Testing and WHC and make sure they are packed in ice.

5.7 Register the sample in the "Sample Log Form" and provide any necessary or interesting disruptions or observations. Fill out the "Chain-Of-Custody" forms and a "Sample Analysis Request Form" for the sample. Steam clean all sampling tools.

5.8 Repeat steps 5.6 and 5.7 until all elevations at the site are sampled.

5.9 Select a new sample location from in the waste site, locate and stake the site.

5.10 Repeat steps 5.2 through 5.9, continue to sample the waste site until all locations have been completed.

NOTE: The testing laboratory can take a limited number of samples per week. Laboratory requirements must be coordinated as the sampling proceeds. Do not begin a sample excavation unless all samples from the excavation can be handled by the laboratory within the shelf life of the sample for the type analysis to be completed. (Five days maximum)

NOTE: Any deviations from this procedure will be noted in the WSE Representatives Log in detail.

A13057

Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington 99352

CHAIN OF CUSTODY

Company Contact: ____________________ Telephone: __________

Samples Collected by: ______________ Date: __________ Time: ______

Sample Location: ______________________________

Ice Chest No.: ____________________ Field Logbook Page No.: ______

Remarks: ______________________________

____

Method of Shipment: ______________________________

Sample Identification

______	______
______	______
______	______
______	______
______	______
______	______
______	______
______	______
______	______
______	______
______	______
______	______

CHAIN OF POSSESSION

Relinquished by:	Received by:	Date/Time:
______	______	______
Relinquished by:	Received by:	Date/Time:
______	______	______
Relinquished by:	Received by:	Date/Time:
______	______	______
Relinquished by:	Received by:	Date/Time

Sample Log Form

Sample No.	Date	Time	Sample Size	Name of Collector	Signature	Description

A13057

SAMPLE ANALYSIS REQUEST

Westinghouse
W/B-46 / 337 Bldg. !/ WHC / 300 Area

United States Testing Company. In
2800 George Washington Way
Richland WA 99352

Collector ______________________

Date /Time Sampled ______________________

Company Contact Carolyn Duduis 376-3318

Received by ______________________

Title ______________________

Date ____________ Time ____________

CHAIN OF CUSTODY NO. ______________________

SAMPLE ID ______________________

UST SAMPLE ID ______________________

☐ WATER ☒ SOIL ☐

☐ OTHER ______________________

COMMENTS

FULL ANALYSIS

	CODE	CONSTITUENT	(3) 40ml G	(2) 250ml G	(3) 125ml G			
1	725	ICP METALS 6010						
2	726	ICP METALS 6010 ENHANCED			X			
3	A20	ARSENIC			X			
4	A21	MERCURY			X			
5	A22	SELENIUM			X			
6	A23	THALLIUM			X			
7	A24	THIOUREA 8330						
8	727	METHOD 8330 ENHANCED		X				
9	A51	LEAD BY GFAA			X			
10	739	PCB						
11	728	PESTICIDES 8080						
12	729	PESTICIDES 8080 ENHANCED		X				
13	730	VOA METHOD 8240						
14	731	VOA METHOD 8240 ENHANCED	X					
15	732	A/B/N 8270						
16	733	A/B/N 8270 ENHANCED		X				
17	734	PESTICIDES METHOD 8140		X				
18	C68	TOX	X					
19	C69	TOC		X				
20	C70	CYANIDE			X			
21	735	NITRATE, SULPHATE,.... (IC)			X			
22	C77	PERCHLORATE			X			
23	C78	SULFIDE			X			
24	C80	AMMONIUM ION		X				
25	C81	ETHYLENE GLYCOL		X				
26	109	COLIFORM BACTERIA			X			
27	181	RADIUM			X			
28	212	ALPHA			X			
29	111	BETA			X			
30	C36	DIOXIN		X				
31	C37	CITRUS RED #2			X			
32	191	CONDUCTIVITY						
33	199	pH						
34	736	DIRECT AQUEOUS INJECTION		X				
35	738	HERBICIDE 2,4-D, 2,4,5-TP SILVEX						
36	737	HERBICIDE 8150 ENHANCED		X				

DR2:[7,9]66

SHALLOW SOILS SAMPLING

Third Party Inspection Checklist

Inspection Checklist

*Sample location identification.			
*Date/Time sample taken.			
*Correct measurement for sample location.			
*Tools were cleaned before sampling.			
*Sample materials taken from the proper depth.			
*Seal tape applied to sample bottle caps.			
*Chain-Of-Custody Form and Analysis Request Form perpared.			
*Geologist sample taken.			

For comments put 1, 2, 3, ... at the point the comment applies and write the comment on the back of this sheet.

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