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Closure Plan
216-A-36B Crib

February 1988

Prepared by:
U.S. Department of Energy
Richland Operations Office
Hanford Site
Richland, Washington

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RESOURCE CENTER

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1.0 FACILITY DESCRIPTION

This section is intended to provide the permit application reviewer/permit writer with an overview of the Hanford Site and the subject hazardous waste management facility, the 216-A-36B Crib.

1.1 GENERAL DESCRIPTION

The Hanford Site is a 570 sq mi (1,476 sq km) tract of semiarid land that is owned by the U.S. Department of Energy (DOE) and co-operated by the DOE, Richland Operations Office (DOE-RL) and the Westinghouse Hanford Company (WHC). This site is located northwest of the city of Richland, Washington, along the Columbia River. The city of Richland lies approximately 3 mi (4.8 km) from the southernmost portion of the Hanford Site boundary and is the nearest population center (Figure 1-1).

In early 1943, the U.S. Army Corps of Engineers selected the Hanford Site as the location for reactor, chemical separation, and related facilities for the production and purification of plutonium. A total of eight graphite-moderated reactors using Columbia River water for once-through cooling were built along the Columbia River. These reactors were operated from 1944 to 1971. The N Reactor, which is a dual-purpose reactor for plutonium production and the generation of steam for electricity, began operating in 1963 and uses recirculating water coolant.

Activities are centralized in numerically designated areas on the Hanford Site. The reactor facilities (active and decommissioned) are located along the

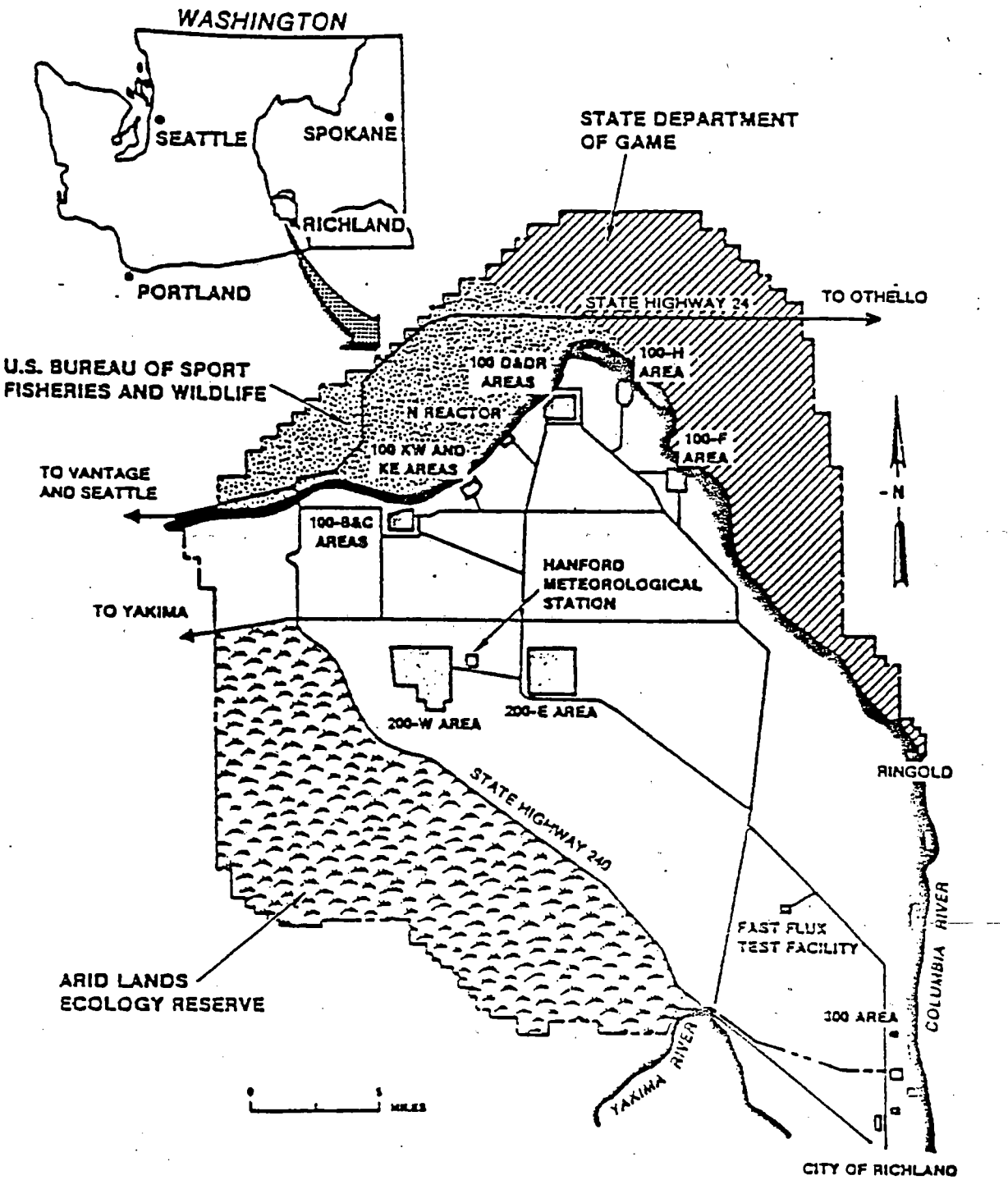

Figure 1-1. Surrounding Land Use.

Columbia River in what are known as the 100 Areas. The reactor fuel processing (PUREX Plant) and waste management facilities are located in the 200 Areas, situated on a plateau about 7 mi (11.2 km) from the river. The 300 Area, located north of Richland, contains the reactor fuel manufacturing facilities and the research and development laboratories. The 400 Area, 5 mi (8 km) northwest of the 300 Area, contains the Fast Flux Test Facility. The 1100 Area, north of Richland, contains buildings associated with maintenance and transportation functions for the Hanford Site. Administrative buildings and other research and development laboratories are found in the 3000 Area, also north of Richland.

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1.2 216-A-36B CRIB

The 216-A-36B Crib is located in the southeast portion of the 200 East Area (Figure 1-2), approximately 1200 ft (370 m) due south of the 202-A (PUREX Plant) Building (Figure 1-3). From 1966 to 1972, the crib received the ammonia scrubber distillate (ASD) from PUREX fuel-element decladding operations. When PUREX operations were suspended in 1972, use of the crib was also discontinued. Upon resumption of PUREX operations in November 1983, the 216-A-36B Crib was reactivated for disposal of the ASD stream. The crib continued to operate in this capacity until September 1987, when sampling and analysis (of the ASD) confirmed the presence of ammonium hydroxide in concentrations exceeding the State of Washington Department of Ecology (Ecology) Dangerous Waste Regulations (Chapter 173-303 WAC) criteria for waste designation (WAC 173-303-070). Since September 1987, no liquids have been discharged to the 216-A-36B Crib.

As constructed, the crib was 600 ft (182 m) long by 42 ft (13 m) wide by 24 ft (7.3 m) deep, with a side slope of 1:1.5. Dimensionally, the bottom of the excavation was approximately 500 ft (152 m) by 11 ft (3.4 m) and contained 30-in (0.76 m) of gravel. Above the gravel, the excavation was backfilled to grade with the previously excavated soil. A 6-in (15 cm) diameter, code M-8 stainless steel perforated pipe, placed horizontally within the gravel approximately 23 ft (7.0 m) below grade, served to distribute liquids longitudinally within the crib. Plastic sheeting (ten gauge thickness of "Plastic Gauge" Mylar, as manufactured by the DuPont Company, or approved equal) was used to separate the gravel and soil layers, preventing the downward sifting of soil fines that might otherwise affect the function and longevity of the crib. A sectional sketch of the crib is provided in Figure 1-4.

During its initial period of use, the crib received elevated levels of radioactivity from what were then, routine effluent releases. (The radionuclide content of this waste stream was significantly reduced following relocation of the offgas discharge from the annular dissolvers). As a result, the headend or

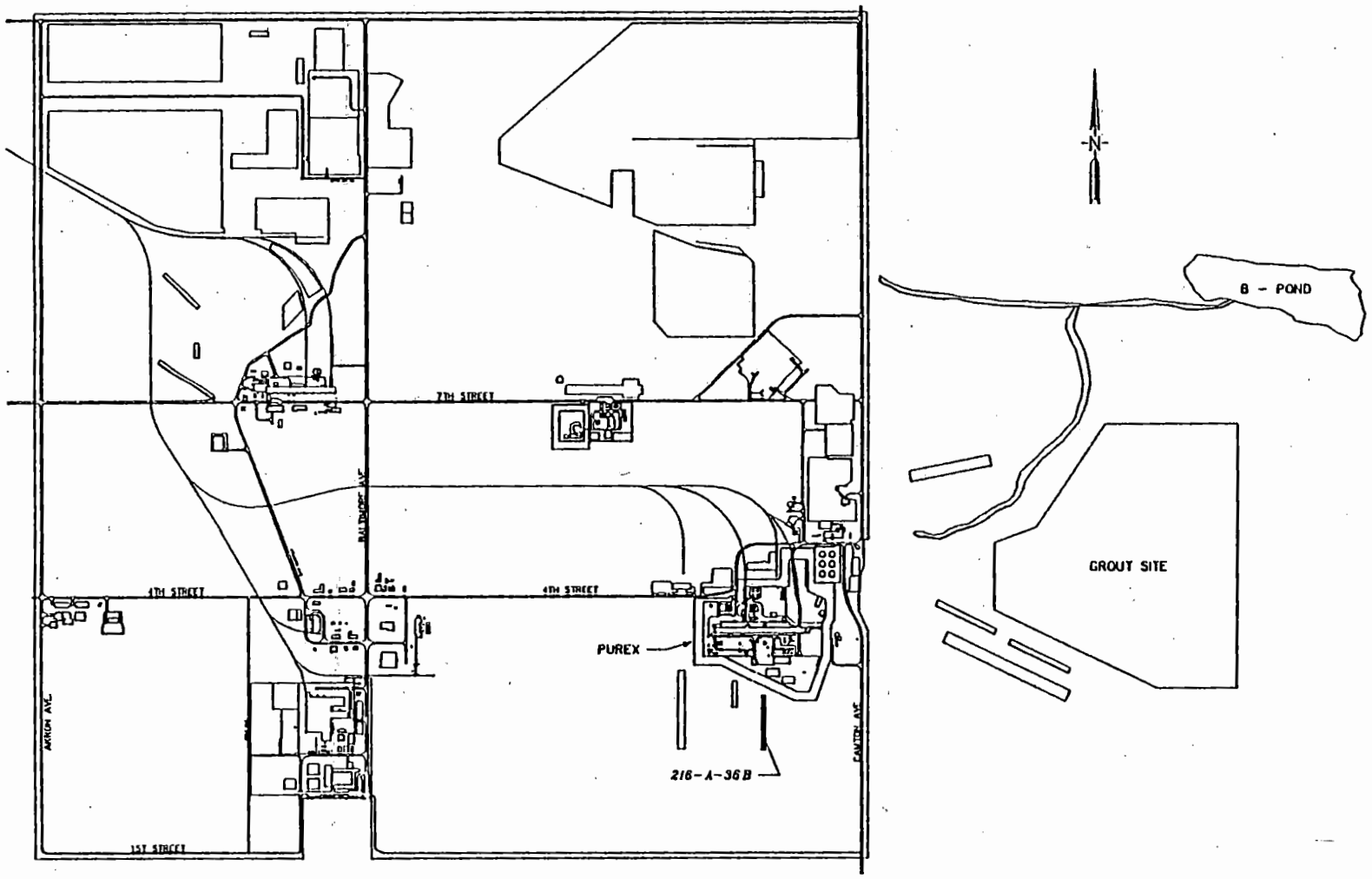


Figure 1-2. 200 East Area Site Plan

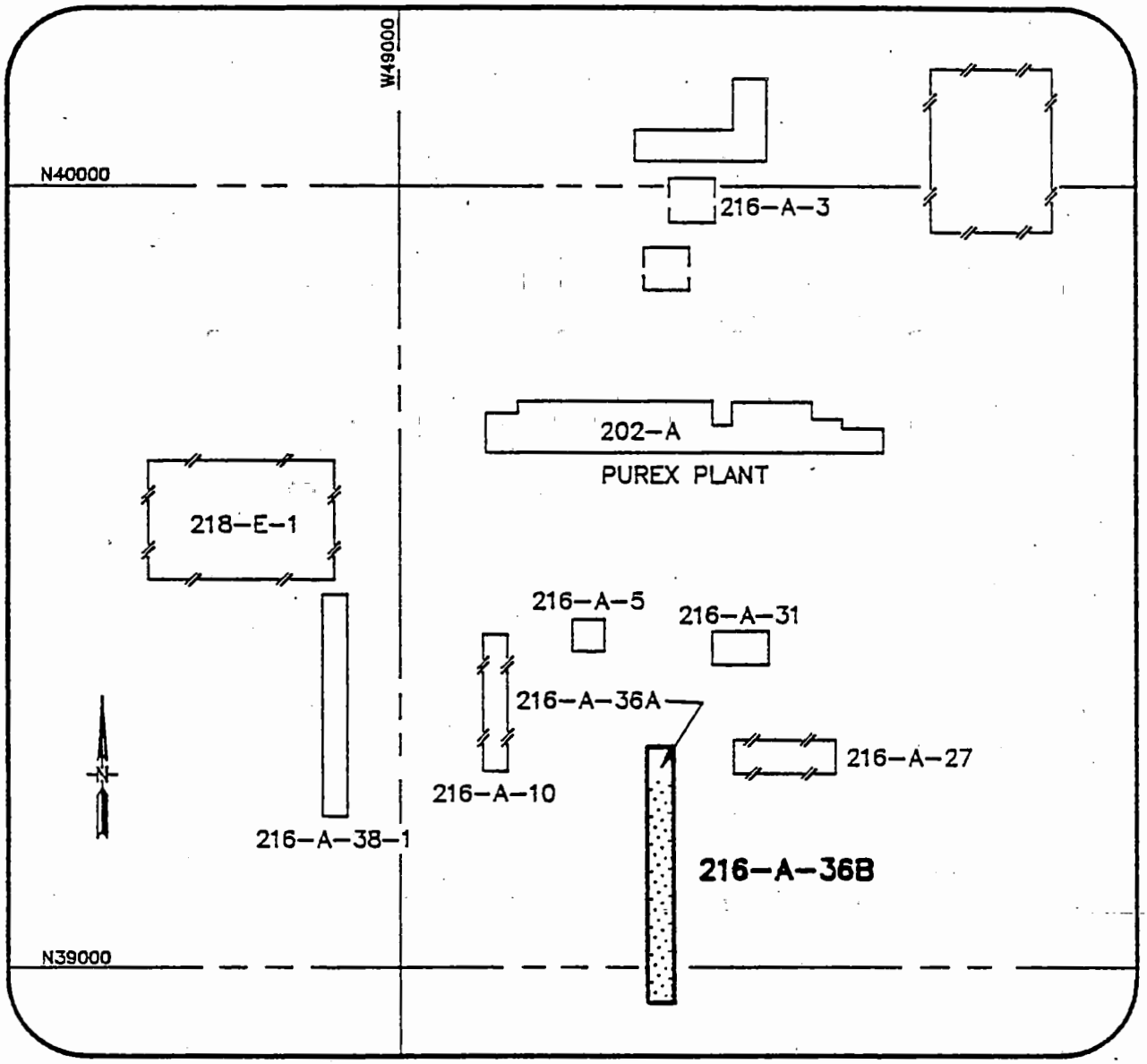
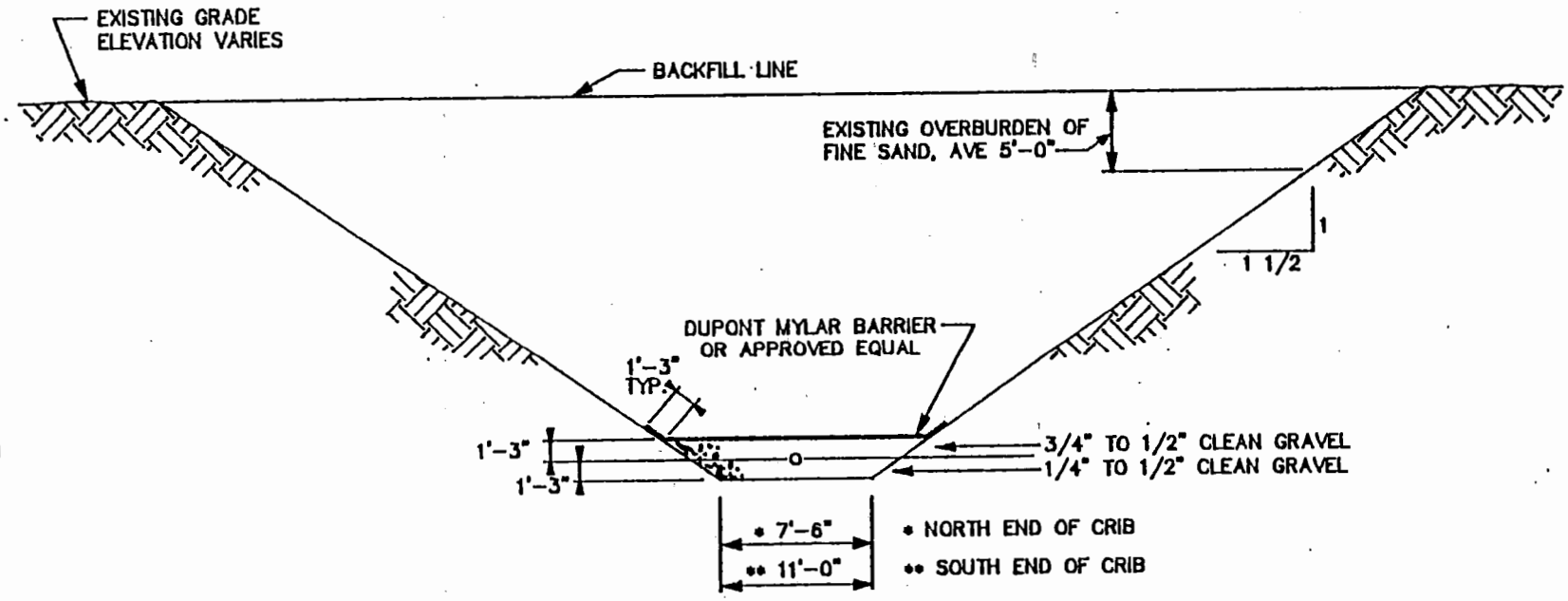


Figure 1-3. 216-A-36B Crib Location



216-A-36B CRIB SECTION

Figure 1-4.

"A" section was physically isolated by pumping grout through two 2-in (5 cm) wells into the gravel layer of the crib. Waste was then directed to the "B" section of the crib by inserting a 4-in (10 cm) diameter, perforated, stainless steel header inside the original 6-in (15 cm) line. That section of the pipe passing through the "A" section of the crib was not perforated and further isolation from the "B" section was provided by an annulus seal installed 12 ft (3.7 m) beyond the grout injection wells. Engineering drawings of the crib and subsequent modifications are contained in appendix A.

Other associated crib structures include a liquid-level monitoring riser (i.e., a gauge well) and a vent riser. The gauge well is constructed of 8-in (20 cm), vitreous clay pipe (VCP), extending from the bottom of the crib to about 3.5 ft (1 m) above grade. The lower portion of the gauge well is perforated to allow monitoring of the depth of liquid in the crib. The vent riser is an 8-in (20 cm) code M-8 stainless steel pipe attached to the end of the distribution line. The vent riser contains an internal tube filter and extends approximately 3 ft (0.92 m) above grade.

1.3 SITE AND TOPOGRAPHICAL MAPS

Appendix A also contains a general overview map of the entire Hanford Site property and the surrounding countryside. This figure is intended as a location map and illustrates the following:

- o Facility (Hanford Site) boundary
- o Surrounding land use including the Saddle Mountain National Wildlife Refuge and the Washington State Game Reserve to the north, and the Arid Lands Ecological Reserve located to the west. Land east of the Hanford Site across the Columbia River is primarily farmland or a part of the Washington State Game Reserve. The surrounding land area is also shown in Figure 1-1.
- o Contours sufficient to show surface water flow. Because of the large facility size, contours are shown at intervals of 20 ft (6 m)
- o Fire control facilities located on the Hanford Site
- o Locations of access roads, internal roads, railroads, and perimeter gates and barricades
- o Longitudes and latitudes.

Figure 1-5 illustrates wind roses for various locations on the Hanford Site. Winds are predominately from the west.

The location of the 216-A-36B Crib within the 200 East Area is indicated on the site plan in Figure 1-2.

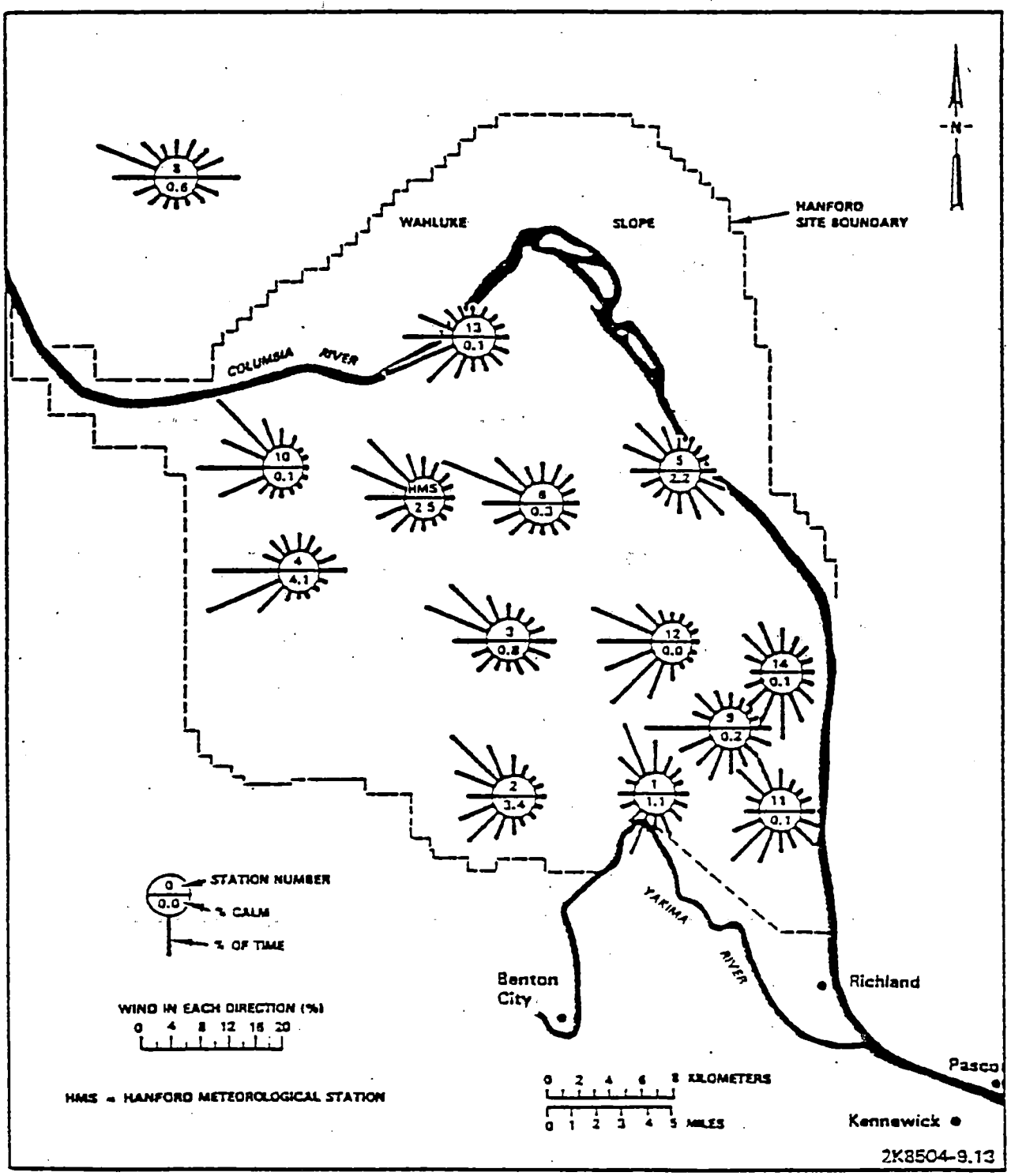


Figure 1-5. Wind Rose Telemetry Network.

More detailed layouts of the 216-A-36B Crib are shown in Figures 1-3 and 1-4, and in Appendix A.

A water-table contour map of the uppermost aquifer showing the groundwater flow gradients for the Hanford Site is also contained in Appendix A. Section 4.0 of this closure plan provides a general discussion of the hydrology and geology of the Hanford Site.

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1.4 LOCATIONAL INFORMATION

1.4.1 Seismic Consideration

The Hanford Site is not located within any of the political jurisdictions identified in Appendix VI of 40 CFR 264 and WAC 173-303-420(3)(c) that are considered to be seismically active.

1.4.2 Floodplain Standard

The U.S. Army Corps of Engineers has calculated the probable maximum flood based on the upper limit of precipitation falling on a drainage area and other hydrologic factors such as antecedent moisture conditions, snowmelt, and tributary conditions that could lead to maximum runoff. The probable maximum flood for the Columbia River below Priest Rapids Dam has been calculated to be 1.4 million cu ft/s (126,000 cu m/s). The floodplain associated with the probable maximum flood is shown in Figure 1-6 (Jamison 1982). The inundated area shown in Figure 1-6 is greater than that which could be inundated during a 100-yr flood. The facility addressed in this closure/post-closure plan is located on the 200 Area plateau, well above the floodplain.

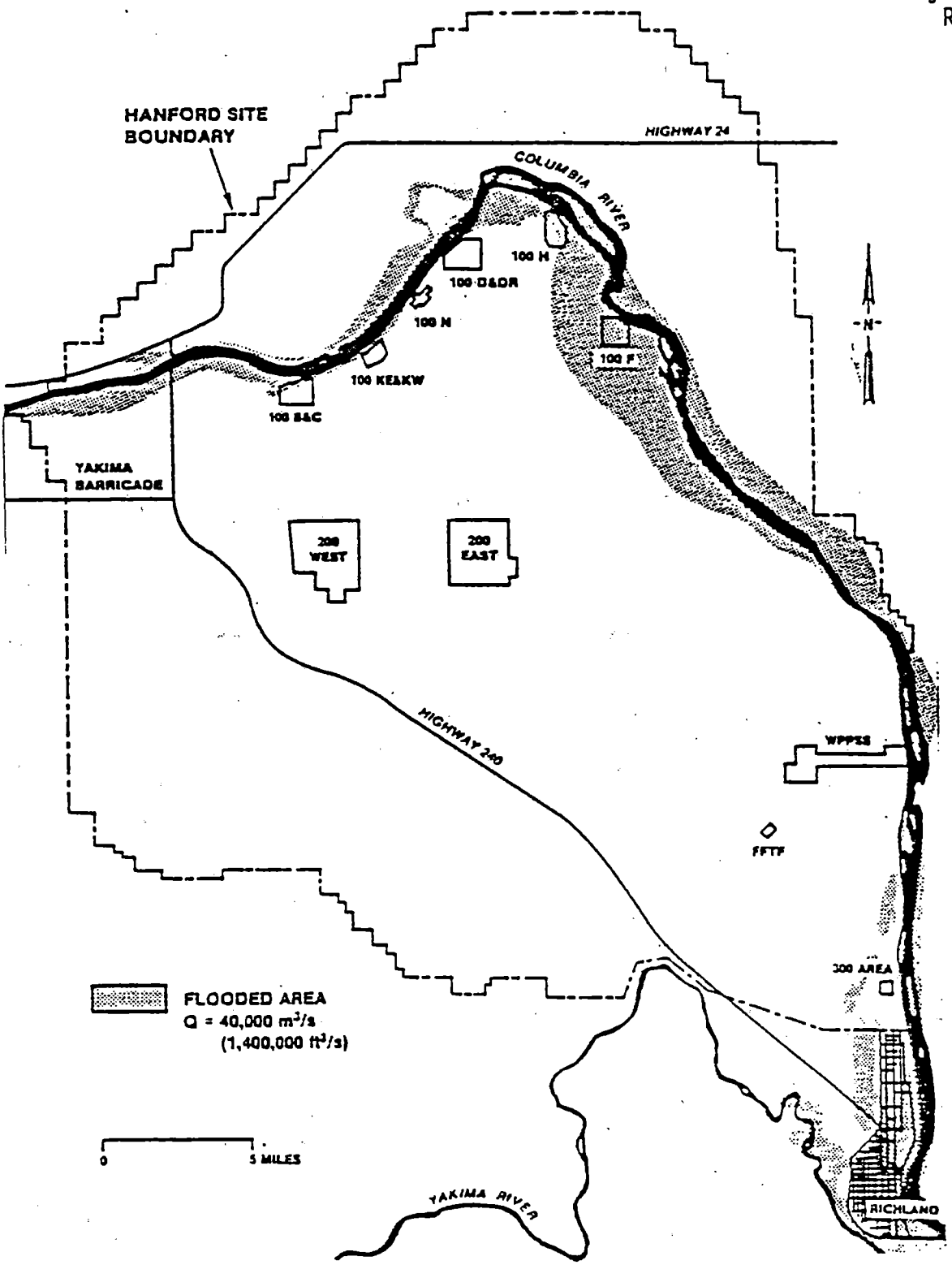

Figure 1-6. Inundated Area for the Probable Maximum Flood.

1.5 TRAFFIC INFORMATION

The 216-A-36B Crib is located within the Hanford Controlled Access Area; these roadways cannot be accessed by the general public. The nearest public highway, Washington State Highway 240, is separated from the patrolled site areas by approximately 4 mi (6.4 km). The majority of traffic inside the Hanford Site boundaries consists of light-duty vehicles and buses used to transport employees to the various operations sites located within the Hanford Site.

Figure 1-7 shows the major roads throughout the Hanford Site. These roads are classified as either primary or secondary routes. The primary routes include Routes 4S, 10, 4N, 3 and the portion of 11A east of Route 4N. Both primary and secondary routes are constructed of bituminous asphalt (usually 2 in (5 cm) thick, but the thickness of the asphalt layer will vary with each road) with an underlying aggregate base. The aggregate base consists of various types and sizes of rock found on the Hanford Site.

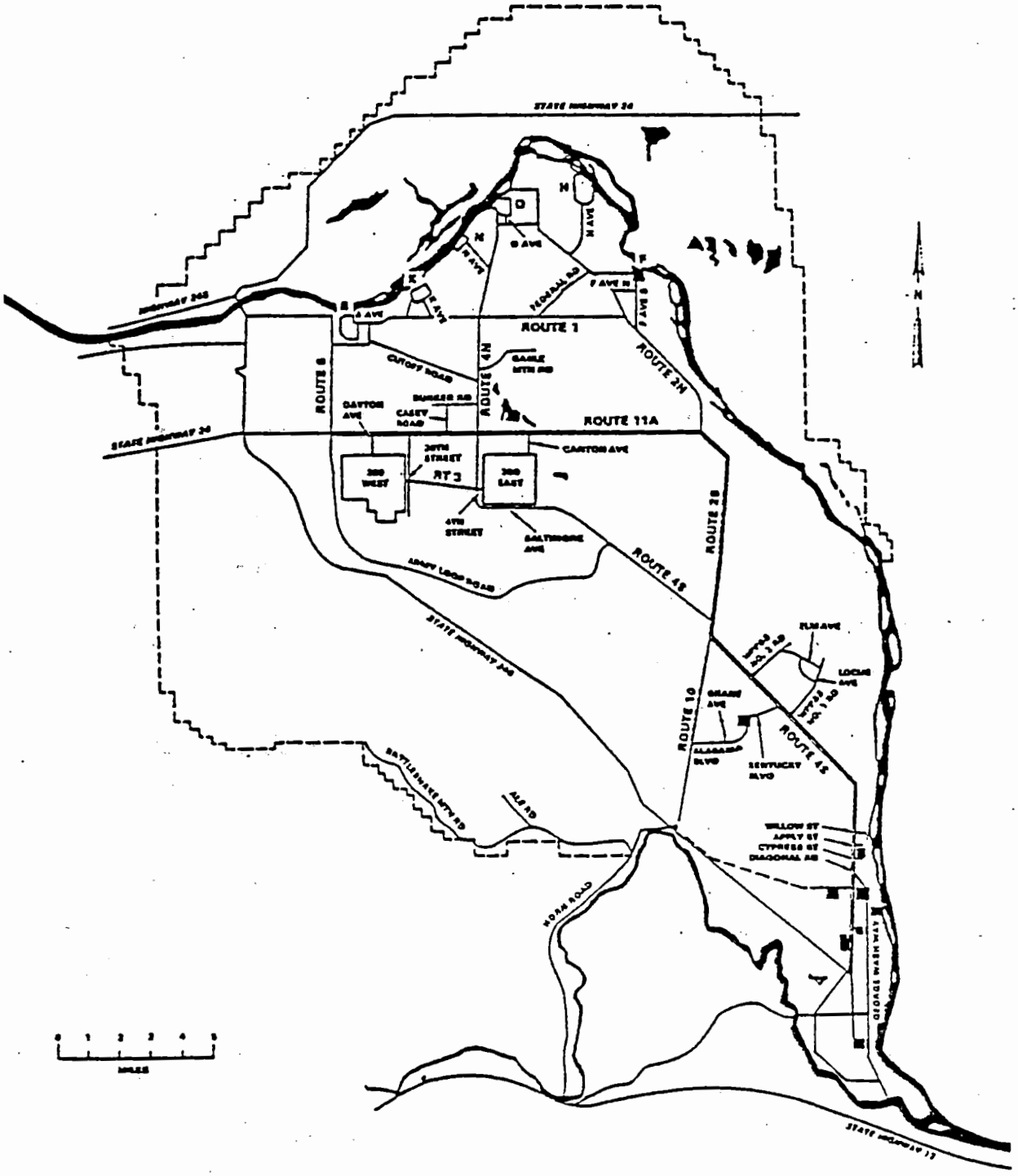

Figure 1-7. Hanford Site Roads.

1.6 REFERENCES

WAC, 1986, Dangerous Waste Regulations, WAC 173-303, Washington Administrative Code, Olympia, Washington.

EPA, 1986, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Title 40, Code of Federal Regulations, Part 264, U.S. Environmental Protection Agency, Washington, D.C.

Jamison, J.D., 1982, Standardized Input for Hanford Environmental Impact Statements, Part II: Site Description, PNL-3509 PT2, Pacific Northwest Laboratory, Richland, Washington.

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2.0 WASTE CHARACTERISTICS

This section describes the chemical and physical characteristics of the ammonia scrubber distillate (ASD) discharged to the 216-A-36B Crib.

2.1 BACKGROUND INFORMATION

Zirconium-clad N Reactor fuel is chemically declad in the PUREX Plant dissolvers with a solution of ammonium fluoride-ammonium nitrate (AFAN). This process, known as the "Zirflex" process, produces waste streams containing ammonium salts originating from the AFAN decladding solution. Waste stream processing, including evaporation, residual solids dissolution, and chemical neutralization, produces the ASD which is a secondary liquid waste stream containing varying concentrations of ammonia and low-level concentrations of radionuclides.

From 1966 to 1972, and again from November 1983 to September 1987, the ASD was discharged to the 216-A-36B Crib for disposal. Throughout these periods of operation, the ASD discharges were monitored and controlled, primarily on the basis of radionuclide concentration, consistent with the operating parameters established by applicable DOE orders. Evaluations of monitoring data revealed no cause for concern regarding the continued discharge of ASD to the ground. In addition, based on the Atomic Energy Act (AEA) definition of "byproduct material", the ASD was considered a direct process waste (i.e., a waste directly yielded in, or a necessary consequence of, the process of producing and utilizing special nuclear material) and therefore, exempt from regulation under Resource Conservation and Recovery Act (RCRA).

However, the lack of specificity in the AEA's definition of "byproduct material", coupled with RCRA's exclusion of byproduct material from its hazardous regulatory scheme, raised questions concerning which DOE radioactive waste streams, if any, should be considered byproduct material not subject to regulation under RCRA. Consequently, the authority to regulate waste that was both radioactive and hazardous remained in dispute for some time. These issues were finally resolved in a DOE interpretative rule issued on May 1, 1987.

Clarification of the applicability of RCRA to DOE wastes prompted further compliance assessments, including the review of flowsheet calculations and chemical analysis of ASD samples. It was during this period of time that data revealed increases in ASD ammonium hydroxide concentrations corresponding to the approximately 8 hr decladding portion of the total 29 hr fuel processing cycle. (Previous ASD sampling had occurred within the approximately 21 hr following the decladding portion of the total processing cycle and as a result, the ammonium hydroxide concentrations were well below the designation limits for dangerous waste). Determination that the ammonium hydroxide concentrations exceeded the dangerous waste designation criteria prompted the suspension of PUREX operations and regulatory agency notification of the "state only" dangerous waste release.

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2.2 CHEMICAL PROPERTIES OF THE ASD

The ASD ammonium hydroxide concentration is variable during the 29 hr spent fuel processing cycle. The ammonium hydroxide concentration reaches a maximum value within 2 hr of the start of the decladding operation and decreases continuously throughout the remainder of the processing cycle. The peak number of moles is discharged during the initial 2 hr decladding operation and ranges between 10,000 and 12,000 g-moles at a pH of 11.5, and decreases to about 250 g-moles following the headend decladding operation. The concentration of ammonium hydroxide remains essentially constant throughout the remainder of the fuel processing cycle.

Ammonium hydroxide values for each hour of the subsequent 4 hr are about 10,000 g-moles, 8,000 g-moles, 6,000 g-moles and 4,800 g-moles, respectively. The flow rate during the fuel decladding is about 3,500 gal/hr (13,000 l/hr) and the total quantity of ammonium hydroxide discharged per total fuel processing cycle is approximately 3,000 lb or 49,000 g-moles.

Although ammonium hydroxide has been identified as the primary constituent of concern, much smaller quantities of ammonium fluoride are also present in the ASD. However, based on ten hourly samplings of the ASD beginning with the initial headend decladding portion of the fuel processing cycle, the ammonium fluoride concentration ranged between 0.77 and 33 ppm, and averaged 8.3 ppm.

Concentration data for waste components other than ammonium hydroxide and ammonium fluoride are provided in Table 2-1. The concentrations of all components are based on the analysis of two samples that were collected near the beginning of the fuel decladding cycle.

Table 2-2 provides a summary of the number of decladding events occurring throughout the operational history of the crib, estimates of the total effluent volume, and the quantities of ammonium hydroxide and ammonium fluoride associated with those decladding events.

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Sampling date	August 23, 1985	May 8, 1987
Aluminum	<1.5 E+02	<1.5 E+02
Antimony	<1.0 E+02	<1.0 E+02
Barium	<6.0 E+00	<6.0 E+00
Beryllium	<5.0 E+00	<5.0 E+00
Cadmium	<2.0 E+00	<2.0 E+00
Calcium	7.4 E+01	9.8 E+01
Chromium	1.3 E+01	<1.0 E+01
Copper	<1.0 E+01	<1.0 E+01
Iron	<5.0 E+01	<5.0 E+01
Lead	<3.0 E+01	<5.0 E+00
Magnesium	2.1 E+01	<5.0 E+01
Manganese	<5.0 E+00	<5.0 E+00
Mercury	<1.0 E−01	<1.0 E−01
Nickel	1.1 E+01	<1.0 E+01
Potassium	<1.0 E+02	<1.0 E+02
Silver	<1.0 E+01	<1.0 E+01
Sodium	5.3 E+02	<1.0 E+02
Strontium	<3.0 E+02	<3.0 E+02
Uranium	2.7 E−01	NA
Vanadium	<5.0 E+00	<5.0 E+00
Zinc	5.3 E+01	7.7 E+01
Chloride	3.9 E+02	5.8 E+02
Cyanide	<1.0 E+01	<1.0 E+01
Nitrate	7.0 E+02	<5.0 E+02
Phosphate	<1.0 E+03	<1.0 E+03
Sulfide	HTE	<1.0 E+03
Sulfate	<5.0 E+02	<5.0 E+02
Benzyl alcohol	1.2 E+01	
pH	9.74	8.90
Temperature (°C)	31.0	29.6
Alpha Activity (pCi/L)	1.3 E+00	3.1 E+00
Beta Activity (pCi/L)	1.4 E+05	1.4 E+04
Total Organic Carbon (ppb)	9.6 E+03	<5.5 E+02
Total Organic Halide (ppb)	<1.0 E+02	<2.0 E+01

NOTE: Analyte concentrations are in parts per billion. Result notations include measurements made after holding times were exceeded (HTE), and measurements that have not been received from the laboratory (NA).

Table 2-1. Ammonia Scrubber Distillate Waste Stream Chemical Parameters.

9 1 1 1 3 9 4 0 9 8 7 6

Year	Decladding events	Volume (L)	NH_4OH (g)	NH_4F (g)
1966 - 1972	1,367	9.4×10^7	3.78×10^8	4.79×10^5
1983 - 1985	233	13.3×10^7	4.02×10^8	11.3×10^5
1986	94	5.66×10^7	1.62×10^8	4.55×10^5
1987	17	2.48×10^7	0.293×10^8	0.822×10^5
Total 1983 - 1987	344	21.5×10^7	5.93×10^8	1.37×10^6

Table 2-2. Estimated Quantity of NH_4OH and NH_4F Discharges to the 216-A36B Crib.

9 1 1 8 9 4 0 8 7 7

2.3 OTHER PROPERTIES AND CHARACTERISTICS

Other information relative to past discharges of the ASD to the 216-A-36B Crib has been compiled through an existing monitoring system at the facility. This existing system is comprised of two groundwater wells and four unsaturated (vadose) zone wells (see Figure 2-1). Total vadose zone wells (designated 299-E17-4, 299-E17-7, 299-E17-11, and 299-E17-51) are monitored quarterly by total gamma logging for radiological purposes only. The groundwater wells (designated 299-E17-5 and 299-E17-9) are monitored monthly for radionuclides, pH, and nitrates. The groundwater concentrations of radiological parameters and nitrate for the ASD and groundwater near the crib are presented in Table 2-3.

Beginning in March 1987, the groundwater wells have been monitored quarterly for hazardous waste parameters as well. The concentrations of these nonradiological parameters for the groundwater near the crib are provided in Table 2-4.

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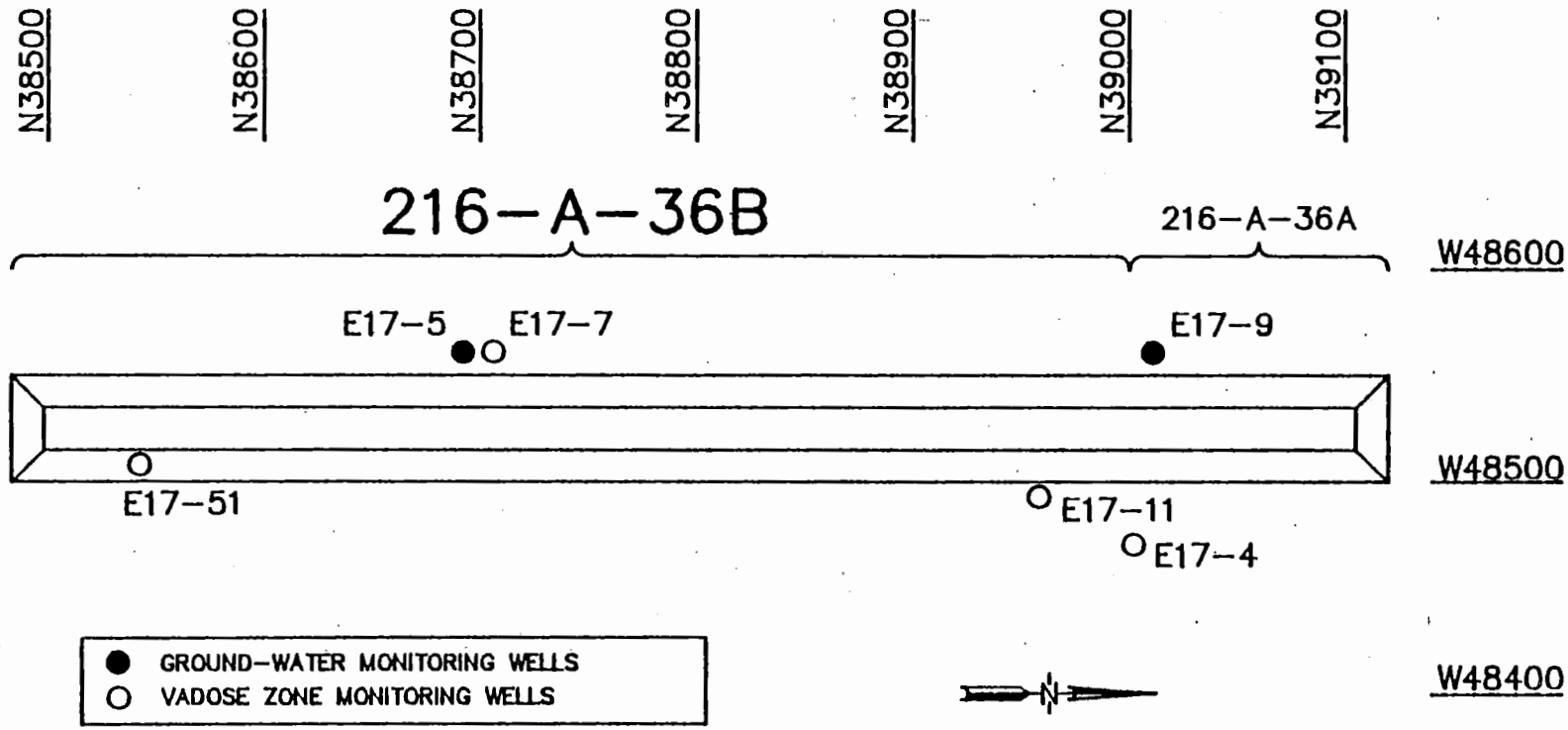

Figure 2-1. Well Locations at the 216-A36B Crib.

1983		Total alpha (pCi/mL)	Total beta (pCi/mL)	Tritium (pCi/mL)	^{90}Sr (pCi/mL)	^{137}Cs (pCi/mL)	^{106}Ru (pCi/mL)	^{60}Co (pCi/mL)	U (pCi/mL)	NO_3 (as nitrate) (mg/L)
Waste stream										
PUREX (ASD)		1.61 E+00	1.88 E+01	5.63 E+02	2.20 E+00	6.59 E+00	NA[a]	NA[a]	1.38 E+00	NA[a]
Wells										
299-E17-5	Max	1.14 E-01	1.63 E-01	5.70 E+02	8.23 E-02	1.42 E-02	4.28 E-02	1.08 E-02		40
	Ave	1.39 E-02	4.59 E-02	5.01 E+02	1.04 E-02	3.91 E-03	1.36 E-02	2.47 E-03	7.69 E-03	25
	Min	1.54 E-03	9.99 E-03	3.81 E+02	0.00 E+00[c]	0.00 E+00	0.00 E-00[c]	0.00 E+00[c]		19
299-E17-9	Max		8.47 E-02	1.06 E+04	1.08 E-02	2.08 E-02	2.35 E-02	1.02 E-02		145
	Ave	1.19 E-03	4.09 E-02	7.02 E+03	4.24 E-03	5.43 E-03	4.97 E-03	2.8 E-03	NA[a]	106
	Min		1.57 E-02	3.27 E+03	4.06 E-04	0.00 E+00[c]	0.00 E+00[c]	0.00 E+00[c]		12

1984		Total alpha (pCi/mL)	Total beta (pCi/mL)	Tritium (pCi/mL)	^{90}Sr (pCi/mL)	^{137}Cs (pCi/mL)	^{106}Ru (pCi/mL)	^{60}Co (pCi/mL)	U (pCi/mL)	NO_3 (as nitrate) (mg/L)
Waste stream										
PUREX (ASD)	Ave	<9.00 E-02	3.00 E+02	5.00 E+03	7.00 E-01	8.00 E+00	2.00 E+02	NA[a]	BDL[b]	1.62 E+01
Wells										
2E 17 5	Max	1.03 E-02	9.93 E-02	2.49 E+03	1.00 E-02	6.26 E-03	6.42 E-02	7.82 E-03	1.15 E-02	7.92 E+01
	Ave	4.45 E-03	5.95 E-02	1.06 E+03	3.31 E-03	1.35 E-03	1.97 E-02	1.75 E-03	5.15 E-03	4.47 E+01
	Min	0.00 E-01[c]	1.58 E-02	5.17 E+02	0.00 E-01[c]	0.00 E-01[c]	0.00 E-01[c]	0.00 E-01[c]	1.26 E-03	3.03 E+01
2E 17 9	Max	NA[a]	7.67 E-02	3.87 E+03	2.50 E-02	8.54 E-03	9.96 E-02	2.84 E-02	NA[a]	9.52 E+01
	Ave		4.05 E-02	3.03 E+03	6.75 E-03	1.98 E-03	2.69 E-02	6.51 E-03		7.33 E+01
	Min		1.58 E-02	2.53 E+03	6.37 E-01	0.00 E-01[c]	0.00 E-01[c]	0.00 E-01[c]		6.25 E+01

Table 2-3. Average Concentrations of Radiological Parameters and Nitrate for PUREX ASD Waste Stream and Groundwater Near the 216-A-36B Crib. (Sheet 1 of 3)

1985		Total alpha (pCi/mL)	Total beta (pCi/mL)	Tritium (pCi/mL)	^{90}Sr (pCi/mL)	^{137}Cs (pCi/mL)	^{106}Ru (pCi/mL)	^{60}Co (pCi/mL)	U (pCi/mL)	NO_3 (as nitrate) (mg/L)
Waste stream										
PUREX (ASD)	Ave	<4 E+02	6 E+05	3 E+06	NA[a]	3 E+04	1 E+04	NA	3 E+05	NN[d]
Wells										
2-E17-5	Max	1.20 E+01	6.60 E+01	2.71 E+06	1.16 E+02	5.14 E+00	7.67 E+00	7.89 E+00	4.79 E+01	2.26 E+01
	Ave	8.29 E+00	3.28 E+01	2.03 E+06	9.18 E+01	3.14 E+00	-4.65 E-01	2.11 E+00	-5.24 E+00	1.17 E+01
	Min	5.56 E+00	2.21 E+01	1.31 E+06	6.46 E+01	2.32 E+00	-1.41 E+01	-1.82 E+00	-8.01 E+01	6.53 E+00
2-E17-9	Max	6.08 E+00	3.60 E+01	5.56 E+06	1.72 E+02	4.71 E+00	7.12 E+00	7.11 E+00	7.12 E+01	5.91 E+00
	Ave	3.54 E+00	2.71 E+01	4.68 E+06	1.40 E+02	4.17 E+00	-4.87 E-02	1.96 E+00	1.32 E+01	5.24 E+00
	Min	2.15 E+00	2.20 E+01	3.82 E+06	1.08 E+02	3.30 E+00	-9.25 E+00	-7.09 E+00	-2.98 E+01	4.56 E+00

1986		Total alpha (pCi/mL)	Total beta (pCi/mL)	Tritium (pCi/mL)	^{90}Sr (pCi/mL)	^{137}Cs (pCi/mL)	^{106}Ru (pCi/mL)	^{60}Co (pCi/mL)	U (pCi/mL)	NO_3 (as nitrate) (mg/L)
Waste stream										
PUREX (ASD)	Ave	<3.71 E+02	8.44 E+05	2.42 E+06	3.72 E+03	6.14 E+03	4 E+05	NA[a]	NN[d]	NA[a]
Wells										
299-E17-05	Max	1.44 E+01	7.09 E+01	5.06 E+06	3.58 E+00	7.70 E+00	4.42 E+01	8.03 E+00	9.71 E+00	1.19 E+02
	Ave	9.18 E+00	3.37 E+01	3.88 E+06	2.84 E+00	5.55 E-01	5.48 E+00	1.51 E+00	6.60 E+00	9.90 E+01
	Min	5.75 E+00	2.29 E+01	2.69 E+06	2.33 E+00	-1.35 E+01	-3.67 E+01	-4.13 E+00	4.30 E+00	8.68 E+01
299-E17-09	Max	5.20 E+00	2.54 E+01	6.62 E+06	5.01 E+00	1.20 E+01	4.43 E+01	5.09 E+00		2.07 E+02
	Ave	3.90 E+00	2.10 E+01	5.84 E+06	3.67 E+00	9.24 E-01	1.31 E+01	-1.90 E-01	NN[d]	1.38 E+02
	Min	3.19 E+00	1.75 E+01	3.55 E+06	1.95 E+00	-8.31 E+00	-2.20 E+01	-1.13 E+01		9.38 E+01

Table 2-3. Average Concentrations of Radiological Parameters and Nitrate for PUREX ASD Waste Stream and Groundwater Near the 216-A-36B Crib. (Sheet 2 of 3)

1987		Total alpha (pCi/mL)	Total beta (pCi/mL)	Tritium (pCi/mL)	^{90}Sr (pCi/L)	^{137}Cs (pCi/L)	^{106}Ru (pCi/mL)	^{60}Co (pCi/mL)	U (pCi/mL)	NO_3 (as nitrate) (mg/L)
Wells										
2-E17-5	Max	8.87 E+00	6.13 E+02	5.39 E+06	3.27 E+00	7.94 E+00	5.57 E+02	6.03 E+01	1.05 E+01	1.07 E+02
	Ave	6.68 E+00	1.75 E+02	4.42 E+06	2.78 E+00	9.65 E−01	9.28 E+01	1.22 E+01	8.16 E+00	9.78 E+01
	Min	5.83 E+00	4.65 E+01	4.09 E+06	2.52 E+00	−5.99 E+00	−5.431	−9.11 E+00	5.89 E+00	7.52 E+01
2-E17-9	Max	4.16 E+00	3.40 E+01	6.29 E+06	3.43 E+00	8.55 E+00	1.12 E+02	5.61 E+00	4.29 E+00	1.70 E+02
	Ave	3.26 E+00	2.32 E+01	5.53 E+06	3.33 E+00	−1.49 E+00	1.91 E+01	−1.53 E+00	3.61 E+00	1.54 E+02
	Min	2.10 E+00	1.42 E+01	4.93 E+06	3.28 E+00	−1.59 E+01	−5.42 E+01	−1.07 E+01	2.64 E+00	1.37 E+02

[a]NA = No analysis for this constituent.
[b]BDL = Below detectable limit.
[c]Negative analytical values appear as zeroes.
[d]Analyses not necessary (as determined from inventory, effluent history, or gross alpha/beta analyses).

Table 2-3. Average Concentrations of Radiological Parameters and Nitrate for PUREX ASD Waste Stream and Groundwater Near the 216-A-36B Crib. (Sheet 3 of 3)

Well	Date	Ammonia (ppm)	Fluoride (ppm)	Nitrate (ppm)	pH	TOC (ppm)	Chloride (ppm)	Conductivity (μmho/cm)
299-E17-5	March 4, 1987	<0.050	<0.500	99.8	7.85	0.516	6.87	452
	April 9, 1987	<0.050	<0.500	89.5	7.62	0.763	6.83	435
	July 20, 1987	0.064	0.675	118.0	7.77	0.531	6.22	422
	October 10, 1987	<0.050	<0.500	261.0	--	--	--	--
299-E17-9	March 4, 1987	<0.050	<0.500	171.0	7.63	0.414	8.31	639
	April 14, 1987	<0.050	<0.500	153.0	7.50	0.455	6.87	728
	July 20, 1987	<0.050	0.812	128.0	7.54	0.466	6.95	477
	October 10, 1987	<0.050	<0.500	123.0	--	--	--	--

Table 2-4. Groundwater Parameters Measured in Wells Monitoring the 216-A-36B Crib.

3.0

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3.0 PROCESS INFORMATION

The 216-A-36B Crib received the PUREX ammonia scrubber distillate (ASD) from the headend processing of spent nuclear fuel. During fuel decladding and solids metathesis, about 75 percent of the ammonium ions charged to the dissolvers is evolved as ammonia gas, which is absorbed in dissolver condensate or scrubbed from the dissolver off-gas with raw water. The remaining 25 percent of the ammonium ions stay in the cladding removal waste (CRW) until the waste is treated and neutralized with sodium hydroxide prior to transfer for storage in underground tanks. During neutralization, about 15 percent of the CRW ammonium ion content (about 3 to 4 percent of the total ammonium ions charged to the dissolver) is released as ammonia gas, which is then scrubbed into raw water.

All of the dissolver condensate and scrubber liquid, called ammonia scrubber feed (ASF), is collected in a tank (F12) and pumped to the E-F11 Evaporator to concentrate the solution radionuclides in the evaporator bottoms. The ASF is concentrated to ammonia scrubber waste (ASW) to minimize the high-level radioactive waste volume requiring underground storage in tanks. The ASW batchwise removal frequency is currently determined by the concentration of ruthenium-106 in the evaporator overheads.

Essentially all of the ammonia from E-F11 is volatilized during boiling and is reabsorbed in the condensed overhead solution, called the ammonia scrubber distillate (ASD). Until September 1987, the ASD was pumped to the 216-A-36B Crib, while being sampled and monitored for radionuclide concentration. When PUREX operations resume, the feed previously routed to the E-F11 concentrator will be routed to underground tanks for storage. Concurrent with this modification in operating procedure, efforts are underway to develop and

implement an ammonium destruction process at PUREX. Implementation of the ammonium destruction process will support fuel processing campaigns in fiscal year 1989 and beyond, and return to near normal the volume of waste requiring underground storage in tanks.

Indicative of the non-steady state headend fuel processing cycle, the concentration of ammonia absorbed in the ASD varies with the processing operation taking place. During fuel decladding, when from 70 to 75 percent of the charged ammonia is absorbed in condensate or scrubbed into raw water, the ASD absorbed ammonia concentration may be as high as 1.0 molar. In contrast, during solids metathesis and CRW neutralization, when only 3 to 5 percent of the charged ammonia is released and absorbed, the ASD ammonia concentration may decrease twenty-fold to levels significantly below regulatory concern. Efforts will continue, through implementation of the ammonia destruction process and other plant improvements, to eliminate any significant variability and reduce peak ammonium concentration values to well below the designation limits (WAC 173-303-070) for dangerous waste.

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5.0 INTERIM STATUS CLOSURE/POST-CLOSURE PLAN

The purpose of this section is to demonstrate that the Department of Energy - Richland Operations Office (DOE-RL) and Westinghouse Hanford Company (WHC) are cognizant of past operations at the 216-A-36B Crib, and that efforts are underway to close and administer the unit in a manner that minimizes potential future impacts to human health and the environment.

5.1 INTRODUCTION AND BACKGROUND

The 216-A-36B Crib is an engineered subsurface liquid effluent disposal facility that received the PUREX ammonia scrubber distillate (ASD) from 1966 to 1972, and again from November 1983 to September 1987. (Information specific to the chemical and physical characteristics of the ASD and the PUREX processes responsible for its generation, are provided in sections 2.0 and 3.0, respectively.) Throughout these periods of operation the ASD discharges were monitored and controlled, primarily on the basis of radionuclide concentration, consistent with the operating parameters established by applicable DOE orders. Evaluations of monitoring data revealed no cause for concern regarding the continued discharge of ASD to the ground. In addition, based on the Atomic Energy Act (AEA) definition of "byproduct material", the ASD was considered a direct process waste (i.e., a waste directly yielded in, or a necessary consequence of, the process of producing and utilizing special nuclear material) and therefore, exempt from regulation under the Resource Conservation and Recovery Act (RCRA).

However, the lack of specificity in the AEA's definition of "byproduct material", coupled with RCRA's exclusion of byproduct material from its hazardous waste regulatory scheme, raised questions concerning which DOE radioactive waste streams, if any, should be considered byproduct material not subject to regulation under RCRA. Consequently, the authority to regulate waste that was both radioactive and hazardous remained in dispute for some time. These issues were finally resolved in a DOE interpretative rule issued on May 1, 1987. This ruling (10 CFR 962) established that any radioactive waste that contains regulated hazardous waste components is subject to regulation under RCRA.

Clarification of the applicability of RCRA to DOE wastes prompted further compliance assessments, including the review of flowsheet calculations and chemical analysis of ASD samples. It was during this period of time that data revealed increases in ASD ammonium hydroxide concentrations corresponding to the headend decladding portion of the fuel processing cycle. Additional sampling verified that ammonium hydroxide concentrations during fuel cladding removal (approximately 8 hr out of the total 29 hr processing cycle) exceeded the designation limits for dangerous waste (WAC 173-303-070), and consequently, PUREX operations were suspended and notifications to the regulatory agencies were made.

Subsequent evaluations of data on the chemistry of ASD discharges to the 216-A36B Crib indicate that the only constituent of regulatory or environmental concern is ammonium, because of its biological conversion to nitrites and nitrates. All other ASD chemical constituents (Table 5-1) are far below established WAC 173-303-070 limits for waste designation based on the WAC 173-303 designation logic illustrated in Figure 5-1. However, because the facility was designed and operated for the disposal of liquids, and because those liquids at times exceeded the WAC 173-303 designation limits for dangerous waste, Ecology has classified the crib as landfill that received non-containerized waste. This closure plan has been prepared for sumbittal to Ecology who on November 23, 1987, was granted the authority to operate the RCRA program for the hazardous component of radioactive waste.

Sampling date	August 23, 1985	May 8, 1987
Aluminum	<1.5 E+02	<1.5 E+02
Antimony	<1.0 E+02	<1.0 E+02
Barium	<6.0 E+00	<6.0 E+00
Beryllium	<5.0 E+00	<5.0 E+00
Cadmium	<2.0 E+00	<2.0 E+00
Calcium	7.4 E+01	9.8 E+01
Chromium	1.3 E+01	<1.0 E+01
Copper	<1.0 E+01	<1.0 E+01
Iron	<5.0 E+01	<5.0 E+01
Lead	<3.0 E+01	<5.0 E+00
Magnesium	2.1 E+01	<5.0 E+01
Manganese	<5.0 E+00	<5.0 E+00
Mercury	<1.0 E−01	<1.0 E−01
Nickel	1.1 E+01	<1.0 E+01
Potassium	<1.0 E+02	<1.0 E+02
Silver	<1.0 E+01	<1.0 E+01
Sodium	5.3 E+02	<1.0 E+02
Strontium	<3.0 E+02	<3.0 E+02
Uranium	2.7 E−01	NA
Vanadium	<5.0 E+00	<5.0 E+00
Zinc	5.3 E+01	7.7 E+01
Chloride	3.9 E+02	5.8 E+02
Cyanide	<1.0 E+01	<1.0 E+01
Nitrate	7.0 E+02	<5.0 E+02
Phosphate	<1.0 E+03	<1.0 E+03
Sulfide	HTE	<1.0 E+03
Sulfate	<5.0 E+02	<5.0 E+02
Benzyl alcohol	1.2 E+01	
pH	9.74	8.90
Temperature (°C)	31.0	29.6
Alpha Activity (pCi/L)	1.3 E+00	3.1 E+00
Beta Activity (pCi/L)	1.4 E+05	1.4 E+04
Total Organic Carbon (ppb)	9.6 E+03	<5.5 E+02
Total Organic Halide (ppb)	<1.0 E+02	<2.0 E+01

NOTE: Analyte concentrations are in parts per billion. Result notations include measurements made after holding times were exceeded (HTE), and measurements that have not been received from the laboratory (NA).

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Table 5.1. Ammonia Scrubber Distillate Waste Stream Chemical Parameters.

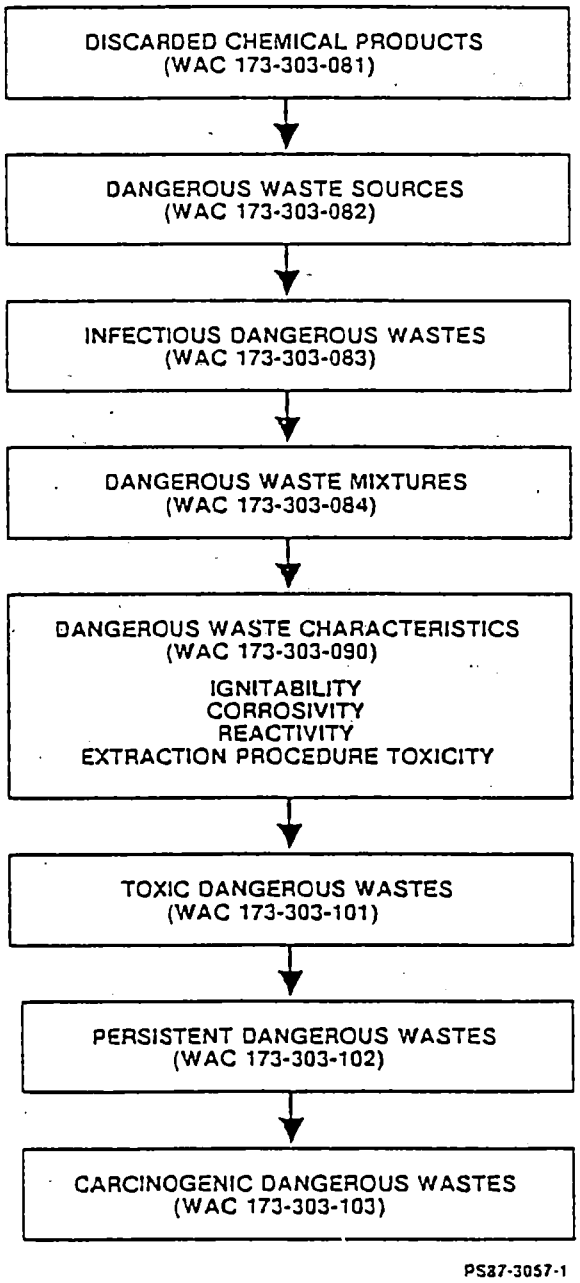

Figure 1. Designation Logic from Section 173-303-070 of the Washington Administrative Code.

5.2 CLOSURE PERFORMANCE STANDARDS

Due to Ecology's classification of the 216-A-36B Crib as a landfill, DOE-RL and WHC, co-operator's of the Hanford Site, intend to close the facility with waste remaining in place. DOE-RL and WHC further expect to achieve, to the extent practical, the following performance standards:

Further (i.e., future) maintenance will be minimized by defining, through a site characterization effort, the extent of contamination (both horizontally and at depth) resulting from past ASD discharges to the crib. Adequate definition of the extent of contamination will provide assurance that all of the waste remaining in place is satisfactorily isolated from the physical and biological processes that might otherwise contact and expose the waste, thereby creating unplanned and/or additional future maintenance needs.

Potential future threats to human health and the environment will also be minimized through adequate isolation of the waste remaining in the ground. By design, the 216-A-36B Crib was constructed in such a manner that liquid wastes entered the soil column at a depth of approximately 23 ft (7m) below grade. Thus, waste isolation is provided by what can be termed a "massive soil" barrier. Because such a barrier is totally composed of natural earthen materials of obvious endurance, there is no reason to suspect diminishing effectiveness due to the naturally occurring physical and biological processes that are normally considered important to a cover design.

In addition, the depth of the existing soil cover, the aridity of the Hanford environment, the high evapotranspiration potential, and the very limited (if any) amount of recharge attributable to a very reduced amount of naturally occurring precipitation, all combine to minimize if not eliminate, liquid migration which might mobilize contaminants and cause their movement toward the unconfined aquifer. It should also be noted that the unconfined aquifer is not a source of on- or off-site drinking water.

Finally, the closure actions (described in more detail in subsequent sections of this plan) include revegetation of the crib and any surrounding surface area disturbed during the accomplishment of this closure plan. While some succession of plant species can be expected to occur naturally over time (i.e., a potential 30 yr post-closure care period), the species chosen for planting will include only those that are known to be tolerant of the local soils and droughty conditions. The initial establishment of perennial plants that are tolerant of local conditions will greatly reduce the degree of plant succession that might otherwise occur.

The remaining sections of this plan describe in more detail the actions that are planned to achieve compliance with all of the applicable requirements of WAC 173-303.

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5.3 CLOSURE PLANS

The DOE-RL and WHC anticipate that some of the closure activities described below may be termed partial in that a comprehensive plan has not yet been approved. In fact, some of the activities described may need to be completed before regulatory agency approval of a final closure plan can be obtained. Nonetheless, all of the actions already taken, as well as those that are planned and described, collectively comprise the process that is currently planned for final closure of the 216-A-36B Crib.

The following actions have already been taken or are currently underway with respect to final closure of the 216-A-36B Crib. Their inclusion is intended to be informational and necessary to the extent that actions have been taken to eliminate the discharge that prompted this closure plan, and to satisfy the regulatory agencies that these efforts are intended to preclude the occurrence of similar discharges at any time in future.

1. **Immediate** (to the extent that safe shutdown of the PUREX Plant could be achieved in September) **cessation of all discharges to the crib.** This action will reduce the potential rate at which contaminants might otherwise move toward the water table.

2. **Implementation of modifications to eliminate ASD discharges to the crib following the resumption of PUREX operations.** The ammonia scrubber feed previously routed to the E-F11 concentrator is now routed to underground double-shell tanks for storage.

3. **Issuance of a plan for implementation of a PUREX ammonia management and destruction process.** Implementation will eliminate significant concentrations (and variations) of waste

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stream ammonia in support of fuel processing campaigns in fiscal year 1989 and beyond, and return to near normal the volume of waste requiring underground storage in double-shell tanks.

4. **Preparation of specifications, sampling plans and procedures to support closure site characterization and the installation of groundwater monitoring wells.** The administrative activities preparatory to these activities are currently underway. Three 150 ft deep boreholes (i.e., vadose zone wells) will be used to initially investigate the unsaturated sediments and assess the extent of contamination beneath the crib. Information useful to the characterization effort will also be obtained during the installation of groundwater wells which are scheduled to be installed within approximately the same time frame.

5.3.1 Partial and/or Final Closure Activities

Beyond those actions summarized above, the initial efforts toward characterization of the unsaturated sediments beneath the crib are presently planned for May 1988. Current plans call for three wells to be installed 10 ft (~3 m) on either side of the crib centerline to completed depths of 150 ft (46 m) at the locations indicated in Figure 5-2. Based on experience gained during previous on-site unsaturated zone investigations and knowledge that Hanford Site soils are predominantly sands and gravels that are generally quite permeable, the area directly beneath the crib is the area with the highest probability of containing regulated waste (i.e., ammonium hydroxide contaminated sediments). Well locations 10 ft (~3 m) from the centerline were chosen so that the synthetic membrane overlying the gravel fill and influent distribution line would remain undisturbed. A completed depth of 150 ft (46 m) was based on a combined need for information specific to waste retention, distribution, and biological conversion to nitrites/nitrates in the vadose zone.

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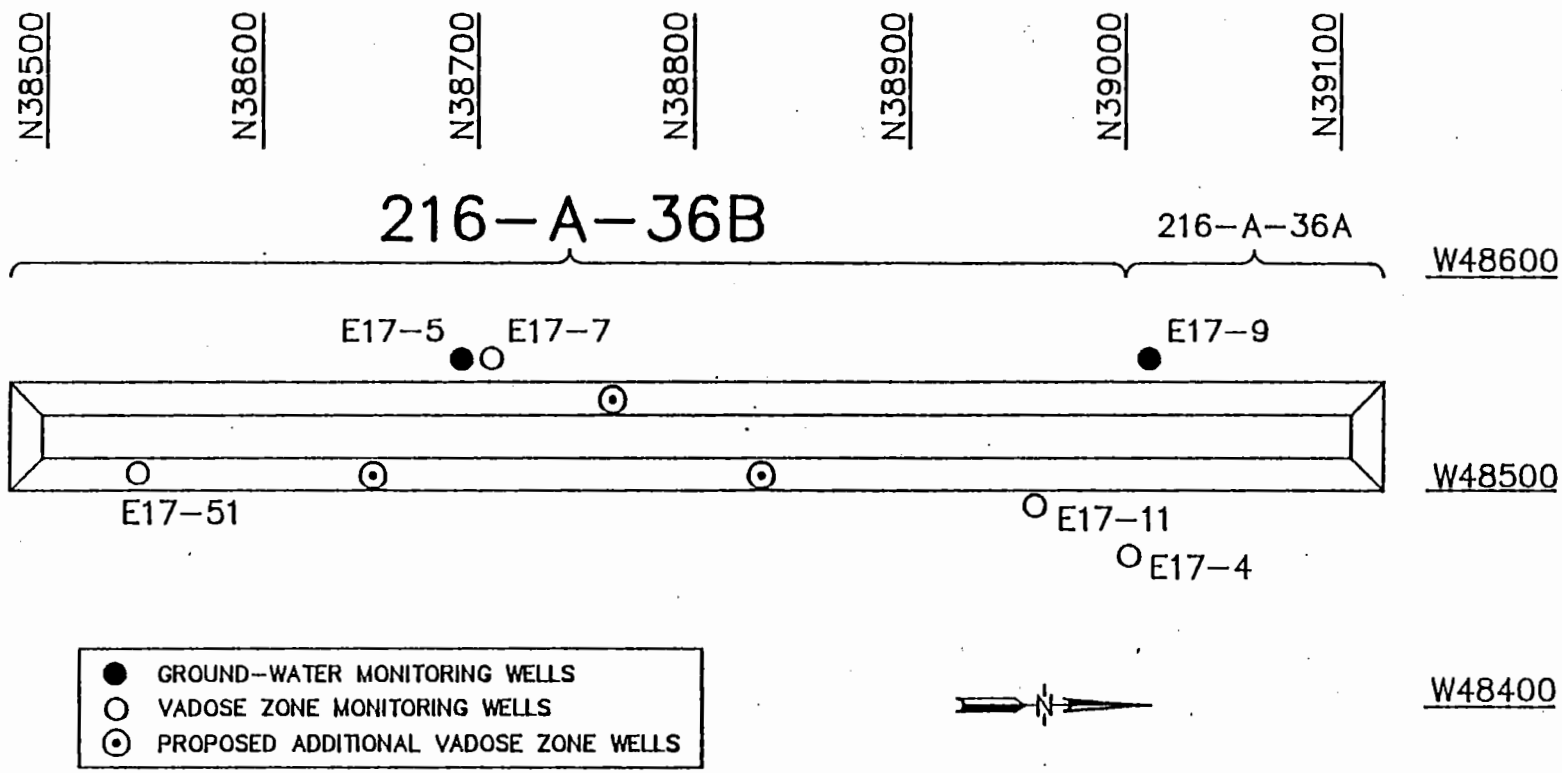

Figure 5.2. Proposed Characterization Well Locations

A cable tool drilling rig will be used to complete the boreholes to a depth of 150 ft (46 m). A 4-in (10 cm) diameter or greater drive barrel will be used unless radiological conditions dictate the use of a dual wall sampler. Samples will be obtained at 5 ft (1.5 m) intervals and at changes in lithology. Sample collection, preservation, chain-of-custody, etc., will be performed in accordance with the instructions of a sampling plan which in turn will follow the Environmental Protection Agency's SW-846 protocol in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA 1982). (The sampling plan for the unsaturated zone investigation at the crib is being prepared and will be appended to this plan or in the interim, made available to Ecology upon request.) A geologist will examine the sediments and record lithologic characteristics in a bound logbook. All other information pertinent to the sampling will also be recorded in a bound logbook in a legible fashion.

Because the samples obtained from the unsaturated zone are likely to be radiologically contaminated, they will be processed through the WHC 222-S Laboratory for analysis. The analyses will consider the analytes detected in previous samples (see Table 5-1) which were analyzed according to procedures of EPA protocol SW-846, when available, by recently introduced EPA methods, or by standard analytical methods (APHA 1985). Table 5-2 lists the appropriate analytical methods. It should be noted, however, that some analytes are not satisfactorily detected by the currently available methods. Included among this latter group of analytes is nitrite.

The statistical treatment of all analytical data will be as described in EPA protocol SW-846 and other guidance documents (EPA 1982; Barth and Mason 1984). Actual values received from the laboratory will be retained for later inclusion as an appendix to this closure plan, or in the interim, be made available to Ecology for independent review upon request.

Table 5.2 Analytical Methods.

Analysis	Analytes	SW-846
Inductively coupled plasma	Cations [a]	6010
Mercury (CV/AA)	Mercury	7470
Lead (GF/AA)	Lead	7421
Cyanide	Cyanide	9010
Total organic halides	TOX	9020
Total organic carbon	TOC	SM505
Ion chromatography	Anions [c]	EPA-300 [b,d]
Sulfide	Sulfide	9030
Ammonium (SIE)	Ammonium	SM417E [b]
Gross alpha	Gross alpha	EPA-680 [d]
gross beta	Gross beta	EPA-680 [d]
Volatile organic analysis	Organics	8240
A/B/N (simivolatile organics)	Organics	8270
Direct aqueous injection	Organics	"8240" [e]

NOTE:

CV/AA = Cold vapor-atomic absorption
GF/AA = Graphite furnace-atomic absoption
SIE = Specific ion electrode
SW-846 = Test Methods for Evaluating Solid Waste

[a] Cations include aluminum, antimony, barium, beryllium, cadmium, calcium, chromium, copper, iron, magnesium, manganese, nickel, potassium, silver, sodium, strontium, vanadium, zinc.
[b] "1985-Standard Method for the Examination of Water and Wastewater" (APHA).
[c] Anions include chloride, fluoride, nitrate, phosphate, sulfate.
[d] EPA method, EPA-680/4-75-001.
[e] Direct sample injection into a GC/MS with subsequent analysis by Method 8240.

Based on an analysis of data obtained during the initial investigation, the need for additional boreholes will be determined. The decision to proceed with additional boreholes will include development of the basis and rationale for their proposed locations and depths. In support of this characterization effort, some amount of supplemental information useful to these determinations should be derived from the installation of groundwater monitoring wells around the closure area. (Details of the initial groundwater monitoring well installations (to be completed by June 1, 1988) including the accompanying sampling and analytical efforts planned, are not yet available for inclusion in this plan.) This characterization effort will conclude upon compilation of the data necessary to demonstrate adequate knowledge of the extent of contamination resulting from past ASD discharges to the crib. Demonstrated knowledge regarding the extent of contamination will permit a determination of whether or not the final cover (described below) provides the degree of isolation needed to adequately minimize or eliminate the physical and biological processes which might otherwise contact the waste and cause its movement toward the surface or the water table.

By design, the 216-A-36B Crib was constructed in such a manner that liquid wastes entered the ground at a depth approximately 23 ft (7 m) below grade. Based on the functional and operational history of the crib, there is no reason to suspect that any WAC 173-303 regulated contaminants are present above the point at which those wastes entered the ground. Furthermore, it is expected that the characterization data will confirm that any contaminants resulting from past discharges to the crib are fully contained within the sediments below the influent distribution line. Accordingly, final closure of the 216-A-36B Crib will be achieved through isolation by what can best be termed a "massive soil" barrier.

For a cover to be effective it must isolate any waste remaining in place from a variety of physical and biological processes that can transport, or cause its transport, to the surface or the groundwater. Plants and burrowing animals can penetrate through the soil or other protective cover materials and into underlying waste. Such contact can in turn transport contaminants to the

surface where direct human exposure or further dispersion might occur; or create preferential pathways which can affect the rate at which contaminants migrate toward the water table. Plant species common to the 200 Area plateau include native perennial shrubs (big sagebrush - Artemisia tridentata; and gray rabbitbrush -Chrysothamnus nauseousus) and annual forbs and grasses (Russian thistle - Salsola kali; and cheatgrass - Bromus tectorum). A number of studies have been conducted at Hanford to evaluate the potential for deep-rooted plants to contact and translocate contaminants (primarily radionuclides) to the surface. As indicated in the following table, none of the depths reported for plants that are common to the 200 Areas are great enough to penetrate the soil cover existing over the crib.

Table 5-3. Maximum Rooting Depths for Plants Common to the 200 Area Controlled Zone

Species	Rooting Depth (m)	Reference
Big Sagebrush	2.5	Klepper et al. 1985
Gray Rabbitbrush	2.5	Klepper et al. 1985
Russian Thistle	2.4	Cline et al. 1980
	2.1	Klepper et al. 1985
Cheatgrass	2.0	Hironaka (1961)
	1.1	Harris (1967)

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Animal excavations for den construction and prey capture have also been implicated as a biological transport mechanism for buried waste (Hedlund and Roger 1976; Klepper et al. 1979; and Winsor and Whicker 1980). Examples of some of the species common to the Hanford Site include small mammals (Townsend ground squirrels - Spermophilus townsendii; Great Basin pocket mice - Perognathus parvus; and badgers - Taxidea taxus) and insects (ants - Pogonomyrmex owyheei). Table 5-4 indicates the burrowing depths reported for these animals. Again, none of the reported depths begin to approach the approximately 23 ft (7 m) of soil existing over the crib.

Table 5-4. Burrowing Depths Reported for Animals Which Inhabit the Hanford Site

Species	Burrowing Depth (m)	Reference
Pocket mice	>2.0	McKenzie et al. 1986
Ground Squirrels	>2.0	McKenzie et al. 1986
Badgers	>2.0	McKenzie et al. 1986
Ants	>2.0	Fitzner et al. 1979

A variety of destructive processes (e.g., wind erosion, subsidence, and physical damage attributable to biological intrusion) are also potentially detrimental to the functional longevity of disposal site covers. The occurrence of dust storms and the presence of active dunes at the Hanford Site provide evidence that wind erosion is a potential problem. However, experience indicates that wind erosion rates are reduced by an armoring effect produced as fine-grained materials are removed by the wind, leaving a coarser fraction which acts as a deterrent to further wind erosion. This "desert pavement" effect is reported to limit wind erosion rates to as little as 0.0001-in/yr (0.025 mm/yr) (DOE 1986). Even if a worst-case rate of 1-in/yr (2.5 cm/yr) is assumed, the losses potentially occurring over a 30 yr post-closure care period would not necessarily prove detrimental to the continued isolation of waste remaining in the ground. However, the worst-case assumption is unreasonable in that a vegetative cover and post-closure care will preclude the occurrence of any significant erosion of the final cover.

As indicated in Tables 5-3 and 5-4, the potential for deep-rooted plants and burrowing animals to directly contact the waste remaining in place is essentially excluded by the depth of cover existing over the crib. Of greater concern is the potential enhancement of pathways which might accelerate the rate of contaminant migration toward the water table. For example, plant and animal penetration of a cover can be expected to increase the infiltration and percolation of water through the waste zone. Decaying plant roots can also provide preferential pathways for moisture migration to depth. None of these potentially damaging mechanisms are unique to Hanford or the final cover planned for isolation of the waste remaining in place at the crib.

Careful selection of the vegetative cover will significantly reduce the degree of plant succession that could occur over the post-closure care period. For example, an established vegetative cover comprised of a variety of perennial grasses can effectively exploit the resources available and necessary for survival at the site. Other plants attempting to invade the site will find it difficult to

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become established due to the interspecific competition afforded by the already established plant cover. The influx of potentially troublesome deep rooting annual forbs and shrubs can be effectively controlled in this manner. A vegetative cover comprised of a mixture of grasses is also much less susceptible to fire than a cover largely made up of shrubs (e.g. sagebrush). Species selection for the final cover will also consider the palatability and hence the tendency for certain plants to attract burrowing or otherwise troublesome animals. Finally, since the site will be closed with waste remaining in place, there will be provisions for post-closure maintenance to ensure that the damaging effects of plants and animals do not circumvent the functional effectiveness of the cover.

Although subsidence is a significant factor that must be considered during the closure of any facility, there is absolutely no basis for any further consideration in view of the facility's design and construction. On the basis of the above discussion, the rationale and justification for utilizing the soil cover already existing over the crib is determined to be technically sound.

5.3.2 Maximum Extent of Operation

The maximum extent of operations remaining unclosed during the active life of the 216-A-36B Crib is fully contained within the area delineated by the following Hanford coordinates (also refer to Figure 5-2):

N38475, W48500 to N39000, W48500 to
N39000, W48550 to N38475, W48550.

However, the facility is no longer active in that all effluent discharges have ceased. Upon regulatory approval of this closure plan, all of the closure activities described will be completed and the appropriate facility operator and independent certifications to that effect will be provided.

5.4 REMOVAL AND MANAGEMENT OF HAZARDOUS WASTE

5.4.1 Maximum Inventory of Hazardous Waste

Because bulk and non-containerized liquids were routinely discharged to the crib, the maximum inventory of waste will conservatively assume that the soil column beneath the crib and extending to the water table, is contaminated. Utilizing the coordinates in section 5.3.2 to define the areal extent of the facility at grade, and assuming that the upper 20 ft of soil overlying the crib is free of any regulated waste, the maximum inventory of waste is determined as follows:

Surface dimensions: 525 ft X 50 ft = 26,250 sq ft

Elevations: 695 ft above MSL at 20 ft below grade

399 ft above MSL at water the table

695 ft - 399 ft = 296 ft soil column depth

Maximum Inventory: 26,250 sq ft X 296 ft = 7,770,000 cu ft*

* approximately 288,000 cu yd

Data and information derived from investigations of the unsaturated zone and groundwater beneath the crib will be used to refine the maximum inventory of waste. Any changes in the estimate of the maximum waste inventory will be reported, along with supporting documentation, to the regulating agencies.

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5.4.2 Hazardous Waste Inventory Removal

The purpose of this plan is provide the information necessary to close the 216-A-36B Crib as a landfill with waste remaining in place. To accomplish this, the extent of contamination resulting from past ASD discharges must be determined through characterization of the unsaturated sediments beneath the crib. As a result, this characterization activity is likely to generate some amount of contaminated sediments that will have to handled, tested, and appropriately disposed of following an analytical determination of its chemical and/or radiological content.

The detailed instructions and procedures for this portion of the closure activity will be provided by a number of sources. The Sampling Plan for investigating the unsaturated sediments beneath the crib will describe how to handle all materials brought to the surface throughout the course of the characterization activity. The Sampling Plan will also define the individual responsibilities of the Site Safety Coordinator (SSC) and the Radiation Protection Technologist (RPT) assigned to this activity. In general, the SSC is responsible for assuring that all requirements of the Health and Safety Plan are met, including operation of the hazardous waste monitoring equipment (e.g., HNU, OVA, etc.). The RPT is responsible for radiological safety and insuring that all work is performed according to the provisions of the Radiation Work Permit (RWP). In addition, an Industrial Safety and Fire Protection specialist will provide overview of the sampling operation and insure that all activities are consistent with WHC safety practices.

The Sampling Plan, Health and Safety Plan, and RWP will be prepared and internally approved in advance of any portion of the characterization activity taking place. Although these documents will be appended to this plan at a later date, they will be available to the regulating agencies upon request.

All **potentially hazardous, but non-radiologically contaminated** sediments generated during the characterization effort will be considered contaminated pending receipt of the analytical results. Accordingly, all (non-radiologically contaminated) materials brought to the surface (that are in excess of the sample quantities submitted for analysis) will be packaged according to the requirements of RHO-RE-MA-13, Nonradioactive Dangerous Waste Packaging and Disposal Requirements (Rockwell 1987). If the analytical results prove negative (i.e., no contamination is present or detectable above the WAC 173-303 designation limits for dangerous waste) the drummed sediments can be handled as non-regulated waste and dispositioned accordingly. However, if the analytical data result in the waste being designated, a uniform hazardous waste manifest will be used to accompany the waste during transport (per RHO-MA-201, Hazardous Material Packaging, Shipping and Transportation Manual (Rockwell 1984)) to the 616 Building (the on-site Nonradioactive Dangerous Waste Storage Facility) where it will be processed for off-site recycling, treatment and/or disposal. (See section 5.4.3 for offsite TSD facilities currently under contract with the DOE-RL and WHC.)

All **radiologically contaminated** sediments and related sampling materials will be treated as if containing hazardous waste as well as radioactive waste (i.e., mixed waste). These materials will be handled and packaged according to the revised requirements for mixed wastes contained in RHO-MA-222 Rev 3, Hanford Radioactive Solid Waste Packaging and Disposal Requirements (Rockwell 1985). Should the analytical data confirm that the wastes do in fact contain both radioactive and hazardous constituents, the materials will be appropriately designated, manifested, and transported to the interim mixed waste storage facility located within the 200 West Area. Final dispositioning of these stored mixed wastes will include consideration for treatment prior to disposal in on-site facilities which are yet to be constructed or permitted.

If waste which is designated "mixed" prior to testing is determined (analytically) to contain no regulated components, the waste will be disposed as either waste that is radioactive only, or in lieu of any detectable

radioactivity, as sanitary waste. In either case, onsite facilities will be used for its disposal.

All aspects of the characterization activities involving potentially radioactive waste will be supported by WHC Tank Farms Process Engineering (TFPE). TFPE will provide the operating procedures necessary for contamination control at the closure site. They will also provide technical guidance for processing radioactive sample materials and decontamination of sampling equipment at the 2706-T and the T-Plant canyon facilities. Decontamination wastes generated at the 2706-T and T-Plant canyon facilities are collected for testing and treatment prior to dispositioning for disposal. The Tank Farms Process Engineer will provide radioactive waste shipping containers as necessary and arrange for a certified shipper to provide the necessary Radioactive Shipment Record (RSR) forms.

WHC Tank Farms Services (TFS) will provide operator support for radiological control and related waste handling activities at the closure site. TFS will also provide for transportation of any radiologically contaminated sampling equipment to the 2706-T or T-Plant decontamination facilities. All radioactive and potentially mixed waste transported from the closure site will be accompanied by the RSR assigned to the Tank Farms Services waste truck assigned to support the closure activity. All mixed waste will be accompanied by a uniform hazardous waste manifest form as well.

5.4.3 Off-Site TSD Facilities

Any nonradioactive dangerous waste generated during closure will be recycled, or treated and disposed under an existing contract between DOE-RL and WHC, and Northwest EnviroService Inc. Northwest EnviroService Inc. (EPA ID# WAD 058367152), is currently operating its TSD facilities under interim status and is located at the following address:

P.O. Box 24443
54 South Dawson Street
Seattle, WA 98134

The treatment methods employed by Northwest EnviroService Inc. include chemical neutralization, solidification and volume reduction prior to disposal. Incineration and other treatment processes may also be used under subcontracts established and managed by the Northwest EnvrioService Inc. WHC periodically exercises its right to inspect the above off-site facilities for assurance that Hanford Site generated wastes are being properly and compliantly handled through final disposal.

It is possible that the off-site TSD facility identified above will no longer be under contract at the time the 216-A-36B Crib undergoes final closure. Should a contractual change occur, this closure plan will be amended to reflect that change.

5.4.4 Personnel and Equipment Decontamination

Throughout the characterization portion of this closure activity, personnel and equipment will potentially be exposed to contaminated materials. During drilling and sampling activities at the closure site, field workers may become potentially contaminated in a number of ways, including airborne vapors, gases, and aerosols; splashes and spills; walking through contaminated areas; and handling contaminated equipment. Therefore, the following decontamination protocols for personnel and equipment will be followed by all personnel whose responsibilities will cause them to operate within any "exclusion" or "contamination reduction" zones established for this closure activity.

Personnel Decontamination Procedure

All personnel who access established "exclusion" and "decontamination reduction" zones will process through decontamination at the end of any given shift. A contamination reduction corridor will be established within the contamination reduction zone set up for each sample site supporting this closure activity. The contamination reduction corridor consists of a series of washing and rinsing steps (soap and water) in combination with a sequential doffing of equipment as shown in Figure 5-3. All decon solutions will be retained for periodic sampling according to the EPA protocol SW-846. Decon solutions will be subject to analytical parameters which are consistent with the sediment characterization underway at the time. Any special instructions pertinent to this procedure will be identified in the Sampling, and Health and Safety plans approved in advance of the characterization effort. As noted earlier, these plans will be appended to this closure plan, and in the interim, will be available to the regulating agencies upon request.

Clothing that is disposable will be removed and placed in sealed containers. Clothing that can be cleaned will be removed and sent to the onsite laundry facility located within the 200 West Area. Non-disposable clothing that may be reused will be processed through the soap and water decontamination procedure. Any decon solutions resulting from the cleaning of non-disposable clothing will be sampled as indicated in the paragraph above.

Equipment Decontamination Procedures

Sampling and Monitoring Equipment: All possible measures will be taken by personnel to prevent the contamination of any sampling and monitoring equipment to be used during this closure activity. Sampling devices will become contaminated, but monitoring instruments, unless they are splashed, usually do not. Any delicate instrument that cannot be easily decontaminated will be protected while it is being used by placing it in

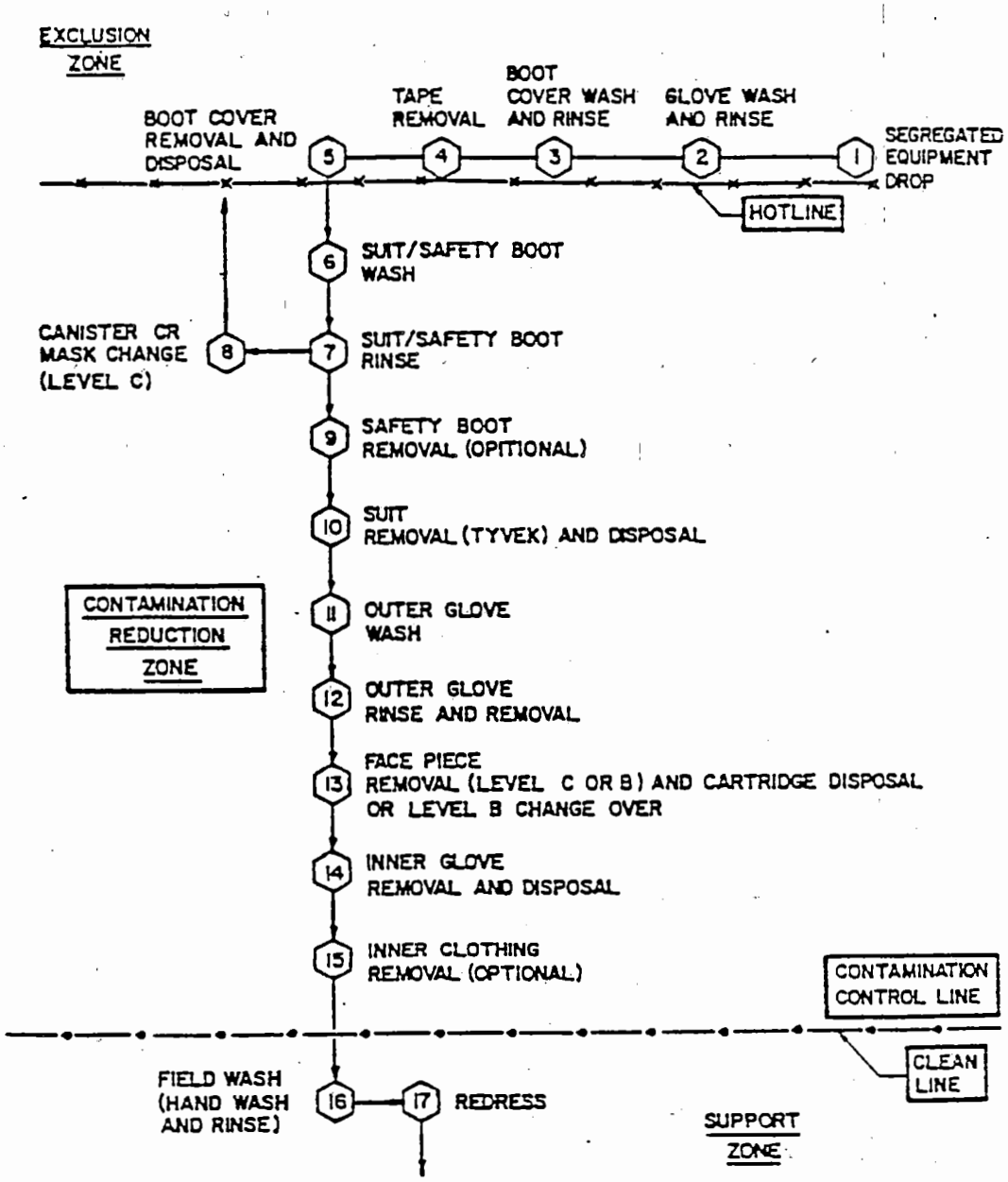

Figure 5.3. Contamination Reduction Corridor

a bag and using tape to secure it around the instrument. Openings in the bag can be made for sample intake, etc. All potentially contaminated protective wrappings and related materials will be double-bagged upon their removal and placed in appropriately marked containers. Any rags used for cleaning will handled in a like manner. Any decontamination solutions generated during this procedure will be properly secured in their container(s) at the end of each shift. Should special instructions relative to the cleaning and decontamination of sensitive equipment or sampling devices be necessary, they will be identified in the Sampling Plan to be approved before the characterization activity begins.

It is possible that larger quantities of waste will be generated by cleaning and decontaminating reusable equipment than might be generated through the use of disposable equipment. An example of this might be the drive shoes associated with some of sampling equipment. The decision on whether or not to use disposable equipment will consider the potential reduction in waste volume to be achieved.

Respiratory Protection Equipment: Any personnel who access the exclusion zone may be required to use SCBA equipment or supplied air respirators with egress cylinders (Ska-Pak) in conjunction with a cascade cylinder system. There is a high potential for these units to become contaminated. When decontaminating this equipment, the exterior should be thoroughly cleaned. Certain parts of the contaminated SCBA's, such as harness assemblies and airlines, are difficult to decontaminate. If grossly contaminated, they may have to be discarded. Some parts, such as the face piece and hose, shall be soaked in soap and water. To the extent possible, cleaning and decontamination will be performed at the onsite mask cleaning station. All potentially contaminated materials generated by efforts to decon this support equipment will be double-bagged immediately following their use and secured within

appropriately marked containers. Decon solutions will be securely contained following their use and periodically tested for designation and disposal purposes.

Heavy Equipment: All possible measures will be taken to prevent the contamination of heavy equipment. Those part of drilling equipment that become contaminated, such as auger flights, will be double bagged and taken to the 2706-T building or T-Plant canyon for decontamination before reuse. All decon solutions and residues are collected for testing and designation in accordance the operating procedures for each of those facilities.

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5.5 COVER DESIGN

By design, the 216-A-36B Crib was constructed in such a manner that liquid wastes entered the ground at a depth approximately 23 ft (7 m) below grade. Based on the functional and operational history of the crib, there is no reason to suspect that any WAC 173-303 regulated contaminants are present above the point at which those wastes entered the ground. Furthermore, it is expected that the characterization data will confirm that any contaminants resulting from past discharges to the crib are fully contained within the sediments below the influent distribution line. Accordingly, final closure of the 216-A-36B Crib will be achieved through isolation by what can best be termed a "massive soil" barrier.

For a cover to be effective it must isolate any waste remaining in place from a variety of physical and biological processes that can transport, or cause its transport, to the surface or the groundwater. Plants and burrowing animals can penetrate through the soil or other protective cover materials and into underlying waste. Such contact can in turn transport contaminants to the surface where direct human exposure or further dispersion might occur; or create preferential pathways which can affect the rate at which contaminants migrate toward the water table. Plant species that are common to the 200 Area plateau include native perennial shrubs (big sagebrush - Artemisia tridentata; and gray rabbitbrush - Chrysothamnus nauseousus) and annual forbs and grasses (Russian thistle - Salsola kali; and cheatgrass - Bromus tectorum). A number of studies have been conducted at Hanford to evaluate the potential for deep-rooted plants to contact and translocate contaminants (primarily radionuclides) to the surface. As indicated in Table 5-3, none of the depths reported for plants that are common to the 200 Areas are great enough to penetrate the soil cover existing over the crib.

Animal excavations for den construction and prey capture have also been implicated as a biological transport mechanism for buried waste (Hedlund and Roger 1976; Klepper et al. 1979; and Winsor and Whicker 1980). Examples of some

of the species common to the Hanford Site include small mammals (Townsend ground squirrels - Spermophilus townsendii; Great Basin pocket mice - Perognathus parvus; and badgers - Toxidea taxus) and insects (ants - Pogonomyrmex owyheei). None of the burrowing depths reported for these animals (see Table 5-4) begin to approach the approximately 23 ft (7 m) of soil existing over the crib.

A variety of destructive processes (e.g., wind erosion, subsidence, and physical damage attributable to biological intrusion) are also potentially detrimental to the functional longevity of disposal site covers. The occurrence of dust storms and the presence of active dunes at the Hanford Site provide evidence that wind erosion is a potential problem. However, experience indicates that wind erosion rates are reduced by an armoring effect produced as fine-grained materials are removed by the wind, leaving a coarser fraction which acts as a deterrent to further wind erosion. This "desert pavement" effect is reported to limit wind erosion rates to as little as 0.0001-in/yr (0.025 mm/yr) (DOE 1986). Even if a worst-case rate of 1-in/yr (2.5 cm/yr) is assumed, the losses potentially occurring over a 30 yr post-closure care period would not necessarily prove detrimental to the continued isolation of waste remaining in the ground. However, the worst-case assumption is unreasonable in that a vegetative cover and post-closure care will preclude the occurrence of any significant erosion of the final cover.

As indicated in Tables 5-3 and 5-4, the potential for deep-rooted plants and burrowing animals to directly contact the waste remaining in place is essentially excluded by the depth of cover existing over the crib. Of greater concern is the potential enhancement of pathways which might accelerate the rate of contaminant migration toward the water table. For example, plant and animal penetration of a cover can be expected to increase the infiltration and percolation of water through the waste zone. Decaying plant roots can also provide preferential pathways for moisture migration to depth. None of these potentially damaging mechanisms are unique to Hanford or the existing cover that is planned for isolation of the waste remaining in place at the crib.

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Careful selection of the vegetative cover will significantly reduce the degree of plant succession that could occur over the post-closure care period. For example, an established vegetative cover comprised of a variety of perennial grasses can effectively exploit the resources available and necessary for survival at the site. Other plants attempting to invade the site will find it difficult to become established due to the interspecific competition afforded by the already established plant cover. The influx of potentially troublesome deep rooting annual forbs and shrubs can be effectively controlled in this manner. Thus, large roots that might be susceptible to decay following the destruction of the above ground portion of the plant (by fire for example) are essentially eliminated from the site. A vegetative cover comprised of a mixture of grasses is also much less susceptible to fire than a cover largely made up of shrubs (e.g. sagebrush). Species selection for the final cover will also consider the palatability and hence the tendency for certain plants to attract burrowing or otherwise troublesome animals. Finally, since the site will be closed with waste remaining in place, there will be provisions for post-closure maintenance to ensure that the damaging effects of plants and animals do not circumvent the functional effectiveness of the cover.

On the basis of the above discussion, the rationale and justification for utilizing the soil cover already existing over the crib is determined to be technically sound.

5.5.1 Minimization of Liquid Migration

Contaminants remaining in place upon closure of a disposal site can only reach the groundwater by transport through the unsaturated sediments underlying the waste disposal site. The primary mechanism for contaminant migration is the movement of dissolved contaminants in water percolating through the unsaturated zone.

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To the extent that the crib received bulk liquids for the purpose of disposal, some contaminant transport may be inevitable as the water mound (free liquid) recedes toward the water table beneath the crib. Over the long-term, however, the major mechanism for downward migration will be the leaching of contaminants into solution in water infiltrating through the waste from the land surface (i.e., recharge water).

The rate at which the leaching process and contaminant migration occurs depends on the amount of water entering the surface soil, the rate of infiltration, the solubility of the waste constituents, and the tendency of the dissolved wastes to adsorb on the sediments. The toxicity of the wastes reaching the water table will in turn depend on the tendency for waste components to undergo chemical and/or biological transformation in the unsaturated zone.

Natural recharge is an almost immeasurably slow process at Hanford given the local arid conditions created by an average rainfall of less than 6-in (~15 cm) annually. In a closed-bottom lysimeter study conducted on the Hanford 200 Area plateau, recharge was found to be negative (net movement of water was upward over a 16 yr study period) (DOE 1986). For all practical purposes, there is apparently no recharge. In the event that the rainfall were to double, it is estimated that recharge rates might increase to 0.2 to 2-in/yr (0.5 to 5 cm/yr). However, the probability of an increase of this magnitude (i.e., a 100 percent increase in annual precipitation) over a 30 yr period is extremely, if not acceptably, small.

To understand the impact of past discharges to the crib relative to the potential worst case recharge scenario, consider the following. It is estimated that approximately 68,000 lb (31,000 kg) of ammonium hydroxide (or its nitrate equivalent) exists within the pore space of the unsaturated sediments beneath the 216-A-36B Crib (Environmental Technology Staff 1988). Based on currently available information, no other contaminants are present at concentrations

approaching the WAC 173-303 designation limits for dangerous waste. Drawing from on-site experience derived from the closure of similar facilities over the years, it has been found that the water present in the sediments at the time of closure continue to drain at a significant, exponentially decreasing rate. This condition persists for about one year at which time the volumetric water content of sediments approaches 10%. At this point, water drainage is considered imperceptible, so that any further movement can be attributed to the effect of natural recharge.

Combining the estimated 68,000 lb (31,000 kg) inventory of ammonium hydroxide and the upper recharge limit of 2-in/yr (5 cm/yr), a worst case estimate of annual liquid migration (i.e., recharge) and contaminant transport can be derived as follows:

The recharge rate (r) is defined as (Heller, Gee and Meyers 1985):

$$r = LO/T \qquad (1)$$

Where:

L = depth to groundwater (in cm)
O = volumetric moisture content (cm3/cm3)
T = time in yr required for recharge from the surface to groundwater

Therefore:

$$T = LO/r \qquad (2)$$

$$= (296 \text{ ft})\ (30.48 \text{ cm/ft})\ (0.10)\ /\ 5 \text{ cm/yr}$$

$$= 180 \text{ yr}$$

Since recharge occurs at approximately a constant rate, 1/180 of the nitrate equivalent in the crib will be discharged in the groundwater each year, or:

31,000,000 g / 180 yr = 1.72 E+5 g nitrate/yr

Dilution in the groundwater by a factor of approximately 12 must also be considered as follows:

$$D = \frac{\text{Volume of Groundwater}}{\text{Volume of Discharge}} \qquad (3)$$

Therefore:

V of GW = (D) (V of D)

= 4.0 E+7 l/yr (Environmental Technology Staff 1988)

(12) = 4.8 E+8 l/yr

Assuming the volume of recharge is insignificant, the dilution of nitrate is:

$$D = \frac{1.72\ E{+}5\ g/yr}{4.8\ E{+}8\ l/yr}$$

$$= 3.6\ E{-}4\ g/l$$

$$= 0.36\ ppm\ nitrate\ (in\ the\ groundwater)$$

Therefore, the maximum concentration that will ever occur in the unconfined aquifer beneath the crib is approximately 0.4 ppm. In view of the fact that the unconfined aquifer is not a source of on- or off-site drinking water, there is no technical or regulatory justification for supplementing or modifying the cover already existing over the crib.

5.5.2 Maintenance Needs

The final cover intended for closure of the 216-A-36B Crib was essentially fully emplaced at the time the crib was constructed approximately 22 yr ago. During this approximately 22 yr period of time, no significant maintenance has been required beyond occasional clean soil additions needed to compensate for natural settlement of the backfill materials. More recently, the surface of the crib received a new covering of coarse sand to correct some minor and localized disturbance resulting from the remediation of several nearby wells.

Based on experience from on-site surface stabilization (revegetation) conducted over approximately 800 acres since 1978, very little maintenance is required following the successful establishment of a vegetative cover. Successful establishment of the perennial grasses used for revegetation at Hanford generally requires from two to three years. During this period, the straw mulch applied for initial stabilization and the natural emergence of cheatgrass (Bromus tectorum), which is ubiquitous in southeastern Washington, combine to protect the soil cover from erosion by wind. Also, personnel knowledgeable of the grasses planted and the conditions necessary to their continued survival, periodically evaluate seedling progress and the overall condition of the site. Should these evaluations reveal any problems, recommendations for corrective actions are made at that time. During the initial establishment period, herbicides may be used to selectively control the influx of some of the more undesirable species (primarily Russian thistle) which compete for available moisture and nutrients. Herbicide applications are discontinued following successful establishment of the perennial grass. Fertilizer may also be applied after closure to stimulate plant vigor during the second or third year.

Based on experience from other on-site stabilization and revegetation activities, small rodent activity (burrowing) and subsidence have not proven to be a cause for any significant increase in maintenance. No additional backfilling has been required as a result of wind or water erosion. Maintenance of the final

cover is not expected to be dissimilar from that experienced to date on other Hanford stabilization projects.

5.5.3 Drainage and Erosion

No artificial drainage will be incorporated into the existing final cover. Soil permeability and typical rainfall intensities are such that water erosion has not been a problem at Hanford. The greatest potential for erosion arises in the late winter when rapid snow melts may occur over frozen ground. However, even under that sort of worst-case condition, no significant erosion has been observed.

Initial erosion/abrasion protection of the cover will be provided by the application of a straw mulch. The entire cover and surrounding area disturbed during closure will be mulched at a rate of approximately one ton of straw per acre. Mulching has been an integral part of the revegetation process at Hanford and it has proven very effective in minimizing seedling damage and potential soil loss by winds. Once established, the perennial grasses provide the protection necessary to minimize erosion over the long-term. There have been no instances of wind/water induced maintenance on the approximately 800 acres revegetated to date.

5.5.4 Settlement, Subsidence and Displacement

Considering that the existing cover was essentially emplaced approximately 22 years ago, it is highly probable that the little amount of settlement that might occur, has already occurred. Beyond some potential for isolated instances of localized settlement, the design of the crib and the backfill materials used during construction are not prone any significant subsidence. Nevertheless, settlement will be monitored through periodic surface measurements taken from permanent benchmarks and concrete perimeter posts. Possible maintenance related actions are address in the post-closure section of this plan.

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5.5.5 Cover Permeability

Based on the stratigraphy of an area near the 216-A-36B Crib (Figure 5-4), there is no reason to believe that the permeability of the cover soil is greater than that of the underlying sediments. Also, the calculations in section 5.5.1 indicate that moisture movement in the unsaturated sediments beneath the closure site is acceptably small. Further evidence and data to support the calculations will be obtained throughout the course of the crib characterization activity. This information will be appended to this plan, or in the interim, made available to the regulating agencies upon request.

5.5.6 Freeze/Thaw Cycle Effects

The cover existing over the crib is composed of a largely homogeneous mixture of local soil at a thickness (approximately 23 ft) which is unlikely to be affected by upheaval caused by expanding ice crystals. The greatest frost penetration depth of record (1952 and 1980) is 36-in.

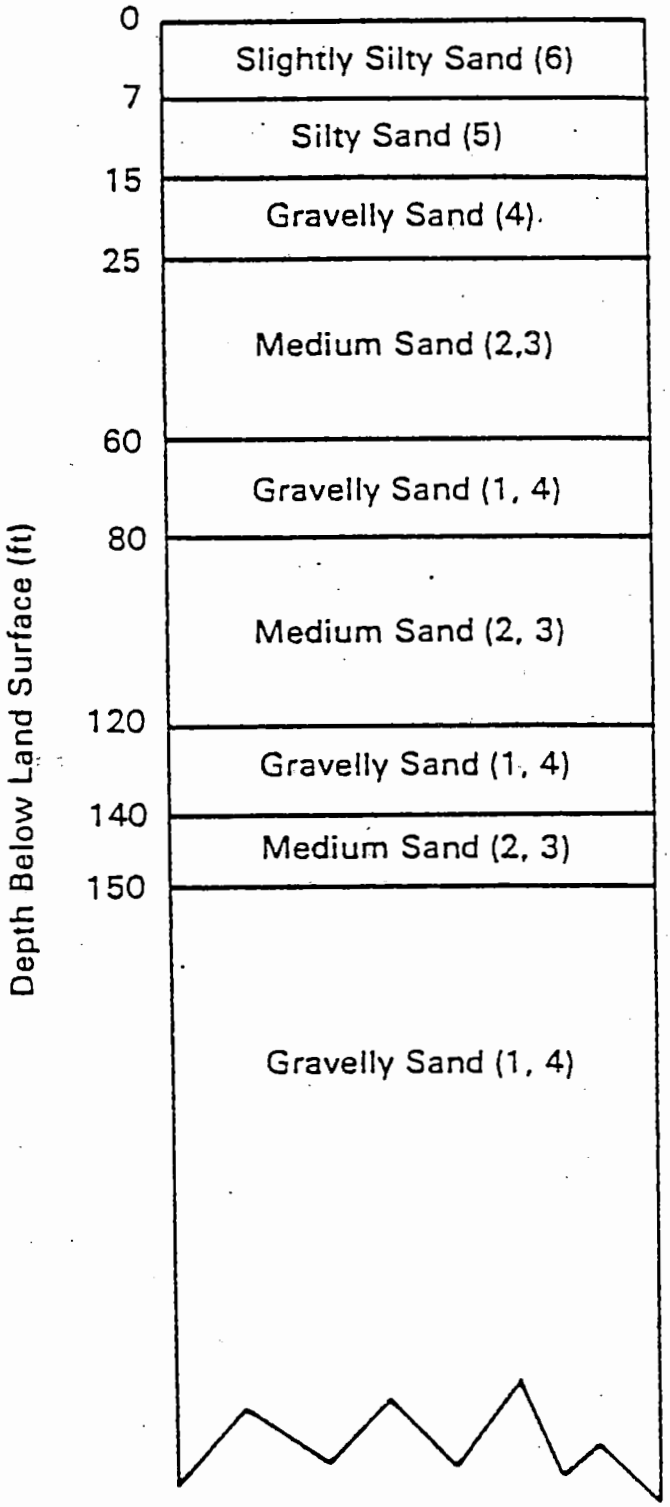

Figure 5-4. Stratigraphy in the Vicinity of the 216-A-36B Crib.

5.6 SCHEDULE FOR CLOSURE

As indicated throughout this closure plan, the final cover is essentially complete, just as it was emplaced at the time the 216-A-36B Crib was constructed. The primary closure activity is, therefore, accomplishment of the characterization activities needed to compile the data and interpretative information needed to demonstrate adequate knowledge of the vertical and horizontal extent of contamination resulting from past ASD discharges and use of the crib.

The initial efforts undertaken toward characterization of the closure site are scheduled to begin in May 1988. Due to the nature of any characterization activity, it is impossible to determine the number of boreholes and samples that will be required to complete the overall effort. The data derived from the initial effort will used to determine the location(s) and extent of additional sampling. The characterization process is, therefore, an reiterative one that one builds upon itself.

As a result, it is not possible to provide a detailed schedule for closure at this time. As the characterization efforts progress, the regulating agencies will apprised of the data and interpretative results. As soon as enough information has been compiled to demonstrate adequate knowledge of the waste and dimensional extent of the resulting contamination, a detailed schedule for all of the remaining activities necessary for closure will be prepared. The schedule for final closure of the 216-A-36B Crib will then be submitted to the regulating agencies.

5.6.1 Extensions for Closure Time

Should it be determined by the characterization activity that closure will take longer than the 180 days allowed (following closure plan approval), the justification necessary to support a request to extend the 180 day closure period will be prepared.

5.7 POST-CLOSURE PLAN

Due to Ecology's classification of the 216-A-36B Crib as a landfill, DOE-RL and WHC, co-operator's of the Hanford Site, intend to close the facility as a landfill with waste remaining in place. Accordingly, following certification that closure has been completed in accordance with the requirements of the closure plan, the following post-closure plan requirements will take effect.

5.7.1 Inspection Plan

The DOE-RL and/or WHC will designate post-closure responsibility to an individual or group who will become knowledgeable of the closure site and the requirements for its post-closure performance and care. As a minimum, the following monitoring activities will be performed semiannually for the first five years, and annually for the remainder of the post-closure period:

(a) Evaluation of settlement
(b) Evaluation of vegetative cover
(c) Evaluation of bench marks
(d) Evaluation of rodent intrusion
(e) Evaluation of erosion

The indicated frequency of inspection is expected to be adequate to detect any serious problems which could affect the performance of the final cover.

Maintenance action will be initiated within 90 days if the inspection reveals that the integrity of the final cover can potentially be breached. A potential breach is defined below along with the possible maintenance action:

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(a) Settlement/subsidence greater than 18 inches (0.5 meters) will initiate maintenance action. Maintenance action may include backfilling to a grade consistent with that of the remainder of the cover; or some method of mechanical compaction prior to backfilling to ensure the minimization of any further settlement related maintenance. Any area of the surface cover (vegetation) disturbed by such maintenance action will be repaired to return the cover to its pre-maintenance condition.

(b) Vegetative cover density of less than ten percent after two years of closure will initiate maintenance action. Maintenance actions will include reseeding and possible fertilizer application.

(c) Bench marks observed to be damaged or out of alignment will result in maintenance action. Maintenance action will include replacement of damaged bench marks and resurveying of bench marks found to be out of alignment.

(d) Rodent intrusion in densities that are judged to threaten the integrity of the final cover will result in maintenance action. Maintenance action might include the use of chemical deterrent and/or trapping.

(e) Erosion damage that results in the loss of 18 inches (0.5 meters) of the final cover soil will result in maintenance action. Maintenance action will include replacement of the soil at the affected area, reseeding, and performing other selected tasks that were performed during closure to insure a vigorous vegetative growth.

5.7.2 Monitoring Plan

During the post-closure care period, groundwater monitoring will be conducted as described in section 4.0 (to be appended at a later date). There are no liners or leachate collection and removal systems at the 216-A-36B Crib. All groundwater monitoring wells for the crib will be within a secured area of the Hanford Site. All wells will be routinely inspected to ensure proper condition and operation.

5.7.3 Maintenance Plan

During the post-closure care period, the maintenance operations are directed at maintaining the integrity of the final cover. On-site experience since 1978 indicates that minimum maintenance activities are required once the vegetative cover is successfully established. Invading undesirable plants, primarily Russian thistle (*Salsola kali*), often compete with the seeded species for the resources necessary to survival. The active elimination of these competing species for two to three years after seeding generally allows the vegetative cover enough time to become firmly established.

Each Spring (generally between March 15, and April 15) for two to three years following closure, selective herbicides will be applied to the closure area to minimize the establishment of deep rooting broadleaf annual plants that compete with the grasses for moisture and nutrients. Selective herbicide applications will be discontinued following successful establishment of the perennial grass cover.

Soil permeabilities and rainfall intensities at Hanford are such that water erosion has proven to be practically nonexistent. However, the potential for wind erosion is possible, particularly during the period of vegetative establishment.

Current mulching practices, which will be implemented during closure, have been quite effective at minimizing wind erosion. To date, there has been no need to import or provide additional backfill as a result of erosion.

Maintenance of bench marks has not been a problem to date. Vegetation typical of the arid Hanford environment is sufficient to prevent drifting sand from overrunning or obscuring the bench marks, and small enough in stature that observation is not obscured. However, if a bench mark becomes physically damaged and needs to be replaced, that action will be completed within 90 days of the original observation.

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5.8 NOTICE IN DEED

Notice to Local Land Authority

The DOE-RL will file, within 90 days after the start of the post-closure care period, the following documents or similar documents to the local land use authority and the regulating authority. The land use authority is the Benton County Planning Department located at Courthouse Building, Prosser, Washington, 99350.

(a) A survey plat indicating the location and dimensions of the crib to the extent the information exists and with respect to permanently surveyed bench marks will be submitted. This plat will be prepared by a certified professional land surveyor.

(b) The following note is to accompany the survey plat:

This plat describes real property in which hazardous wastes have been disposed and buried in accordance with requirements of 40 CFR Part 264 and/or WAC 173-303. Although this hazardous waste disposal facility is now closed, public health, environmental safety, and regulations issued by the EPA in 40 CFR 264.119 and/or WAC 173-303-610(9) require that post-closure use of the property never be allowed to disturb the integrity of the final cover unless it can be demonstrated that any proposed disturbance will not increase any risk to human health or the environment.

(c) A record of the type, location, and quantity of hazardous wastes disposed of within the crib to the extent that the information exists will be submitted. During the post-closure care period, any changes to this record will be submitted to the regulating authority.

Notice in Deed to Property

The DOE-RL will, in accordance with state law, sign, notarize, and attach the following notation to the deed of the 216-A-36B Crib area within 180 days of the start of the post-closure care period:

TO WHOM IT MAY CONCERN

The U.S. Department of Energy-Richland Operations Office, an operations office of the U.S. Department of Energy, which is a Department of the United States Government, the undersigned, whose local address is the Federal Building, 825 Jadwin Avenue, City of Richland, County of Benton, State of Washington, hereby gives the following notice as required by 40 CFR 270.14(b)(14) and/or WAC 173- 303-806(4)(a)(xiv):

(a) The U.S. Department of Energy is, and since April 1943, has been in possession in fee simple of the following described lands (legal description).

(b) Since November 19, 1980, the U.S. Department of Energy-Richland Operations Office has disposed of hazardous and/or dangerous waste under the terms of regulations promulgated by the United States Environmental Protection Agency and/or Washington Department of Ecology to the above-described land.

(c) The future use of the above-described land is restricted under the terms of 40 CFR 264.117(c) and/or WAC 173-303-610(7).

(d) Any and all future purchasers of this land should inform themselves of the requirements of the regulations and ascertain the amount and nature of wastes disposed on the above-described property.

(e) The U.S. Department of Energy-Richland Operations Office has filed a survey plat with the Benton County Planning Department and with the United States Environmental Protection Agency Region 10 and/or Washington Department of Ecology showing the location and dimensions of the 216-A-36B Crib and a record of the type, location and quantity of waste disposed within the area of the crib.

5.9 CLOSURE COST ESTIMATE

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

5.10 FINANCIAL ASSURANCE MECHANISM FOR CLOSURE

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

5.11 POST-CLOSURE COST ESTIMATE

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

5.12 FINANCIAL ASSURANCE MECHANISM FOR POST-CLOSURE CARE

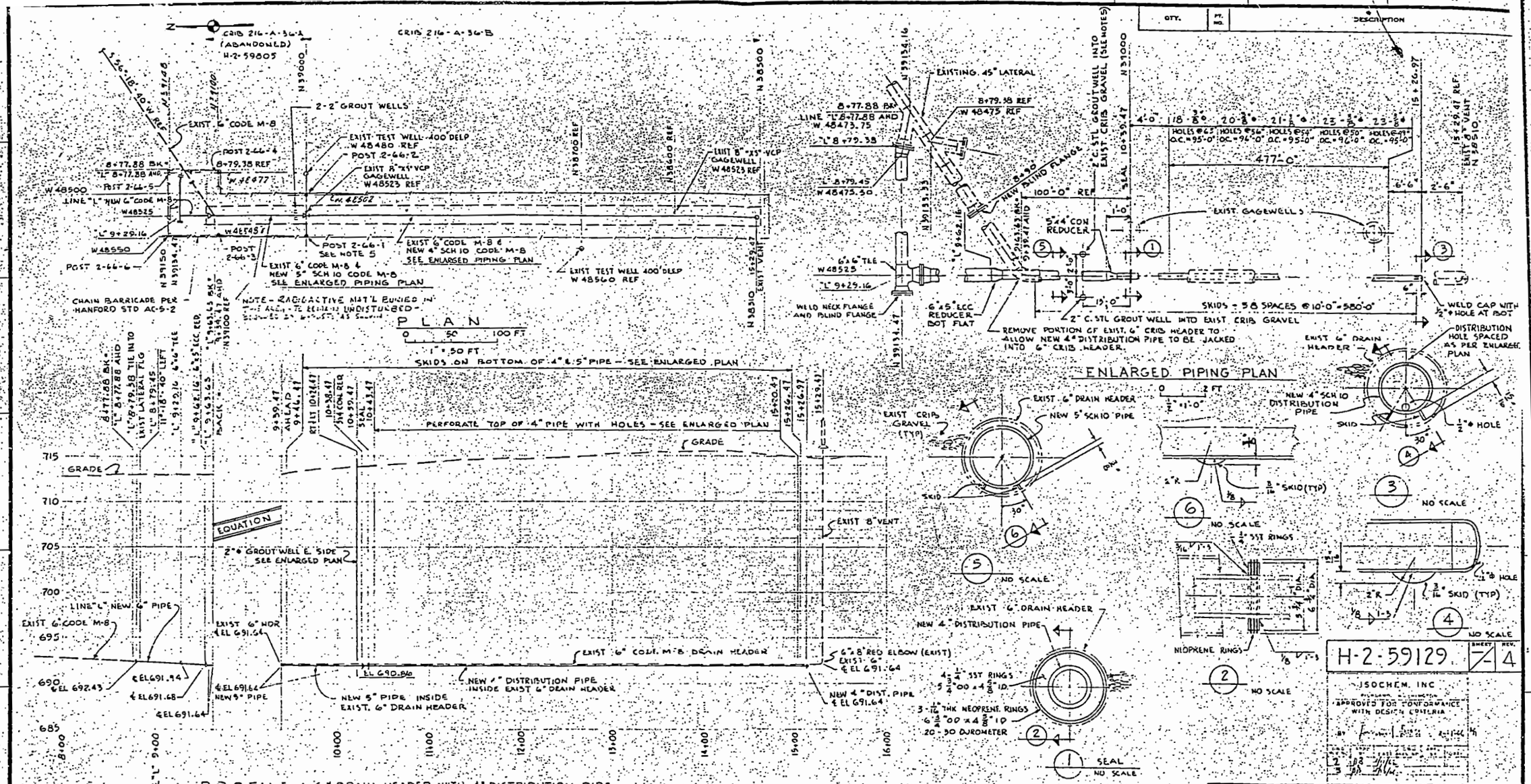
This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

9 1 1 1 3 2 4 0 9 7 6

5.13 LIABILITY REQUIREMENTS

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

9 1 1 3 2 1 0 9 3 7



GENERAL NOTES

1. INSTALLATION OF UNDERGROUND PIPING SHALL BE PER HWS 6138-5
2. PIPING MATERIAL PER "PIPING MATERIAL CODE" REF H-2-31750 SHB UNLESS OTHERWISE NOTED.
3. FOR WELDING SPEC REF HWS 8242, WELDING ROD TO BE TYPE 308L SST. ALL BUTT JOINTS SHALL BE FULL PENETRATION WELDS.
4. FOR EXCAVATION, BACKFILL & GRADING REF SPEC. HWS-8340
5. IDENTIFICATION MARKERS FOR ISURIED RADIOACTIVE MATERIAL AS PER HANFORD STD AC-5-40 AND ARE LOCATED AS FOLLOWS:
   POST 2-66-1 N-39000 W-48548 POST 2-66-2 N 39114 W 48477
   POST 2-66-3 N 39000 W 48562 POST 2-66-5 N 39148 W 48477
   POST 2-66-3 N 39100 W 48548 POST 2-66-6 N 39148 W 48548
6. 2" GROUT WELL - TWO JOHNSON RED HEAD DRIVE POINTS, 2"-3'x 42", 304 SS SLOT SIZE 80 OPNG. WERE USED. 1.5 C.Y. OF PORTLAND CEMENT ASTM TYPE 2, WITH A MIN. WATER CONTENT OF 3.9 GAL/100 LB SACK AND A MAXIMUM WATER CONTENT OF 5.5 GAL/100 LB SACK WAS PUMPED INTO EACH WELL.

THIS DWG MODIFIES

H-2-44501	SH. 15, 26 AREA MAPS
ARH-1562	200 E & W. LIQUID WASTE SITES
H-2-31750	SHB PIPING MATERIAL CODE
HWS-3341	EXCAVATION, BACKFILL & GRADING
HWS 8242	WELDING SPECIFICATION
HWS-6138-5	U-G PIPING SPECIFICATION
H-2-59805	PLAN & PROFILE 6" DRAIN HDR

REFERENCE DRAWINGS

USED WITH DWG. H-2-59805

REV.	BY	DATE	DRAWING STATUS	APPROVAL AUTHORITY	ECN NO.
4			ADD REFERENCE DWGS & DOCUMENT ECN 23726		
3			AS-BUILT REVISIONS		
2			CHECKED FOR AS-BUILT PROJECT COMPLETE		
1			REV'D HOLE SIZE & SPACING		
			COMMENT PRINT — ISSUE NO.		
			CHECK PRINT — ISSUE NO.		

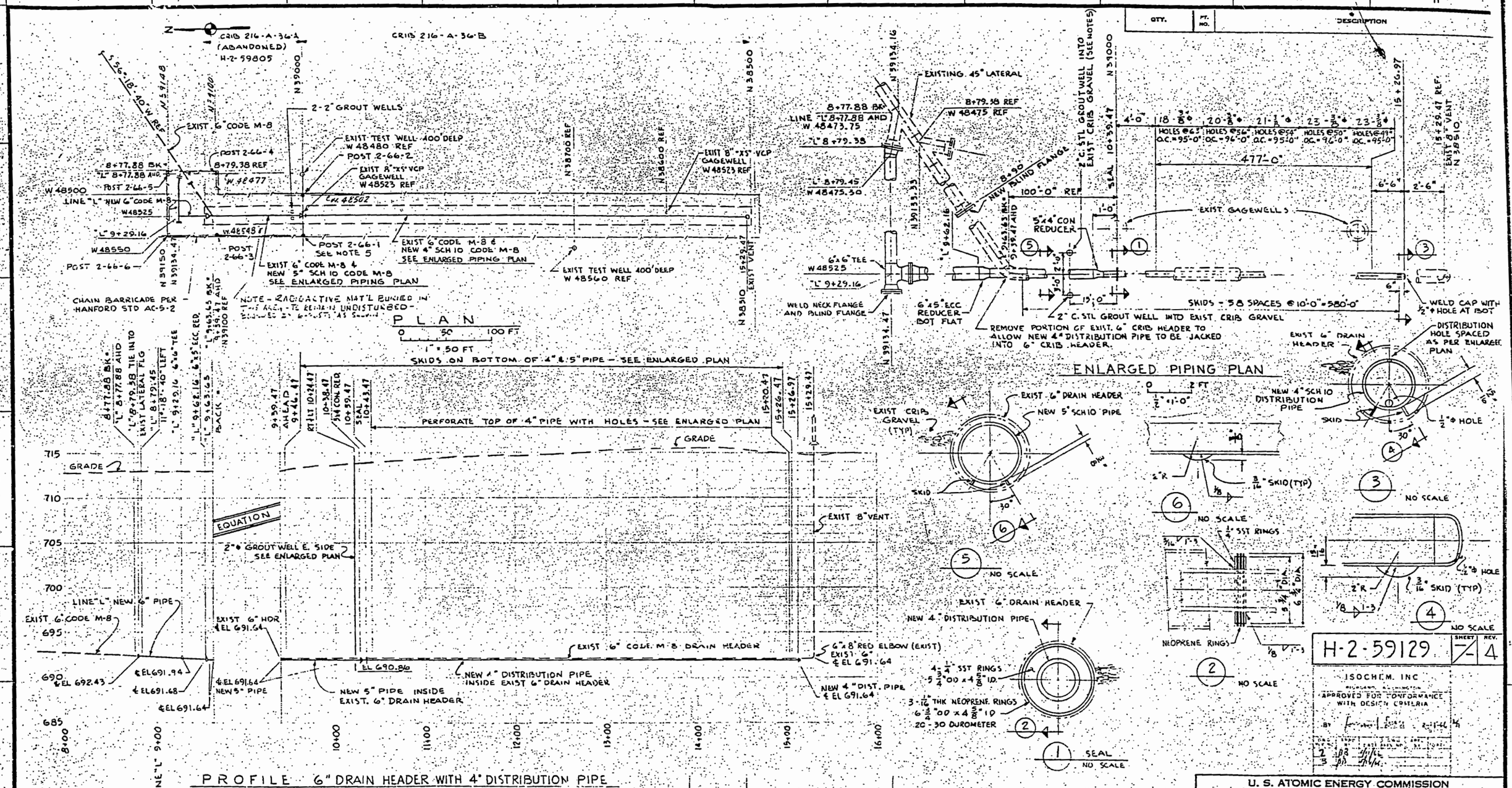
U. S. ATOMIC ENERGY COMMISSION
RICHLAND OPERATION OFFICE

VITRO ENGINEERING CO.
A DIVISION OF VITRO CORP. OF AMERICA

SCALE SHOWN
DRAWN BY E. A. GOAKEY 1-20-66
CHECKED BY
APPROVED
APPROVED
APPROVED
CLASSIFICATION NONE

CRIB 216-A-36B PLAN PROFILE & DETAILS, 4" DISTRIBUTION PIPE

W.O. NO. CE-0159
TITLE INCREASED PROCESSING FLEXIBILITY
216-A
0401
DWG. NO. H-2-59129



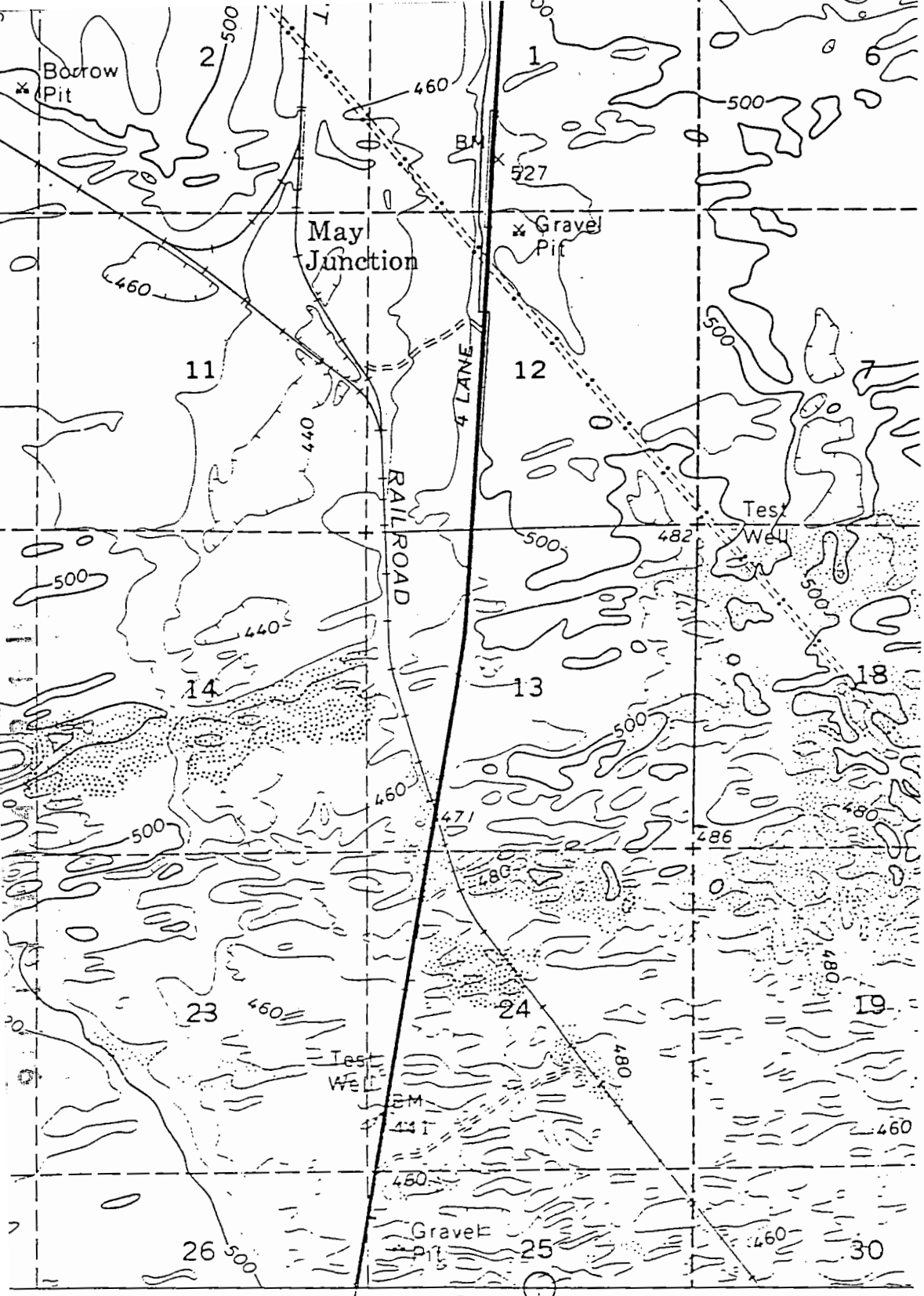
GENERAL NOTES

1. INSTALLATION OF UNDERGROUND PIPING SHALL BE PER HWS 6138-S
2. PIPING MATERIAL PER "PIPING MATERIAL CODE" REF H-2-31750 SH 8 UNLESS OTHERWISE NOTED.
3. FOR WELDING SPEC REF HWS 8242. WELDING ROD TO BE TYPE 308L SST. ALL BUTT JOINTS SHALL BE FULL PENETRATION WELDS.
4. FOR EXCAVATION, BACKFILL & GRADING REF SPEC. HWS-8340
5. IDENTIFICATION MARKERS FOR BURIED RADIOACTIVE MATERIAL AS PER HANFORD STD AC-5-40 AND ARE LOCATED AS FOLLOWS:

POST 2-66-1	N-39000 W-48548	POST 2-66-4	N 39100 W 48477
POST 2-66-2	N 39000 W 48502	POST 2-66-5	N-39148 W 48477
POST 2-66-3	N 39100 W 48548	POST 2-66-6	[illegible]

6. 2" GROUT WELL - TWO JOHNSON RED HEAD DRIVE POINTS. 2"-36"x 42", 304 SS SLOT SIZE 80 OPNG. WERE USED. 1.5 C.Y. OF PORTLAND CEMENT ASTM TYPE 2, WITH A MIN. WATER CONTENT OF 3.9 GAL/100 LB SACK AND A MAXIMUM WATER CONTENT OF 5.5 GAL/100 LB SACK WAS PUMPED INTO EACH WELL.

THIS DWG MODIFIES



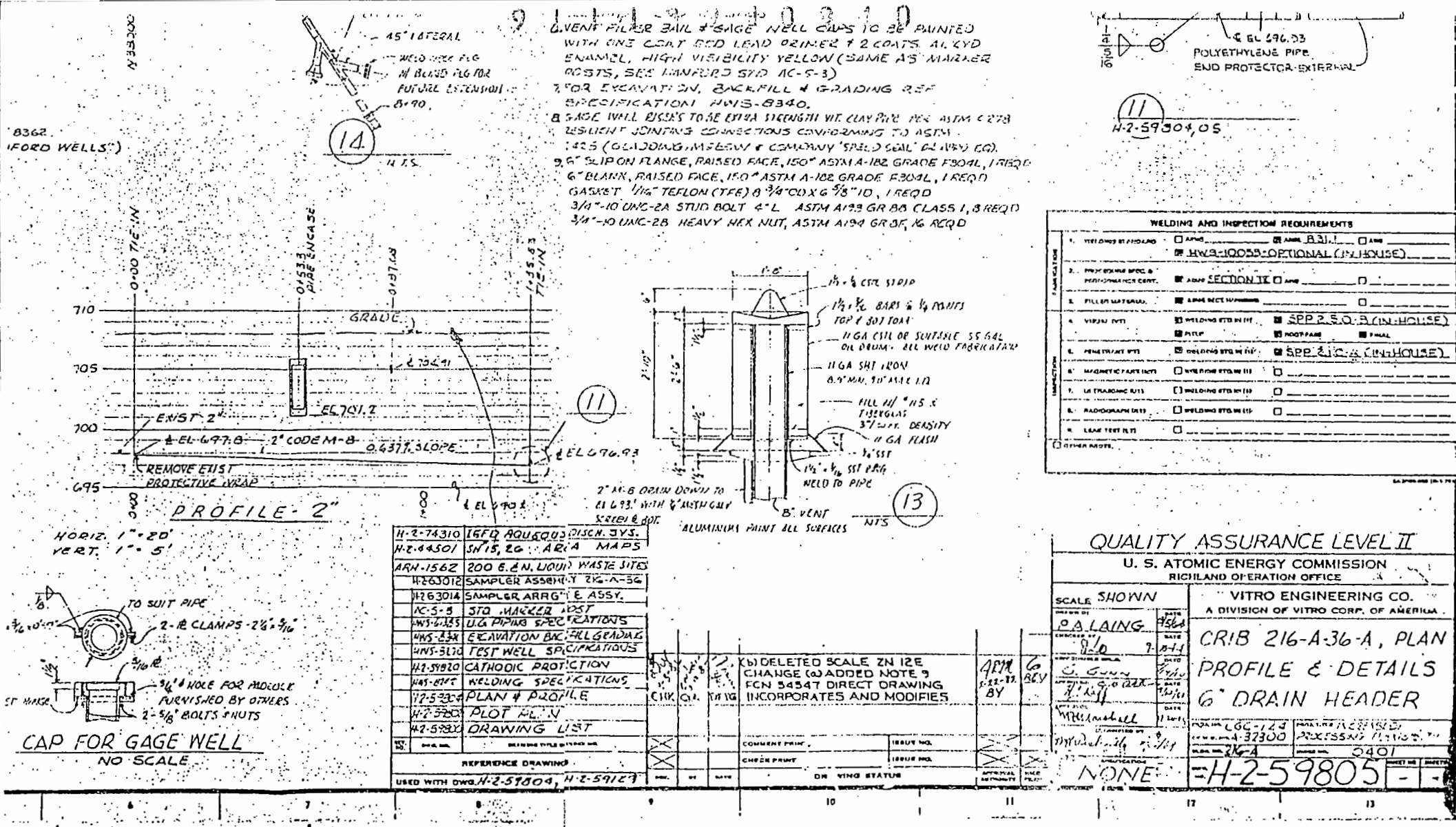
SCALE 1:62500

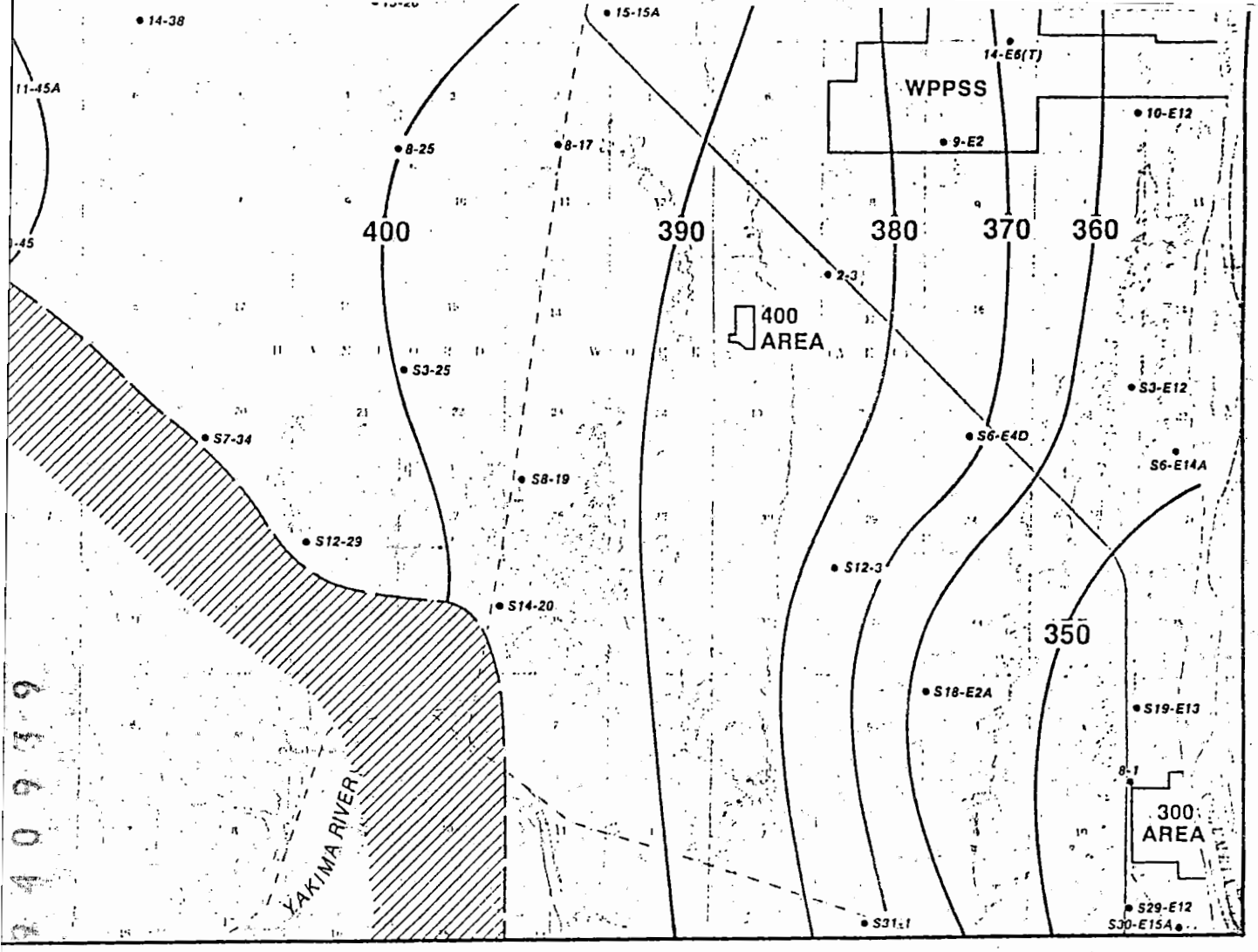
0 1 2

3000 6000 9000 12000 150

5 0 1 2 3

CONTOUR INTERVAL 20 FEET


6. VENT FILLER BAIL & GAGE WELL CAPS TO BE PAINTED WITH ONE COAT RED LEAD PRIMER & 2 COATS ALKYD ENAMEL, HIGH VISIBILITY YELLOW (SAME AS MARKER POSTS, SEE HANFORD STD AC-5-3)
7. FOR EXCAVATION, BACKFILL & GRADING REF SPECIFICATION HWS-8340.
8. GAGE WELL RISERS TO BE EXTRA STRENGTH VIT. CLAY PIPE PER ASTM C 278 RESILIENT JOINTING CONNECTIONS CONFORMING TO ASTM C425 (OLDDOMINION MFG CO & COMPANY "SPEED SEAL" OR APPD EQ).
9. 6" SLIP ON FLANGE, RAISED FACE, 150# ASTM A-182 GRADE F304L, 1 REQD
6" BLANK, RAISED FACE, 150# ASTM A-182 GRADE F304L, 1 REQD
GASKET 1/16" TEFLON (TFE) 8 3/4" OD X 6 5/8" ID, 1 REQD
3/4"-10 UNC-2A STUD BOLT 4" L ASTM A193 GR B8 CLASS 1, 8 REQD
3/4"-10 UNC-2B HEAVY HEX NUT, ASTM A194 GR 8F, 16 REQD
45° LATERAL
WELD HEX PLG W/ BLIND FLG FOR FUTURE EXTENSION
B-90
14
H.T.S.
N 33300
8362
(FORD WELLS)
0.00 TIE-IN
0.533 PIPE ENCASE
0.37.63
1.35.63 TIE-IN
710
705
700
695
GRADE
EL 703.41
EL 701.2
EXIST 2"
℄ EL 697.8
2" CODE M-8
0.437% SLOPE
℄ EL 696.93
REMOVE EXIST PROTECTIVE WRAP
℄ EL 690.2
PROFILE - 2"
HORIZ. 1" = 20'
VERT. 1" = 5'
11
℄ EL 696.93
POLYETHYLENE PIPE END PROTECTOR-EXTERNAL
11
H-2-59804,05
1'-6"
1/8 x 1/8 CSF STRIP
1 1/2 x 1/2 BARS & 1/4 NUTS TOP & BOT TOW
11 GA CSF OR SUITABLE SS GAL OIL DRUM - ALL WELD FABRICATION
11 GA SHT IRON 8.9" MIN, 9.0" AVG I.D.
FILL W/ "HS" FIBERGLAS 3#/CU.FT. DENSITY
11 GA FLASH
1/4" SST
1 1/2 x 1/16 SST BRG WELD TO PIPE
2" M-6 DRAIN DOWN TO EL 693' WITH 1/4" MESH GUY SCREEN & BOT.
8" VENT
ALUMINUM PAINT ALL SURFACES
NTS
13
TO SUIT PIPE
2-℄ CLAMPS - 2 1/2 x 3/16"
3/16 ℄
3/4" ϕ HOLE FOR PADLOCK FURNISHED BY OTHERS
2-5/8" BOLTS & NUTS
CAP FOR GAGE WELL
NO SCALE
WELDING AND INSPECTION REQUIREMENTS
FABRICATION
1. WELDING & PROCEDURE — ASME B31.1 — HWS-10055-OPTIONAL (IN-HOUSE)
2. PROCEDURE SPEC & PERFORMANCE CERT. — ASME SECTION IX
3. FILLER MATERIAL — ASME SECT IX
INSPECTION
4. VISUAL (VT) — WELDING STD IN EFF — SPP 2.5.0.B (IN-HOUSE)
5. PENETRANT (PT) — WELDING STD IN EFF — SPP 2.1.0.A (IN-HOUSE)
6. MAGNETIC PARTICLE (MT)
7. ULTRASONIC (UT)
8. RADIOGRAPH (RT)
9. LEAK TEST (LT)
OTHER NOTE
H-2-74310 IGFD AQUEOUS DISCH. SYS.
H-2-44501 SN 15, 26 AREA MAPS
ARH-1562 200 E. & N. LIQUID WASTE SITES
H-2-63012 SAMPLER ASSEMBLY 216-A-36
H-2-63014 SAMPLER ARRG'T & ASSY.
AC-5-3 STD MARKER POST
HWS-6385 U.G. PIPING SPECIFICATIONS
HWS-8340 EXCAVATION BACKFILL GRADING
HWS-5170 TEST WELL SPECIFICATIONS
H-2-59820 CATHODIC PROTECTION
HWS-8747 WELDING SPECIFICATIONS
H-2-59804 PLAN & PROFILE
H-2-59805 PLOT PLAN
H-2-59806 DRAWING LIST
REFERENCE DRAWING
USED WITH DWG. H-2-59804, H-2-59127
(b) DELETED SCALE ZN 12E
CHANGE (a) ADDED NOTE 9
FCN 54547 DIRECT DRAWING
INCORPORATES AND MODIFIES
BY
COMMENT PRINT
CHECK PRINT
ISSUE NO.
DRAWING STATUS
QUALITY ASSURANCE LEVEL II
U. S. ATOMIC ENERGY COMMISSION
RICHLAND OPERATION OFFICE
SCALE SHOWN
VITRO ENGINEERING CO.
A DIVISION OF VITRO CORP. OF AMERICA
CRIB 216-A-36-A, PLAN PROFILE & DETAILS 6" DRAIN HEADER
NONE
H-2-59805



the Environmental Technology
ion of Westinghouse Hanford
nap were issued semiannually as
RE-SR-86-65 DEC P. The current
e 1987 and is issued as WHC
been made to achieve compliance

l semiannually. Unconfined
ater-level measurements made in
d piezometers are used in

ed about 1 ft since the December
ation of U Pond in the fall of 1984,
of approximately 7 ft. The water-
y approximately 1½ ft since the
renewed activity at the

map. The water-table elevations
heets.

elix 199, wells in the 200 East and
the rest of the map have the

by 0.3048 to obtain elevation (m).

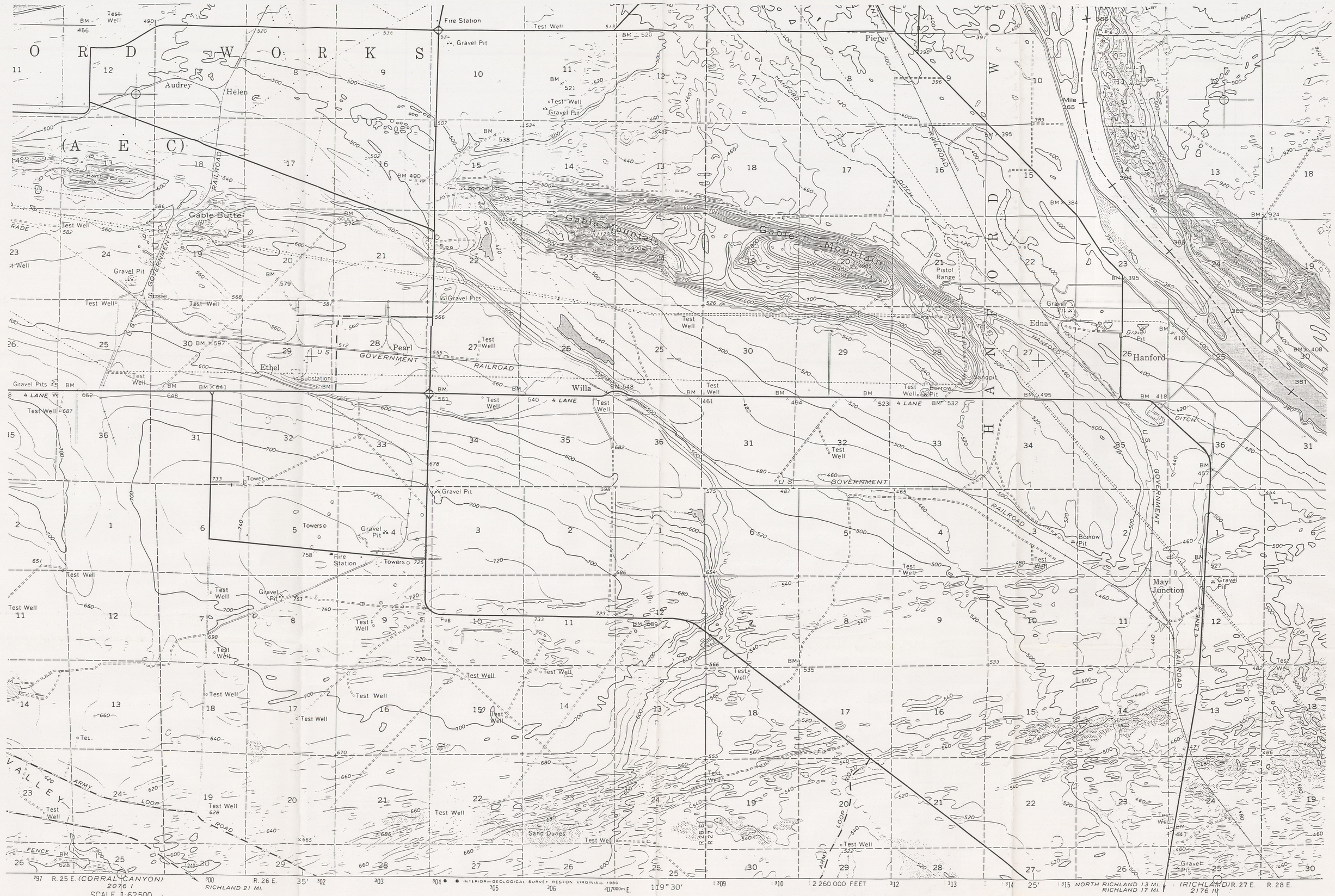
DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE

WESTINGHOUSE HANFORD COMPANY

HANFORD SITE WATER TABLE
JUNE 1987
WHC-EP-0054-1

APPROVED	A.G. LAW	
DATA COMPILED	A.L. SCHATZ	
DATA DRAFTED	A.L. SCHATZ	
	J.A. SERKOWSKI	
MEASUREMENTS	A.L. SCHATZ	
	J.J. AMMERMAN	

2B8708-11.1



SCALE 1:62500

CONTOUR INTERVAL 20 FEET

ROAD CLASSIFICATION

Heavy-duty — Light-duty

Medium-duty — Unimproved dirt

State Route

Mapped, edited, and published by the Geological Survey in cooperation with the Army Map Service

Control by USGS and USC&GS

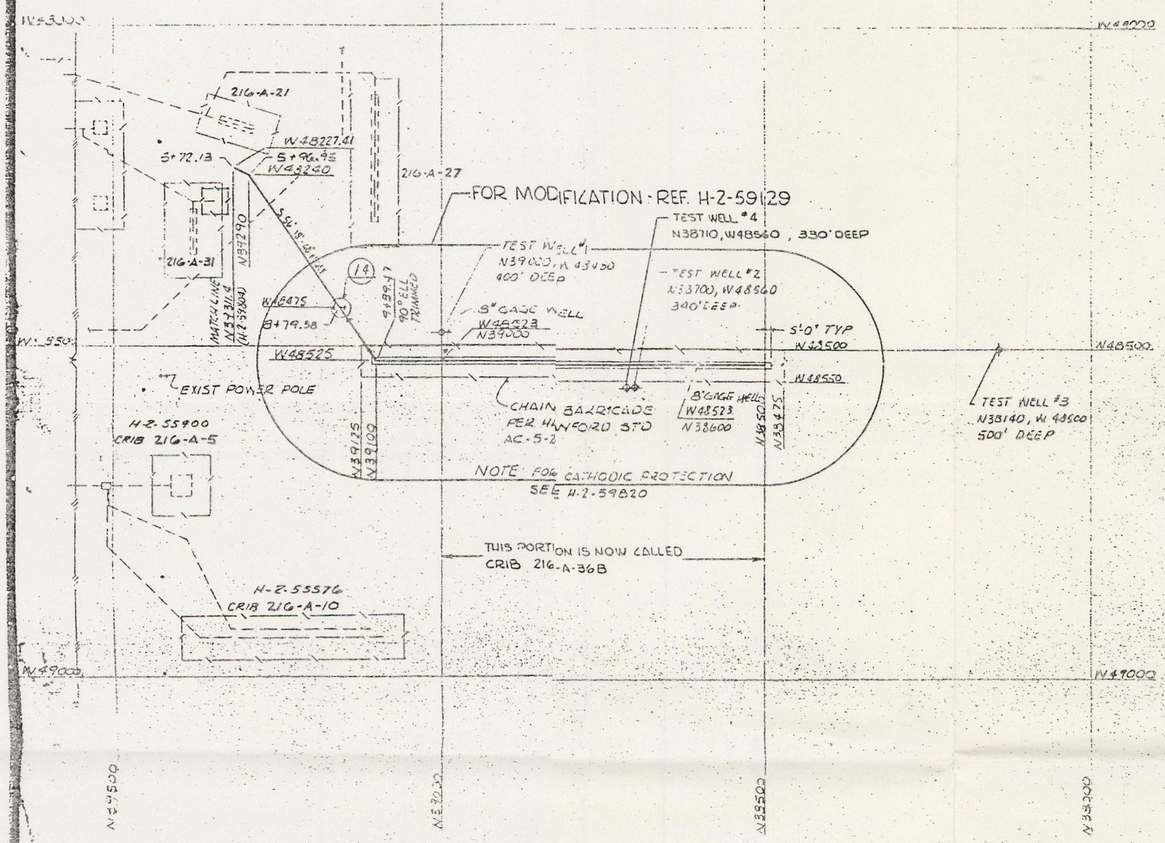
Topography by photogrammetric methods from aerial photographs taken 1948 and planetable surveys 1951

Revised from aerial photographs taken 1964

GN MN 1°43' 21° 373 MILS

SCALE 1:62500

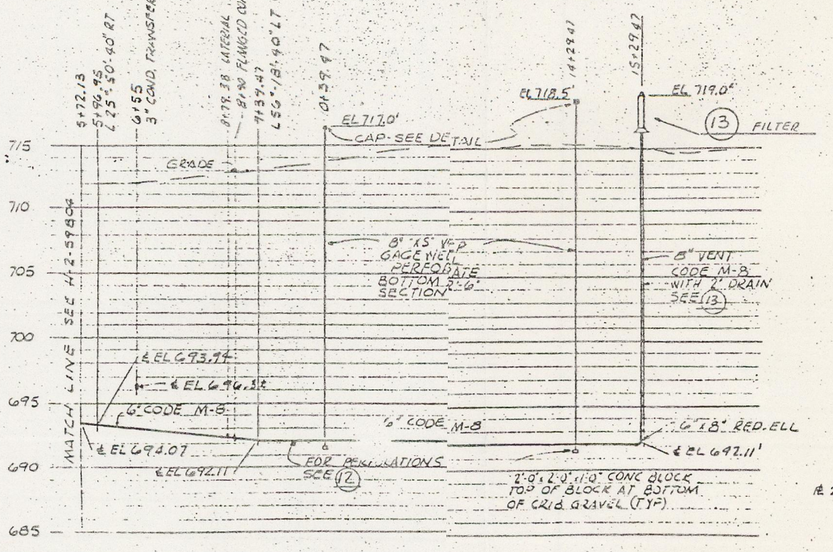
CONTOUR INTERVAL 20 FEET



PLAN

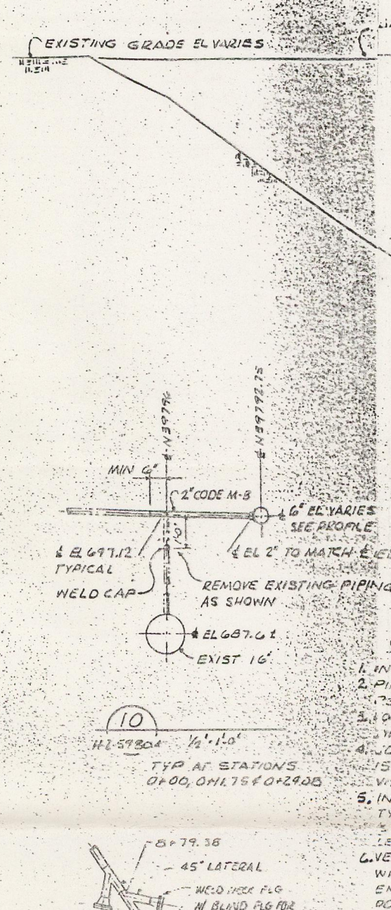
1" = 1'-0" 0 100 FT

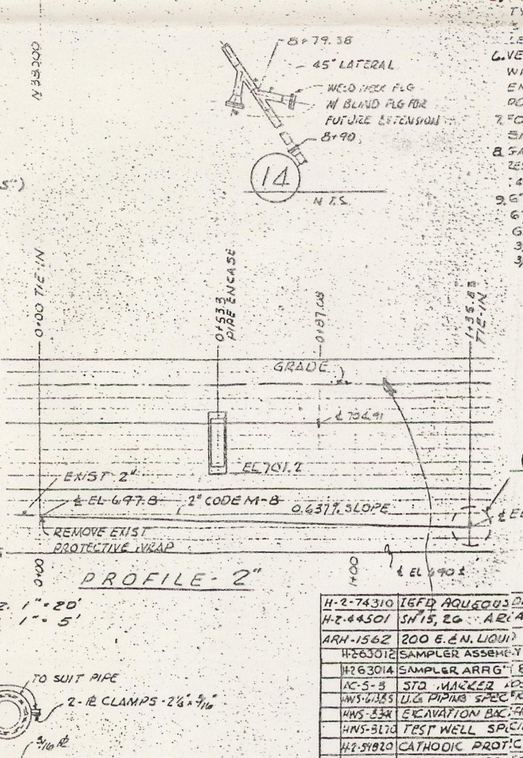
TEST WELLS (3) PER SPEC HWS 8362
(REF BNWL-928 "HANFORD WELLS")



PROFILE - 6" DRAIN HEADER & CRIB

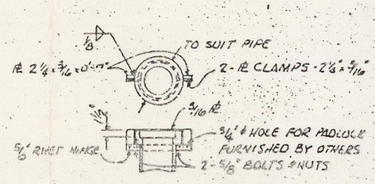
HORIZ 1" = 100' VERT 1" = 5'





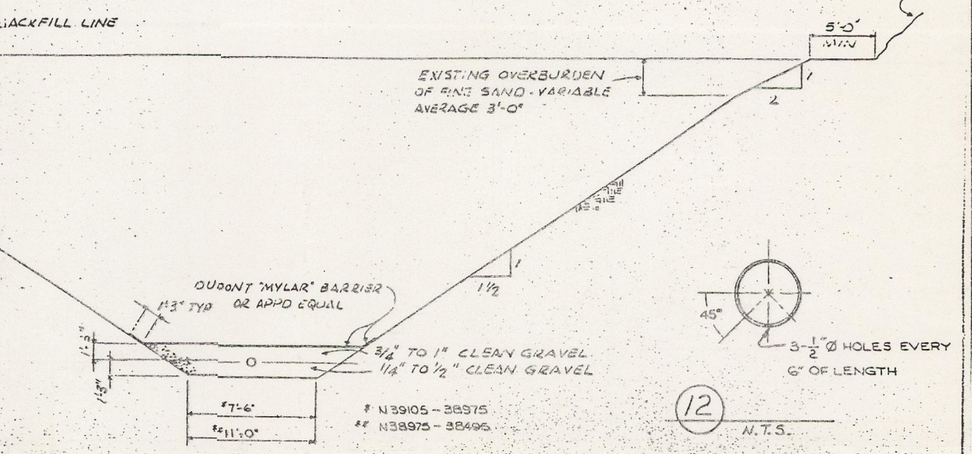
PROFILE - 2"

HORIZ. 1" = 20'
VERT. 1" = 5'



CAP FOR GAGE WELL

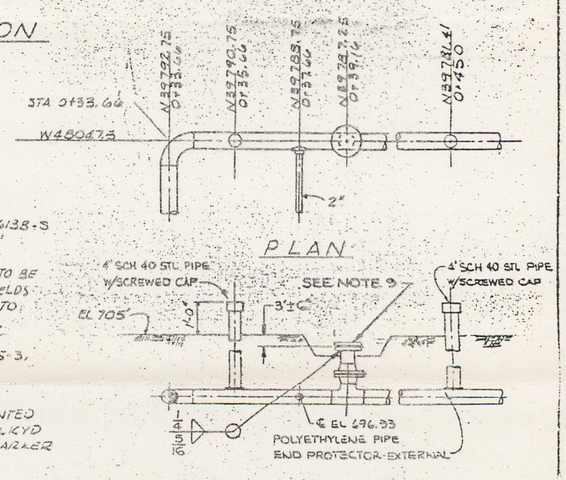
NO SCALE



TYPICAL CRIB SECTION

0 10 FT

12
N.T.S.

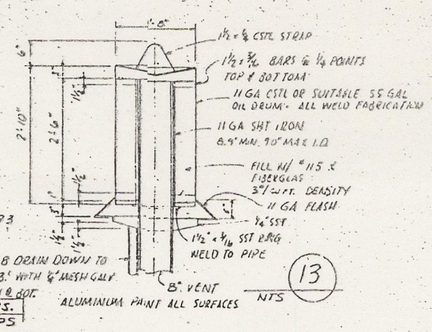


PLAN

11
H-2-59804, 05

GENERAL NOTES

1. INSTALLATION OF UNDERGROUND PIPING PER HWS-6138-S
2. PIPING MATERIAL PER "PIPING MATERIAL CODE" REF. H-2-81750 SHEET 8.
3. OK WELDING SPECS REF HWS-8242, WELDING ROD TO BE TYPE 308L SST. ALL BUTT JOINTS SHALL BE FULL PENETRATION WELDS.
4. JOINTS SHALL BE CHALKED & LINE PRESSURIZED TO 150 PSIG HYDROSTATIC FOR 30 MINUTES. ALL "VISIBLE" LEAKS REPAIRED & LINE RETESTED.
5. INSTALL MARKER POST PER HANFORD STD AC-5-3, TYPE II, AT STUBS FOR FUTURE EXTENSION (STA 0+79.38) NAME PLATE SHALL BEAR THE LEGEND "END OF STUB"
6. VENT FILTER, BALL & GAGE WELL CAPS TO BE PAINTED WITH ONE COAT RED LEAD PRIMER & 2 COATS ALKYD ENAMEL, HIGH VISIBILITY YELLOW (SAME AS MARKER POSTS, SEE HANFORD STD AC-5-3)
7. FOR EXCAVATION, BACKFILL & GRADING REF SPECIFICATION HWS-8340.
8. GAGE WELL RISERS TO BE EXTRA STRENGTH VIT. CLAY PIPE PER ASTM C 278 RESILIENT JOINTING CONNECTIONS CONFORMING TO ASTM C425 (GLADDING-McBEAN & COMPANY "SPEL-SEAL" OR APPD EQ).
9. 6" SLIP ON FLANGE, RAISED FACE, 150# ASTM A-182 GRADE F304L, 1 REQD
   6" BLANK, RAISED FACE, 150# ASTM A-182 GRADE F304L, 1 REQD
   GASKET 1/16" TEFLON (TFE) 8 3/4" OD X 6 5/8" ID, 1 REQD
   3/4"-10 UNC-2A STUD BOLT 4" L ASTM A193 GR B8 CLASS 1, 8 REQD
   3/4"-10 UNC-2B HEAVY HEX NUT, ASTM A194 GR 8F, 16 REQD



WELDING AND INSPECTION REQUIREMENTS			
FABRICATION	1. WELDING STANDARD	☐ ASME ☒ AWS R.31.1	☐ AWS ☒ HWS-10055-OPTIONAL (IN HOUSE)
	2. PROCEDURE SPEC. & PERFORMANCE CERT.	☒ ASME SECTION IX ☐ AWS	☐
	3. FILLER MATERIAL	☒ ASME SECT. II, NUMBERED	☐
INSPECTION	4. VISUAL (VT)	☒ WELDING STD. IN (1) ☒ PIT-UP	☒ SPP 2.5.0-8 (IN-HOUSE) ☒ ROOT PASS ☒ FINAL
	5. PENETRANT (PT)	☒ WELDING STD. IN (1)	☒ SPP 2.10-6 (IN-HOUSE)
	6. MAGNETIC PARTS (MT)	☐ WELDING STD. IN (1)	☐
	7. ULTRASONIC (UT)	☐ WELDING STD. IN (1)	☐
	8. RADIOGRAPH (RT)	☐ WELDING STD. IN (1)	☐
	9. LEAK TEST (LT)	☐	☐
☐ OTHER NOTE.			

H-2-74310	IGFD AQUEOUS DISCH. SYS.
H-2-44501	SH 15, 26 - AREA MAPS
ARH-1562	200 E.N. LIQUID WASTE SITE
H-2-63012	SAMPLER ASSEMBLY 216-A-36
H-2-63014	SAMPLER ARRG'T & ASSY.
AC-5-3	STD. MARKER POST
HWS-6385	U.G. PIPING SPECIFICATIONS
HWS-8341	EXCAVATION BACKFILL & GRADING
HWS-8170	TEST WELL SPECIFICATIONS
H-2-59820	CATHODIC PROTECTION
HWS-8147	WELDING SPECIFICATIONS
H-2-59804	PLAN & PROFILE
H-2-59805	PLOT PLAN
H-2-59800	DRAWING LIST

REFERENCE DRAWING
USED WITH DWG. H-2-59804, H-2-59129

CHK	QA	DFTG	
			(6) DELETED SCALE IN 12E CHANGE (4) ADDED NOTE 9 FCN 54947 DIRECT DRAWING INCORPORATES AND MODIFIES

APR 22-72 BY 6 REV

COMMENT PRINT ISSUE NO.
CHECK PRINT ISSUE NO.
DRAWING STATUS

QUALITY ASSURANCE LEVEL II

U. S. ATOMIC ENERGY COMMISSION
RICHLAND OPERATION OFFICE

SCALE SHOWN

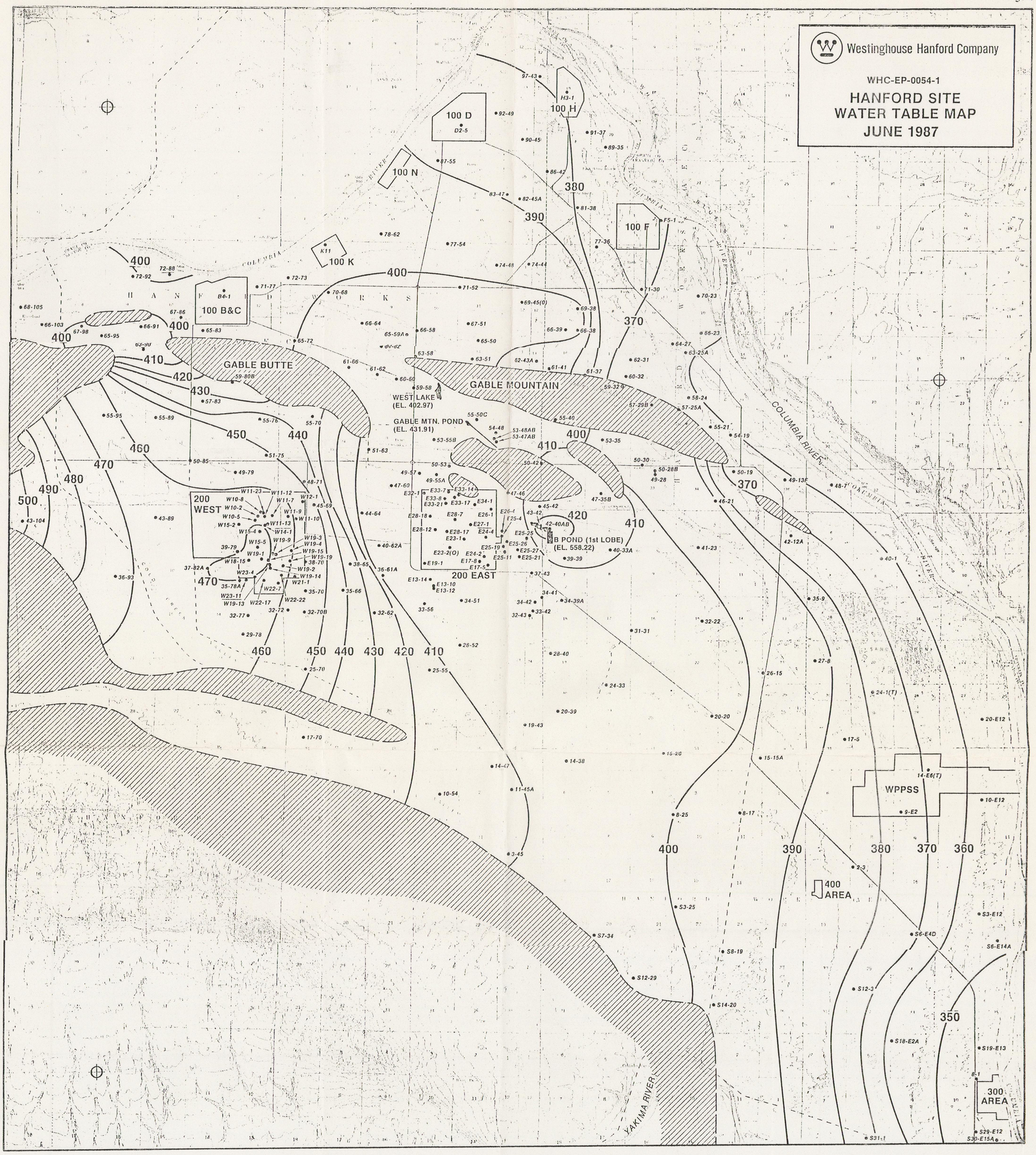
VITRO ENGINEERING CO.
A DIVISION OF VITRO CORP. OF AMERICA

DRAWN BY O A LAING 7-6-61
CHECKED BY 7/10 9-6-61
RESPONSIBLE ENGR. G. GUNN 9/6/61
APPROVED W. E. Lanshell 9/11/61
CLASSIFIED BY W. E. Lanshell 9/11/61
ASSOCIATION NONE

CRIB 216-A-36-A, PLAN
PROFILE & DETAILS
6" DRAIN HEADER

PGA NO. LGC-123 PROJECT FILE NO. 12E (REVISED)
CH. W.O. NO. A-32300 PROCESSING PLANT
W.O. NO. 2K-4 IMAGE NO. 0401

DWG. NO. H-2-59805 SHEET NO. - SHEETS -



SCALE

0 1 2 3 MILES

0 1 2 3 KILOMETERS

GN MIN

1° 43' 21°

31 MILS 373 MILS

UTM GRID AND 1951 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

WELLS USED IN PREPARATION OF MAP

PONDS, WATER SURFACE ELEVATION (ft-MSL)

BASALT OUTCROPS ABOVE WATER TABLE, AS INFERRED

—10— WATER TABLE CONTOURS IN FEET ABOVE MEAN SEA LEVEL (ft-MSL) (10 FOOT CONTOUR INTERVAL)

BASE MAPS ARE PORTIONS OF HANFORD, COYOTE RAPIDS, RICHLAND AND CORRAL 15' QUADRANGLES PUBLISHED BY U.S. DEPT OF INTERIOR, GEOLOGICAL SURVEY.

The Hanford Site water-table map is prepared by the Environmental Technology Section of the Defense Waste Management Division of Westinghouse Hanford Company (WHC). The first 21 revisions of this map were issued semiannually as Sheet H-2-38396. Revision 22 was issued as RHO-RE-SR-86-65 DEC P. The current map depicts the water-table configuration in June 1987 and is issued as WHC document WHC-EP-0054-1. These changes have been made to achieve compliance with company procedures.

The water table on the Hanford Site is monitored semiannually. Unconfined ground-water elevation maps are prepared from water-level measurements made in June and December. Approximately 240 wells and piezometers are used in contouring the water table.

The water-table mound beneath U Pond has declined about 1 ft since the December 1986 measurements were taken. Since the deactivation of U Pond in the fall of 1984, the water-table mound has had an overall decline of approximately 7 ft. The water-table mound surrounding B Pond has increased by approximately 1½ ft since the December 1986 measurements, corresponding to renewed activity at the Plutonium/Uranium Extraction (PUREX) facility.

For clarity, only the well numbers are shown on this map. The water-table elevations measured in these wells are shown on separate sheets.

Well numbers of wells in the 100 Areas have the prefix 199, wells in the 200 East and 200 West Areas have the prefix 299, the wells for the rest of the map have the prefix 699.

NOTE: To convert to metric, multiply elevation (ft) by 0.3048 to obtain elevation (m).

DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE

WESTINGHOUSE HANFORD COMPANY

HANFORD SITE WATER TABLE
JUNE 1987
WHC-EP-0054-1

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