DOE/RL-88-04
Revision 3

Copy No. _____

183-H Solar Evaporation Basins Closure/Post-Closure Plan

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ATTACHMENT 11 TO THE DANGEROUS WASTE PORTION OF THE RESOURCE CONSERVATION AND RECOVERY ACT PERMIT FOR THE TREATMENT, STORAGE AND DISPOSAL OF DANGEROUS WASTE (Second Draft)

United States
Department of Energy
Richland, Washington

Approved for Public Release

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ENCLOSURE 2

STATE ENVIRONMENTAL POLICY ACT (SEPA)

CHECKLIST

FOR THE

183-H SOLAR EVAPORATION BASINS

CLOSURE/POST-CLOSURE PLAN

REVISION 2

FEBRUARY 26, 1990

WASHINGTON ADMINISTRATIVE CODE
ENVIRONMENTAL CHECKLIST FORMS
[WAC 197-11-960]

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A. BACKGROUND

1. Name of proposed project:

   Closure of the 183-H Solar Evaporation Basins (183-H Basins).

   Information contained in this checklist pertains to only the 183-H Basins. In the context of the document, 'site' refers to only the physical concrete structures of the 183-H Basins, whereas 'Site' refers to the Hanford Site.

2. Name of applicants:

   U.S. Department of Energy, Richland Operations (DOE-RL) and Westinghouse Hanford Company (WHC)

3. Address and phone number of applicants and contact persons:

U.S. Department of Energy Richland Operations Office P.O. Box 550 Richland, Washington 99352	Westinghouse Hanford Company P.O. Box 1970 Richland, Washington 99352

   Contact Persons:

R. D. Izatt, Director Environmental Restoration Division (509) 376-5441	R. E. Lerch, Manager Environmental Division (509) 376-5556

4. Date checklist prepared:

   February 26, 1990

5. Agency requesting the checklist:

   State of Washington
   Department of Ecology
   Mail Stop PV-11
   Olympia, Washington 98504-8711

6. Proposed timing or schedule (include phasing, if applicable):

   If the 183-H Basins are closed with contaminated subsoils remaining in place (checklist question A.11.), emplacement of the landfill cover is expected to be completed in October 1992. This action will coincide with final closure of the facility. Post-closure monitoring of the landfill facility and the groundwater under the facility will continue for up to 30 years after closure or as directed by the Washington State Department of Ecology (Ecology) [WAC 173-303-610(7)].

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.

The 183-H Basins will be permanently closed to waste receipt pending the approval of the Closure/Post-Closure Plan, which is being submitted to Ecology concurrently with this checklist. Post-closure activities will be conducted at the site per the Post-Closure Permit, to be issued by Ecology.

The distribution and concentrations of contaminants in the 100-H Area groundwater indicate that the 183-H Basins are only one of several possible sources of groundwater contamination in the 100-H Area. Thus groundwater investigations must be conducted in conjunction with investigations of other contamination sources. All 100-H Area inactive facilities, including the 183-H Basins, are designated for soil and groundwater investigation/remediation activities as part of the inactive sites-operable units process. Any corrective actions required during the post-closure care period will be addressed through the inactive sites-operable units process. When the detailed groundwater and waste source operable unit remediation plans are finalized, the plans will integrate the 183-H Basins' groundwater monitoring and soil characterization information with similar data from related sites. The remediation plan will identify the mechanism for initiating the preferred groundwater remediation alternative, as well as any possible contingency actions.

8. **List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.**

- The 183-H Basins and the groundwater beneath the basins are to be discussed in the Remedial Investigation/Feasibility Study (RI/FS) Work Plans for the 100-HR-1 and 100-HR-3 Operable Units, respectively.

- **The *183-H Solar Evaporation Basins Final Status Post-Closure Permit Application* (DOE/RL 88-09) (FSPCPA) was submitted to Ecology in June 1988. Ecology's Notice of Deficiency is anticipated for the Fall of 1990.**

- **This SEPA checklist is being submitted concurrently with the *183-H Solar Evaporation Basins Closure/Post-Closure Plan* (Rev. 2).**

- A NEPA memorandum to File (accompanied by a DOE-RL environmental evaluation and a NEPA checklist) was prepared in accordance with DOE NEPA guidelines.

Additional environmental information regarding the 100-H Area and the Hanford Site, in general, can be found in the U.S. Department of Energy *Final Environmental Impact Statement - Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes* (DOE/EIS-0113), released in 1987, in the *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNL-6415 (Pacific Northwest Laboratory,

1998, Richland, Washington), and in the *Draft Environmental Impact Statement-Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington*, DOE/EIS-0119D (U.S. Department of Energy, 1989, Washington, D.C.).

9. Do you know whether applications are pending for government approvals of other proposals directly affecting property covered by your proposal? If yes, explain.

Both the Closure/Post-Closure Plan and the Final Status Post-Closure Permit Application must be approved by the regulating agencies [Ecology and the Environmental Protection Agency (EPA)]. Ecology must issue a permit before activities described in the Final Status Post-Closure Permit Application may begin. In addition, the 183-H Basins have been identified as a waste source in the Hanford Site 100-H Area Aggregate Operable Units, nominated to the National Priorities List (NPL) of federal facilities requiring remedial action and regulation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

10. List any government approvals or permits that will be needed for your proposal, if known.

Ecology and the EPA are the only agencies authorized to approve or permit final closure of the facility under requirements authorized by the Resource Conservation and Recovery Act of 1976 (RCRA), as amended, and Chapter 173-303 of the Washington Administrative Code. No other permits are required.

11. Give a brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page.

The 183-H Basins site description is provided in the answer to checklist question B.8.c. The 183-H Basins will be decontaminated in preparation for final facility closure. Liquid waste and waste sludge have been removed from the 183-H Basin floors and walls, packaged within the confines of the basins, and shipped off-site. After removal of the packaged waste, the facility walls and floors will be tested for dangerous waste constituents. Both shallow and deep soil samples will be taken from beneath the basin floors and surrounding the outside basin perimeter. In addition, background soil samples will be collected for comparison with these soil samples. The soil samples will be used to define the extent and magnitude of the contamination plume in the vadose zone beneath the basins. Following soil sampling, the facility will be demolished. Clean rubble generated during demolition of the basins will be placed in an adjacent subsurface facility, which will then be filled to ground level with clean soil. However, if traces of hazardous material

remain after successive decontamination attempts, the facility will be demolished and compacted for in situ disposal.

The results of the soil sampling effort will be used to assess closure options as specified under EPA RCRA regulations 40 CFR 265.197(a) and (b). Under current regulations, two options are available: clean closure, or removal and disposal of all soils contaminated above background concentrations; and landfill closure, or in place disposal of contaminated soils in a monitored landfill. The landfill closure option may be exercised only if clean closure can be demonstrated to be impracticable. Landfill closure may still require partial removal of contaminated soils, particularly if such soils are designated extremely hazardous waste (EHW) under Chapter 173-303 of the Washington State Administrative Code.

If at closure waste material remains in situ, regulations require the installation of a multilayer earthen cover to minimize water intrusion to the underlying contaminants. The cover, as designed for calculation purposes, will measure approximately 140 feet by 230 feet (actual dimensions will be dependent on the extent of the plume of contamination). The landfill cover will have a total thickness of about seven feet, encompassing four earthen layers (topsoil, sandy drainage layer, low permeability soil layer, and foundation soil layer) and two geosynthetic fabric layers. The final cover will be seeded with grass species that grow well in the semiarid climate at the Hanford Site. It is anticipated that the grasses will remove moisture from the soil through evapotranspiration and that, due to the construction criteria of the final cover, any other moisture present in the cover will be limited to the uppermost soil layer.

Following installation of the final cover, a chain link fence will be erected to surround the entire perimeter. The fence will remain locked at all times, except when personnel need access to conduct monitoring and sampling of groundwater, inspections, or necessary repairs. The closed facility will meet all applicable closure requirements as set forth in the issued permit.

Groundwater monitoring activities will be conducted at the 183-H Basins throughout the post-closure monitoring period. Closure of the 183-H Basins will be performed in a manner that minimizes potential future impacts to human health and the environment.

12. Give the location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.

The 183-H Solar Evaporation Basins are in the 100-H Area in the northern part of the Hanford Site. Maps and plans of the 100-H Area are contained in Appendix A of the revised closure plan submitted with this checklist. The basins can be located on the Locke Island, Washington, Quadrangle Map: NE 1/4, SW 1/4, NE 1/4, Section 18, T14N, R27E of the Willamette Principle Meridian.

B. ENVIRONMENTAL ELEMENTS

1. Earth

a. General description of the site: Flat, rolling, hilly, steep slopes, mountainous, other.

Flat.

b. What is the steepest slope on the site (approximate percent slope)?

The approximate slope of the land around the 183-H Basins is less than two percent.

c. What general types of soils are found on the site (for example, clay, sandy gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any prime farmland.

The soil at the 183-H Basins site is sandy gravel. Surficial sediments consist of eolian silt and fine sands (loess). No farming is permitted on the Hanford Site.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

No.

e. Describe the purpose, type, and approximate quantities of any filling or grading proposed. Indicate the source of fill.

If closure is conducted with contaminants remaining in situ, an engineered barrier (cover) is required by regulations to be placed over waste zones remaining at the facility upon closure. The designed cover will minimize water infiltration into underlying waste zones where contaminants may be leached into the groundwater. A brief description of this cover, as presently designed, follows. A more detailed description appears in the closure plan.

The lower-most component of the landfill cover will be a one-foot thick foundation layer, which will require about 1,200 cubic yards of sandy soil. The foundation layer will function to fill low spots and voids on the surface of the site, thus providing a

level and stable base for the overlying cover components. No borrow site has been chosen yet for this soil.

Above the foundation layer will be a two-feet thick, low-permeability soil layer, composed of a mixture of 15% bentonite (about 400 cubic yards of material) and 85% native soil (about 2,500 cubic yards of material). An impermeable geomembrane will be placed above and in direct contact with the low-permeability soil, and this geomembrane/clay layer will be overlain by a one-foot thick sand drainage layer requiring approximately 1,500 cubic yards of material. Surface water infiltrating to the highly permeable sand drainage layer will be laterally channeled to the edges of the cover within the drainage layer and prevented from percolating deeper into the cover by the geomembrane/clay layer. As yet no borrow site has been chosen for the earthen components of these two layers.

A woven synthetic geotextile fabric will be placed on the sand drainage layer. The geotextile fabric will serve two functions: 1) to protect the sand drainage layer during construction of the cover, and 2) to provide a particle filtration function to prevent the infiltration of fines into the sand drainage layer, thus preventing clogging of that layer.

Overlying the geotextile fabric, the top soil of the final cover will consist of a three-feet deep revegetated soil (sandy silt to silt). The top soil will provide storage for annual precipitation and support the establishment and growth of a perennial grass cover that will stabilize the surface of the cover and enhance soil-water removal. Approximately 3,400 cubic yards of topsoil will be required. The most promising borrow site identified thus far is the McGee Ranch near the northwest corner of the Hanford Site.

A cobble filter layer and overlying cobble layer will be placed on the cover embankment slopes and two feet horizontally onto the cover beyond the upper edge of the embankment. The cobble filter layer, requiring approximately 505 cubic yards of fine gravel to coarse sand, will serve to stabilize the overlying two-feet thick cobble layer. This cobble layer will function as a protective component of the cover, providing erosion resistance (and thereby enabling a steeper side slope design) and helping to reduce the potential of small animal intrusion through the embankment side slopes.

f. Could erosion occur as a result of clearing, construction, or use? If so, describe.

The erosion potential of this proposal is minimal. There are three possible sources of erosion damage in the area of the 183-H Basins: flood, wind, and precipitation. The probability of serious damage to the area due to flooding or precipitation is low; the flow in the Hanford Reach of the Columbia River is

controlled by upstream dams, and the basins are above the 100-year floodplain. The combination of semi-arid regional climate, high evapotranspiration rates, and minimal local slope in the vicinity of the proposed project makes damage from all but rare high-intensity rain events unlikely. The potential for erosion from wind and precipitation will be largely offset by mulching practices and the establishment of a perennial grass cover over the closed facility.

g. Approximately what percentage of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

Closure of the 183-H Basins with contaminants remaining in place will require the installation of an earthen cover designed to minimize, if not eliminate, water infiltration to the underlying waste zones (checklist question B.1.e.). One hundred percent of the original basin area will be capped by the designed cover. The site will be revegetated as part of the cover installation.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if there are any?

If the 183-H Basins are clean closed, the uppermost surface slope of the project site will be leveled to equal that of the surrounding area and revegetated. A straw mulch will be applied to assist in erosion control prior to the establishment of perennial grasses. Closure of the basins with waste buried in place will require installation of a final cover, which will be similarly revegetated to halt minor erosional damage to the area. Earthen materials for constructing the landfill cover will be taken from existing borrow areas to the extent practical. Regular inspections of the cover and revegetated areas will be accomplished and corrective action taken as necessary throughout the post-closure period.

2. <u>Air</u>

a. What types of emissions to the air would result from the proposal (i.e., dust, automobile, odors, industrial wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities, if known.

Cement dust may be generated during basin decommissioning activities (e.g., wet sandblasting and concrete cutting), but no measurable levels of airborne contaminants are expected to be produced as a result of such activities. Heavy equipment used to construct the final cover and trucks transporting material from the facility will generate dust and gaseous (exhaust) emissions. After physical closure of the facility, automobile exhaust will be generated as a result of inspection and maintenance activities.

b. Are there any off-site sources of emissions or odors that may affect your proposal? If so, generally describe.

No.

c. Proposed measures to reduce or control emissions or other impacts to the air, if any?

In order to reduce the amount of dust generated during closure activities, water trucks will be available onsite that will periodically spray the affected area. Water will be used during wet sandblasting to minimize dust generation. Continuous air monitors will be utilized during basin decommissioning activities to detect dangerous and radioactive particulate matter.

3. <u>Water</u>

a. Surface

1) Is there any surface water body in or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into.

At the closest point, the 183-H Solar Evaporation Basins are approximately 550 feet from the Columbia River, the nearest natural watercourse.

2) Will the project require any work over, in, or adjacent to (within 200 feet) the described waters?

Several existing groundwater monitoring wells lie between the 183-H Basins and the Columbia River. The well closest to the river lies approximately 100 feet from the water's edge. Available plans are included in the *183-H Solar Evaporation Basins Closure/Post-Closure Plan* (Rev. 2), with which this checklist is being submitted.

3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of the fill.

None.

4) Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.

Untreated river water may be sprayed on the ground during construction activities to mitigate dust generation.

5) Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.

No.

6) Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.

No.

b. Ground

1) Will groundwater be withdrawn, or will water be discharged to groundwater?

Storm run-off water from the earthen landfill cover will be absorbed by the surrounding soil and may eventually enter the groundwater.

Groundwater samples are collected on a regular basis from the monitoring wells surrounding the 183-H Basins. Samples are withdrawn to obtain data necessary to comply with state and federal groundwater monitoring requirements.

Prior to sample collection, wells are purged per the sample collection procedure corresponding to the type of dedicated pump(s) installed in the well. The total volume of groundwater withdrawn for purging and sampling will depend on the conditions encountered and the needs at each well. Withdrawals for groundwater monitoring purposes will not exceed 5,000 gallons per day.

Present policy dictates the collection and storage of purgewater from the 183-H Basins monitoring wells. This purgewater, instead of fresh clean water, has been used for washing down the solidification process equipment. Purgewater so used has been containerized and solidified for disposal as liquid waste. After completion of the decontamination of the 183-H Basins, remaining and new purgewater will be collected, stored, and treated with the other Hanford Site purgewater. The ultimate disposition of purgewater will pose no hazard to human health or the environment.

2) Describe waste materials that will be discharged into the ground from septic waste tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals...; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.

Does not apply.

c. Water Run-off (including storm water)

1) **Describe the source of run-off (including storm water) and methods of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other wastes? If so, describe.**

Run-off collection and disposal methods will be necessary only in the event of a severe rain fall or heavy snow melt. The landfill cover will be equipped with drainage pipes extending from the highly permeable drainage layer to drainage ditches at the edges of the cover. The outflow of run-off water will be to the surface, oriented down gradient toward the Columbia River. It is anticipated that the final facility cover, vegetation, and the relatively flat topography of the area will preclude excessive run-off from reaching the river. Run-off will be absorbed by the surrounding soil and no other form of run-off collection system is currently under consideration. The run-off that might occur will not flow into any other wastes.

2) Could waste materials enter ground or surface waters? If so, generally describe.

Beneath the 183-H Basins a plume of contamination extends through the soil column to the groundwater. If significant quantities of water were to transect the soils beneath the final facility cover, leachate from in situ contaminants could enter the groundwater. However, the final facility cover will be constructed so as to minimize, if not eliminate, the intrusion to the soil column of water from severe rain events and sudden snow melt-off.

d. Proposed measures to reduce or control surface, ground, and run-off water impacts, if any:

During 183-H Basins decommissioning, (part of the closure operations), liquid wastes and waste sludges have been removed from the 183-H Basins. Waste sludges have been commingled with sufficient quantities of absorbent material to ensure that no free liquid remains in the waste drums. Liquid wastes have been containerized and solidified within the confines of the basin. 183-H Basins waste removal and decontamination operations are being conducted within the confines of the basins to prevent accidental releases to the environment. At no time will there be a potential for the discharge of waste materials directly to the ground.

Post-closure leaching of contaminated subsoils by surface water will be prevented by the installation of a multilayered barrier (the final cover) designed to preclude the migration of surface

water to underlying contaminated soils. Proposed measures to reduce soil and groundwater contamination (discussed in the answer to checklist question B.3.c.2) are addressed in the Final Status Post-Closure Permit Application.

4. Plants

a. Check the types of vegetation found onsite.

___ deciduous tree
___ evergreen tree
___ shrubs
___ grass
___ pasture
___ crop or grain
___ wet soil plants
___ water plants
___ other types of vegetation

There is no vegetation on the actual 183-H site. Additional information on the Hanford Site environment can be found in the final environmental impact statements referenced in the answer to checklist question A.8.

b. What kind and amount of vegetation will be removed or altered?

A small vegetated area adjacent to the basins may be affected by closure activities. All areas denuded of vegetation as a result of this project will be revegetated appropriately.

c. List threatened or endangered species known to be on or near the site.

No threatened or endangered plant species exist on or in the immediate vicinity of the 183-H Basin site. Additional information on the Hanford Site environment can be found in the final environmental impact statements referenced in the answer to checklist question A.8.

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:

Perennial grass species well suited to the local climate will be used to revegetate the cover of the 183-H Basins.

5. Animals

a. Identify any birds and animals which have been observed on or near the site or are known to be on or near the site:

birds: hawk, heron, eagle, songbirds, other
mammals: deer, bear, elk, beaver, other
fish: bass, salmon, trout, herring, shellfish, other

A variety of insects, birds, and small mammals common to the Hanford Site (including grasshoppers, passerine birds, pigeons, lagomorphs, and coyote), have been observed in the vicinity of the 183-H Basins. Prior to initiation of basin decommissioning activities, a number of swallow nests were encountered within the basins. Additional information on the Hanford Site environment can be found in the final environmental impact statements referenced in the answer to checklist question A.8.

b. List any threatened or endangered species known to be on or near the site.

No threatened or endangered species are known to exist on the facility site. However, the state- and federally-registered threatened bald eagle is a common winter resident along the Columbia River. The only two endangered animal species known to occur in the area -- the American white pelican and the peregrine falcon -- are transient visitors. Additional information on the Hanford Site environment can be found in the final environmental impact statements referenced in the answer to checklist question A.8.

c. Is the site part of a migration route? If so, explain.

No; however, the adjacent Columbia River is considered an important resting place for Pacific flyway waterfowl and shore birds during the autumn migration. Additional information on the Hanford Site environment can be found in the final environmental impact statements referenced in the answer to checklist question A.8.

d. Proposed measures to preserve or enhance wildlife, if any:

None at this time.

6. <u>Energy and Natural Resources</u>

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

The completed project will require the use of portable electric generators for powering groundwater monitoring well pumps during inspection and sampling. Post-closure monitoring activities will require the use of petroleum products to power motor vehicles.

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.

No.

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:

Does not apply.

7. Environmental Health

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste, that could occur as a result of this proposal? If so, describe.

During the decontamination phase of the project, decontamination and monitoring equipment may be exposed to chemically hazardous and radioactively contaminated materials from the 183-H Basins sludges and liquids. Purgewater produced during closure and post-closure groundwater monitoring activities may contain very low concentrations of hazardous and/or radioactive wastes. Closure of the 183-H Basins will be performed in a manner that minimizes potential future impacts to human health and the environment.

1) Describe special emergency services that might be required.

Hanford Site security, fire response, and ambulance services are on call at all times in the event of an onsite emergency.

2) Proposed measures to reduce or control environmental health hazards, if any:

During decontamination proceedings, all equipment decontamination solutions and emergency shower effluent will be retained within the 183-H Basins for collection and packaging. Sludge waste has been commingled with sufficient quantities of absorbent material to ensure that no free liquid remains in the waste drums, and liquid waste have been containerized and solidified within the confines of the 183-H Basins. All waste removal operations will be conducted within the confines of the 183-H Basins to prevent accidental releases to the environment. At no time will there be a potential for the discharge of waste materials directly to the ground.

Waste material, decontamination solutions, and clean-up debris will be collected, packaged (as applicable), and transferred to the appropriate facilities as follows:

- Radioactive mixed waste will be transported to the 200 Area Radioactive Mixed Waste Storage Facility;

- Nonradioactive hazardous waste will be transported to the 600 Area Nonradioactive Dangerous Waste Storage Facility (the 616 Building);

- **Nonhazardous radioactive waste will be transported to the 200 Area Low-Level Waste Burial Grounds.**

Once physical closure of the basins is complete, no exposure to personnel is expected; however, post-closure monitoring, sampling, and inspection personnel will be required to wear appropriate protective clothing while at the site. Personnel will be trained to recognize and correct/reduce any environmental health hazards. Training requirements are fully described in the Closure/Post-Closure Plan. The physical security of a chain link fence around the basins and access limited to only authorized personnel will further reduce potential exposures.

b. Noise

1) What type of noise exists in the area which may affect your project (for example: traffic, equipment, operation, etc.)?

None.

2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, etc.)? Indicate what hours noise would come from the site.

Construction activities will temporarily increase noise levels during normal day-shift hours. On completion of the project, the only noise generated will be that of the portable generators used to power groundwater well sampling and monitoring equipment.

3) Proposed measures to reduce or control noise impacts, if any:

Construction equipment will meet manufacturer's requirements for noise suppression.

8. <u>Land and Shoreline Use</u>

a. What is the current use of the site and adjacent properties?

The 183-H Basins are part of the Hanford Site which is owned by the U.S. Government. The basins were utilized for waste reduction via the natural process of liquid evaporation. No dangerous waste shipments have been received since November 1985.

b. Has the site been used for agriculture? If so, describe.

No portion of the Hanford Site (including the 183-H Basins) has been used for agricultural purposes since 1943.

c. Describe any structures on the site.

The 183-H Basins are composed of four contiguous concrete holding basins. The basins are above-ground structures, each containing a deep sedimentation basin and a shallow flocculation basin. The sedimentation basins are a nominal 53 feet-6 inches wide and 95 feet in length, with a depth varying from 16 feet-6 inches at the north end to 15 feet-6 inches at the south end. The flocculation basins, at the north end of and within the long boundaries of the sedimentation basins, are 45 feet-6 inches wide, 33 feet in length, and 9 feet-6 inches deep.

Approximately 45 feet to the south of and parallel to the 183-H Basins are the 183-H Clear Water Reservoirs (clearwells). These subsurface structures are a total of 858 feet long, east to west, (parallel to the 183-H Basins) and 184 feet wide, north to south. The clearwells were used as a reservoir for treated river water intake to the 105-H Reactor, which was deactivated in April 1965. Since that time, the clearwells have been used as a collection site for clean (nonregulated) waste materials.

d. Will any structures be demolished? If so, what?

During the closure process, the 183-H Basins will be demolished. Clean rubble generated during demolition of the basins will be placed in the adjacent clearwells, which will then be filled to ground level with clean soil. However, if traces of dangerous material remain after successive decontamination attempts, the rubble will be compacted for in situ disposal beneath the earthen cover described in the answer to checklist question B.1.e.

e. What is the current zoning classification of the site?

The Hanford Site is zoned by Benton County as an Unclassified Use (U) district.

f. What is the current comprehensive plan designation of the site?

The 1985 Benton County Comprehensive Land Use Plan designates the Hanford Site as the 'Hanford Reservation.' Under this designation, land on the Site may be used for "activities nuclear in nature." Non-nuclear activities are authorized "if and when DOE approval for such activities is obtained."

g. If applicable, what is the current master shoreline program designation of the site?

Does not apply.

h. Has any part of the site been classified as an 'environmentally sensitive' area? If so, specify.

No.

i. **Approximately how many people would reside or work in the completed project?**

None.

j. Approximately how many people would the completed project replace?

None.

k. **Proposed measures to avoid or reduce displacement impacts, if any:**

Does not apply.

l. **Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:**

Does not apply. (See answer to checklist question B.8.f.)

9. <u>Housing</u>

a. Approximately how many units would be provided, if any? Indicate whether high-, middle-, or low-income housing.

None.

b. Approximately how many units, if any, would be eliminated? Indicate whether high-, middle-, or low-income housing.

None.

c. **Proposed measures to reduce or control housing impacts, if any:**

Does not apply.

10. <u>Aesthetics</u>

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

Closure of the basins with waste in place will require the installation of an earthen cover. The cover, as designed, will have a maximum height of approximately nine feet at the crest. The chain link perimeter fence around the 183-H Basins may attain a height of ten feet.

b. What views in the immediate vicinity would be altered or obstructed?

None.

c. Proposed measures to reduce or control aesthetic impacts, if any:

None at this time.

11. Light and Glare

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

None.

b. Could light or glare from the finished project be a safety hazard or interfere with views?

No.

c. What existing off-site sources of light or glare may affect your proposal?

None.

d. Proposed measures to reduce or control light and glare impacts, if any:

Does not apply.

12. Recreation

a. What designated and informal recreational opportunities are in the immediate vicinity?

None.

b. Would the proposed project displace any existing recreational uses? If so, describe.

Does not apply.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any?

Does not apply.

13. Historic and Cultural Preservation

a. Are there any places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or next to the site? If so, generally describe.

No part of the 183-H Basins is listed on or proposed for inclusion on preservation registers. Additional information on the Hanford Site environment can be found in the environmental impact statements referenced in the answer to checklist question A.8.

b. Generally describe any landmarks or evidence of historic, archaeological, scientific, or cultural importance known to be on or next to the site.

The Hanford Cultural Resource Laboratory conducted a cultural resource review in the project area, and reported that no cultural properties are known to be located on the site of the 183-H Basins or in the area from which background samples will be taken. Additional information on the Hanford Site environment can be found in the environmental impact statements referenced in the answer to checklist question A.8.

c. Proposed measures to reduce or control impacts, if any:

If the 183-H Basins are clean closed, contaminated soils will be excavated and removed from the site as necessary. Backfill and soils to be used in the earthen cover will be excavated from borrow sites around the Hanford Site. Prior to any excavation proceedings, a cultural resources review will be conducted under the authority of the National Historic Preservation Act. Significant archaeological finds may result in schedule delays until a plan to mitigate excavation impacts can be devised and implemented.

14. Transportation

a. Identify public streets and highways serving the site, and describe proposed access to the existing street system. Show on site plans, if any.

None.

b. Is site currently served by public transit? If not, what is the approximate distance to the nearest transit stop?

The facility is not publicly accessible and, therefore, is not served by public transit.

c. How many parking spaces would the completed project have? How many would the project eliminate?

None.

d. Will the proposal require any new roads or streets, or improvements to existing roads or streets, not including driveways? If so, generally describe (indicate whether public or private).

No.

e. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.

No.

f. How many vehicular trips per day would be generated by the completed project? If known, indicate when peak volumes would occur.

None.

g. Proposed measures to reduce or control transportation impacts, if any:

Does not apply.

15. Public Services

a. Would the project result in an increased need for public services (for example: fire protection, police protection, health care, schools, other)? If so, generally describe.

No.

b. Proposed measures to reduce or control direct impacts on public services, if any:

Does not apply.

16. Utilities

a. List utilities currently available at the site (electricity, natural gas, water, refuse service, telephone, sanitary sewer, septic system, etc.):

The only utility currently available at the site is fresh water.

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.

A portable air supply for pneumatically operated equipment and a portable electrical generator will be necessary for closure

operations. Water trucks will be available onsite to periodically spray the area, reducing airborne particles generated during construction activities. After final closure of the facility, the only utility necessary for operation will be portable electric generators for powering groundwater monitoring well pumps during inspection and sampling.

General construction activities are outlined in the answer to checklist question A.11.

SIGNATURES

The above answers are true and complete to the best of my knowledge. We understand that the lead agency is relying on them to make its decision.

R. D. Izatt, Director
Environmental Restoration Division
U.S. Department of Energy
Richland Operations Office

4/11/90
Date

R. E. Lerch, Manager
Environmental Division
Westinghouse Hanford Company

3-22-90
Date

ENCLOSURE 3

183-H SOLAR EVAPORATION BASINS

CLOSURE/POST-CLOSURE PLAN

REVISION 2

SUBMITTED

APRIL 13, 1990

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DOE/RL 88-04

183-H SOLAR EVAPORATION BASINS CLOSURE/POST-CLOSURE PLAN

REVISION 2

APRIL 13, 1990

Reference herein to any trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof.

RECORD OF REVISION

(1) Document Number

DOE/RL 88-04

(2) Title

183-H Solar Evaporation Basins Closure/Postclosure Plan

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog./Proj. Engr.	(6) Cog./Proj. Mgr.	Date
2	(7) Addresses Ecology's Notice of Deficiency Comments	SB Clifford	FA Ruck III	4-13-90
3	Responses (noted with change bars) to Ecology's Notice of Deficiency (08-15-90) and Notice of Deficiency Response Acceptance (01-28-91) page changes: Table of Contents, II-6, I-12, I-67, I-69/70, I-72, I-103, I-104, I-111, I-114, I-119, I-138, I-142, I-144, I-146, I-150; II-4, II-6, II-10, II-11, II-12, II-13; III-4, III-16, III-17, III-18, III-19, III-20, III-53, III-58, III-59, III-72; APP-i, APP D-7, APP D-8, APP G-3, and APP N (new)	SB Clifford	FA Ruck III	6-19-91

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ACRONYMS

ACI	American Concrete Institute
ANSI	American National Standards Institute
ARCL	allowable residual contamination level
CAM	continuous air monitor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COLIWASA	composite liquid waste sampler
CWDPs	chemical waste disposal permits
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy-Richland Operations Office
DW	dangerous waste
Ecology	Washington State Department of Ecology
EHW	extremely hazardous waste
EPA	U.S. Environmental Protection Agency
FFTF	Fast Flux Test Facility
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FSPCPA	Final Status Post-Closure Permit Application for the 183-H Solar Evaporation Basins
HELP	Hydrologic evaluation of landfill performance
HSWA	Hazardous and Solid Waste Amendments
IC	ion chromatography
ICP	inductively coupled plasma
MSL	mean sea level
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
PAH	polycyclic aromatic hydrocarbons
PNL	Pacific Northwest Laboratory
QA/QC	quality assurance and quality control
RCRA	Resource Conservation and Recovery Act
RPT	radiation protection technologist
SEPA	State Environmental Policy Act
SERPT	senior environmental radiation protection technologist
SSP	site surveillance personnel

ACRONYMS (cont)

TDS	total dissolved solids
TOC	total organic carbon
TOX	total organic halides (halogens)
TSCA	Toxic Substances Control Act
USBR	U.S. Bureau of Reclamation
USCS	Unified Soil Classification System
WAC	Washington Administrative Code
Westinghouse Hanford	Westinghouse Hanford Company (WHC)

ABBREVIATIONS

cm/s	centimeter per second
°C	degree Celsius
°F	degree Fahrenheit
mg/L	milligrams per liter
pH	negative logarithm of the hydrogen-ion concentration
ppb	parts per billion
ppm	parts per million
pCi/g	picocuries per gram
pCi/L	picocuries per liter

I. GENERAL CLOSURE REQUIREMENTS

The U.S. Department of Energy-Richland Operations Office (DOE-RL) will close the 183-H Solar Evaporation Basins (183-H Basins) in accordance with the U.S. Environmental Protection Agency (EPA), Resource Conservation and Recovery Act (RCRA) of 1976, as administered by the Washington State Department of Ecology (Ecology) through the Washington Administrative Code (WAC) *Dangerous Waste Regulations* [WAC 173-303 (Ecology 1989)]. Additionally, the 183-H Basins will be closed in accordance with all applicable environmental regulations and the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989).

In November 1985, the DOE-RL filed a 183-H Solar Evaporation Basins' Part A Permit Application under the EPA/Ecology Identification Number WA 7890008967, and submitted Revision 0 of the 183-H Basins Closure Plan. This document, Revision 2 of the *183-H Solar Evaporation Basins Closure/Post-Closure Plan* (DOE/RL 88-04), together with the forthcoming revision of the *183-H Solar Evaporation Basins Final Status Post-Closure Permit Application* (DOE/RL 1988a), will complete the submittal for the 183-H Basins permit application as required by WAC 173-303.

While preparing this document, it has been acknowledged that this RCRA closure site is located within an identified *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) (CERCLA 1980) unit; 100-Areas site. Per the *Hanford Federal Facility Agreement and Consent Order*, the 100-HR-1 operable unit will be remediated as a RCRA past practices unit. Therefore, the proposed closure activities (e.g., soil sampling, groundwater monitoring, waste removal, and landfill cover design and installation) will be conducted in conjunction with the future RCRA past practices remediation. Completion of closure has been scheduled for October 1992. Per Ecology's direction, groundwater remediation will be addressed in the forthcoming revision of the *183-H Solar Evaporation Basins Final Status Post-Closure Permit Application*.

This document is organized into four chapters and 13 appendices:

- General Closure Requirements (Chapter I)
- Closure Requirements for Landfills (Chapter II)
- Post-Closure Requirements (Chapter III)
- References (Chapter IV)
- Appendices (A through M).

This document will fully replace all prior versions of the *183-H Solar Evaporation Basins Closure/Post-Closure Plan*.

Hanford Site--The Hanford Site covers approximately 560 square miles of semiarid land that is owned by the U.S. Government and managed by the DOE-RL.

For purposes of RCRA and WAC 173-303, the DOE-RL is the owner and operator, and Westinghouse Hanford Company (Westinghouse Hanford) is the co-operator, with the DOE-RL, of certain hazardous waste management units on the Hanford Site, e.g., the 183-H Basins. The Hanford Site is located northwest of the city of Richland, Washington, in the Columbia Basin (Figure 1.A-1 and Map 1 of Appendix A). The city of Richland lies approximately 5 miles from the southernmost portion of the Hanford Site boundary and is the nearest population center. In early 1943, the U.S. Army Corps of Engineers selected the Hanford Site as the location for reactor, chemical separation, and related facilities and activities for the production and purification of plutonium.

Activities at the Hanford Site are centralized in numerically designated areas. The reactor facilities (active and deactivated) are located along the Columbia River in what are known as the 100 Areas. The reactor fuel processing and waste management facilities are in the 200 Areas, that are on a plateau approximately 7 miles from the Columbia River. The 300 Area, located north of Richland, contains the reactor fuel manufacturing facilities and the research and development laboratories. The 400 Area, 5 miles northwest of the 300 Area, contains the Fast Flux Test Facility (FFTF) used in the testing of liquid metal reactor systems. The 600 Area covers all locations not specifically given an area designation. Administrative buildings are located in the 700 Area in downtown Richland. In north Richland, the 1100 Area contains facilities associated with administration, maintenance, transportation, and materials procurement and distribution. The 3000 Area, between the 1100 and 300 Areas, contains the Environmental Division, engineering offices, and administrative offices.

The 100-H Area, located north in the Hanford Site along the Columbia River (Figure I.A-2), was an operational reactor facility from October 1949 to April 1965. The 183-H Basins were originally designated as part of the 183-H Filter Plant that operated concurrently with the 100-H Reactor. The filter plant provided water treatment, filtering facilities, and reservoir capacity for the reactor process water system. The filter plant consisted of a head house and chemical building, 16 flocculation and sedimentation basins, filter building, and clearwell storage with a pump room. Figure I.B-3 (page I-75) illustrates a complete filter plant (100-D Area) prior to demolition.

The 183-H Basins--In 1973, 4 of the 16 flocculation and sedimentation basins were designated for use as solar evaporation basins; i.e., the 183-H Basins (Figure I.A-3). The purpose of the 183-H Basins was to provide a means of waste reduction by natural evaporation of the liquid chemical wastes resulting from the 300 Area (N Reactor) fuel fabrication facilities. The natural evaporation (treatment) process involved temporary storage of the wastes in order to accommodate the evaporation phenomenon. Prior to use, a 6-foot chain link fence was installed around the four 183-H Basins.

In the spring of 1974, after decontamination, demolition of the 183-H Filter Plant was initiated under the Hanford Site Housekeeping and Cleanup Program for the 100-H Area. The 183-H head house, 12 of the flocculation and sedimentation basins, the filter building, and the clearwell pump room were demolished to ground level and the underground portions were

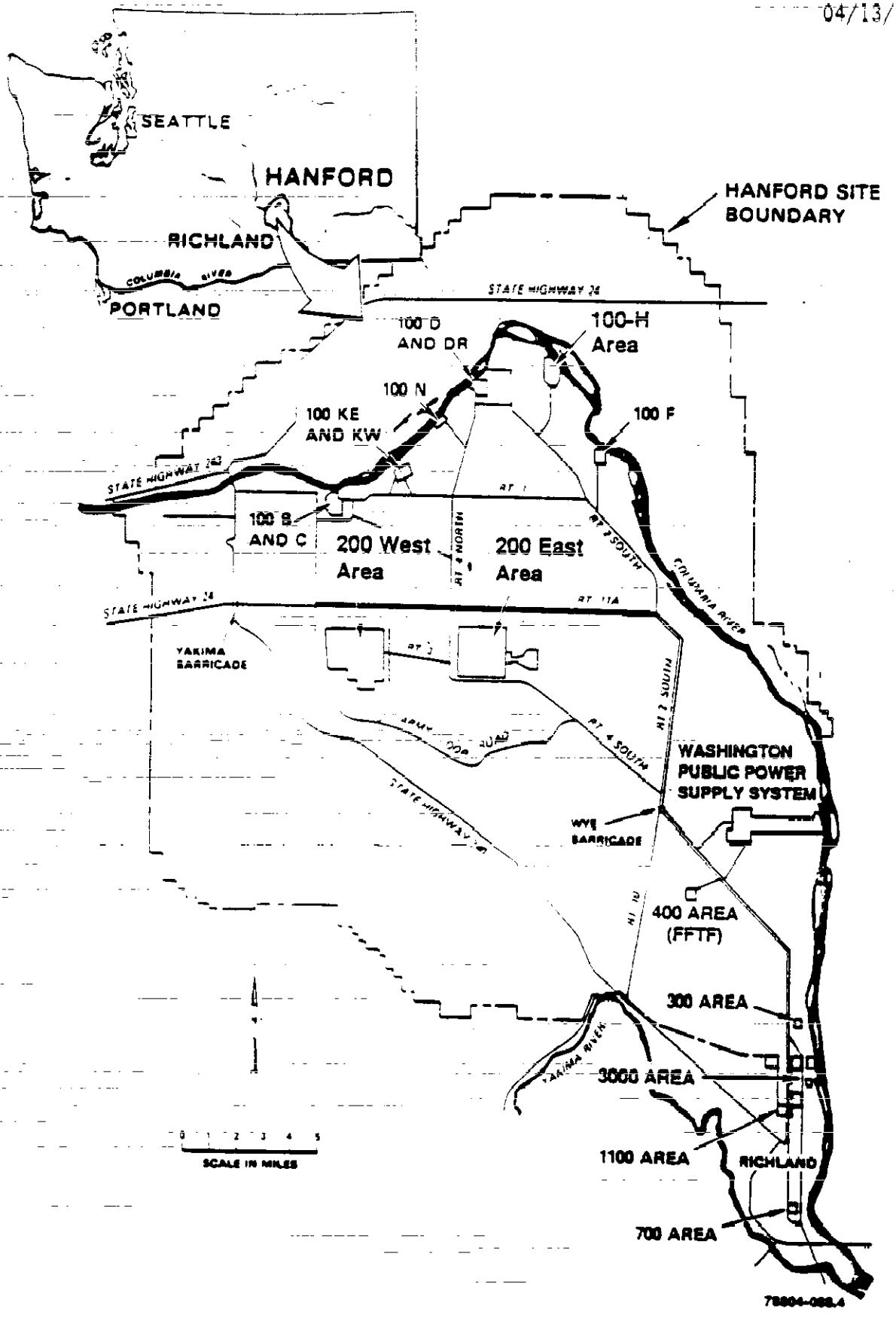

Figure I.A-1. Hanford Site Map.

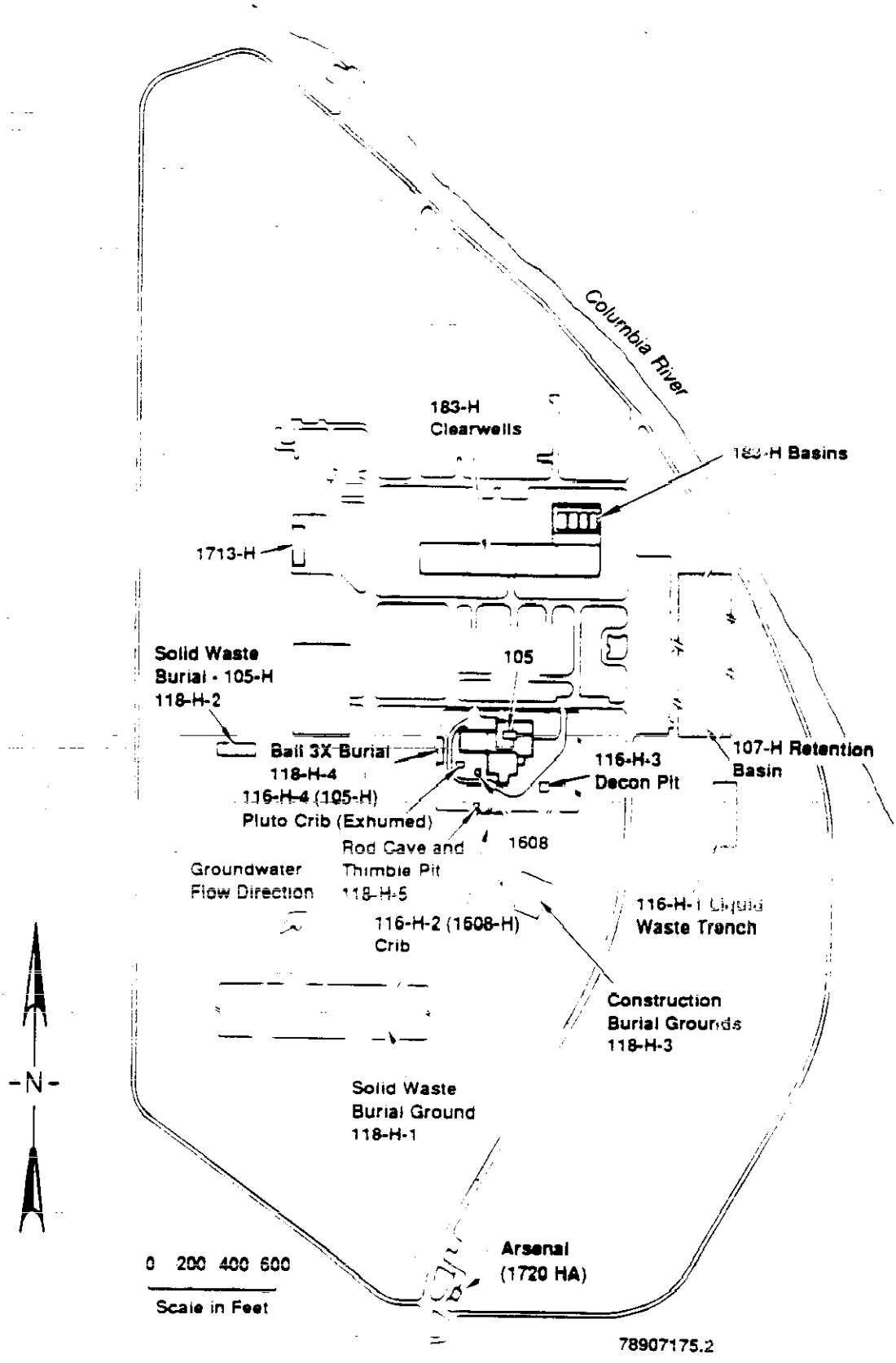

Figure I.A-2. 100-H Area Map.

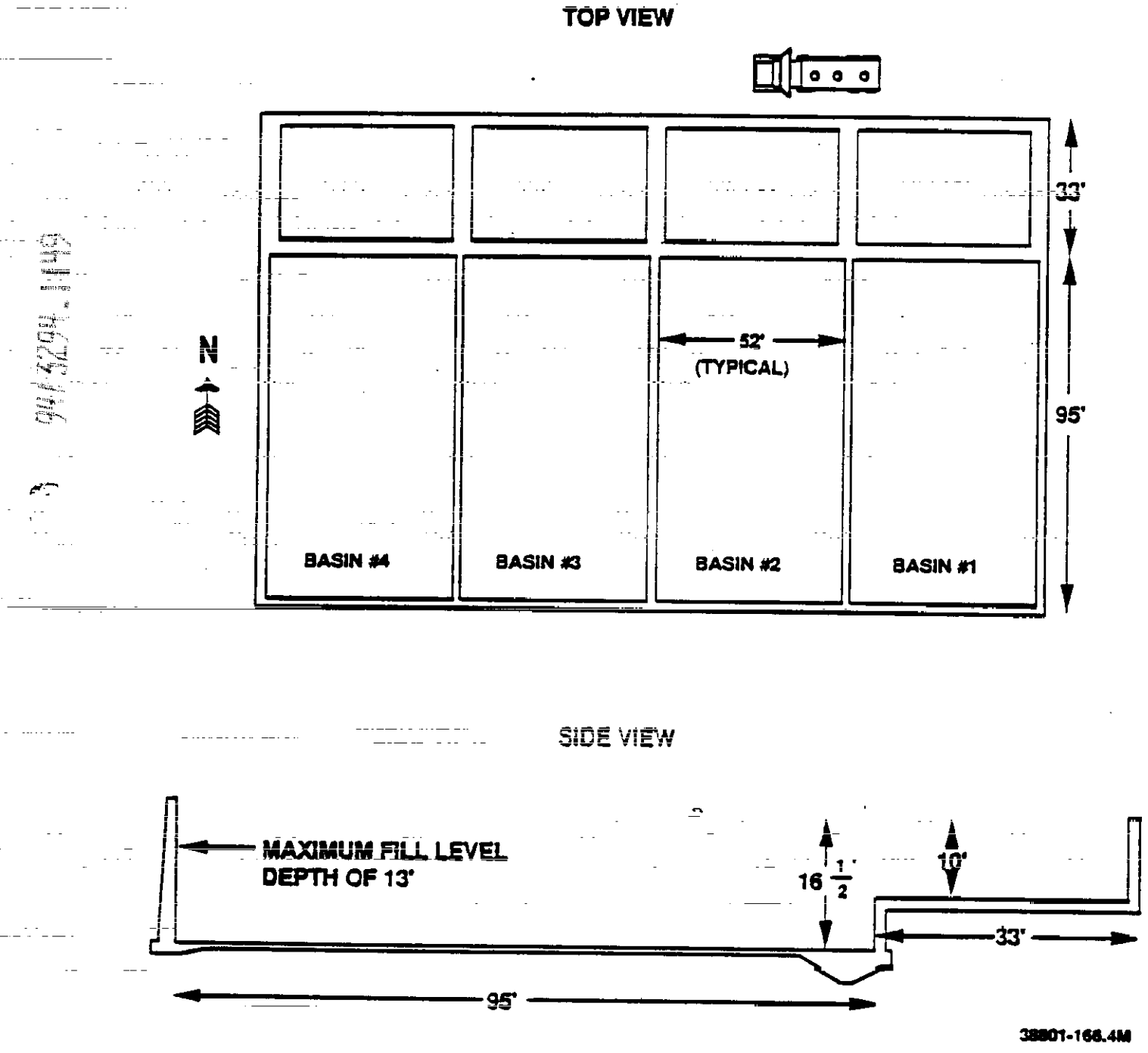

Figure I.A-3. Dimensions of the 183-H Basins.

backfilled to ground level. The clearwells were left intact for future use as a disposal site for clean debris.

In November 1985, the last shipment of wastes was sent to the 183-H Basins. The wastes have been undergoing solar evaporation and the remaining liquids are super-saturated and ready for further treatment; i.e., liquid solidification. Liquid transfers between the basins have permitted the isolation and removal of waste precipitates/sludges. In September 1988, the final drums of 'absorbed' sludges were shipped to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility. From June to December 1989, solidification of the liquid wastes occurred. In 1990 the crystallized solids which are remaining in two basins will be removed.

The typographical map (H-6-958) in Appendix A provides a general overview of the Hanford Site and contiguous area. It is intended to be used as a location map and to illustrate the following:

- Hanford Site boundary
- Surrounding land use
- Contours (20-foot intervals) to show the surface water flow direction
- Fire control facilities on the Hanford Site
- Access roads, internal roads, railroads, gates, and barricades
- Longitudes and latitudes.

Appendix A also contains a 200-scale topographic map of the 100-H Area indicating the location of the 183-H Basins. The topographic map has the following features:

- Hanford Site boundary and wind rose
- Contours (2-foot intervals) to show surface water flow direction
- Monitoring wells and 100 year flood maximum elevation
- The 100-H Area waste management units.

Implementation of this closure plan minimizes the need for post-closure maintenance and control, and minimizes or eliminates post-closure escape of residual contaminants or the migration of waste decomposition products to the ground, surface waters, or the atmosphere. This plan summarizes the types and amounts of dangerous waste that the 183-H Basins have received. A waste analysis plan is provided in Section I.A-6 that includes the practices that are used to sample and analyze the remaining liquid wastes and to verify ycleanup and decontamination.

Appendix N provides personnel training that will be used for closure and post-closure activities.

I.A. CLOSURE PERFORMANCE

This section describes how closure of the 183-H Basins will meet the closure requirements and control post-closure escape of dangerous waste, dangerous waste constituents, leachate, contaminated run-off, and waste decomposition products to the groundwater, surface water, and atmosphere.

I.A-1. Minimize Need for Post-Closure Maintenance and Controls

In September 1988, all remaining regulated solid wastes had been removed from the 183-H Basins and only regulated liquid wastes remained in Basin Numbers 2 and 3. Decontamination of the concrete floors and walls of the 183-H Basins began in November 1988 using appropriate technologies such as sandblasting, wet spray sandblasting, and/or steam cleaning. The floors and walls will be sampled for dangerous waste constituents according to the decontamination and removal of dangerous waste inventory, as described in Section I.B-4. Based on these analyses, one or more of four actions will be taken as outlined in Section I.B-1.

From June to December 1989 the remaining liquid wastes were solidified in drums. After curing, the drums were shipped to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility.

Final Cover--As described in Section II.B-1, a multilayer soil cover may be installed that will minimize water intrusion to the underlying soils. The final cover will be seeded with two species of perennial grasses that grow well in the semiarid climate at the Hanford Site. The grasses will remove moisture from soil through evapotranspiration and residual moisture will be held in the upper area of the soil cover due to the permeability of the final cover. The final cover will minimize, if not eliminate, the need for further maintenance.

Ecology has stipulated that the final cover's maximum sideslope shall be 4H:1V per the Notice of Deficiency process. This is being included as part of the final design criteria. However, this document contains the preliminary cover design and only considers 3H:1V slopes.

Quarterly Inspections--Quarterly inspections to monitor the integrity of the cover and surrounding chain link fence will minimize the need for extensive maintenance by correcting problems in the early stages.

Groundwater Monitoring--Once waste removal and other closure activities have been completed, the level of groundwater contamination is expected to be stabilized or decreased. Since ceasing to use Basin Number 1 in 1977, the level of groundwater contamination attributable to 183-H Basins has generally decreased, with the exception of elevated levels in several downgradient wells (Section III.A-2d and Figure III.A-2) noted for a short interval of time in 1986.

I.A-2. Minimize Post-Closure Escape of Dangerous Waste

The post-closure escape of dangerous waste, i.e., dangerous waste constituents, leachate, or contaminated run-off, will be minimized by removing all dangerous wastes and residues from the 183-H Basins to the maximum extent practicable. No waste decomposition products of the buried materials (183-H Basins) are expected for this closure.

The primary method for minimizing post-closure escape of dangerous wastes is waste removal. The alternate method is an engineered landfill cover. This final (multilayered) cover will be constructed to engineering specifications, as described in Sections II.B-1 and II.B-2, and will eliminate or minimize water intrusion into the vadose zone beneath the buried 183-H Basins. The cover will be seeded with two species of perennial grasses in a silty loam topsoil that will ensure the effective removal of available moisture. The cover's topsoil layer will be engineered to support sufficient rooting depth of the intended grasses (plant cover) because the grasses will hold the soil and the soil will be deep enough to hold sufficient water for the grasses. Maintaining sufficient soil and water storage for grass growth and transpiration will ensure that the underlying cover stays intact, thus minimizing additional maintenance.

In order for a multilayer cover to be effective in eliminating maintenance, it must be capable of storing or shedding the anticipated annual precipitation and, preferably, the maximum expected amount. The greatest annual amount of precipitation recorded at the Hanford Site is about 11 inches. Precipitation data were collected at the Hanford town site from 1912 until 1946, when the Hanford Meteorological Station continuously began recording the data. However, in the city of Richland, in 1948, annual precipitation was recorded as 12.20 inches and this recording will be used as the peak annual precipitation event when the hydrologic evaluation of landfill performance (HELP) model is rerun for the final cover design. This level of precipitation has been established as a design criterion.

The preliminary cover design (1987) was evaluated using the hydrologic evaluation of landfill performance model that used Hanford precipitation data including the 1983 data of 10.62 inches of annual rainfall. Based upon this value, the average annual percolation through the bottom of the cover was estimated to be 0.019 inches per year. When the cover design is finalized, more conservative precipitation and percolation values for the hydrologic evaluation of landfill performance model will be used to determine potential releases of dangerous waste constituents to the environment.

I.A-3. Historical Summary of Wastes Discharged to 183-H Basins

The 183-H Basins received both routine and nonroutine wastes. The routine waste stream consisted of spent acid etch solutions (primarily nitric, sulfuric, hydrofluoric, and chromic acids) generated by the nuclear fuel fabrication process. Typically these acidic solutions were reacted (neutralized) with excess sodium hydroxide before being transported to the 183-H Basins. Metal constituents in the waste included copper, silicon,

zirconium, aluminum, chromium, manganese, nickel, and uranium. Following reaction with sodium hydroxide, these metals were present primarily in the form of precipitates. The resultant slurry of liquid and metal precipitates was transported and discharged into the 183-H Basins.

Several nonroutine wastes were discharged to the 183-H Basins during the period of operation. Addition of each nonroutine waste was controlled by a procedure requiring a review of the proposed discharge by nuclear fuel fabrication engineering personnel. Because the chemical waste was placed in the 183-H Basins for volume reduction and storage, the review was performed to determine whether undesirable chemical reactions would take place. A 'chemical waste disposal permit' system was developed for acceptance of wastes in the 183-H Basins. The 'permit' system was for internal use only and should not be considered in the same context as a state or EPA 'permitted' system. The guidance and restrictions that were considered before discharge of each nonroutine waste are discussed in the remainder of this section.

Nonroutine wastes consisted of unused chemicals and spent solutions from miscellaneous processes, developments tests, and laboratories. Nonroutine wastes fell into three categories: listed wastes, nonlisted wastes that were added directly to the 183-H Basins, and nonlisted wastes that were mixed with the routine waste stream before being transported to the 183-H Basins.

Chemical designations for routine and nonroutine wastes were not pursued once wastes were placed in the 183-H Basins. However, an approximation of the 183-H Basins wastes analytical results has been reconstructed after-the-fact from chemical designations for some of these routine and nonroutine wastes.

The remainder of Section I.A-3 and Section I.A-4 through I.A-6 provide further information on routine and nonroutine waste discharges to the 183-H Basins. However, the clarification of certain facts is required before continuing.

I.A-3a. Routine Wastes. The first load of routine wastes was discharged to the 183-H Basins in July 1973. The last waste discharge occurred in November 1985. During the time of use, 2,542,000 gallons of routine wastes were added to the 183-H Basins. Table I.A-1 provides a summary of the routine wastes discharged for each year of use. Information presented in the table is based upon operating logs and routine analyses of waste loads (Section I.A-4).

As indicated in Table I.A-1, the major chemical constituent in the wastes was nitrate ion. Over 3,000,000 pounds of this ion were discharged to the 183-H Basins. Sulfate ion contributed another 753,000 pounds. Copper was the major metal constituent of the waste, totalling over 400,000 pounds.

During the 183-H Basins operating life, systematic chemical analyses were not performed for the routine wastes discharges. However, from the data available (chemical waste disposal permits), it is known that some of the individual waste loads exhibited the corrosivity characteristic. The average

Table I.A-1. Routine Wastes Discharged to 183-H Basins.

Year	Total gallons	Number of loads	Uranium (lbs)	Chromium (lbs)	Manganese (lbs)	Copper (lbs)	Nitrate Ion (lbs)	Sulfate Ion (lbs)	Ammonium Ion (lbs)	Fluor. Ion (lbs)	Average pH
1973	19,000	7	40	a	a	2,900	26,500	7,500	a	a	9.1
1974	0	0	--	--	--	--	--	--	--	--	--
1975	142,000	51	150	130	260	30,300	160,400	44,900	260	14,900	9.4
1976	127,000	46	80	270	170	17,700	168,100	40,800	340	17,300	10.0
1977	155,000	59	160	160	230	25,700	200,900	37,300	260	16,500	10.4
1978	150,000	57	340	110	270	28,400	154,400	46,400	250	9,400	10.3
1979	160,000	59	540	190	240	36,800	166,200	47,100	150	13,100	10.1
1980	151,000	60	410	200	300	33,200	151,800	59,900	130	10,800	9.3
1981	200,000	75	520	150	340	38,200	252,700	50,800	260	12,700	12.7
1982	247,000	112	470	130	420	44,600	309,400	58,000	290	17,700	9.9
1983	406,000	184	630	120	380	72,600	451,300	122,300	760	22,700	9.6
1984	416,000	185	600	90	300	57,000	431,700	141,200	660	32,700	9.6
1985	369,000	163	440	90	200	49,000	550,000	97,000	520	27,000	10.3
TOTAL	2,542,000	1,058	4,380	1,640	3,110	436,400	3,023,400	753,200	3,880	194,800	9.8

[a]Data not available for 1973.

pH for the year of 1981, for example, was 12.7. Additionally, waste records show that some loads had pH values of about 2.0. Also, the highest chromium level found was a monthly composite sample of 700 parts per million; compared to a 500 parts per million limit for designation as an extremely hazardous waste. Additional data from other months indicate that chromium concentrations frequently exceeded Extraction Procedure Toxicity designation limits for this constituent. With known toxic constituents such as copper, fluoride, and chromium, the routine waste stream would most likely have been designated for toxicity via WAC 173-303-084(5), although an actual toxicity evaluation was not performed at the time of waste discharges to the 183-H Basins.

The routine waste stream also contained uranium and technetium-99. The presence of these constituents caused the material to be categorized as low-level, nontransuranic radioactive waste.

I.A-3b. Listed Nonroutine Wastes. Table I.A-2 is a summary of the nonroutine wastes discharged to the 183-H Basins, which has been based upon a review of the chemical waste disposal permits. The chemical waste disposal permits, that were used for discharging nonroutine wastes to the 183-H Basins, have shown that six different listed wastes were discharged. Four of these listed materials were added directly to Basin Number 1. The other two wastes were mixed with the routine waste stream and then transported to the 183-H Basins. The quantities of listed nonroutine wastes discharges were small: 4.5 pounds of solid materials and slightly over 2 gallons of solution.

I.A-3c. Nonlisted, Nonroutine Wastes Discharged Directly into 183-H Basins. Twelve chemical waste disposal permits stipulated discharge of nonlisted wastes directly into the 183-H Basins. A summary of these discharges, along with probable waste designation numbers, is provided in Table I.A-3. Discharges totalled approximately 110 pounds of apparently designated solid materials and less than 1,530 gallons of apparently designated liquid wastes. In addition, 10,400 gallons of waste, that were believed to have been nondesignated waste, were also discharged directly to the 183-H Basins.

I.A-3d. Nonlisted, Nonroutine Wastes Mixed with Routine Waste Stream. A common practice for disposal of nonroutine wastes was to mix the materials with the routine waste stream before the wastes were transported to the 183-H Basins. In the case of nonroutine acidic wastes, the mixing was typically done such that the material would pass through the sodium hydroxide addition process. Nonacidic wastes were normally added downstream from the caustic addition process. Table I.A-4 presents a detailed summary of the nonlisted, nonroutine wastes that were mixed with the routine waste stream. The chemical waste disposal permits indicate that about 11,700 gallons of liquid wastes and 3,400 pounds of solid wastes were discharged to the 183-H Basins in this manner.

I.A-4. General Waste Analyses

During October 1984, the wastes in Basin Number 1 were sampled. The wastes contained three strata: a wet sludge, a liquid phase, and a relatively

Table I.A-2. Summary of Nonroutine Wastes: Listed Wastes Discharged into the 183-H Basins.

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Dangerous waste number	Disposal technique
1-76	1/15/76	Unused formic acid		2	U123	Mixed with routine waste solution and transported to 183-H Basins
3-76	1/15/76	Unused cyanide solutions	2		P030	Solutions poured directly into 183-H Basins
23-76	6/29/76	Unused saturated vanadium pentoxide aqueous solution	0.25		P120	Mixed with routine waste solution and transported to 183-H Basins
5-77	3/7/77	Unused chemicals: cuprous cyanide sodium cyanide		1 1	P029 P106	Chemicals poured directly into 183-H Basins
7-77	3/9/77	Unused potassium cyanide		0.5	P098	Chemical poured direction into 183-H Basins

[a] CWDP=Chemical waste disposal permit

dry white stratum. During the summer and fall of 1985, following transfer of as much liquid as possible into the adjacent 183-H Basins, the sludge and the dry waste strata were removed from Basin Number 1. Removal was accomplished by packaging the waste into 90-mil polyethylene liners inside of U.S. Department of Transportation 17H 55-gallon drums. Absorbent material was added to absorb free liquids and fill voids within the drums. The drums were then sealed and transported to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility.

In January 1986, the wastes in Basin Number 2 were sampled. The waste consisted of a wet sludge and a liquid phase. Later that year, the liquid was transferred into Basin Numbers 3 and 4; the Basin Number 2 sludge was containerized [galvanized steel drums with 90-mil polyethylene liners and a 10-mil polyethylene inner liner (Section I.B-3b)] and shipped to the 200 West

Table I.A-3. Summary of Nonroutine Wastes: Nonlisted Wastes Discharged Directly into 183-H Basins. (sheet 1 of 3)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Probable designation	Summary of lab results	Comments
11-76	3/08/76	Unused chemicals:					
		sodium arsenate acid (dibasic)		7	WT01	None	None
		ammonium phosphate (dibasic)		25	WT02		
					D004 (EHW)[b]	None	None
15-77	9/13/77	Unused chemicals:					
		nickel oxide, mixed nickel,		12	WC02	None	None
		copper, and iron oxides		66	WC02	None	None
1 78	1/06/78	Clean waste from shake down tests of acid digestion system. Solution contains sodium nitrate, sodium sulfate (anhydrous), sodium chloride, sodium carbonate	1,500		Not regulated	pH = 12.45 16,000 ppm sodium 2 ppm chromium 10 ppm nickel 16 ppm aluminum 10 ppm iron	Concentration of makeup materials not known
2 78	1/26/78	Clean waste from shake down tests of acid digestion system. Solution contains sodium nitrate, sodium sulfate (anhydrous), sodium chloride, sodium carbonate	1,000		Not regulated	None	Permit indicated "pH >10"
3-78	3/7/78	Clean waste from shake-down tests of acid digestion system. Solution contains sodium nitrate, and sodium sulfate (anhydrous), sodium chloride, and sodium carbonate	3,000		Not regulated	None	Estimated to contain 5% sodium nitrate concentration of other materials known

Table I.A-3. Summary of Nonroutine Wastes: Nonlisted Wastes Discharged Directly into 183-H Basins. (sheet 2 of 3)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Probable designation	Summary of lab results	Comments
1-79	1/16/79	Clean waste from shake-down tests of acid digestion system. Solution contains sodium nitrate, sodium sulfate (anhydrous), sodium chloride, sodium carbonate	800		Not regulated	None	Permit indicated "pH >10"
3-79	3/1/79	Clean waste from shake-down tests of acid digestion system. Solution contains sodium nitrate, sodium sulfate (anhydrous), sodium chloride, and sodium carbonate	1,800		Not regulated	None	Permit indicated "pH >10"
7-79	12/4/79	Clean waste from shake-down tests of acid digestion system. Solution contains sodium nitrate, sodium sulfate (anhydrous), sodium chloride, and sodium carbonate	1,000		Not regulated	None	Permit indicated "pH >10"
3-80	5/1/80	Sodium Carbonate sludge pumped from bottom of sodium hydroxide storage tank	~625		Undetermined; possibly D009[c]	None	
5-80	11/7/80	Clean waste from shake-down tests of acid digestion system. Solution contains sodium nitrate and sodium sulfate (anhydrous)	800		Not regulated	None	Permit indicated "pH >10"

Table I.A-3. Summary of Nonroutine Wastes:
Nonlisted Wastes Discharged Directly into 183-H Basins. (sheet 3 of 3)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Probable designation	Summary of lab results	Comments
6-80	11/26/80	Used boiler cleaning solutions, including approximately 600 gal of pH 10, 200 gal of pH 5, and rinse water. Makeup of cleaning solutions include ethylenediaminetetraacetic acid (300 lb max), ammonium persulfate (450 lb max), aqua ammonia (200 gal max), ethylene diamine (55 gal max), hydrazine (47 gal max), thiourea (50 lb max) Iron, copper and nickel are expected in used solution	900		WT01 (based upon max concentration)	None	None
2-81	9/23/81	Clean waste from shake down tests of acid digestion system. Solution contains nitrate and sodium sulfate (anhydrous)	500		Not regulated	None	Permit indicated "pH ~10"

[a] CWDP=Chemical waste disposal permit.
[b] EHW=Extremely hazardous waste.
[c] Sludge was flushed with water for 5 days before being pumped into tanker for disposal at 183-H Basins. Previous laboratory data indicated mercury content in insoluble sludge of about 1/2 percent. Amount remaining after flushing is unknown. Analysis of mercury in Basin Numbers 2, 3, and 4 showed that mercury levels were below Extraction Procedure Toxicity Designation Limit.

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 1 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
1-75	7/21/75	Used sulfamic-acid-based proprietary solution from film developing process	35		pH = 1.7 684 ppm chromium 34 ppm iron 14 ppm aluminum	None
2-75	12/11/75	Used chromium plating solution	55		Total acid normality = 1.9 >20,000 ppm chromium 2,000 ppm copper 1,000 ppm iron 20 ppm barium 40 ppm cadmium 10 ppm molybdenum	None
3-75	12/12/75	Synthetic salt solution; initial makeup was: sodium hydroxide-13% sodium aluminate-5% sodium nitrate-24% sodium nitrite-8% water-50%	495		pH = 12.0 Spectrochemical analysis showed no heavy metals	None
1-76	1/15/76	Unused oxalic acid		70	None	None
2-76	1/15/76	Unused chemicals:			None	None
		hydrobromic acid		19		
		hydroiodic acid		2		
		perchloric acid		3		
		phosphoric acid	5			
		hydrochloric acid	0.5			
		hypophosphorous acid	1			

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 2 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
4-76	1/19/76	Used absorbing solution containing mercuric chloride (0.067 lb/gal), ethylenediaminetetraacetic acid (0.01 lb total), and potassium chloride	20		None	None
5-76	1/30/76	Used battery acid containing sulfuric acid and lead	240		None	None
6-76	2/02/76	Used battery acid containing sulfuric acid and lead	140		None	None
7-76	2/17/76	Used battery acid containing sulfuric acid and lead	52		Approximately 2 lb sulfuric acid/gal 1 ppm lead 2 ppm barium 1 ppm cobalt 5 ppm chromium 2 ppm copper 5 ppm nickel	None
8-76	2/20/76	Used battery acid containing sulfuric acid and lead	275		None	None
9-76	3/08/76	Unused oxalic-acid-based proprietary chemicals:				
		Chemical 1		45	10,000 ppm calcium	Apparently also citric acid
		Chemical 2		30	500 ppm calcium 200 ppm sodium	Apparently also citric acid

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 3 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
9-76 (cont)		Chemical 3		26	20,000 ppm sodium 2,000 ppm calcium	Apparently also citric acid
		Chemical 4	6		pH = 4.9 >5,000 ppm sodium	None
10-76	3/08/76	Unused ethylenediaminete-tra-acetic acid-based chemicals:				
		Chemical 1	3		>5,000 ppm sodium	Lab results showed no heavy metals in any of the five chemicals
		Chemical 2	3		>5,000 ppm sodium	
		Chemical 3		35	50 ppm calcium	
		Chemical 4		100	200 ppm sodium	
		Chemical 5		25	200 ppm sodium	
11-76	3/08/76	Unused chemicals:				
		sodium hydrosulfite		75	None	None
		sodium		10	None	None
12-76	3/08/76	Unused phosphoric acid-based proprietary chemicals:				
		Chemical 1	10		2,000 ppm aluminum 2,000 ppm silicon 5 ppm barium 50 ppm iron	None
		Chemical 2	4		700 ppm aluminum 700 ppm silicon 10 ppm nickel 20 ppm iron	None
		Chemical 3	4		700 ppm silicon 200 ppm aluminum 40 ppm iron	None

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 4 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
12-76 (cont)		Chemical 4	3.5		600 ppm aluminum 600 ppm silicon 20 ppm iron	None
		Chemical 5	2		600 ppm aluminum 600 ppm silicon 20 ppm iron	None
		Chemical 6	4		250 ppm silicon 250 ppm aluminum 3 ppm nickel 1 ppm vanadium 5 ppm iron	None
		Chemical 7	5		500 ppm aluminum 250 ppm silicon 5 ppm barium 2 ppm vanadium 2 ppm cobalt 1 ppm molybdenum 5 ppm nickel 10 ppm iron	None
		Chemical 8	1		200 ppm aluminum 200 ppm silicon 1 ppm barium 1 ppm vanadium 1 ppm nickel 10 ppm iron	None

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 5 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
12-76 (cont)		Chemical 9	1		500 ppm aluminum 250 ppm silicon 1 ppm barium 1 ppm vanadium 2 ppm nickel 5 ppm iron	None
		Chemical 10	1		300 ppm aluminum 300 ppm silicon 1 ppm barium 1 ppm vanadium 3 ppm nickel 5 ppm iron	None
		Chemical 11	4		350 ppm aluminum 350 ppm silicon 2 ppm barium 2 ppm vanadium 3 ppm nickel 7 ppm iron	None
		Chemical 12	13		1,000 ppm aluminum 1,000 ppm silicon 10 ppm barium 100 ppm iron	None
		Chemical 13	11		700 ppm aluminum 700 ppm silicon 20 ppm iron	None

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 6 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
13-76	3/8/76	Unused sulfamic-acid-based proprietary chemicals:				
		Chemical 1		75	10,000 ppm sodium	None
		Chemical 2		75	20,000 ppm sodium 2,000 ppm calcium	None
16-76	3/17/76	Used battery acid containing sulfuric acid and lead	107		5.7 normal hydrogen ion 0.2 ppm silver 0.05 ppm chromium 2 ppm lead 2 ppm copper	None
17-76	3/17/76	Used battery acid containing sulfuric acid	72		3.0 normal hydrogen ion 1 ppm copper 0.5 ppm nickel 0.5 ppm lead	None
18-76	3/25/76	Unused chemicals: nickel plating solution	0.75		pH approximately 7.0 >2% nickel 2,000 ppm boron 10 ppm cobalt 20 ppm copper 40 ppm manganese	None
		Copper sulfate		4	None	None
19-76	3/25/76	Unused chemicals: Proprietary solution containing sulfuric acid and nitric acid	5		9.1 normal hydrogen ion 200 ppm copper 20,000 ppm sodium	None

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 7 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
19-76 (cont)		Fuming sulfuric acid	1		None	None
20-76	3/25/76	Unused chromic acid		100	None	None
21-76	6/29/76	Unused chemicals: sodium aluminate	55		pH = 10.5 1,000 ppm aluminum 40 ppm copper 200 ppm nickel 40,000 ppm sodium 20 ppm iron	None
		Proprietary caustic materials: Chemical 1: solution	55		pH = 11.8	None
		powder		125	>100,000 ppm sodium 200 ppm phosphorous 5 ppm lead 2 ppm aluminum	
		Cleaner		400	pH = 11.2 10,000 ppm phosphorous 100,000 ppm sodium	None
		All-purpose synthetic cleaner	55		pH = 11.2 1,000 ppm phosphorous 10 ppm copper 6,000 ppm sodium 10,000 ppm silicon 6 ppm iron	None

Table II.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 8 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
21-76 (cont)		Chemical 2		275	pH = 9.2 10,000 ppm phosphorous >100,000 ppm sodium 20,000 ppm silicon 50 ppm iron 20 ppm aluminum	None
		Chemical 3	0.25		pH = 12.3 100 ppm aluminum 4 ppm barium 10,000 ppm sodium 1,000 ppm silicon	None
		Alkaline rust remover		6	5 ppm manganese 100,000 ppm sodium 20 ppm strontium 10 ppm aluminum	None
22-76	6/29/76	Unused acid-plating solutions: cobalt plating solution	0.25		pH = 2.3 >20,000 ppm cobalt 200 ppm nickel 2 ppm magnesium	None
		Activating solution 2	0.25		100 ppm nickel >20,000 ppm sodium 10 ppm cobalt	None
		Nickel acid solution	0.125		pH = 1.5 30,000 ppm nickel 100 ppm copper 10 ppm manganese 10 ppm chromium 300 ppm cobalt 20 ppm magnesium 5 ppm aluminum	None

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 9 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
22-76 (cont)		Activating solution 1	0.25		0.2 ppm nickel 0.1 ppm aluminum 0.1 ppm iron	Appears to have been dilute sulfuric acid solution
		Copper acid solution	0.25		pH = 1.1 20,000 ppm copper 20 ppm nickel 10 ppm iron	None
		Used proprietary solution containing nitric, sulfuric, and chromic acid	20		None	None
23-76	6/29/76	Unused chemicals:				
		copper sulfate		100	None	None
		ferric sulfate		2		
		sodium hypophosphite		0.25		
		urea		1		
		Proprietary solution:	0.75		pH = 7.3 >20,000 ppm nickel 10,000 ppm phosphorous 1,000 ppm cobalt 10 ppm chromium	None
24-76	7/12/76	Caustic materials in drums found onsite (4 drums):				
		Drum 14		55	500 ppm aluminum 500 ppm iron 100 ppm uranium 10 ppm chromium	None

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Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 10 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
24-76 (cont)		Drum 14			50 ppm strontium	
					50 ppm nickel	
					5 ppm lead	
					>100,000 ppm sodium	
					5 ppm manganese	
					1 ppm copper	
					1,000 ppm silicon	
					10 ppm magnesium	
		Drum 40		39	1,000 ppm aluminum	None
					500 ppm iron	
					100 ppm nickel	
					20 ppm strontium	
					10 ppm chromium	
					5 ppm manganese	
					50 ppm barium	
					>100,000 ppm sodium	
					10 ppm magnesium	
		Drum 31	15.5		pH = 8.5	None
					>3,000 ppm copper	
					30 ppm nickel	
					6 ppm cadmium	
					5 ppm aluminum	
					10 ppm magnesium	
		Drum 39	0.5		90 ppm iron	None
					90 ppm manganese	
					4 ppm chromium	
					1 ppm nickel	
					2 ppm barium	
					900 ppm sodium	
					40 ppm aluminum	
					1 ppm magnesium	

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 11 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
25-76	7/12/76	Strong acid solution found in drum	1.5		4,000 ppm iron 800 ppm nickel 800 ppm molybdenum 400 ppm copper 80 ppm chromium 40 ppm manganese 40 ppm cobalt 4 ppm vanadium 80 ppm aluminum 8 ppm magnesium	None
26-76	8/05/76	Used battery acid containing sulfuric acid and lead	60		None	None
27-76	8/17/76	Unused chemicals:				None
		acetic acid	0.75		None	
		diethanolamine	0.25		None	
		mercuric nitrate	0.125		None	
		sodium hydroxide	0.25		None	
		mercaptoacetic acid	0.125		None	
		choline chloride		2.25	None	
		deoxycholic acid		0.125	None	
		phosphomolybdic acid		1	None	
		sodium chromate		2	None	
		trichloracetic acid		0.25	None	
28-76	8/17/76	Used phosphoris pentaoxide desiccant		5	None	None

Table II.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 12 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
29-76	8/17/76	Used ethylenediaminetraacetic acid solution	185		10 ppm chromium 6,000 ppm copper 6,000 ppm iron 600 ppm manganese 100 ppm molybdenum 1,000 ppm sodium 300 ppm nickel 100 ppm lead 10 ppm zinc 30 ppm aluminum	None
30-76	9/2/76	Used hydrochloric acid solution (<1 normal)	0.25		None	Contained 1 g beryllium according to permit
31-76	10/01/76	Sodium nitrate contaminated with dirt		150	None	None
32-76	10/11/76	Used battery acid containing sulfuric acid and lead	301.5		None	None
33-76	10/28/76	Used wetting and foaming agent from testing of corrosion rate with uranium; test makeup included 0.003 lb uranium and 0.006 gal wetting and foaming agent	5		None	None

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 13 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
34-76	12/14/76	Used inhibited hydrochloric acid cleaning solution from derusting of degreasing solvent storage tank; makeup solution of 20% hydrochloric acid and 1% amine-based inhibitor	2,000		None	None
35-76	12/14/76	Used citric and ammoniated citric acid solution from passivating of degreasing solvent storage tank; makeup solution was 1/4% citric acid, followed by pH adjustment to 8 to 9 by addition of ammonium hydroxide	1,319		None	None
1-77	1/24/77	Unused 35% hydrogen peroxide solution	6		None	None
2-77	2/28/77	Unused chemicals:				
		phosphoric acid	0.25		None	None
		acetic acid	2.5		None	None
3-77	3/01/77	Unused ammonium bifluoride crystals		400	None	None

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 14 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
4-77	3/07/77	Unused chemicals:				
		nickel chloride		5	None	None
		nickel sulfate		5	None	
		sodium phosphate		1	None	
		sodium borate		1	None	
		boric acid		1	None	
		cupric sulfate		6	None	
		lithium fluoride		1	None	
		aluminum chloride		1	None	
		sodium fluoride		1	None	
6-77	3/09/77	Unused chemicals:				
		ammonium fluoride		4	None	None
		sodium fluoride		2.5	None	
		sodium chromate		4	None	
		ammonium citrate		3	None	
		oxalic acid		12	None	
		citric acid		6	None	
		barium perchlorate		4	None	
		ammonium ceric sulfate		4	None	
8-77	3/09/77	Unused chromic acid		6	None	None
11-77	4/13/77	Unused chemicals:				
		potassium nitrate		2	None	None
		potassium dichromate		2	None	
		sodium dichromate		1	None	
		sodium citrate		1	None	
		sodium acetate		1	None	

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 15 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
13-77	5/23/77	Used sulfuric acid solution	450		70% sulfuric acid solution; 0.2 ppm silver 10 ppm barium 5 ppm cobalt 100 ppm chromium 30 ppm copper 50 ppm manganese 500 ppm molybdenum 500 ppm nickel 10 ppm lead 5 ppm vanadium 30 ppm iron 10 ppm magnesium 3 ppm titanium	None
		Used nitric acid solution	50		None	None
14-77	6/13/77	Unused nickel sulfate solution containing 62 g/l of nickel sulfate	20		None	None
15-77	9/13/77	Unused chemicals:				
		proprietary alkaline rust remover		440	>100,000 ppm sodium	None
		proprietary chemical		200	>100,000 ppm sodium	Apparently contains sodium bisulfate
		ammonium persulfate		220	None	None
		ethylenediamine	39		None	

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 16 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
16-77	9/13/77	Used drum dryer product containing aluminum nitrate and sodium nitrate		400	30,000 ppm aluminum 50,000 ppm calcium 100 ppm copper 3,000 ppm iron 5,000 ppm magnesium 10 ppm manganese 100,000 ppm sodium 10 ppm boron	None
5-78	5/02/78	Unused proprietary rust prevention material containing sodium nitrite		55	None	None
6-78	5/08/78	Used absorbing solution consisting of neutral salt mixture of mercuric chloride (10 g/l) ethylenediaminetetraacetic acid (0.07 g/l) and potassium chloride (6 g/l)	10		None	None
8-78	9/07/78	Used copper strip solution containing depleted uranium	200		0.66 lb/gal nitric acid 1.22 lb/gal copper 0.18 lb/gal uranium 15 ppm cobalt 2 ppm chromium 2 ppm manganese 2 ppm nickel 2 ppm titanium	None
2-79	1/26/79	Waste nitric acid solution solution containing depleted uranium	526		111 lb (total) of depleted uranium; 810 lb (total) of nitric acid	None

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 17 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
4-79	7/05/79	Used derusting solution; prior to neutralization with sodium hydroxide, solution consisted of 2.5% oxalic acid, 3.9 vol% hydrogen peroxide, and 0.01 vol% of concentrated sulfuric acid	165		None	None
5-79	10/30/79	Unused chromic acid plating solution containing 40 oz/gal chromic acid and 1% sulfuric acid	30		None	None
6-79	10/30/79	Dilute beryllium sulfate solution containing 10 ppm beryllium sulfate from testing of effects on trout fry and eggs	220		None	None
8-79	12/13/79	Used copper strip solution containing depleted uranium	300		300 g/l nitric acid 185 g/l copper 14.7 g/l uranium 2 ppm silver 2 ppm manganese	None
1-80	2/01/80	Used sulfuric acid from start-up tests of acid digestion system	935		230 g/l sulfuric acid 30 ppm barium 30 ppm chromium 300 ppm copper 30 ppm manganese 5 ppm molybdenum 3,000 ppm sodium 60 ppm nickel 1 ppm vanadium 300 ppm zinc	None

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 18 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
4-80	10/02/80	Used glycol/sodium metasilicate-based proprietary silk screen cleaning solution	100		pH = 12.1 90-100 ppm barium 10 ppm cadmium 30 ppm copper 500-1100 ppm potassium 16,000-21,000 ppm sodium 40-60 ppm lead 40 ppm zinc 5-10 ppm boron	None
1-81	2/12/81	Used copper strip solution containing depleted uranium	300		2.63 lb/gal nitric acid 1.46 lb/gal copper 0.022 lb/gal uranium 30 ppm chromium 6 ppm manganese 10 ppm nickel 40 ppm zinc	None
3-81	12/03/81	Unused chemicals: nickel acetate solution	0.25		pH = 3.24 13 ppm arsenic 1 ppm zinc 1 ppm nickel	None
		Proprietary chemical 1	1.5		pH = 7.79 90 ppm chromium 570 ppm sodium 0.3 ppm copper 1 ppm antimony	None
		Proprietary chemical 2	0.75		pH = 7.45 350 ppm sodium	None

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 19 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
3-81 (cont)		Nickel sulfate solution	1		pH = 5.34 1,530 ppm nickel 1 ppm arsenic 1 ppm cobalt 1 ppm chromium	None
		Proprietary chemical 3	0.75		pH = 8.43 25 ppm cobalt 150 ppm sodium	None
		Proprietary chemical 4	0.75		pH = 8.92 80 ppm chromium 1 ppm antimony 360 ppm sodium	None
1-82	1/05/82	Used copper strip solution containing depleted uranium	300		<0.1 lb/gal nitric acid 1.31 lb/gal copper 0.152 lb/gal uranium 6 ppm cobalt 28 ppm nickel 100 ppm zinc 20 ppm titanium	None
2-82	1/05/82	Used glycol/sodium metasilicate-based proprietary silk screen cleaner	50		pH = 11.78 28 ppm barium 140 ppm copper 4,100 ppm sodium 26 ppm lead 3 ppm zinc 1 ppm chromium 5 ppm titanium 12 ppm phosphorous	None

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 20 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
3-82	7/09/82	Unused chemicals:				
		Oxalic acid		35	None	None
		Proprietary chemical	55		pH = 13.7 18 ppm copper 3,800 ppm silicon 13 ppm zinc	None
		Solution in unmarked container	5		pH = 13.3 6 ppm copper	None
4-82	11/05/82	Used nitric acid solution containing uranium	13		0.32 lb/gal nitric acid 607 ppm uranium	None
1-83	1/17/83	Used absorbing solution containing mercuric chloride (100 g/l)	12		None	None
2-83	4/22/83	Used glycol/sodium metasilicate-based proprietary silk screen cleaning solution (two drums):				
		Drum 1: pH = 10.7	30		2 ppm barium 630 ppm sodium	None
		Drum 2: pH = 12.8	30		20 ppm barium 2 ppm molybdenum 1,400 ppm sodium 260 ppm lead 2 ppm strontium	

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 21 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
3-83	4/25/83	Used copper strip solution containing depleted uranium	400		1.07 lb/gal nitric acid 1.52 lb/gal copper 0.816 lb/gal uranium 280 ppm zinc 790 ppm titanium 30 ppm nickel	None
4-83	7/11/83	Used copper strip solution containing depleted uranium	550		3.0 lb/gal nitric acid 1.5 lb/gal copper 0.3 lb/gal uranium 324 ppm zinc 30 ppm nickel 270 ppm titanium 98 ppm lead	None
1-84	4/18/84	Used glycol/sodium metasilicate-based proprietary silk screen cleaning solution (three drums):				
		Drum 1	30		pH = 12.9 45 ppm barium 12 ppm chromium 10,900 ppm sodium 110 ppm lead 2,200 ppm silicon 2.7 ppm strontium	None
		Drum 2	30		pH = 11.9 1.1 ppm copper 670 ppm sodium 370 ppm phosphorous 340 ppm silicon	

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 22 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
1-84 (cont)		Drum 3	30		pH = 12.2 42 ppm barium 6 ppm chromium 1 ppm copper 10,600 ppm sodium 50 ppm lead 1 ppm strontium 2,480 ppm silicon 2 ppm zinc 20 ppm phosphorous	
2-84	5/3/84	Used copper strip solution containing depleted uranium	225		0.19 lb/gal nitric acid 1.80 lb/gal copper 0.44 lb/gal uranium 336 ppm lead 588 ppm zinc 212 ppm titanium 374 ppm chromium 3,820 ppm gadolinium 1,120 ppm phosphorous	None
1-85	4/12/85	Used copper strip solution containing depleted uranium	200		0.07 lb/gal nitric acid 1.60 lb/gal copper 0.394 lb/gal uranium 1,400 ppm aluminum 60 ppm cobalt 1,600 ppm sodium 2,000 ppm magnesium 600 ppm phosphorous 700 ppm silicon 300 ppm zinc 150 ppm titanium	None

Table I.A-4. Summary of Nonroutine Wastes: Nonlisted Wastes Mixed with Routine Waste Before Transport to 183-H Basins. (sheet 23 of 23)

CWDP[a] Number	Permit date	Material description	Quantity (gal)	Quantity (lb)	Summary of lab results	Comments
2-85	5/10/85	Used phosphoric/citric-acid-based proprietary cleaning solution	80		0.38 lb/gal phosphoric acid 1,400 ppm citrate, pH=1.0 30 ppm sodium	None
3-85	5/21/85	Residual 36% sulfuric acid in 20 drums	Unknown (residue in "empty" drums)		None	None
4-85	10/16/85	Used copper strip solution containing depleted uranium	200		0.032 lb/gal nitric acid 1.19 lb/gal copper 0.249 lb/gal uranium 1,200 ppm magnesium 90 ppm titanium	None

[a] CWDP=Chemical waste disposal permit.

Area Central Waste Complex, Retrievable Waste Storage Facility. Also a 36-mil Hypalon* liner was then installed in Basin Number 2. Subsequently, all the liquid from Basin Numbers 3 and 4 was transferred back into the lined Basin Number 2.

During March 1987, the wet sludge and relatively dry crystalline strata in Basin Numbers 3 and 4 were sampled. At the same time, the liquid in Basin Number 2 also was sampled. During the summer of 1987, Basin Number 3 was cleaned out, the containerized materials were shipped to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility, and a 36-mil Hypalon liner was installed. As of January 1988, the sludge and crystalline waste stratum remained in Basin Number 4 and Basin Number 2 still contained liquid wastes. Basin Numbers 1 and 3 were empty except for accumulated rainwater.

During the summer of 1988, all the solid materials were removed from Basin Number 4, containerized, and shipped to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility. The following technical information summarizes the analytical results for the previous waste sampling efforts. Additional information is contained in Section I.A-6, Waste Analysis Plan.

I.A-4a. Basin Number 1 Solids. The wastes in the 'inner' portion of Basin Number 1 consisted primarily of sludge intermixed with a residual liquid (Figure I.A-4 and Figure A.1 of Appendix B). Since the cleanout effort involved pumping as much of the liquid phase as possible into Basin Number 2, a discussion of the analytical results for the Basin Number 1 liquid is not necessary. The solid phase represented the major percentage of the waste removed. The liquid phases from Basin Numbers 1, 2, 3, and 4 were eventually consolidated into Basin Number 2. The consolidated liquid analyses are presented after the discussions of the solid wastes in the other basins; Section I.A-4d is entitled "Basin Number 2 Liquid".

In addition to the sludge in the 'inner' portion of Basin Number 1 (henceforth referred to as 'inner' basin waste), a buildup of relatively dry waste was present along the two long walls (east and west) of the facility (Figure I.A-4). This 'outer' basin waste (Figure I.A-5 and Figure A.2 of Appendix B) was visibly different from the 'inner' basin waste, and thus samples taken from this stratum were analyzed separately. During removal of waste from Basin Number 1, however, no attempt was made to segregate the 'inner' and 'outer' basin wastes. As a consequence, the most conservative designation resulting from the separate analyses was assigned to all Basin Number 1 waste.

Inorganic chemical analyses were performed on five samples of the 'inner' basin waste. Results of this effort are summarized in Table I.A-5 for major constituents (i.e., constituents comprising greater than one percent of the waste). The 'average' values presented in the following tables reflect the sample 'mean', assuming a normal distribution. These results showed that

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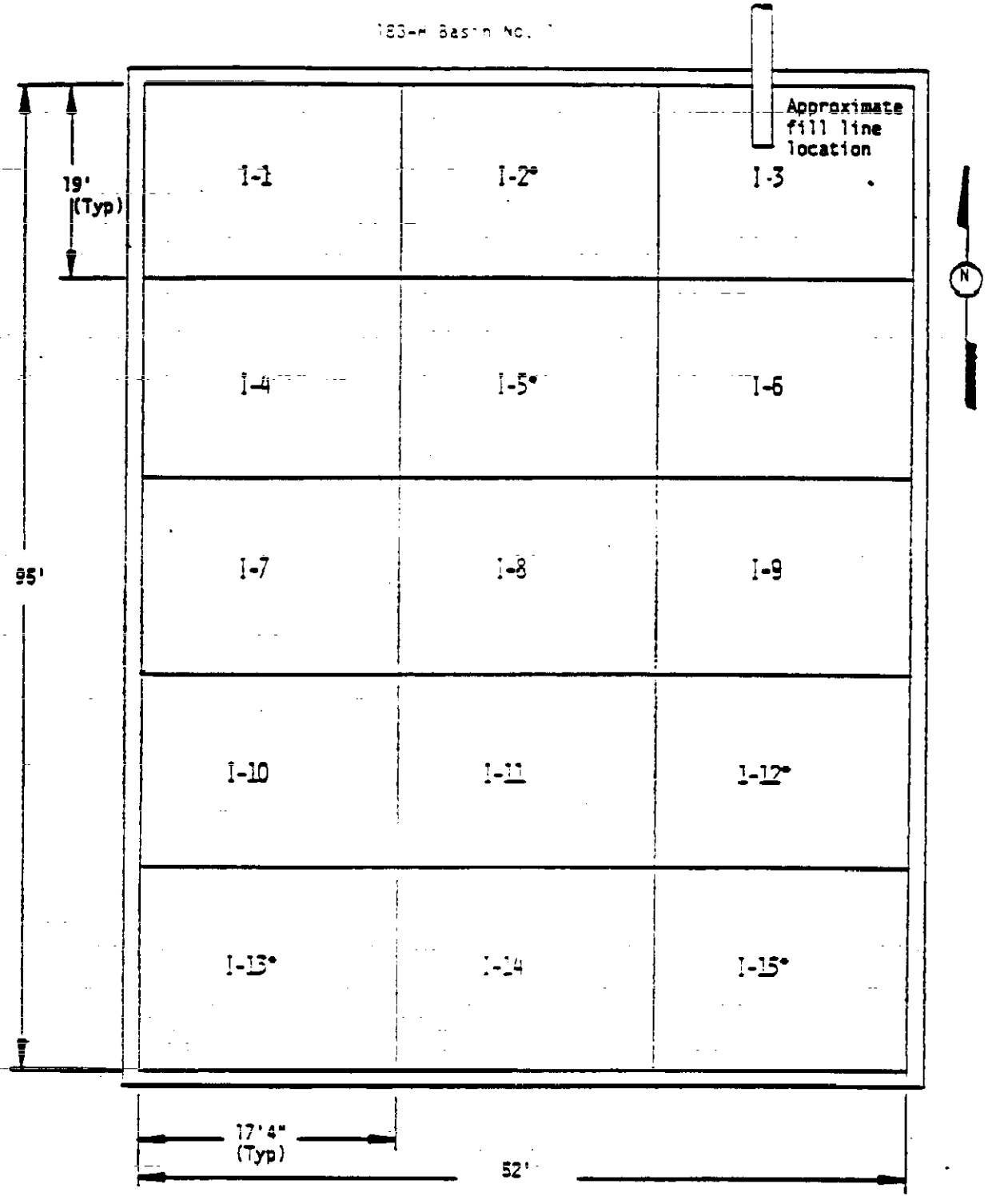
* Hypalon is a trademark of E.I. duPont de Nemours and Company, Incorporated.



*Samples randomly selected for analyses.

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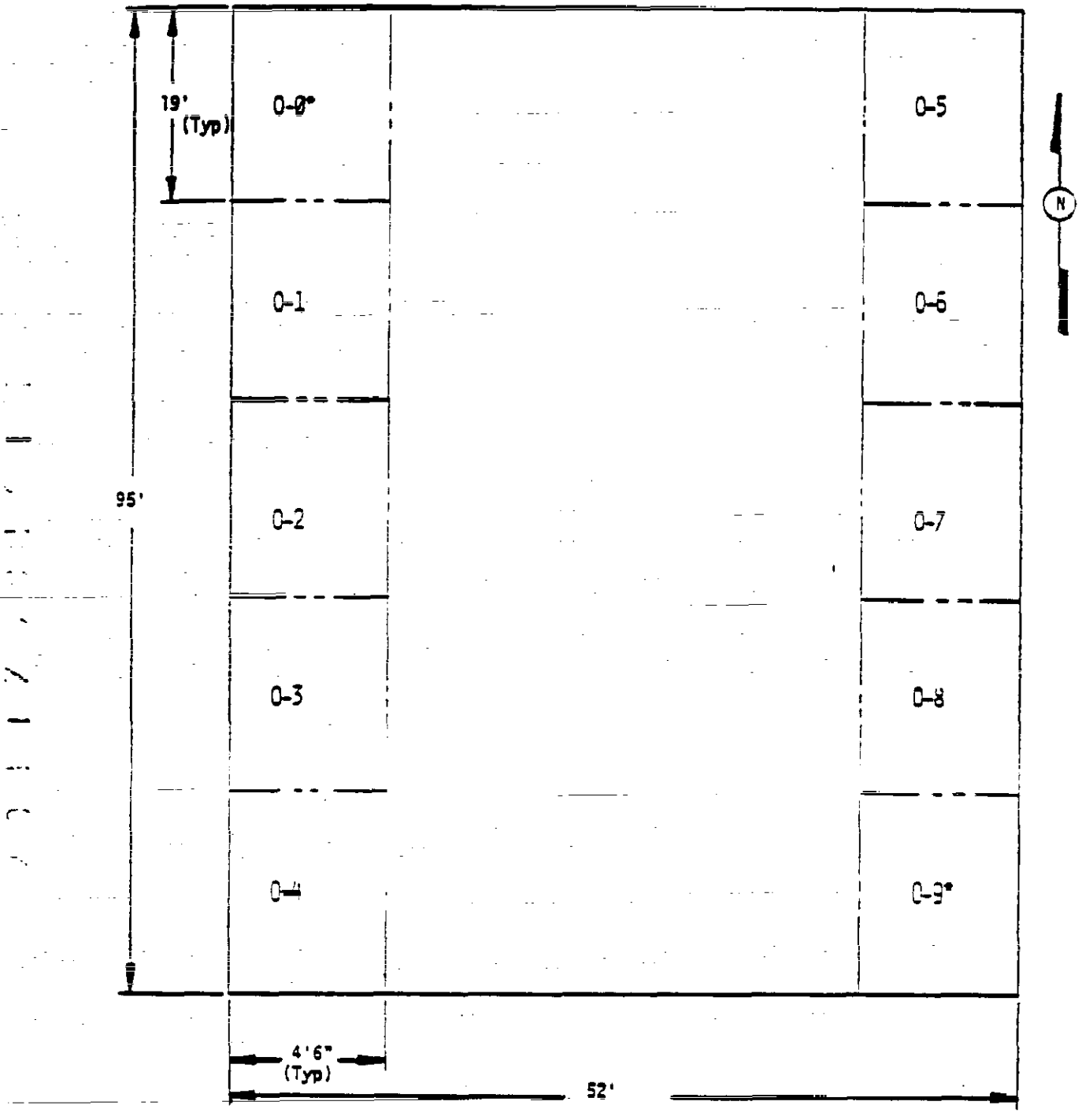
Figure I.A-4. "Inner" Basin Waste Sampling Grid.



*Samples randomly selected for analyses

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Figure I.A-5. "Outer" Basin Waste Sampling Grid.

the waste consisted largely of sodium sulfate, along with water held as moisture and as water of hydration. Nitrate and fluoride ions also were present in high concentrations. Copper constituted about 12 percent of the waste. Based upon the neutralization reaction, this copper would have been present primarily in the form of copper oxide and, to a lesser extent, copper hydroxide.

Two samples of the 'outer' basin waste were analyzed for inorganic constituents. As shown in Table I.A-5, this stratum had a significantly higher sulfate ion content and much lower concentrations of nitrate ion and copper than the inner basin waste.

Table I.A-5. Basin Number 1 Solids Samples: Constituents Greater than One Percent.

Constituent	'Inner' basin sludge content (%) Average	Range	'Outer' basin sludge content (%) Sample number 0-0	Sample number 0-9
Sodium	20.0	17.7 - 23.5	20.5	22.9
Copper	11.9	10.0 - 11.2	5.4	6.3
Zirconium	3.2	1.9 - 3.9	1.6	1.8
Fluoride ion	6.0	5.4 - 6.4	7.1	6.7
Nitrate ion	8.0	6.1 - 10.4	1.4	1.6
Sulfate ion	20.2	17.7 - 23.5	35.5	32.7
Water (dried to 105 °C)	22.2	18.7 - 24.5	22.8	23.1
Silicon	<1	<1	2.8	0.6

Table I.A-6 shows the trace constituents detected in the 'inner' and 'outer' basin waste samples. The uranium concentration ranged from 390 to 530 parts per million. As a consequence, the material was determined to be a low-level, nontransuranic radioactive waste.

Results of additional waste tests are summarized in the applicable sections discussing waste designation. Appendix B contains a copy of the waste characterization report prepared upon completion of the Basin Number 1 sampling and analysis effort.

I.A-4b. Basin Number 2 Sludge. Prior to removing sludge from Basin Number 2, samples of the liquid and sludge phases were analyzed for chemical constituents. As with Basin Number 1, the Basin Number 2 liquid was transferred into the adjacent basins before the sludge was removed. Only the results for the sludge (phase) are discussed in this section. Within the Basin Number 2 Liquid section is the discussion of analyses results for the consolidated liquid phases. As shown in Table I.A-7, the major constituents in the sludge were copper (13 percent), sodium ion (9.7 percent), and nitrate ion (13.5 percent). Moisture content in the sludge averaged 53 percent.

Table I.A-6. Basin Number 1 Solids Samples: Trace Constituents Detected.

Constituent	'Inner' basin sludge content (ppm) Average	Range	'Outer' basin sludge content (ppm) Sample number 0-0	Sample number 0-9
Aluminum	2,100	1,800 - 2,400	7,900	1,300
Barium	a	a	100	50
Boron	a	a	100	100
Calcium	800	700 - 1,000	3,100	500
Chromium	900	700 - 1,000	400	500
Iron	1,700	1,300 - 1,900	3,400	1,000
Lithium	a	a	100	60
Manganese	1,200	1,000 - 1,400	700	800
Magnesium	a	a	1,200	<500
Nickel	100[b]	<100 - 200	400	<400
Phosphorous	1,100	900 - 1,300	a	a
Silicon	8,100	7,200 - 9,300	a	a
Titanium	100	70 - 200	400	<100
Zinc	300	300 - 400	300	300
Uranium	420	390 - 530	82	155

[a] Constituent not detected.
[b] Nickel undetected in one sample in inner basin sludge.

Table I.A-7. Basin Number 2 Sludge Samples: Solids Constituents Greater than One Percent.

Constituent	Average content (%)	Range (%)
Copper	13.0	9.9 - 15.4
Sodium	9.7	4.2 - 15.9
Silicon	2.4	0.06 - 9.3
Zirconium	3.2	2.8 - 3.5
Fluoride ion	1.1	0.57 - 1.81
Nitrate ion	13.5	8.2 - 17.5
Sulfate ion	3.8	0.65 - 15.2
Moisture	52.7	45.7 - 57.7

Table I.A-8 lists the trace constituents detected in the sludge. Analytical results showed uranium present in the sludge in concentrations up to 2,500 parts per million. Other radioactive analysis indicated an average technetium-99 concentration of 1,170 picocuries per liter. As a consequence, the Basin Number 2 sludge was determined to be a low-level, nontransuranic radioactive waste.

Table I.A-8. Basin Number 2 Sludge Samples: Trace Constituents Detected.

Constituent	Average content (ppm)	Range (ppm)
Aluminum	1,950	540 - 4,470
Beryllium	6.0	4.4 - 7.8
Calcium	334	158 - 634
Chromium	450	292 - 727
Mercury	1.3[a]	<0.4 - 3
Iron	1,066	641 - 1,559
Silver	218[b]	119 - -308
Uranium	1,250	28 - 2,500
Vanadium	2.5[c]	<1.25 - 3.13
Total organic carbon	1,905	237 - 3,828

[a] Constituent above detection limit in one sample.
[b] Constituent below detection limits in two samples.
[c] Constituent below detection limits in three samples.

I.A-4c. Basin Numbers 3 and 4 Sludge and Crystalline Strata. The solid wastes in Basin Numbers 3 and 4 were sampled concurrently, and the analytical results were similar enough to be treated within a single discussion. There were two visibly distinct waste strata in each of the basins. These consisted of: (1) a moist sludge (inner basin), and (2) a relatively dry white crystalline stratum (outer basin) near the walls and around miscellaneous debris (e.g., tumbleweeds). Samples of the two strata were analyzed separately and each basin was sampled separately.

Table I.A-9 provides a summary of the analytical results for major inorganic constituents found in 20 samples (5 samples of both strata in each basin). The sludge stratum in both basins consisted primarily of sodium, nitrate ion, and copper. Moisture content in this stratum averaged greater than 40 percent in each basin. The concentrations of major constituents showed no significant differences between the two basins for this stratum.

The crystalline stratum contained high average concentrations of sodium and sulfate ions. The sulfate ion content varied greatly in Basin Number 4, ranging from 1.5 to 31 percent. A major difference among the basins was observed in the nitrate ion concentrations in the crystalline stratum. Basin Number 4 nitrate levels ranged from 7 to 70 percent; Basin Number 3 levels were all less than 1 percent.

Table I.A-10 provides a summary of the trace inorganic constituent results for the sludge strata. Table I.A-11 provides similar information for

Table I.A-9. Basin Numbers 3 and 4 Sludge Samples: Major Inorganic Constituents.

	Concentration in Basin Number 4 sludge samples (%)		Concentration in Basin Number 3 sludge samples (%)	
Constituent	Average	Range	Average	Range
Copper	10.3	9.7 - 12.0	11.2	8.8 - 14
Sodium	24	23 - 26	23	20 - 30
Zirconium	4.4	0.34 - 13.0	8.7	2.2 - 22
Fluoride ion	1.1	0.98 - 1.2	1.3	0.98 - 1.5
Nitrate ion	22	20 - 24	26	17 - 29
Sulfate ion	1.9	1.3 - 3.9	3.7	1.9 - 5.3
Moisture	46	43 - 51	42	35 - 51

	Concentration in Basin Number 4 crystalline samples (%)		Concentration in Basin Number 3 crystalline samples (%)	
Constituent	Average	Range	Average	Range
Sodium	38	30 - 50	42	35 - 55
Sulfate ion	13	1.5 - 31	20	16 - 26
Fluoride ion	2.2	0.28 - 5.8	3.6	2.9 - 4.9
Nitrate ion	46.6	7.1 - 71	<1	<1
Moisture	6.6	1.1 - 25	1.1	0.55 - 1.8

the crystalline wastes. Table I.A-12 lists the inorganic constituents for which analyses were performed but which were not detected in the samples.

Volatile organic analysis was performed per Method 8240 (EPA 1986c) on 10 samples of wet sludge (five samples from each basin). The primary reason for obtaining this analysis was to determine if tetrachloroethane and 1,1,1-trichloroethane (two solvents routinely used in the nuclear fuels fabrication processes) had reached the 183-H Basins via carryover into the routine waste stream. The analytical results showed that both constituents of concern were less than the detection limits, which ranged from 8 to 25 parts per billion for the Basin Number 4 sludge. Basin Number 3 samples showed an average tetrachloroethane concentration of 74 parts per billion; while 1,1,1-trichloroethane was less than detection limits, which ranged from 13 to 50 parts per billion. Other volatile organic constituents detected in the samples are shown in Table I.A-13. Table I.A-14 shows volatile organic materials for which analyses were performed but which were not detected.

Uranium analyses results are summarized in Table I.A-15. Based upon these results, the material is categorized as low-level, nontransuranic radioactive waste. Appendix C presents a copy of the waste characterization report prepared at the completion of the Basin Numbers 3 and 4 sampling and analysis effort.

Table I.A-10. Basin Numbers 3 and 4 Sludge Samples: Trace Inorganic Constituents Detected.

	Concentration in Basin Number 4 sludge content (ppm)		Concentration in Basin Number 3 sludge content (ppm)	
Constituent	Average	Range	Average	Range
Aluminum	430	390 - 490	8,900	1,100 - 17,000
Barium	24[a]	<1 - 39	6[b]	<1 - 22
Beryllium	0.4[b]	<0.09 - 1.8	2.3	<0.5 - 3.8
Boron	31	26 - 38	40[b]	<20 - <60
Cadmium	3.8	2.9 - 4.5	6[d]	3.6 - <9
Chlorine ion	210	170 - 230	310	150 - 410
Calcium	84	67 - 110	290	180 - 650
Chromium	260	210 - 340	390	290 - 530
Cobalt	2[a]	0.66 - 3.1	5[b]	<3 - <9
Iron	2,100	1,200 - 3,800	710	540 - 1,000
Lead	36[c]	14 - <50	<80	<80
Magnesium	21	15 - 32	67[a]	39 - 120
Manganese	760	680 - 890	970	800 - 1,100
Nickel	96	81 - 110	130	96 - 180
Nitrite ion	390	330 - 460	660	430 - 790
Potassium	330	78 - 430	680[a]	<300 - 1,600
Silver	170	140 - 220	190	120 - 290
Strontium	4.0	3.5 - 4.7	17	11 - 36
Tin	600	470 - 680	480	360 - 750
Vanadium	4[c]	<2 - <10	<30	<30
Zinc	360	310 - 420	370	280 - 520

[a] Constituent less than detection limit in one sample.
[b] Constituent less than detection limit in four samples.
[c] Constituent less than detection limit in three samples.
[d] Constituent less than detection limit in two samples.

I.A-4d. Basin Number 2 Liquid. After sludge was removed in 1986, Basin Number 2 was equipped with a new Hypalon liner. Subsequently, the liquids from Basin Numbers 3 and 4 were pumped into Basin Number 2. Five samples were taken of this liquid. As shown in Table I.A-16, the major constituents found were sodium and nitrate ions (14 and 38 percent respectively). Moisture content averaged 57 percent. Table I.A-17 provides a summary of trace inorganic constituents detected in the liquid samples. Table I.A-18 lists inorganic constituents for which analyses were performed but were not detected.

Five liquid samples also were subjected to testing for volatile organic constituents per EPA document SW-846, Method 8240 (EPA 1986c). The constituent 1,1,1-trichloroethane was detected in three of the samples, with an average concentration of 21 parts per billion. Tetrachloroethane was not detected in any of the samples. Additional volatile organic constituents are

Table I.A-11. Basin Numbers 3 and 4 Crystalline Samples: Trace Inorganic Constituents Detected.

	Concentration in Basin Number 4 crystalline content (ppm)		Concentration in Basin Number 3 crystalline content (ppm)	
Constituent	Average	Range	Average	Range
Aluminum	440	200 - 610	810	780 - 880
Barium	2.3	0.96 - 3.4	8[b]	2.5 - <10
Beryllium	0.4[a]	<0.09 - 0.6	1.0[c]	<4 - 1.3
Boron	1,400	300 - 2,700	2,700	2,200 - 3,000
Calcium	61	43 - 100	83	48 - 140
Chlorine ion	110[b]	<20 - 330	50[b]	<10 - 180
Chromium	5.8	3.4 - 11	21	6.6 - 40
Cobalt	3[a]	0.8 - <6	<3	<3
Copper	2,600	1,700 - 4,500	9,900	4,200 - 18,000
Iron	77	42 - 150	97	48 - 180
Lead	14[a]	<5 - <20	<30	<30
Magnesium	26[b]	13 - 35	29[a]	<20 - 37
Manganese	20[c]	9.8 - 34	66	31 - 140
Nickel	7[a]	<2 - <10	11[a]	<10 - 13
Potassium	56[b]	<20 - 130	<100	<100
Silver	11.6[c]	1.6 - 32	11[c]	<5 - 17
Strontium	2.3[b]	1.0 - <3	3.4[b]	<3 - 4.8
Thallium	34[a]	<10 - <50	<50	<50
Tin	58[c]	<5 - 150	39[d]	<20 - 73
Zinc	12	7 - 20	33	17 - 52
Zirconium	1,300	290 - 3,300	6,200	560 - 15,000

[a] Constituent less than detection limit in four samples.
[b] Constituent less than detection limit in three samples.
[c] Constituent less than detection limit in one sample.
[d] Constituent less than detection limit in two samples.

shown in Table I.A-19. Table I.A-20 lists the volatile organic constituents for which analysis was performed but were not detected.

Radioactive analysis of five samples yielded an average uranium content of 82,400 picocuries per liter. The maximum concentration detected was 94,000 picocuries per liter. Although not measured in the Basin Number 2 liquid samples, technetium-99 also should be present because of its occurrence in basin sludge samples and its known tendency to follow uranium in the nuclear fuel cycle. Based upon these results, the Basin Number 2 liquid is categorized as low-level, nontransuranic radioactive waste.

Appendix C presents a copy of the waste characterization report that was prepared at the completion of the Basin Number 2 liquid sampling and analysis effort.

Table I.A-12. Basin Numbers 3 and 4 Sludge and Crystalline Samples: Inorganic Constituents Below Detection Limits.

Constituent	Sludge sample detection limit (ppm)	Crystalline sample detection limit (ppm)
Antimony	90	30
Arsenic	100	40
Lithium	5,000	2,000
Molybdenum	20	8
Selenium	200	60
Tellurium	200	--
Vanadium	--	10
Ortho-phosphate	430	520
Nitrate	--	230
Cadmium	--	3

Table I.A-13. Basin Numbers 3 and 4 Sludge Samples: Volatile Organics Detected.

	Basin Number 3		
Constituent	Number of samples in which constituent was detected	Average of quantifiable concentrations (ppb)	Range (ppb)
Methylene chloride	3	73	25 - 97
Acetone	5[a]	54	53 - <100
Toluene	5[a]	83	<13 - 100
4-methyl-2-pentanone	3[b]	81	<25 - <100
Tetrachloroethane	5	74	40 - 90
2-hexanone	4[c]	165	<25 - 170
Total xylenes	2[d]	240	<15 - 240

	Basin Number 4		
Constituent	Number of samples in which constituent was detected	Average of quantifiable concentrations (ppb)	Range (ppb)
Methylene chloride	4	59	<13 - 110
Acetone	5	98	58 - 190
Toluene	1	25	--
4-methyl-2-pentanone	5[e]	245	<50 - 440
Ethylbenzene	4	78	21 - 170
Total xylenes	5	340	27 - 930

[a] Present, but below quantifiable levels in three of five positive samples.
[b] Present, but below quantifiable levels in two of three samples.
[c] Present, but below quantifiable levels in two of four samples.
[d] Present, but below quantifiable level in one of two samples.
[e] Present, but below quantifiable level in one of five positive samples.

Table I.A-14. Basin Numbers 3 and 4 Samples: Volatile Organics Sought but not Detected.

Constituent	Detection limit (ppb)[a]	Not detected in Basin Number 3	Not detected in Basin Number 4
Chloromethane	100	X	X
Bromomethane	100	X	X
Vinyl chloride	100	X	X
Chloroethane	100	X	X
Carbon disulfide	50	X	X
1,1-dichloroethene	50	X	X
1,1-dichloroethane	50	X	X
Trans-1,2-dichloroethene	50	X	X
Chloroform	50	X	X
1,2-dichloroethane	50	X	X
2-butanone	100	X	X
1,1,1-trichloroethane	50	X	X
Carbon tetrachloride	50	X	X
Vinyl acetate	100	X	X
Bromodichloromethane	50	X	X
1,2-dichloropropane	50	X	X
Trans-1,3-dichloropropene	50	X	X
Trichloroethene	50	X	X
Dibromochloromethane	50	X	X
1,1,2-trichloroethane	50	X	X
Benzene	50	X	X
Cis-1,3-dichloropropene	50	X	X
2-chloroethylvinylether	100	X	X
Bromoform	50	X	X
1,1,2,2-tetrachloroethane	50	X	X
Chlorobenzene	50	X	X
Styrene	50	X	X
Tetrachloroethane	25	-	X
2-hexanone	50	-	X
Ethylbenzene	50	X	-

[a] Varied among samples; values shown are the highest of ten samples.

I.A-5. Listed Waste Designations

The waste designation codes applicable to each of the 183-H Basins' wastes are summarized in the following list. A discussion of these designations follows the list and the 183-H Basins Part A permit application contains the same information in a summary form.

Basin Number 1 Solid: U123, P029, P030, P098, P106, P120 - Discarded chemical products WT01 - Toxicity (extremely hazardous waste).

Table I.A-15. Basin Numbers 3 and 4 Samples: Uranium Results.

Sample stratum	Average content[a] (pCi/g)	Range (pCi/g)
Basin Number 3 sludge	870	320 - 1,560
Basin Number 3 crystalline	25	8 - 62
Basin Number 4 sludge	520	44 - 820
Basin Number 4 crystalline	12	7 - 20

[a] Dry weight.

Table I.A-16. Basin Number 2 Liquid Samples: Major Inorganic Constituents.

Constituent	Average concentration (mg/L)	Range (mg/L)
Sodium	140,000	120,000 - 160,000
Nitrate ion	380,000	310,000 - 430,000
Moisture	(57%)	(57 - 58%)

Table I.A-17. Basin Number 2 Liquid Samples: Trace Inorganic Constituents.

Constituent	Average contents (mg/L)	Range (mg/L)
Aluminum	36	30 - 44
Boron	63[a]	<30 - 97
Calcium	9[a]	<5 - 13
Chlorine ion	290	260 - 320
Chromium	20	16 - 23
Cobalt	0.6	<0.4 - 0.77
Copper	410	120 - 940
Fluorine ion	1,500	1,400 - 1,600
Iron	7	2.8 - 14
Manganese	7[a]	<4 - 13
Molybdenum	1[b]	<1 - <2
Nickel	9	8.3 - 10
Nitrite ion	890	790 - 1,020
Potassium	720	670 - 820
Silver	1.8	1.1 - 2.8
Strontium	0.6[c]	<0.5 - 0.81
Tin	15	10 - 25
Sulfate	8,000	7,800 - 8,300
Zinc	2.8	1.0 - 5.4
Zirconium	780	320 - 1,500

[a] Constituent less than detection limit in one sample.
[b] Constituent less than detection limit in four samples.
[c] Constituent less than detection limit in three samples.

Table I.A-18. Basin Number 2 Liquid Samples: Inorganic Constituents Below Detection Limits.

Constituent	Detection limits (mg/L)
Antimony	5
Arsenic	7
Cadmium	0.6
Lead	5
Lithium	300
Magnesium	5
Selenium	10
Thallium	10
Vanadium	2
Ortho-phosphate	300

Table I.A-19. Basin Number 2 Liquid Samples: Volatile Organics Detected.

Constituent	Number of samples in which constituent was detected	Average of quantifiable concentrations (ppb)	Range (ppb)
Methylene chloride	5	6	5 - 7
Acetone	5	48	39 - 63
2-butanone	5	24	19 - 30
1,1,1-trichloroethane	3	21	<5 - 49
Toluene	3[a]	24	<5 - 41
2-hexanone	4	19	<10 - 28
Chloroform	1	<5	<5
4-methyl-2-pentanone	1	<10	<10

[a] Present, but less than quantifiable level in one of three positive samples.

Basin Number 2 Sludge: U123, P029, P030, P098, P106, P120 - Discarded chemical products WT02 - Toxicity (dangerous waste), D007 - Extraction Procedure Toxicity (chromium).

Basin Numbers 3 and 4 Sludge and Crystalline Strata: U123, P029, P030, P098, P106, P120 - Discarded chemical products WT01 - Toxicity (extremely hazardous waste).

Basin Number 2 Liquid: U123, P029, P030, P098, P106, P120 - Discarded chemical products WT01 - Toxicity (extremely hazardous waste), D007 - Extraction Procedure Toxicity (chromium).

Table I.A-20. Basin Number 2 Liquid Samples: Volatile Organics Sought but not Detected.

Constituent	Detection limit (ppb)
Chloromethane	10
Cis-1,3-dichloropropene	5
Bromomethane	10
2-chloroethylvinylether	10
Vinyl chloride	10
Bromoform	5
Chloroethane	10
Tetrachloroethane	5
Carbon disulfide	5
1,1,2,2-tetrachloroethane	5
1,1-dichloroethene	5
Chlorobenzene	5
1,1-dichloroethane	5
Ethylbenzene	5
Trans-1,2-dichloroethene	5
Styrene	5
1,2-dichloroethane	5
Total xylenes	5
Carbon tetrachloride	5
Vinyl acetate	10
Bromodichloromethane	5
1,2-dichloropropane	5
Trans-1,3-dichloropropene	5
Trichloroethene	5
Dibromochloromethane	5
1,1,2-trichloroethane	5
Benzene	5

As shown in Table I.A-2, there were six listed wastes discharged to the 183-H Basins. Five of these materials were extremely hazardous wastes. All the listed wastes were initially added to Basin Number 1. However, due to subsequent transfers of the liquids among the 183-H Basins, all of the 183-H Basins have been designated as having contained these listed materials. As a consequence, the following waste codes are applicable to all basin wastes: U123, P030, P120, P029, P106, and P098. The pre-1988 waste characterization reports (Appendices B and C) did not designate the waste as listed waste discharges. This oversight was corrected in the March 1988 submittal of this document.

I.A-5a. Toxicity. Bioassay testing was not performed for any of the basin wastes. Instead, it was decided to designate the waste for toxicity based upon the results of chemical analyses. This presented a problem in that the chemical analyses did not show the form of the constituents (i.e., it was not known what percentage of the nitrate ion was present as sodium nitrate). Due to the large percentage of sodium ions present, relative to other cations,

it was decided to treat the major anions present as being in the sodium form for purposes of estimating probable toxicity.

The concentration of fluoride ion (presumed to be in the sodium fluoride form) in Basin Number 1 was high enough to cause an extremely hazardous waste toxicity designation for both the 'inner' and 'outer' basin waste. Although it was believed that much of the fluoride was actually in the sodium fluorozircinate form, subsequent laboratory testing showed that water leaching of the waste generated a solution consisting of sodium and fluoride ions, with very low concentrations of zirconium in solution. As a consequence, the decision to evaluate all fluoride as sodium fluoride for purposes of estimating toxicity was determined to be valid.

Using the same philosophy for Basin Number 2 sludge, the fluoride ion content was high enough to result in a dangerous waste designation for toxicity. Copper, the major metal constituent present, was believed to be primarily in the oxide or hydroxide form as opposed to the highly toxic nitrate form. This belief was supported by analysis of the liquid phase that had been in contact with the sludge phase. The liquid showed an average copper content of only 3 parts per million.

The fluoride content in both strata in Basin Numbers 3 and 4 was high enough to result in a dangerous waste designation for toxicity. In lieu of pursuing bioassay testing, however, it was decided to adopt a conservative approach and designate the waste as extremely hazardous waste. The previous waste characterization report (Appendix C) indicated that the extremely hazardous waste designation for toxicity was further justified because of the presence of copper nitrate and copper sulfate [listed in the CERCLA Spill Table (40 CFR 302) (EPA 1989b) as Toxicity Categories A and B materials, respectively]. A revisitation of the analytical results, however, indicated that the vast majority of the copper was in the oxide or hydroxide form (for which there is no assigned toxicity category). If present in the highly soluble nitrate or sulfate form, the copper content in the Basin Number 2 liquid (which was pumped from Basin Numbers 3 and 4) would have been much higher than the 490 parts per million concentration evidenced.

The Basin Number 2 liquid was designated at the same time as the waste sludge in Basin Numbers 3 and 4, and the same conservative approach was taken regarding waste toxicity. As a consequence, the 183-H Basins wastes were designated as extremely hazardous waste for toxicity, even though the data tended to support a dangerous waste designation.

I.A-5b. Persistence. Two samples from the liquid phase that had been in contact with the Basin Number 1 'inner' basin waste were subjected to the first steps of persistence testing. Using the extraction procedure specified by Ecology, the two samples yielded extract portions well below the 1 weight percent limit where additional testing for polycyclic aromatic hydrocarbon content would be appropriate. The extract portions were, however, in excess of the 0.01 percent limit where additional testing would be appropriate to determine if the waste was designated due to halogenated hydrocarbon content. Procedures controlling discharges into the 183-H Basins, however, prohibited

addition of immiscible liquids, such as oils or degreaser solvents. This prohibition should have precluded the discharge of any significant concentration of halogenated hydrocarbon materials into the 183-H Basins. Persistence testing of the Basin Numbers 3 and 4 sludges and of the Basin Number 2 liquid supports the position that the wastes would not have been designated for the persistence characteristic.

Persistence testing was performed for each of the 10 sludge stratum samples from Basin Numbers 3 and 4. Per the Ecology extraction procedure, residue was below the 1 weight percent polycyclic aromatic hydrocarbon content limit in all samples; but in excess of the 0.01 percent halogenated hydrocarbon content limit in three of the Basin Number 3 samples and in two of the Basin Number 4 samples. As a consequence, Parr* bomb testing was performed to determine if a halogenated hydrocarbon designation was required. Results of this testing yielded a range of less than 10 to 15 parts per million for total halogenated hydrocarbon content, which is well below the 100 parts per million designation limit. Five samples of the liquid in Basin Number 2 were subjected to persistence testing. The highest extract residue obtained was 0.008 weight percent, well below the 0.01 percent limit where further testing would be needed. Based upon the persistence testing results from the Basin Numbers 3 and 4 sludge samples and the Basin Number 2 liquid samples, the wastes from the basin facility were not designated for the persistence characteristic.

I.A-5c. Carcinogenicity. Even when evaluated with very conservative assumptions regarding waste form (e.g., beryllium, presumed to be present as beryllium hydroxide; chromium, present as sodium-chromium oxide; and iron oxides), none of the wastes in the 183-H Basins exceeded the one percent carcinogenic material designation limit.

I.A-5d. Ignitability. The only waste from the 183-H Basins to possibly merit the classification characteristic for ignitability (oxidizer) is the nitrate ion. However, while the high nitrate concentrations were present in both the liquid and solid waste forms, its chemical compounds (form) and the overall water content precluded such a classification. The rationale for this conclusion has been provided by WAC 173-303-090(5)(a)(iv), which uses the U.S. Department of Transportation definition for oxidizers [49 CFR 173.151 (DOT 1988)] and states that an oxidizer is "a substance such as chlorate, permanganate, inorganic peroxide, or a nitrate that yields oxygen readily to stimulate the combustion of organic matter". Little additional clarification is available regarding aqueous solutions or solids with a high water content; other than in 49 CFR 173.182(a), which indicates that a double salt of calcium and ammonium nitrate containing less than 15.5 percent nitrogen (68.6 percent as nitrate) and at least 12 percent water, is exempt from the subject regulations.

Because the mixed salts of nitrate in the 183-H Basins' wastes are no more reactive than calcium and ammonium salts, the wastes would easily meet

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* Parr is a trademark of Parr Instrument Company.

the above criteria for exemption; because the water content of the basin liquids and sludges is greater than 40 percent. Also, because of the method chosen for waste removal, the salts have been combined with about 30 percent inert solids (absorbent clays and/or cement-clay mixtures) and packaged in sealed drums. The induced inert solids will prevent localized heating and decomposition (release of oxygen), thus combustion will not be possible. Additionally, research has shown that mixtures of sodium nitrate and other sodium salts, normally used in defense waste storage, do not react exothermically when water is present in excess of 22 percent. Even with organic material present, combustion is not possible until the water content is reduced below this threshold value (Martin 1985). As a result, the characteristic of ignitability has not been assigned to the 183-H Basins wastes. This designation represents a change from previous characterization reports and the Part A submittal (dated August 15, 1987), which indicated that the basin wastes were designated for ignitability.

I.A-5e. Corrosivity. Based on the following data derived from chemical analyses, the basin wastes are not designated for corrosivity. The following lists the pH values found in the various waste strata.

Strata	Number of samples	pH range
Basin Number 1 inner waste[a]	5	9.3 - 9.7
Basin Number 1 outer waste	2	9.3 - 9.6
Basin Number 2 sludge[a]	6	10.8 - 11.9
Basin Number 3 sludge	5	10.2 - 12.1
Basin Number 3 crystalline	5	9.0 - 10.0

Stratum	Number of samples	pH range
Basin Number 4 sludge	5	9.7 - 9.9
Basin Number 4 crystalline	5	9.2 - 9.7
Basin Number 2 liquid	5	10.5 - 10.7

Note: [a]=pH of liquid phase in contact with sludge.

I-A.5f. Reactivity. Records show that 2.5 pounds of cyanide wastes were discharged initially into Basin Number 1. During the operational life of this basin, approximately 2,500,000 gallons of routine wastes were discharged. Thus, due to the extremely low concentration of cyanide that could have been present, along with the tendency of cyanide materials to decompose, the wastes would not have contained this chemical "in a quantity sufficient to present a danger to human health or the environment". As a consequence, the Basin Number 1 waste was not designated for cyanide reactivity. Cyanide testing was never actually performed on any of the Basin Number 1 waste samples. However, reactivity screening tests were performed on the 20 sludge and crystalline strata samples from Basin Numbers 3 and 4, as well as on five samples of Basin Number 2 liquid. This test consisted of mixing the samples with water and watching for any signs of reaction (i.e., foaming, bubbling, smoking). All samples were negative for water reactivity. In addition, the 183-H Basins wastes were not designated for any of the other reactivity properties (i.e., explosive, unstable, and capable of undergoing violent change, etc.).

I-A.5g. Extraction Procedure Toxicity. The Basin Number 1 'inner' and 'outer' waste sludge samples were subjected to Extraction Procedure Toxicity testing for seven of the eight heavy metals (Extraction Procedure Toxicity testing for mercury was not done). Results of this effort are summarized in Table I.A-21.

Table I.A-21. Basin Number 1 Solids Samples: Extraction Procedure Toxicity Results.

	'Inner' basin sludge content (mg/L)		'Outer' basin waste content (mg/L)	
Constituent	Average	Range	Sample number 0-0	Sample number 0-9
Arsenic	<0.5	<0.5	<0.5	<0.5
Barium	0.02[a]	<0.02 - 0.03	0.05	0.07
Cadmium	0.06[b]	<0.04 - 0.07	0.05	0.05
Chromium	6.1	3.7 - 9.9	8.4	9.2
Chromium VI[c]	1.4	0.8 - 2.2	1.7	1.7
Lead	<0.6	<0.6	<0.6	<0.6
Selenium	<0.1	<0.1	<0.1	0.2
Silver	<0.1	<0.1	<0.5	<0.5

[a] Barium level below detection limit in two samples.
[b] Cadmium level below detection limit in one sample.
[c] Chromium VI (Hexavalent chromium) analysis per EPA Method 7196 (EPA 1982).

Extraction procedure toxicity concentrations for arsenic, barium, cadmium, lead, selenium, and silver were all below designation levels. The testing procedure in effect at the time of the Basin Number 1 analyses made a distinction between total chromium and hexavalent chromium. The concentration of hexavalent chromium found during the Extraction Procedure Toxicity testing was below the 5 parts per million detection limit; therefore, the waste was not designated for this characteristic. Application of current regulations (which are based upon the levels of total chromium) to the Basin Number 1 waste would result in a dangerous waste designation for chromium. The Extraction Procedure Toxicity testing for the Basin Number 2 sludge was not performed. The total chromium in the sludge phase averaged 450 parts per million. The level present in the liquid in contact with the sludge averaged 12.4 parts per million. These data indicate that soluble chromium was most likely present in the sludge in a dangerous waste concentration.

Tables I.A-22 and I.A-23 summarize the results of Extraction Procedure Toxicity testing of the two strata in Basin Numbers 3 and 4. As can be seen, none of the eight heavy metals were present in concentrations exceeding the Extraction Procedure Toxicity concentration limits.

The results of Extraction Procedure Toxicity testing for the Basin Number 2 liquid are shown in Table I.A-24. This waste was designated dangerous waste as a result of the chromium content.

Table I.A-22. Basin Numbers 3 and 4 Sludge Samples: Extraction Procedure Toxicity Results.

Constituent	Basin Number 3 (ppm) Average	Basin Number 3 (ppm) Range	Basin Number 4 (ppm) Average	Basin Number 4 (ppm) Range
Arsenic	<0.04	<0.04	<0.02	<0.02
Barium	<0.09	<0.09	<0.003	<0.003
Cadmium	0.047	0.035 - 0.057	0.062	0.056 - 0.069
Chromium	0.26	0.12 - 0.33	0.51	0.19 - 0.66
Lead	<0.08	<0.08	<0.08	<0.08
Mercury	0.003[a]	<0.002 - 0.005	0.009	0.004 - 0.011
Selenium	0.09[a]	0.04 - <0.1	0.04[a]	0.02 - <0.05
Silver	<0.09	<0.09	<0.08	<0.08

[a] Less than detection limit in four samples.

Table I.A-23. Basin Numbers 3 and 4 Crystalline Samples: Extraction Procedure Toxicity Results.

Constituent	Basin Number 3 (ppm) Average	Basin Number 3 (ppm) Range	Basin Number 4 (ppm) Average	Basin Number 4 (ppm) Range
Arsenic	<0.2[a]	<0.02 - <0.7	0.08[a]	<0.01 - 0.2
Barium	0.09[b]	<0.003 - 0.43	<0.007	<0.007
Cadmium	<0.02	<0.02	<0.009	<0.009
Chromium	0.3	0.12 - 0.53	0.15	0.074 - 0.27
Lead	<0.08	<0.08	<0.2	<0.2
Mercury	<0.02	0.02	0.003[a]	<0.002 - 0.006
Selenium	0.13[a]	<0.01 - 0.30	.2	0.1 - 0.2
Silver	<0.4	<0.4	<0.4	<0.4

[a] Constituent not detected in two samples.
[b] Constituent not detected in four samples.

I.A-6. Waste Analysis Plan

The following three sections describe the waste analysis plan and describe facility usage, basin cleanout, cleanup, and decontamination.

I.A-6a. Waste Analyses During Facility Use. As discussed previously, it was a routine practice for waste shipments to the 183-H Basins to be analyzed for a variety of key constituents. Beginning with the initial wastes discharge in 1973 and continuing through the final wastes addition in November 1985, each load of routine waste was analyzed for uranium, copper, and pH. Nitrate and sulfate ion concentrations were determined for each load until September 1975.

Table I.A-24. Basin Number 2 Liquid Samples: Extraction Procedure Toxicity Results.

Constituent	Content (ppm) Average	Range
Arsenic	0.08	0.04 - 0.1
Barium	0.63	0.47 - 0.89
Cadmium	<0.02	<0.02
Chromium	5.9	4.6 - 7.1
Lead	<0.2	<0.2
Mercury	0.017	0.005 - 0.035
Selenium	0.04[a]	<0.02 - 0.07
Silver	<0.2	<0.2

[a] Constituent below detection limit in two samples.

From September 1975 through November 1985, a composite waste sample was made by combining proportionate aliquots from the samples of the individual loads in a given month. This monthly composite sample was analyzed for the following key ion constituents: nitrate ion, fluoride ion, sulfate ion, ammonia ion, chromium, manganese, and pH. From September 1975 until August 1980, multi-element metal analyses were performed on the monthly composite samples via spectrography. From August 1980 until January 1981, inductively coupled plasma atomic emission spectroscopy was used for multi-element metal analyses on the monthly composite sample. Beginning in January 1981 and continuing through November 1985, inductively coupled plasma analysis was performed on a sample from each waste load.

Engineering personnel responsible for the chemical waste disposal permit program specified analyses for all nonroutine wastes to determine the content. Operational procedures for the chemical waste disposal permit system contained the following guidance and restrictions regarding nonroutine wastes:

- No radioactive elements other than limited quantities of unirradiated low enrichment uranium
- No immiscible liquids, such as oils or degreaser solvents
- No unstable, flammable, or explosive solutions
- The chemicals must be compatible with the bulk waste solutions generated in the fuels processes. Doubtful or unknown chemicals would be laboratory tested for compatibility with the bulk solution. The chemicals would not: (a) form a 'scum' that would inhibit evaporation, (b) form precipitates or crystals that would plug the piping [flocculent precipitates would be no problem], or (c) generate abnormal amounts of heat or gases

- Proprietary or trade name chemicals would be analyzed for heavy metals by inductively coupled plasma (argon) analysis and for specific ions, if deemed necessary.

Compatibility testing, when necessary, typically involved mixing the waste in question with a sample of the nuclear fuels fabrication routine waste.

I.A-6b. Waste Analyses Preparatory to Basin Cleanout. As discussed in Section I.A-4, before pursuing basin cleanout, the wastes from each basin were sampled and analyzed. The following methodology expands on the prior discussion.

I.A-6b(1). Basin Number 1 Solids. The basic dimensions of Basin Number 1 are shown in Figure I.A-3. The material to be removed was present only in the lower portion (i.e., 95 feet by 52 feet area) of the basin. Two distinct waste phases were present in the basin: (1) a sludge layer intermixed with a liquid phase residing on the bottom of the basin, and (2) a buildup of relatively dry waste along two sides of the basin. The second stratum, which appeared to be an accumulation of precipitated salt material, formed 'ridges' of waste along the east and west edges of the basin.

In order to provide representative samples of the material residing on the bottom of the basin, the basin was divided into 15 grids as shown in Figure I.A-4. In October 1984, samples were taken from the approximate center of the grids. Due to the presence of a liquid phase throughout the sludge, liquid nitrogen was used to 'freeze' core samples extending to the basin floor. These core samples, frozen inside a section of polyvinylchloride pipe, were removed and allowed to thaw in plastic sample containers.

The waste 'ridges' along the long sides ('outer' portion) of the basin were sampled based upon the theoretical grid shown in Figure I.A-5. Samples were taken at the approximate center of four randomly selected locations [designated O-0 (Outer-zerO point), O-2, O-5, and O-9]. These samples also were placed in plastic sample containers. Also two grab samples were taken of the liquid within the 'inner' basin grid (Figure I.A-4) identified as I-2 and I-14. These six samples were placed in glass containers and used in persistence testing.

Five of 15 'inner' basin solid waste samples were randomly selected for analyses. The remaining 10 samples were to have been analyzed only if necessary to complete an acceptable statistical evaluation of the Extraction Procedure Toxicity data. These samples were taken from the grids identified as I-2, I-5, I-12, I-13, and I-15 (Figure I.A-4). These samples were separated into component liquid and solid phases before chemical analyses were performed. The phases were then analyzed separately. The phase separation was done because the cleanout effort involved pumping as much of the liquid phase as possible into another basin. The solid phase was of primary interest since it was viewed as most representative of the material that would remain in the basin after completion of liquid transfer. The solid phase was later found to be the material of highest toxicity; therefore, the assignment of waste designation, based on the analyses of this stratum, was conservative.

Two of the 'outer' basin waste samples were randomly selected to undergo analyses. These samples were taken from the grids identified as 0-0 and 0-9 (Figure I.A-5). The analytical tests performed were based on known or suspected constituents in the waste. To determine the content of most of the metals of concern, inductively coupled plasma analysis was selected. Atomic absorption analysis was used for determining beryllium content (a 5 percent beryllium metal alloy was used in the nuclear fuels fabrication process), and X-ray fluorescence was used to quantify the uranium content in the waste. Ion chromatography testing was done to determine the concentrations of various anions known to have been present in the waste (e.g., nitrate, sulfate and fluoride ions).

Additional waste tests were selected based on regulatory designation categories. These tests included persistence (only partially completed), pH (for corrosivity designation), and Extraction Procedure Toxicity testing for seven of the eight metals parameters (analysis for mercury was not performed).

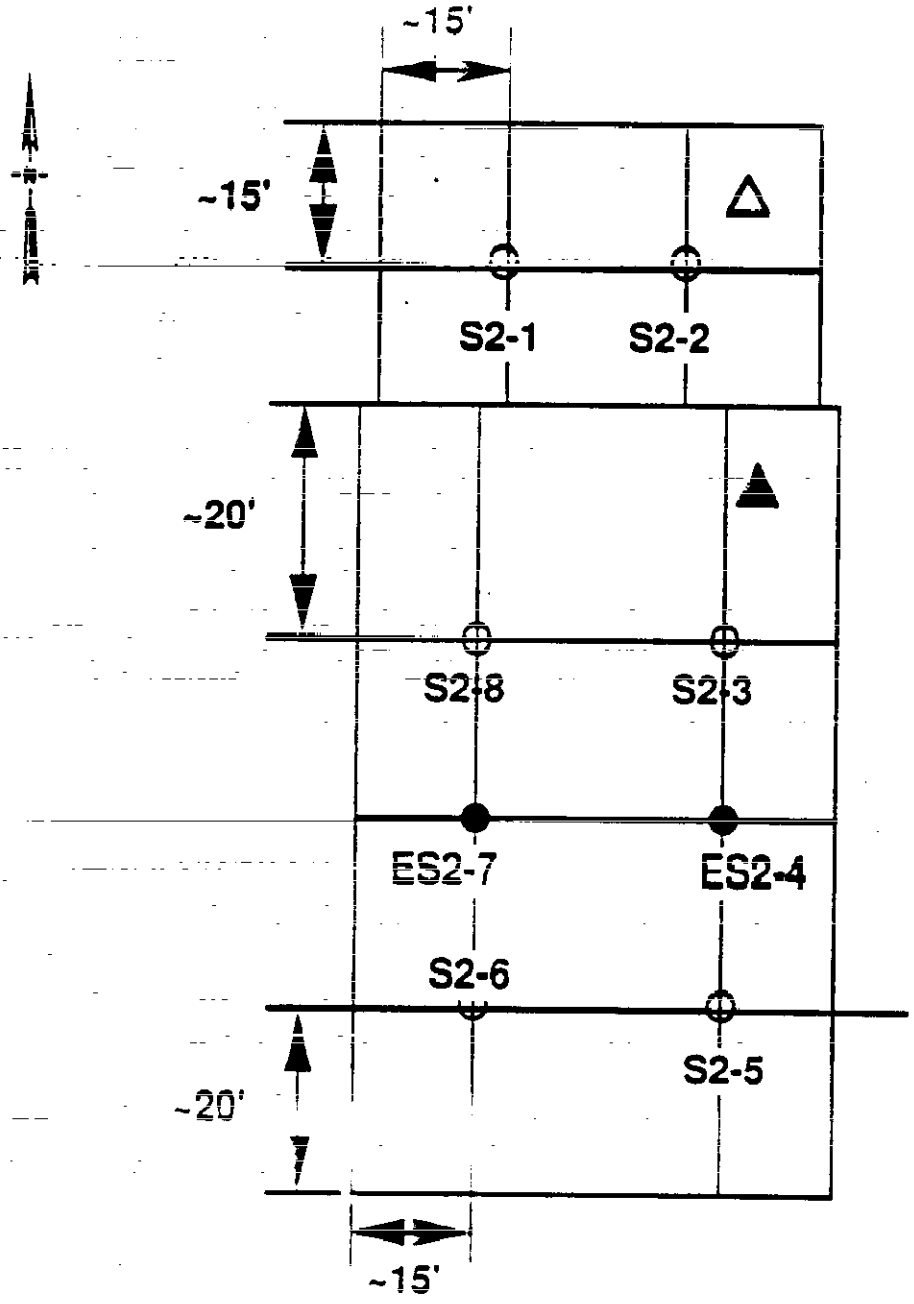
I.A-6b(2). Basin Number 2 Sludge. Sampling locations for Basin Number 2 waste are shown in Figure I.A-6. A sampling tube was used to obtain these samples. The original plan was to obtain separate samples of the liquid and sludge phase at each location. Difficulties were encountered during the actual sampling, however, that prevented this goal from being realized. Instead, each location yielded a single sample containing both liquid and sludge phases.

The cleanout effort involved pumping as much liquid as possible into the other basins before undertaking sludge removal. As a consequence, it was desirable to separately characterize the liquid and sludge phases. This was accomplished by separating the sample phases before undertaking chemical analyses.

Analyses were performed on the sludge samples taken from locations S2-1, S2-2, S2-3, S2-5, S2-6, and S2-8. The analytical tests selected were intended to quantify the known constituents in the waste. Thus, multi-element metal analysis, anion analysis, and percent moisture tests were performed. To determine general concentration of organic materials, a total organic carbon analysis also was performed. Specific waste designation tests (e.g., persistence and extraction procedure toxicity) were not undertaken.

I.A-6b(3). Basin Numbers 3 and 4 Sludge and Crystalline Strata. Sampling of the wastes in Basin Numbers 3 and 4 and of the liquid in Basin Number 2 was done concurrently. The sampling and analysis plan for this effort is included in Appendix C.

The wastes in Basin Numbers 3 and 4 consisted of two obvious strata: (1) a relatively wet sludge stratum, and (2) a white crystalline stratum near the walls and around miscellaneous debris that had fallen into the basins (e.g., tumbleweeds).



○ SAMPLING LOCATION (APPROXIMATE)

● EXTRA SAMPLE LOCATION (FOR REFERENCE)

△ NEW FILL PIPE LOCATION

▲ ORIGINAL FILL PIPE LOCATION

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Figure I.A-6. Sampling Locations: Basin Number 2 Sludge.

The basins were partitioned to yield 40 grid intersection points. An initial sampling location corresponding to one of these intersection points was selected at random for each basin. From this point, other sampling locations were determined by proceeding to every fourth intersection point. Thus, 10 sampling locations were identified for each basin (Figure I.A-7).

In each basin, a sampler was used to collect sludge samples from the 10 preselected locations. At some locations, the sludge had solidified such that the sampling device could not be inserted into the bottom of the basin. In these instances, a gas-powered auger was used to break up the sludge. Following this action, a sampler was used to obtain a representative sample extending from the top of the waste to the bottom of the basin. The samples were placed in amber glass bottles and the bottles were sealed. These sludge samples were identified for inorganic chemical analyses. Five of the 10 sludge sample locations in each basin were selected at random to be sampled for organic constituent analyses. These samples were taken by the same general techniques used for the inorganic sludge samples, except that zero-headspace sample containers were used. Care was taken to minimize the number of air bubbles passing through these samples, and the filled sample containers were either kept on ice or refrigerated until the organic analyses began.

Samples of the crystalline strata in Basin Numbers 3 and 4 were taken from points nearest the sampling locations selected for sludge strata sampling. Thus, 10 crystalline samples were taken from each basin. These samples were obtained by breaking off a portion of the stratum using a hammer, chisel, or other appropriate tool. Crystalline samples were placed in amber glass bottles and the bottles were then sealed.

A chain of custody form was used to control and document the shipment of all samples from the 183-H Basins to the laboratory. Once received at the analytical laboratory, pairs of sludge samples identified for inorganic analyses were combined and homogenized. Thus, the 10 sludge samples from Basin Number 3 were combined to form five composite samples. These composite samples consisted of the following pairs: 3S-1 and 3S-2, 3S-3 and 3S-4, 3S-5 and 3S-6, 3S-7 and 3S-8, and 3S-9 and 3S-10. In a similar fashion, the ten Basin Number 4 sludge samples were combined to yield the following composite samples: 4S-1 and 4S-2, 4S-3 and 4S-4, 4S-5 and 4S-6, 4S-7 and 4S-8, and 4S-9 and 4S-10.

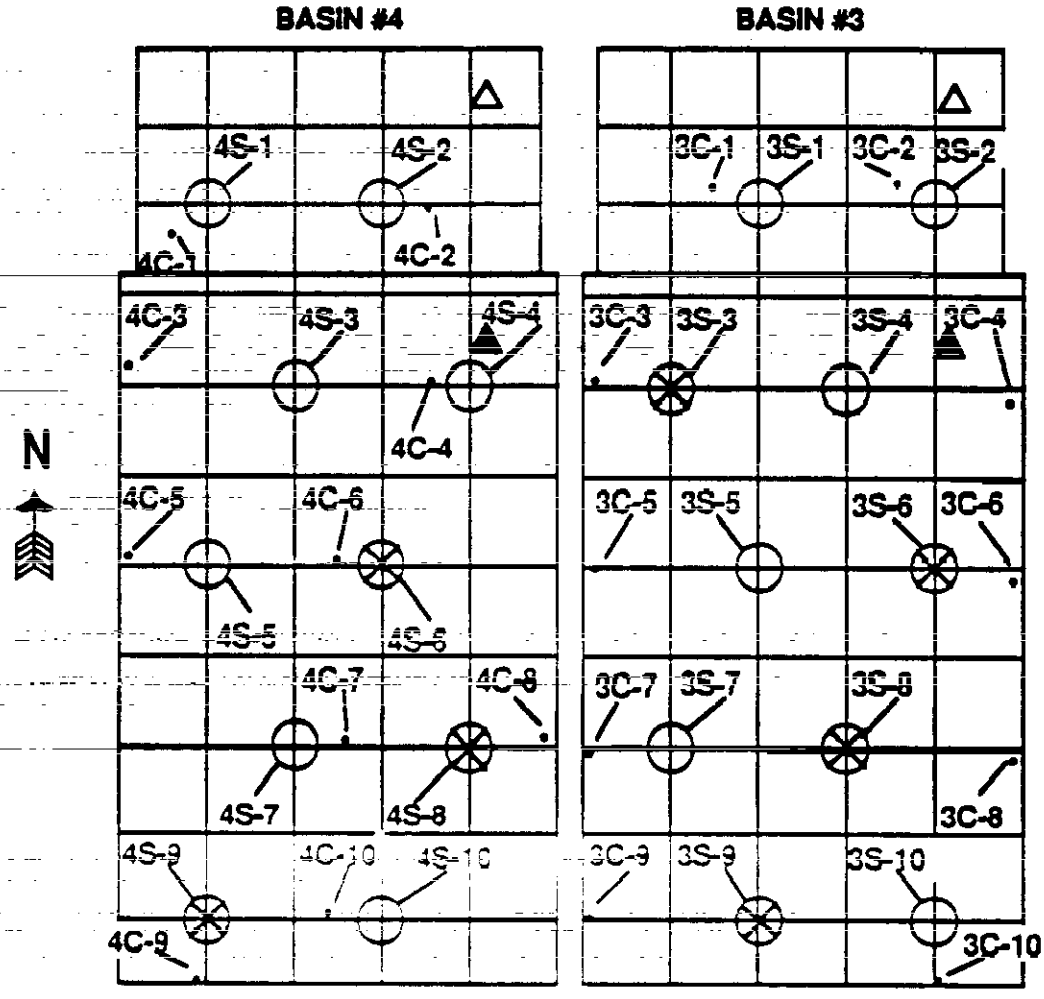
Crystalline strata samples were also combined with sample pairs as follows:

Basin Number 3: 3C-1 and 3C-2, 3C-3 and 3C-4, 3C-5 and 3C-6, 3C-7 and 3C-8, and 3C-9 and 3C-10

Basin Number 4: 4C-1 and 4C-2, 4C-3 and 4C-4, 4C-5 and 4C-6, 4C-7 and 4C-8, and 4C-9 and 4C-10.

The samples identified for organic analyses were tested individually, with no attempt having been made to form composite samples.

SAMPLING LOCATIONS: BASINS #3 AND #4 SOLIDS



SLUDGE STRATUM SAMPLING LOCATION (APPROXIMATE)

SAMPLING LOCATION FOR OBTAINING SAMPLES FOR PERSISTENCE TESTING

NEW FILL PIPE LOCATION

ORIGINAL FILL PIPE LOCATION

CRYSTALLINE STRATUM SAMPLING LOCATION

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Figure I.A-7. Sampling Locations: Basin Numbers 3 and 4 Solids.

The analyses program had two primary goals:

- Obtain a general chemical characterization of the waste
- Perform tests specifically designed to establish designation in accordance with applicable dangerous waste regulations.

In addressing the first goal, analytical tests capable of quantifying a wide range of known or potential chemical constituents were given preference over tests aimed at a specific constituent. In instances where acceptable multi-component tests were not available, analyses for key individual constituents were requested. The following chemical characterization tests were selected.

Test	Test Capability
Inorganic analyses (performed on five composite sludge samples and five composite crystalline strata samples from each basin)	Inorganic analyses
Inductively coupled plasma (Method 6010, EPA 1986)	Multi-element metal analysis for: aluminum antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, sodium, nickel, potassium, selenium, silver, strontium, thallium, tin, vanadium, zinc, zirconium
Ion chromatography	Anions: fluorine ion, chlorine ion, nitrate ion, nitrite ion, phosphate ion, sulfate ion
Percent moisture	Percent moisture
Uranium	Uranium
Organic analyses (performed on five sludge samples from each basin)	
Total organic carbon (Method 8240, EPA 1986)	Total organic carbon
Volatile organic compounds (Method 8240, EPA 1986)	Various volatile organic compounds including tetrachloroethane and 1,1,1-trichloroethane (see Tables I.A-13 and I.A-14 for additional constituents)

Four tests were selected specifically to determine designation per applicable *Dangerous Waste Regulations*. These tests were concerned with the

corrosivity, reactivity, extraction procedure toxicity, and persistence designation categories. The corrosivity, reactivity, and extraction procedure toxicity tests were performed on the 20 composite samples (five crystalline and five sludge strata samples from each basin). The 10 sludge samples identified for organic analyses (five from each basin) were subjected to persistence testing.

The corrosivity and persistence tests were conducted in accordance with the methods specified in Ecology 83-13 (Ecology 1983). The extraction procedure toxicity testing was in accordance with the procedure specified in SW-846 (EPA 1986c), with the exception that the samples were tested only for the eight extraction procedure toxic metals. Testing for the six organic materials (herbicides and pesticides) on the extraction procedure toxicity list was not pursued since records showed that these types of materials were not discharged into the 183-H Basins.

The reactivity testing was done in accordance with a procedure developed by the testing laboratory. This test consisted of mixing the waste samples with water and noting any reaction (i.e., foaming, bubbling, smoking). The laboratory procedure included tests for reactivity when the waste was mixed with concentrated acid and caustic solutions as well. This testing was performed on the 183-H Basins wastes samples, but the results are not pertinent to designation since acid and caustic reactivity are concerns (from a reactivity designation standpoint) only when the waste contains cyanides or sulfides in dangerous concentrations.

The laboratory that performed the sample analyses had extensive previous experience in SW-846 analyses. A quality assurance and quality control program had been established to ensure that all tests were performed in accordance with the procedural requirements, including the analysis of spike and duplicate samples at specified frequencies.

I.A-6b(4). Basin Number 2 Liquid. The Basin Number 2 liquid was sampled in accordance with the plan presented in Appendix C. The basin was partitioned to yield 40 grid intersection points. Five intersection points were randomly selected for sampling (Figure I.A-8).

Using a 'coliwasa' (composite liquid waste sampler), a full column of liquid was obtained at each of the five sampling locations. A portion of each sample was poured into two amber glass vials. The samples were handled so as to minimize contact with air bubbles, and the vials were completely filled before being capped and sealed. These vials were kept either on ice or refrigerated until analyses for organic constituents were undertaken.

Samples for inorganic analyses also were taken at each of the five preselected locations. These samples were placed in amber glass bottles and the bottles were then sealed. A chain of custody form was used to control and document the shipment of the samples from the basin to the analytical laboratory.

Samples identified for inorganic analyses were subjected to the same battery of tests as those performed on the Basin Numbers 3 and 4 sludge and

SAMPLING LOCATIONS: BASIN #2 LIQUIDS

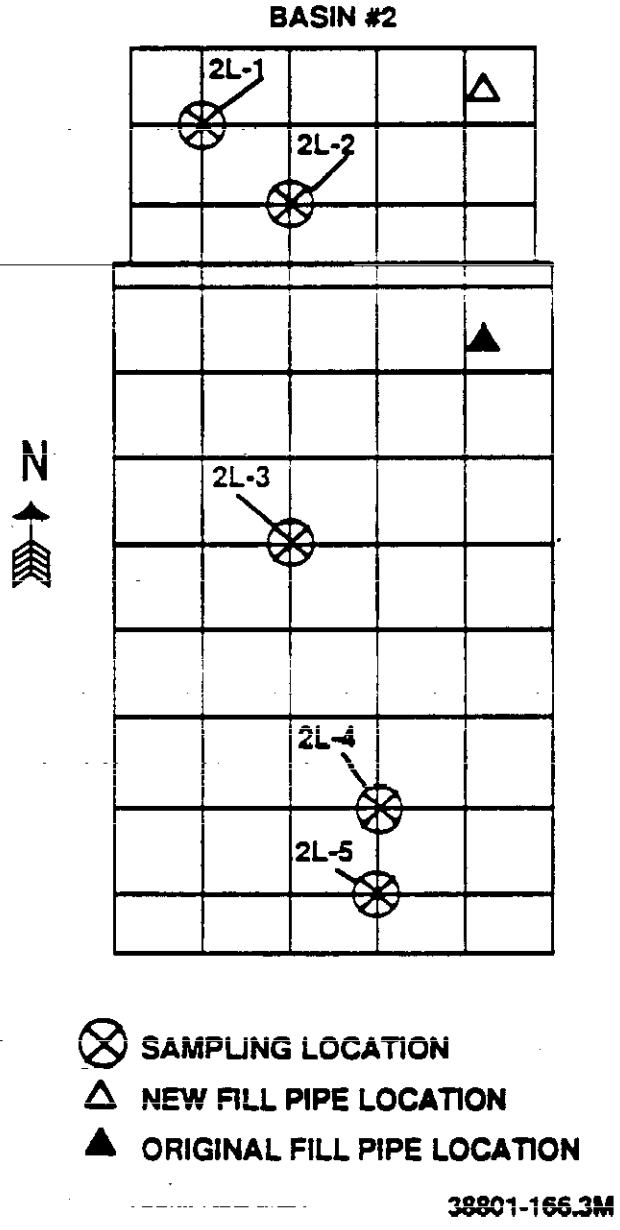

Figure I.A-8. Sampling Locations: Basin Number 2 Liquids.

crystalline samples (see discussion in preceding section). The organic analyses also were identical to those selected for the Basin Numbers 3 and 4 characterization efforts. Likewise, the waste designation tests (reactivity, corrosivity, extraction procedure toxicity, and persistence) performed on the Basin Number 2 liquid samples were the same as those provided for Basin Numbers 3 and 4 samples.

I.A-6c. Sampling and Analysis to Verify Cleanup and Decontamination. As waste removal from each of the 183-H Basins has been completed, a basin cleanup and decontamination program has been undertaken. The adequacy of this effort will be verified in accordance with the concrete sampling and analysis plan presented in Section I.B-4c(1).

I.B. CONTENT OF CLOSURE PLAN

This section describes the 183-H Basins current status (November 1, 1989) and identifies the proposed work necessary to complete final closure.

RCRA/CERCLA Interface--A major issue concerns the applicability of the 183-H Basins (RCRA) Closure/Post-Closure Plan to the future RCRA past practice remedial investigation/feasibility study; since the 183-H Basins and other sites (100-HR-1 operable unit) have all been identified as contributing to the environmental contamination. The unresolved issue concerns the appropriate methodology and action levels to remediate the 100-H Area groundwater contamination plumes, which have emanated from several point sources, including the 183-H Basins. Per Ecology's direction, groundwater remediation will be addressed in the forthcoming revision of the *183-H Solar Evaporation Basins Final Status Post-Closure Permit Application*.

I.B-1. Description of Final Closure

This section provides a description of how the dangerous waste management unit (183-H Basins) will be closed in accordance with the closure performance standards of WAC 173-303-610. This closure plan addresses the complete and maximum extent of all closure activities. Since the early 1970's, the overall operational strategy for the 183-H Basins has been to minimize the volume of liquid wastes by natural (solar) evaporation. Since 1985, when the original Part A application was submitted, the overall closure strategy has been to document the extent of the 183-H Basins contaminant migration (soil sampling), to remove selective contamination if it allows clean closure, and otherwise, to limit soil removal and to close with a RCRA landfill cover.

I.B-1a. Current Status. The 183-H Basins have not received dangerous waste constituents since November 1985. As of September 1988, all the remaining sludge materials have been removed from each basin. During 1988 and 1989, Basin Numbers 1 and 4 were partially decontaminated by wet sandblasting. From June to December 1989, the remaining liquid wastes, which existed only in Basin Numbers 2 and 3, have been removed and solidified into 55-gallon drums and transported to the 200 West Area Central Waste Complex, Retrievable Waste

Storage Facility. The remaining crystallized materials and the Hypalon liners will also be removed, then Basin Numbers 2 and 3 will be decontaminated. Starting in December 1989, the soils beneath Basin Numbers 1 and 4 were sampled and analyzed to document contaminant migration. Following full contaminant profiling, the basin structures will then be demolished to provide access for selective removal of possible highly contaminated soil hot spots. A RCRA approved cover will then be constructed over the site to complete the closure as a landfill.

Last summer, in addition to the solidification of the 183-H Basins' liquid wastes, the accumulated 10,000 gallons of purgewater has been used for equipment washwater, intermixed with the liquid waste, and solidified. The purgewater results from the 100-H Area groundwater well monitoring activities. Any remaining purgewater will be consumed during future 'liquid' waste solidification processes as will other equipment washdown, precipitation, or interstitial liquids from the crystallized materials removal processes in Basin Numbers 2 and 3.

I.B-1b. Closure Activities. The following summary describes each of the closure activities; detailed discussions are provided elsewhere in this document. To assist the reader, appropriate referencing indicates where detailed expansions of respective activities may be found; activity numbers have also been assigned to correspond to the appropriate blocks in Figure I.B-1. As shown in Figure I.B-1, the closure process consists of multiple work activities. Also Section I.B-2 contains copies of current photographs and Section I.B-7 discusses the schedule for closure on an activity-by-activity basis.

A definition of the terms is necessary in order to accurately describe the closure activities and processes; these terms are as follows.

Contamination--Dangerous waste residue and/or radioactive residue.

Crystallized solids--When the liquid waste evaporated under normal conditions, a specific quantity transformed into a crystalized solid material.

Residues--Remaining adherent scale or trace materials either impregnated in the surface of the structure or equipment surfaces after vigorous removal of all liquid and sludge.

Sludge--Remaining particulate (solid) matter and precipitate.

Soil--Earth, sand, or gravel; including the backfill upon which the 183-H Basins were constructed.

The following work tasks comprise the major activities for closure of the 183-H Basins.

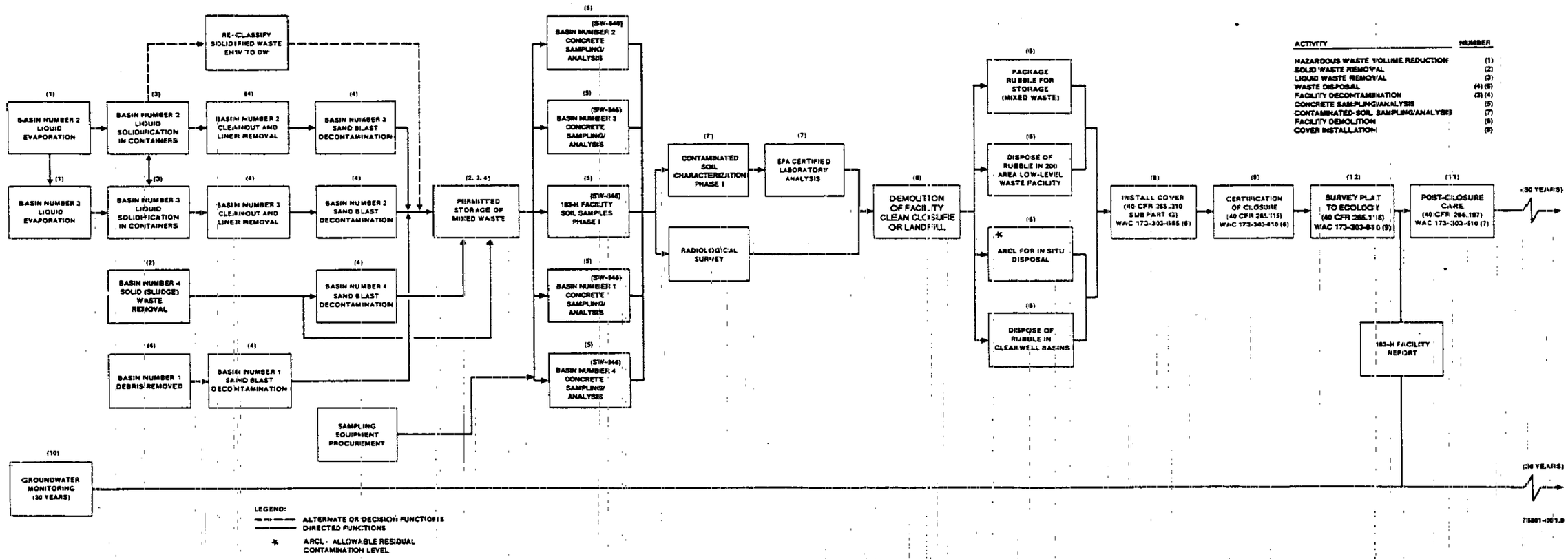

Figure I.B-1. 183-H Basins

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Activity 1: Dangerous Waste Volume Reduction--As of November 1, 1989, all liquids in Basin Numbers 2 and 3 have been evaporated, transformed into a crystallized solid form, or solidified and removed. Some liquid remains in the interstitial solid material, and as it seeps out, the liquid will be combined with other liquids (e.g., precipitation, washwater/purgewater) and solidified. The total liquid volume reduction during 1989 has been estimated at 94,000 gallons. The remaining wastes is now in solid form and has been estimated at 13,200 cubic feet in Basin Number 2 and 8,700 cubic feet in Basin Number 3. Since all of the original liquid wastes have been removed from the 183-H Basins, further volume reduction is not anticipated; and thus, this activity has been closed.

Activity 2: Solid (sludge) Waste Removal--For Basin Number 4, this activity was completed in September 1988, with the removal of approximately 5,280 cubic feet of sludge. The sludge was packaged into U.S. Department of Transportation-approved 55-gallon drums, along with absorbent materials to absorb any free-standing liquids, and the drums were shipped to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility. Following liquid wastes removal from Basin Numbers 2 and 3, the remaining crystallized solids and the Hypalon liners will be removed, packaged in U.S. Department of Transportation-approved drums, and shipped to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility. Details of the solid waste removal process are presented in Section I.B-3c(2).

Activity 3: Liquid Waste Removal--As stated in Activity 1, all free standing liquid wastes have been removed by evaporation, transformation, or solidification. An estimated 33,760 gallons of liquid evaporated from September 1988 through October 1989, the remaining waste has transformed into a crystallized solid (approximately 21,900 cubic feet), and 60,000 gallons of liquid was solidified. Any liquid waste draining from the crystallized solid material, from basin cleanup, and/or resulting from precipitation will undergo the solidification process. Details of the solidification process are presented in Section I.B-3c(2).

Activity 4: Waste Disposal--Routinely, all loaded drums are being manifested and transported per WAC 173-303-190 from the 183-H Basins to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility (about 17 miles). At the Central Waste Complex, the drums are placed in a mixed the waste storage facility until a permitted disposal facility becomes available. All the roads that are used, are within the confines of the Hanford Site restricted area. Additional information on inventory removal is located in Section I.B-3c(2).

Basin decontamination began in October 1988 with the cleaning of Basin Number 1. All concrete surfaces within the basin were wet sandblasted until visibly clean. The basin was marked off into 5-foot by 5-foot sections to facilitate the sandblasting work by ensuring uniform coverage with the sandblasting grit. The sandblasting material used was garnet (mesh number 36) with water. The water used was minimal and readily evaporated. The spent grit was packaged as dangerous waste in the same manner as the sludge material [described in Section I.B-3c(2)]. In addition to cleaning the concrete surfaces, the large concrete pieces, consisting of flocculator equipment

supports and walkway sections, were also cleaned and stored in the south end of the basin. Basin Number 4 was subsequently and similarly cleaned in September 1989, with wet sandblasting, which removed all loose butyl liner material and visibly cleaned all remaining surfaces. Basin Number 4 was also marked off in a grid fashion to ensure uniform cleaning coverage. A detailed description of decontamination removal of dangerous waste residues is presented in Section I.B-4.

The cleanup of structures and equipment began in October 1988 when Basin Number 1 decontamination efforts started. Cleaning agents and solvents have not been used for any decontamination. All rinsate (water and abrasive material) has been collected at the basins' low points, treated as contaminated waste, solidified, and packaged for waste shipment. See Section I.B-4a for more information.

Activity 5: Concrete Sampling and Testing--Some sampling and testing began in October 1988 when decontamination started. Areas of the concrete surfaces that were not exposed to liquid wastes were sampled and analyzed to assess the effectiveness of the decontamination effort. A detailed description of this work and of the decontamination criteria are presented in Section I.B-4. Starting in 1991, all basin concrete surfaces (wall and floors) will be sampled and analyzed to determine and establish the residual contaminants that will remain in the demolished structure and be buried under the RCRA cover as proposed in Section II.B.

Activity 6: Facility Demolition--The 183-H Basins will be demolished using standard practices, such as a wrecking ball, bulldozer, etc. This work is expected to begin in January 1992. Disposal of the uncontaminated rubble will be in the clearwells, due south of the 183-H Basins (Figure I.B-2). Use of the clearwells is based on the assumption that the 183-H Basins' facilities and underlying soils are, or will have been, adequately 'cleaned' so that they can be classified as nonregulated wastes, i.e., clean closure. However, if contamination remains after decontamination attempts, then the rubble will be demolished and compacted for in situ disposal in accordance with WAC 173-303-610. In situ disposal also will be in accordance with the method for determining the allowable residual contamination level (ARCL) as described by Napier (1988). Other storage or disposal options based on dangerous and radioactive waste combinations may be used as indicated in Figure I.B-1. Section I.B-4 contains further details on this subject.

Activity 7: Contaminated Soil Sampling Analysis--The soil sampling analysis is being accomplished in two phases. Phase I, shallow sampling, began in December 1989 with the soils immediately below the concrete floors of Basin Numbers 1 and 4. Both of these basins have been cleaned out and core holes are being drilled through the concrete floors to access the soil. Samples will be taken and analyzed to determine if any 'hot pockets' of contamination exist under the basins. Phase I soil sampling will be completed when the soils below Basin Numbers 2 and 3 and the berms along the outside of the basins, have been sampled. In addition to determining locations of hot spots, the Phase I sampling effort will provide the basis for optimizing the location of sample points for Phase II (deep vadose zone sampling). Phase II will be performed with cable tool drilling equipment to provide information,

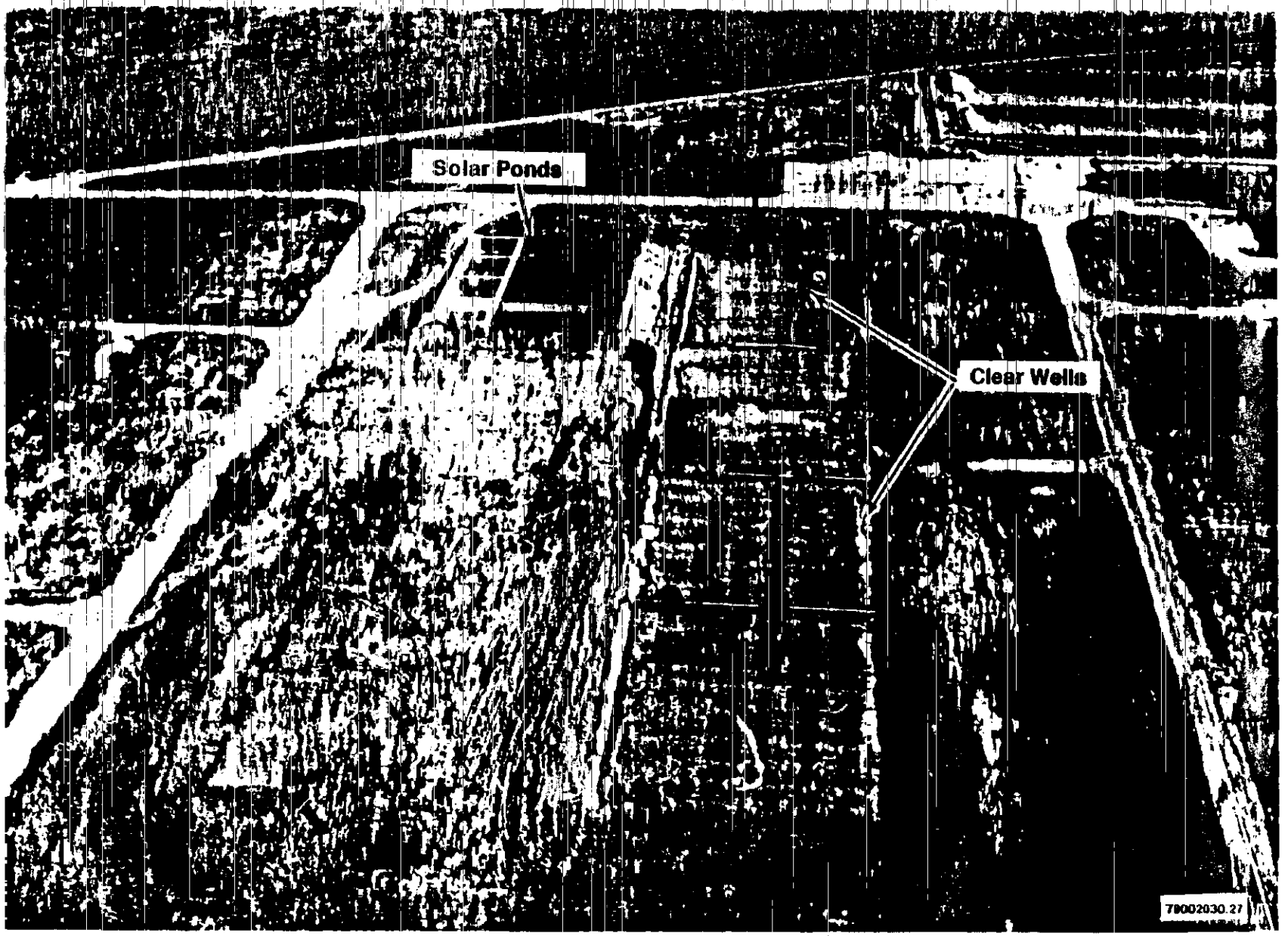

Figure I.B-2. Location of 183-H Clearwells.

beneath and around the 183-H Basins, on the size, extent, and location of any contaminated soil plumes. All of the concrete core holes, and other sampling excavations from both sampling phases will be immediately backfilled and suitably sealed following the sample taking; to preclude precipitation and/or contaminant migration. See Section I.B-4c for more details.

Activity 8: Cover Installation--Final closure of the 183-H site addresses the installation of a RCRA cover to confine any remaining (in situ) wastes for a minimum of 30 years during the post-closure monitoring period. A cover design is provided in Section II.B that is based on WAC 173-303-665.

Activity 9: Certificate of Closure--A state of Washington registered professional engineer will provide the certification of closure. This activity requires ongoing monitoring (started 1988), with the final effort requiring two months prior to submitting the certification (October 1992). See Section I.C for more information.

Activity 10 and 11: Groundwater Monitoring and Post-Closure Care-- As part of the final design of the RCRA cover and associated closure events, a Westinghouse Hanford Company quality assurance program plan will be applied to the 183-H Basins post-closure activities (e.g., groundwater monitoring and post-closure care) affecting the quality of project items or activities related to engineering, procurement, operations, maintenance, and associated administrative controls. This plan will cover all work elements that are variously called quality assurance, quality control, quality engineering, operations, and maintainability engineering, regardless of the organization doing the work. Quality assurance activities will be coordinated, combined, and integrated to provide an effective and efficient application of available resources. The performing functions required for implementation of the quality assurance program are the responsibility of the 183-H Basins closure project organization. Independent overview of all operations and activities is the responsibility of the Westinghouse Hanford Quality Assurance organization. Groundwater monitoring and post-closure care are specifically addressed in Section III.A.

I.B-2. Identification of Maximum Extent of Basin Storage/Treatment Operation

As required by Wac 173-303-610, this section provides information pertaining to the extent of the 183-H Basins solar evaporation operations. As discussed in Section I.A, the purpose of the 183-H Basins was to provide a means of waste reduction by natural evaporation for the liquid chemical wastes resulting from the 300 Area (N Reactor) fuel fabrication facilities. The natural evaporation (treatment) process involved temporary storage of the wastes in order for evaporation to occur. Figure I.B-3 illustrates a complete filter plant (100-D Area), which typifies the 183-H Basins prior to demolition of 12 basins and use of the remaining 4 basins for solar evaporation. The adjoining clearwells also were left intact for future use as a disposal site for clean debris. Figure I.B-4 illustrates the physical relationship of the 183-H Basins to the clearwells and the 105 Reactor. Prior to solar evaporation usage, 6-foot chain link fence was installed around the

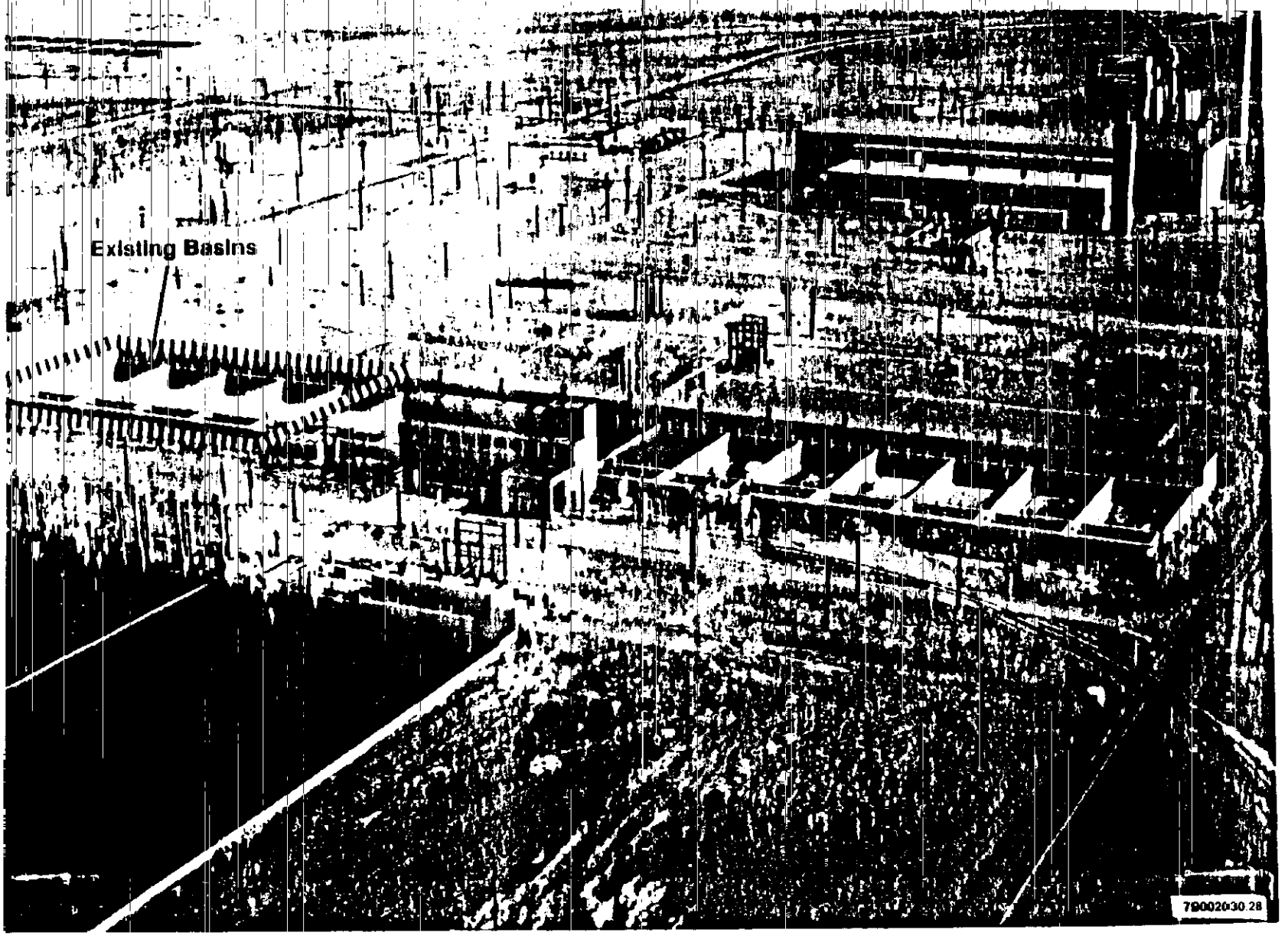

Figure I.B-3. Complete Filter Plant (100-D Area).
[Chartpak identifies Basin Numbers 1, 2, 3, and 4.]

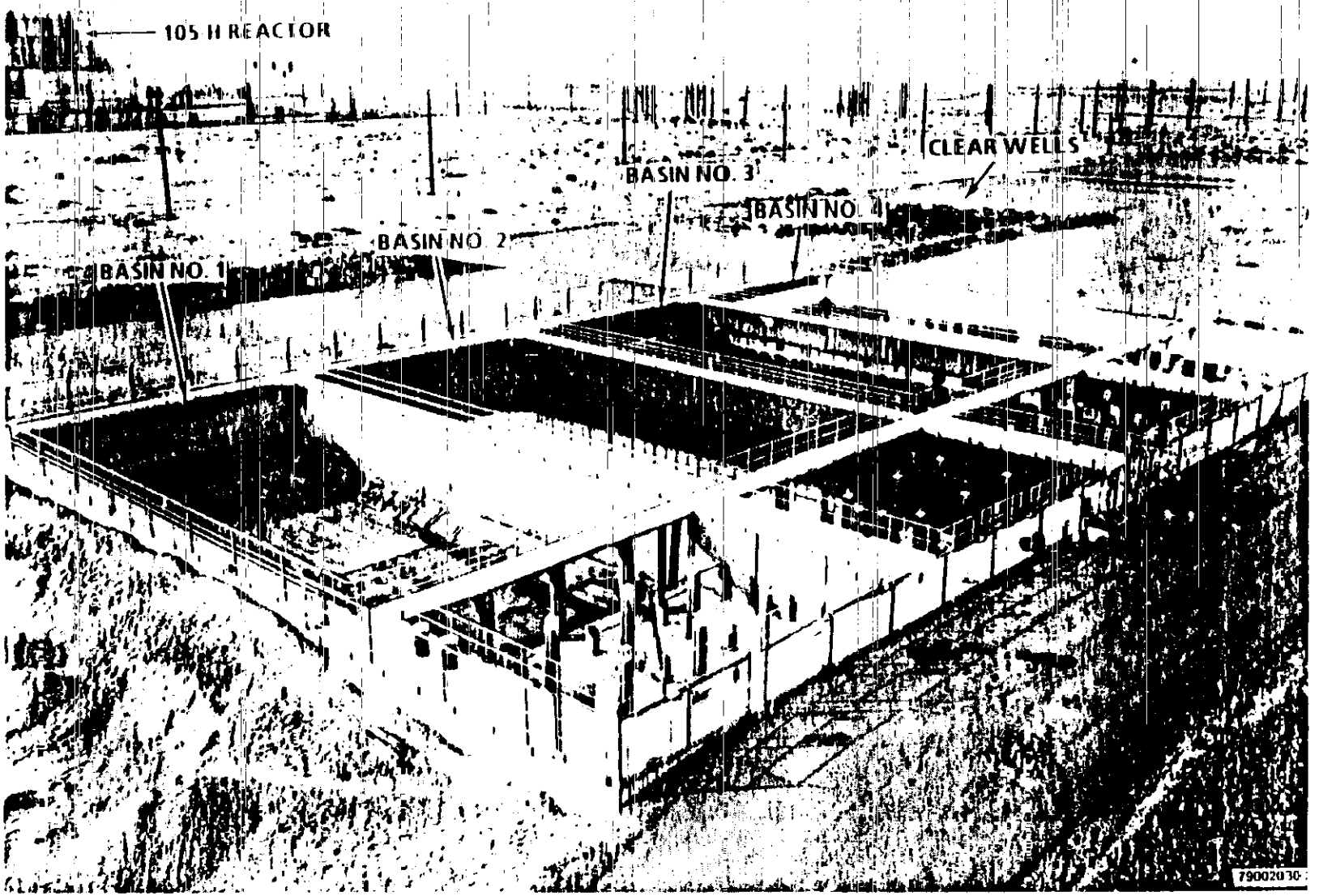

Figure I.B-4. 183-H Basins.

183-H Basins and the 16-inch diameter floor drains in the four sedimentation basins were sealed by filling with concrete.

In 1973, when solar evaporation activities at the 183-H Basins began, a temporary truck unloading line for waste transfer to the 183-H Basins was installed at the northeast corner of Basin Number 1. Subsequently, a second temporary line was added for the other basins, and a 2-inch fresh water line was routed from an existing 8-inch fresh water line (sanitary and fire hydrant use) to the northeast corner of Basin Number 1. The 2-inch line allowed the flushing of the transport truck and unloading lines, and provided a water supply for the safety shower. The 2-inch fresh water line was not used to contain or transfer waste. Used 'fresh' water (rinse water) was flushed from the trucks, unloading lines, and the safety shower drain into the basins.

The 183-H Basins began operation in July 1973 when liquid was pumped into Basin Number 1. Subsequently, leakage was suspected to have occurred from this basin and was apparently sufficient to contaminate the groundwater. The basin was then removed from service. From 1977 to 1978, Basin Numbers 2 and 3 (with sprayed on liners) were put into use, and in October 1982, Basin Number 4 (with a sprayed on liner) was initially used. The last addition of waste into the 183-H Basins was in November 1985.

I.B-2a. Physical Description. The 183-H Basins are aboveground structures, each containing a deep sedimentation basin and a shallow flocculation basin (Figure I.B-5 shows the basin and dimensions). The flocculation basin is 45 feet 6 inches wide, 33 feet long, and 9 feet 6 inches deep. The sedimentation basin is 53 feet 6 inches wide, 95 feet long, 16 feet 6 inches deep at the north end, and 15 feet 6 inches deep at the south end. The 183-H Basins are constructed above ground and have earthen berms on three sides. The northside berm was added to provide an asphalt covered driveway up to the basin deck level to permit the tank truck to unload the chemical waste by gravity flow.

I.B-2b. Construction. In 1949, the 183-H Basins were constructed with above-grade, cast-in-place concrete. All concrete work was specified in accordance with the *American National Standards Institute/American Concrete Institute* (ANSI/ACI) 301, Section 3.5 (ANSI/ACI 1985). Specifications for the concrete included a minimum compressive strength of 3,000 pounds per square inch at 28 days, and a mix as dry as possible, spaded and vibrated to produce a sound, dense, water-tight construction. The slump requirements were 4 inches maximum. The cement type (Type II, low alkali) was in accordance with *American Standards Testing Material* (ASTM) C150 (ASTM 1986c), and the aggregate met ASTM C33 (ASTM 1986a), maximum size of 1.5 inches. The rebar was ASTM A615 (ASTM 1986b) deformed grade 60, and the welded wire fabric met ASTM A185 (ASTM 1985).

Before being used for the collection of wastes, the 183-H Basins were modified to seal openings and to install a surface-mounted pipeline for filling purposes (Figure I.B-5). The distribution flume and gates were above the proposed liquid level and would not be used to confine the wastes. The steel flume gates in Basin Number 1 were removed leaving the gate openings. The gate openings in Basin Numbers 2, 3, and 4 were sealed by filling with

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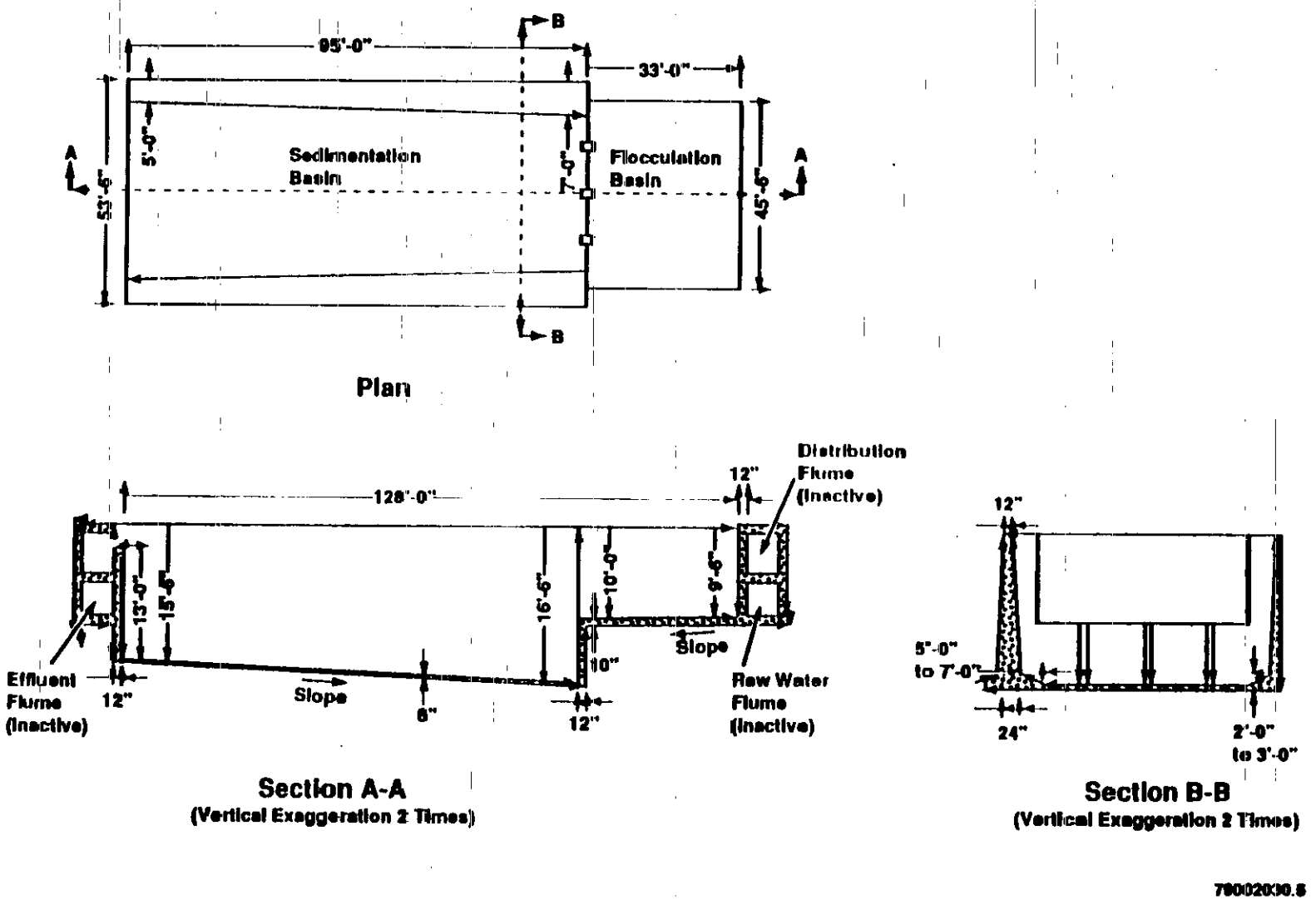

Figure I.B-5. 183-H Basins Typical Dimensions.

concrete to increase their capacity. In 1977 the walls of Basin Numbers 2 and 3 were sealed by spray coating with a black polyurethane material. This material experienced some degradation from sunlight resulting in the 1982 use of a white butyl and Hypalon coating for Basin Number 4.

Subsequently, another set of liners (double containment) were added to Basin Numbers 2 and 3. These liners were a 36-mil Hypalon-membrane sandwich reinforced with a polyester geotextile scrim. The liner in Basin Number 2 was installed in 1986, and the liner in Basin Number 3 was installed in 1987.

I.B-2c. Current Photographs. Figures I.B-6 through I.B-9 illustrate the conditions as of November 1, 1989 for each of the basins.

Basin Number 1: Dry with all liquid and sludge removed; contains 'cleaned' concrete rubble consisting of walkways and support columns. The sedimentation and flocculation basins have been decontaminated by wet sandblasting, which has removed 1/8 to 1/4 inch of the concrete surface and exposed the aggregate.

Basin Number 2: This basin was lined with a 36-mil Hypalon liner to provide double containment. All liquids have been removed and solidified. A puddle from recent precipitation can be see in Figure I.B-7. The remaining crystalline material is 29 inches deep and is approximately 13,200 cubic feet. Some liquid remains trapped in the interstitial voids in the crystallized material. When sufficient liquid accumulates from precipitation or drains out of the solid crystallized material, it will be solidified. The 13,200 cubic feet of solid material was originally 98,540 gallons of filtered liquid that has precipitated/transformed during the 1989 evaporation season.

Basin Number 3: The sedimentation portion of this basin had a 36-mil Hypalon liner installed to provide double containment. All free-standing liquid has been removed. The remaining crystallized solid material is 22.5 inches deep (approximately 8,700 cubic feet) and results from the original 64,890 gallons of filtered liquid that has undergone evaporation and liquid solidification. The flocculation basin contains the liquid solidification equipment; the batch mixer, hoses, pumps, and several 55-gallon drums filled with solidified waste undergoing curing and several empty drums awaiting to be filled.

Basin Number 4: All liquid and sludge have been removed. The small quantity of water shown in Figure I.B-9, is from recent precipitation. This basin has been decontaminated by wet sandblasting. The basin's concrete was coated with a thick grey butyl material followed by a white layer of Hypalon sprayed on top, this material still remains after the sandblasting cleanup. A small tracked, front-end loader is shown in Figure I.B-9. Typically this front-end loader has been used during the sludge removal operations, and will be used again to assist in the removal of the crystallized solid materials from Basin Numbers 2 and 3.

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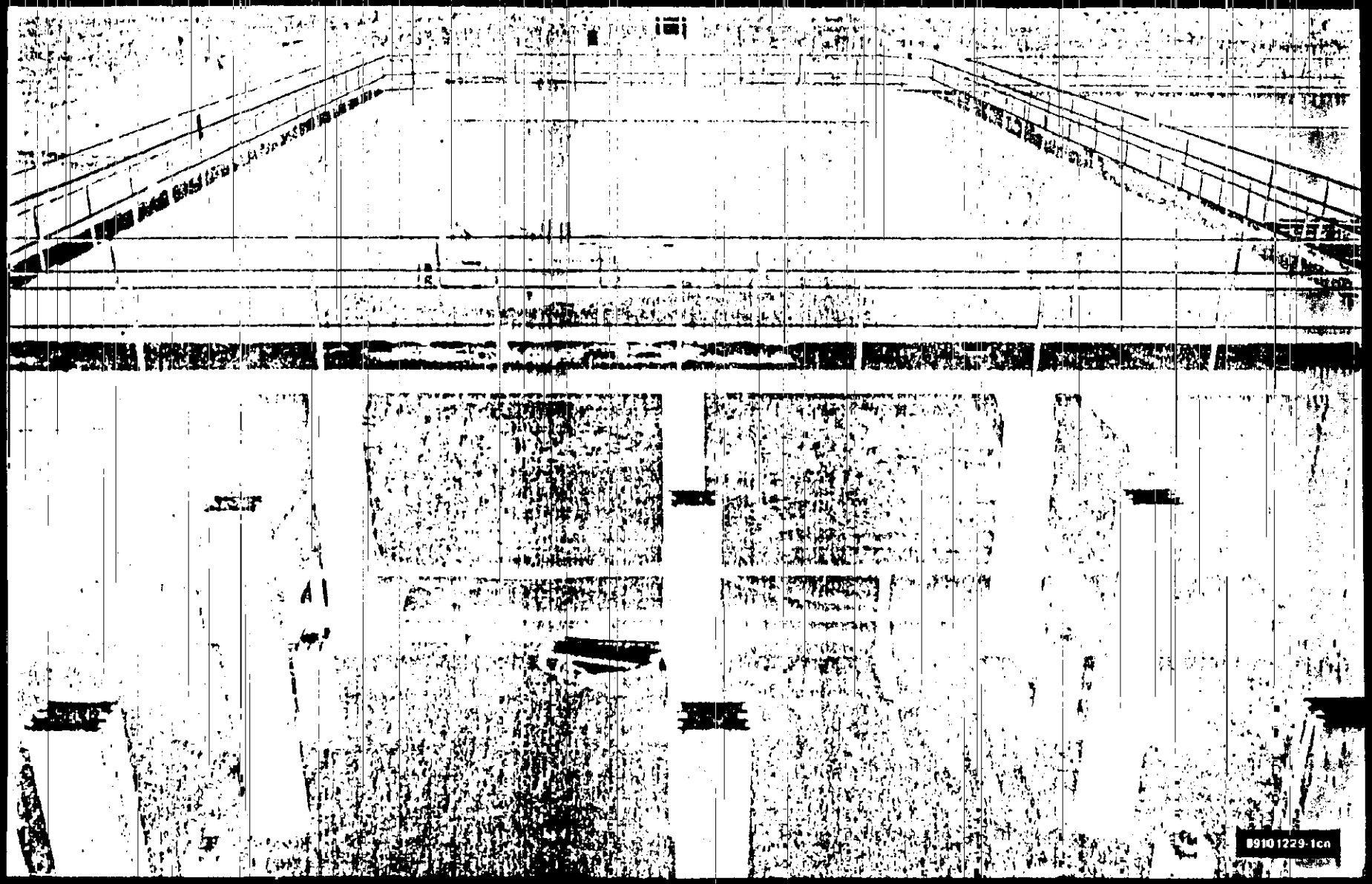

(Photograph taken 11/1/89)

Figure I.B-6. Basin Number 1.

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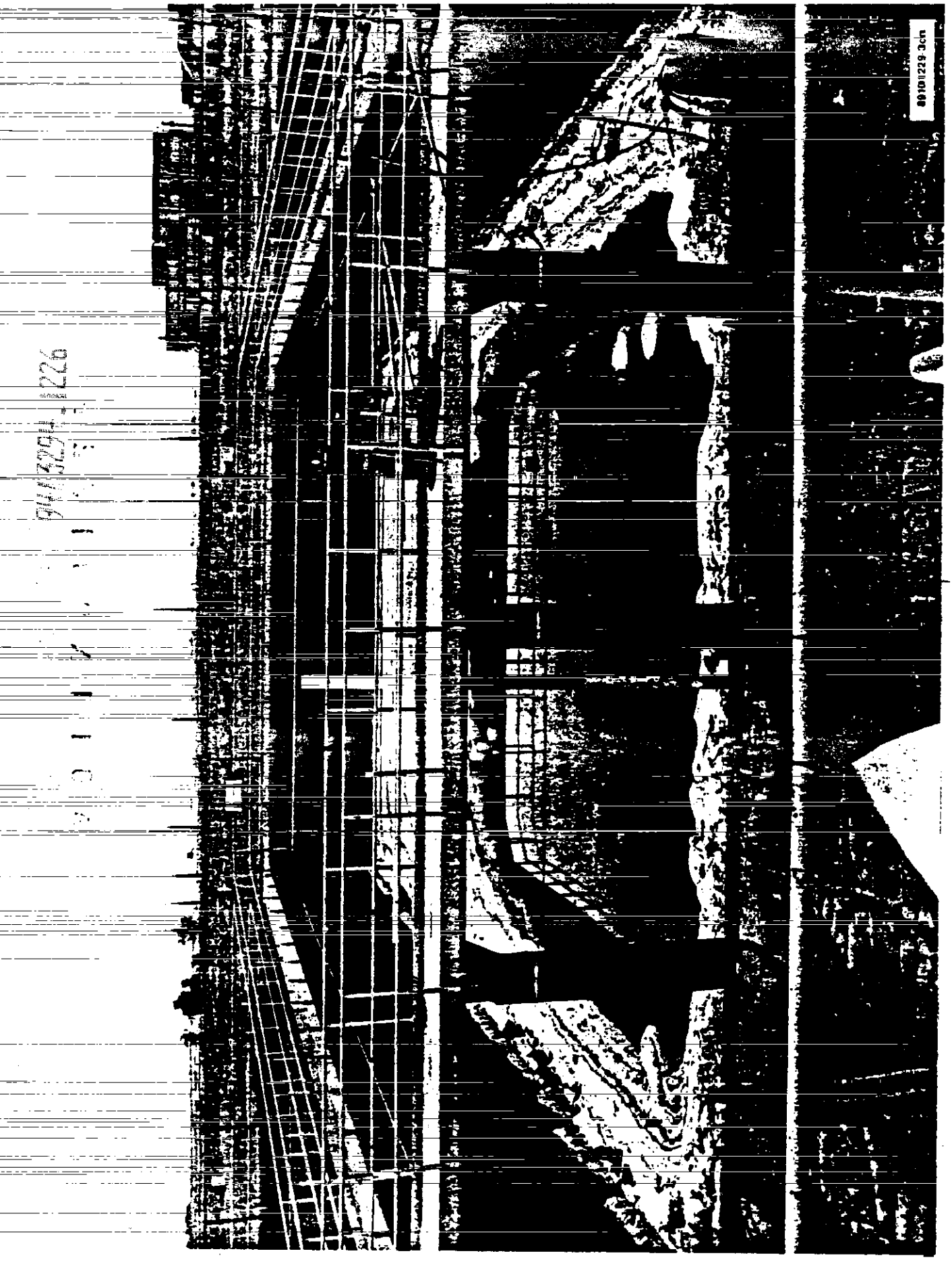

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Figure I.B-7. Basin Number 2.

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Figure I.B-8. Basin Number 3.

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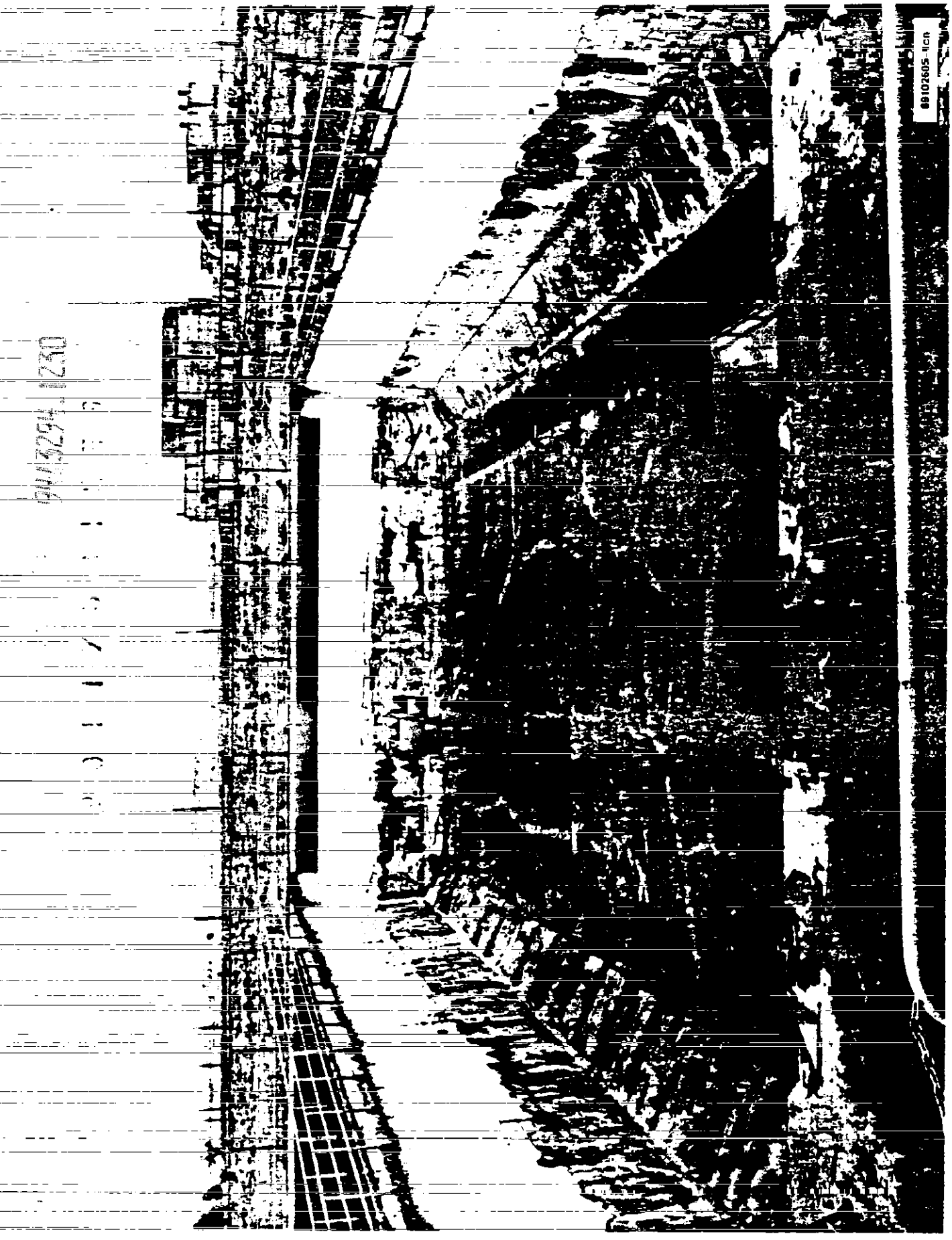

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Figure I.B-9. Basin Number 4.

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I.B-3. Removal and Management of Dangerous Wastes

This section addresses the maximum inventory of wastes held in the 183-H Basins. Section I.B-3a provides the maximum capacities and the estimated inventories during the life of the 183-H Basins. Section I.B-3b is the detailed description of the waste removal process.

I.B-3a. Estimate of the Maximum Inventory of Dangerous Waste in the Basins.

This section presents the data and calculations that document the volume of waste that has been in the 183-H Basins.

I.B-3a(1). Maximum Possible Inventory Expressed as Capacity Volumes. The maximum possible capacity for the 183-H Basins (collectively) remains at 2,167,000 gallons. The maximum capacities of each of the four 183-H Basins are given in Table I.B-1. The waste collection periods, as shown in this table are the consequence of either basin modifications to increase capacity, or the beginning of basin use after preparation to receive waste. The internal dimensions of the four 183-H Basins are the same except that the Basin Number 4 sedimentation basin is 5.5 inches narrower than the other basins. An isometric view of a typical basin is shown in Figure I.B-10.

The maximum liquid capacity for Basin Number 1 is limited by the overflow point at the bottom of the distribution flume gates on the north wall of the flocculation basin. Because the flume gates have been removed, the maximum possible liquid depth is 11.75 feet from the low point of the sedimentation basin to the overflow level. The maximum liquid capacities for Basin Numbers 2, 3, and 4 are limited by the overflow point at the lip of the effluent flume at the south wall of each basin. The maximum possible liquid depth is 13 feet from the floor at the south end of the sedimentation basin to the overflow level. The greatest possible capacity was obtained in September 1983 when the distribution flume gates on the north wall were concrete plugged for Basin Numbers 2, 3, and 4. The gates for Basin Number 1 were not plugged because use of Basin Number 1 for waste collection had been discontinued.

I.B-3a(2). Maximum Inventory Expressed by Actual Waste Volumes and Types. The remaining inventory of wastes is distributed between Basin Numbers 2 and 3. Basin Number 3 contains an estimated 8,700 cubic feet of crystallized solids and Basin Number 2 contains an estimated 13,200 cubic feet of crystallized solids. Basin Numbers 1 and 4 have been cleaned of all waste sludges and liquids, and decontaminated in preparation for soil sampling.

A history of waste collections and basin operations is summarized below:

1973 - Beginning of waste collection in Basin Number 1

1974 - No waste pumped into basins

1975 - Continuing use of Basin Number 1

1977 - Sprayed-on liners installed in Basin Numbers 2 and 3

Table I.B-1. Maximum Basin Capacities.

Waste collection period		Total maximum capacity (gal)	Basin capacities (gal)			
			Basin Number 1	Basin Number 2	Basin Number 3	Basin Number 4
1973	- June 1978	468,000	468,000	a	a	a
June 1978	- December 1978	936,000	468,000	468,000	a	a
December 1978	- October 1982	1,404,000	468,000	468,000	468,000	a
October 1982	- September 1983	1,967,000	468,000	468,000	468,000	463,000
September 1983	- Present[c]	2,167,000	468,000	568,000[b]	568,000[b]	563,000[b]

[a] Basin not in service.
[b] Capacity increase by plugging flume gates.
[c] Last shipment was November 1985.

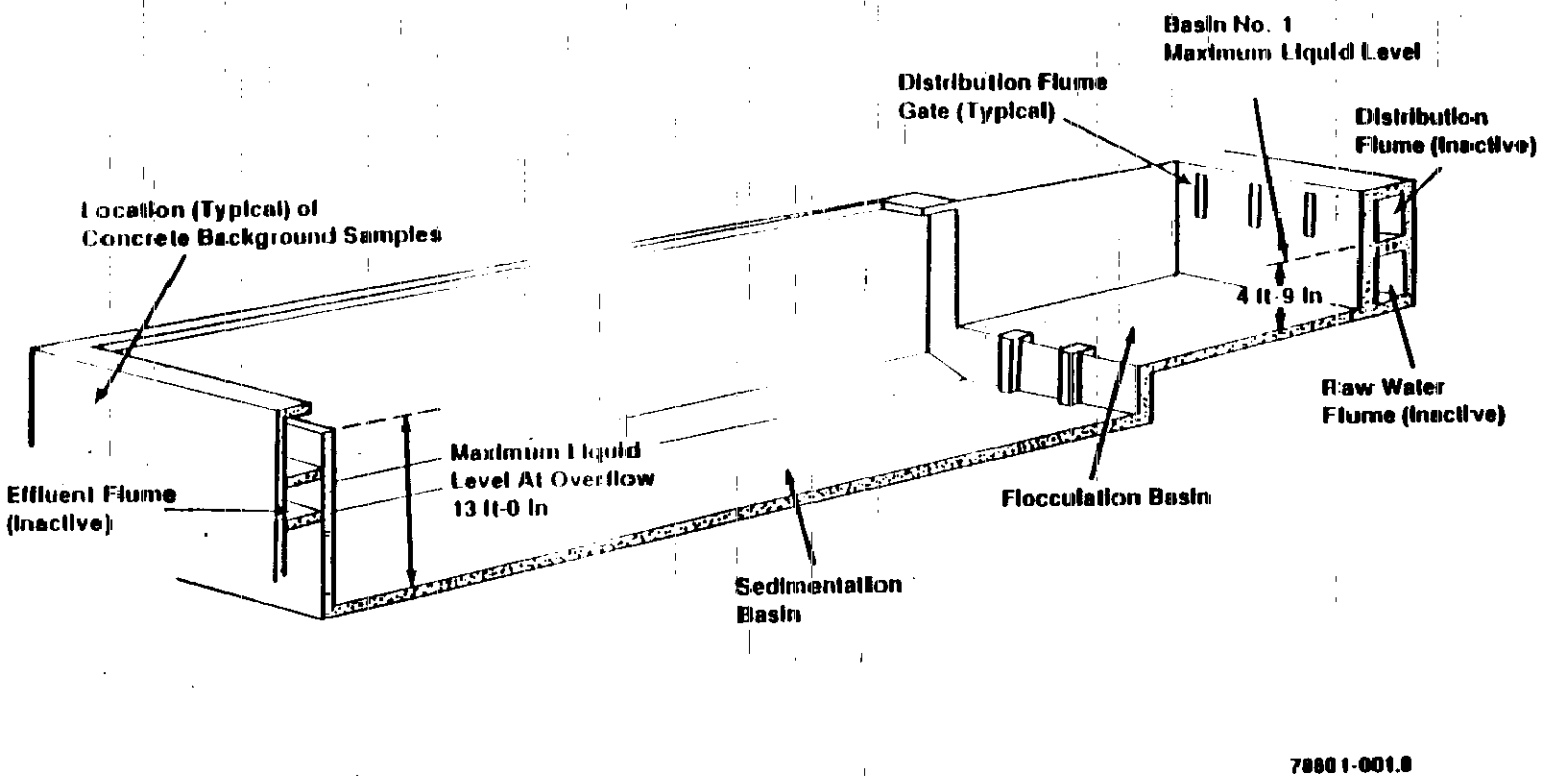


Figure I.B-10. 183-H Basin (Typical).

1978 - Continuing use of Basin Number 1 until midyear
- Use of Basin Number 3 began
- Liquid from Basin Number 1 pumped into Basin Number 3

1979 - Began waste collection in Basin Number 2 after installation of a sprayed-on liner
- Alternating use of Basin Numbers 2 and 3 after installation of a sprayed-on liner in Basin Number 3

1980 - Basin Numbers 2 and 3 in service

1981 - Basin Numbers 2 and 3 in service

1982 - Butyl/Hypalon sprayed-on liner installed in Basin Number 4
- Beginning of waste collection in Basin Number 4 after installation of a sprayed-on liner

1983 - Alternating use of Basin Numbers 2, 3, and 4
- Capacities of Basin Numbers 2, 3, and 4 increased by plugging distribution flume gates

1984 - Continuing use of Basin Numbers 2, 3, and 4

1985 - Continuing use of Basin Numbers 2, 3, and 4, then ceased in November
- Sludge removed from Basin Number 1
- Chemical disposal shipments to 183-H Basins terminated

1986 - Liquid pumped from Basin Number 2 into Basin Numbers 3 and 4
- Sludge removed from Basin Number 2
- Hypalon liner installed in Basin Number 2
- Filtered liquid from Basin Numbers 3 and 4 transferred to Basin Number 2 for assured containment

1987 - Sludge removed from Basin Number 3
- Hypalon liner installed in Basin Number 3

1988 - Sludge removed from Basin Number 4
- Basin Number 1 decontaminated by wet sandblasting

1989 - Liquid waste solidification started/completed in Basin Number 2
- Liquid waste solidification started/completed in Basin Number 3
- Basin Number 4 decontaminated by wet sandblasting
- Basin Numbers 2 and 3 undergoing final waste (crystalline) removal
- Phase I soil sampling initiated in Basin Number 1

1990 - Phase I soil sampling continues in Basin Numbers 1 and 4

As discussed in Section I.A-3, the major quantities of wastes transferred to the 183-H Basins were 'routine' wastes from the 300 Area fuel fabrication facilities. Routine wastes were over-neutralized with caustic materials and then transported via tank truck to the 183-H Basins unloading areas. Certain

'nonroutine' wastes were added to routine wastes prior to transport. Other nonroutine wastes were added directly to the 183-H Basins. Table I.B-2 summarizes the routine and nonroutine wastes. Tables I.A-1 through I.A-4 provide details of these wastes.

Table I.B-3 provides a summary of the estimated annual waste inventory for each basin. The estimates include the effects of volume increase due to annual precipitation and volume decrease due to annual surface evaporation. Supporting calculations and estimates are provided at the end of Section I.B-3a.

The extent and magnitude of contaminated soil below and around the 183-H Basins cannot be known until a soil sampling program is completed. An ultra-conservative estimated maximum quantity of potentially contaminated soil is 530,000 cubic feet, assuming that the vadose soil column (volume) beneath Basin Numbers 1 and 2 would have to be removed. Actual designation of the soil contaminants and determination of the quantity of contaminated soil must be determined by physically sampling and analyzing the soil (Section I.B-4c).

I.B-3b. Calculation of the Maximum Basin Capacities. The nominal basin dimensions are shown in Figure I.B-5. The basin volume is reduced from the nominal value by the thickness of the walls and by the fillets around the periphery of the floors. The volume of Basin Number 4 is also reduced by a thicker side wall on the west side. Because the slopes of the floors, walls, and fillets are uniform, average dimensions are used.

I.B-3b(1). Maximum Volume of Basin Numbers 2 and 3 with Distribution Flume Gates Plugged. In the sedimentation basins, the depths to the overflow lip of the effluent flume measured at each end of the sloped floor are 13 feet and 14 feet. The average depth = (13 + 14)/2 = 13.5 feet. The basin length is 95 feet.

The nominal basin width of 53.5 feet is reduced by one-half of the full wall thickness for each side multiplied by two to account for both side walls. Because the walls are sloped, the average width is calculated at the midpoint of the maximum liquid level.

Maximum liquid depth at midpoint of the basin is 13.5 feet, thus the average basin depth should be measured at 13.5/2 or 6.75 feet. The average wall half-thickness at a depth of 6.75 feet is 0.79 feet, or 1.58 feet for both walls. Thus, the effective width for volume calculations is (53.5 - 1.58) = 51.9 feet.

Table I.B-2. Waste Added to 183-H Basins.

Year	Annual inventory addition (gal)	Basins in Service	Routine and nonroutine volume transported with tanker (gal)	Nonroutine transported with tanker: Solid (lb)	Nonroutine transported with tanker: Liquid (gal)	Nonroutine direct basin additions: Solid (lb)	Nonroutine direct basin additions: Liquid (gal)
1973	19,000	1	19,000	0	0	0	0
1974	0	1	0	0	0	0	0
1975	142,000	1	142,000	0	750	0	0
1976	127,000	1	127,000	1,158	5,738	32	0
1977	155,000	1	155,000	1,764	500	78	0
1978	81,000	1	75,000	0	65	0	5,500
	75,000	3	75,000	0	200	0	0
1979	164,000	2,3	160,000	0	1,241	0	3,600
1980	153,000	2,3	151,000	0	1,035	0	2,325
1981	201,000	2,3	200,000	0	305	0	500
1982	206,000	2,3	206,000	35	410	a	a
	41,000	2,3,4	41,000	0	13		
1983	406,000	2,3,4	406,000	0	1,022		
1984	416,000	2,3,4	416,000	0	315		
1985	369,000	2,3,4	369,000	0	490	—	—
Total	2,555,000		2,542,000	2,957	12,084	110	11,925

[a] No direct additions were made to the 183-H Basins after 1981.

Table I.B-3. Net Annual Waste Inventory.

Year	Basins in service	Waste added (gal)	Evaporation (loss) (gal)	Precipitation (gain) (gal)	Net waste volume per year (gal)
1973 (second half)	1	19,000	42,500	11,500	0[a]
1974	1	0			0[a]
1975	1	142,000	85,000	23,000	80,000
1976	1	127,000	85,000	23,000	65,000
1977	1	155,000	85,000	23,000	93,000
1978 (first half)	1	81,000	55,000	11,500	38,000
1978 (second half)	3	75,000	42,500	11,500	44,000
1979	2,3[b]	164,000	170,000	46,000	40,000[b]
1980	2,3	153,000	170,000	46,000	29,000
1981	2,3	201,000	170,000	46,000	77,000
1982	2,3	206,000	170,000	46,000	82,000
1982 (third quarter)	4	41,000	0	5,750	47,000
1983	2,3,4	406,000	255,000	69,000	220,000
1984	2,3,4	416,000	255,000	69,000	230,000
1985	2,3,4	369,000	255,000	69,000	183,000
1985	Waste additions terminated				

[a] Only sludge remains after evaporation of the initial waste addition.
[b] When multiple basins are in service, the given net volume is for those combined basins.

Note: The distribution between basins has not been estimated.

The sedimentation basin volume is: $(L \times W \times H)V_s$, where V_s are the structural volumes of the two sidewall fillets on the floor minus the fillets on the floor at the north and south ends:

Average sidewall fillet height = (2 + 3)/2 = 2.5 feet
Average sidewall fillet base = (5 + 7)/2 = 6 feet
Total sidewall fillet length = 95 x 2 = 190 feet.

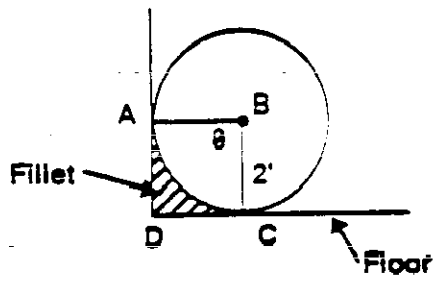
The sidewall fillet has a triangular cross section:

Cross sectional area = 1/2 hb = 2.5/2 x 6 = 7.5 square feet
Sedimentation Basin Volume = 7.5 ft^2 x 190 ft = 1,425 cubic feet.

The north end fillet has a triangular cross section of 1.5 feet height and 1.5 feet base.

V = 1/2 (base x height x length) = 1/2(1.5)(1.5)(53.5) = 60 cubic feet.

The south end fillet has a cover cross section with a radius of curvature of 2 feet.



The cover fillet cross-sectional area is a 2 feet by 2 feet square ABCD less the area of the sector ABC.

Sector area = 1/2 R^2 θ

where

θ = Angle (rad) = 90°
0.01745 = Conversion factor to change ° to radians
Sector area = 1/2 $(2)^2$ 90(0.01745) = 3.14 square feet
Fillet area = (43.14) = 0.86 square feet
Fillet volume = 0.86 x 53.5 = 46 cubic feet,

Total volume of internal structures: V_s = 46 + 60 + 1,425 = 1,531.

Final volume of sedimentation basin:

V = $(L \times W \times H)V_s$ = (95 x 51.9 x 13.5) = 1,531
= 66,562 - 1,531 = 65,032 cubic feet
Volume = 65,032 x 7.4805 = 486,472 = ~486,000 gallons.

I.B-3b(2). Flocculation Basin Volumes for Basin Numbers 2 and 3 with Effluent Flume.

Average depth = (7.0 + 7.5)/2 = 7.25 feet
Nominal width = 45.5 feet
Nominal length = 33 feet.

There are no sloped walls or fillets.

Volume = 33 x 45.5 x 7.25 = 10,886 cubic feet
Volume = 10,886 x 7.4805 = 81,432 gallons.

Total maximum volume of Basin Numbers 2 and 3:

Volume = 81,432 (flocculation basin) + 486,472 (sedimentation basin) gallons
Volume = 567,904 gallons = ~568,000 gallons.

I.B-3b(3). Basin Volumes with Flume Gates Open. The calculated basin volume of 568,000 gallons is correct for Basin Numbers 2 and 3 after the flume gates were plugged. The volume of the basins with the flume gates open was reduced by the difference between the effluent flume overflow lip and the bottom of the flume gate. The level difference, as determined from the basin structural drawings, is 2.08 feet. Thus, the available volume is reduced by:

2.08 [51.9(95) + 33(45.5)]7.085 = 100,078 gallons.

Volume without effluent flume:

568,000-100,000 = 468,000 gallons net.

Volumes of Basin Numbers 2 and 3 prior to gate plugging:

Volume = 468,000 gallons.

I.B-3b(4). Volume of Basin Number 4. The Basin Number 4 west wall is thicker than the other basin walls. The extra thickness shown on the basin structural drawings, reduces the width dimension of the sedimentation basin by 0.5 feet.

Volume reduction for Basin Number 4:

Volume = 0.5 x 95 x 13.5 = 642 cubic feet
642 x 7.4805 = 4,802 gallons ~5,000 gallons

Vmax = 568,000-5,000 = 563,000 gallons.

I.B-3b(5). Volume Increase by Precipitation. The annual volume of liquid added to each basin is calculated as the product of the exposed surface area and the average annual precipitation (rain and snow).

The annual precipitation value used for calculations is 5.8 inches. The estimate is not corrected for annual variations because a 1-inch variation amounts to 4,000 gallons per basin, which is less than 5 percent of the typical 200,000 to 400,000 gallon annual waste addition.

The collection areas for each basin is sedimentation basin width times length plus flocculation basin width times length. The exposed open dimensions are 52.5 feet and 95 feet for sedimentation basin width and length, and 44.5 feet and 33 feet for flocculation width and length:

(5.8 inches/12 inches per foot) x [52.5(95) + 44.5(33)] x 7.48 gallons per cubic foot = 23,340 gallons.

The volume of 23,000 gallons per basin is used for average volume increase as a result of precipitation. For partial year basin usage, a proportional value is used.

I.B-3b(6). Volume Decrease by Evaporation. The annual evaporation loss from each basin is based on actual measurements in Basin Number 2 during the 1987 evaporation season (Table I.B-4). The measurements were read from a gauge board with the zero point at the low point of the sedimentation basin floor.

The exposed surface area in each basin is calculated for partially filled basins.

Sedimentation Basin:

95 feet length x 53.1 feet width = 5,044.5 square feet.

Flocculation Basin:

(33 feet length x 45.5 feet width)-31 square feet for pier area = 1,470.5 square feet.

Total Basin area: = 5,044.5 + 1,470.5 = 6,515 square feet.

From the evaporation table (Table I.B-4) the evaporation rate:

$$\frac{26 \text{ inches}}{188 \text{ days}} \times 0.1429 \text{ days/week} = 0.97 \text{ inches/week.}$$

The evaporation season [May to mid-October (28 weeks)] yields (0.97 x 28) = 27.16 inches/year of evaporation.

When the waste level is above the flocculation floor:

Annual evaporation rate = (27.16 inch/year)/(12 inch/foot) x 6,515 square feet x 7.4805 gallons per cubic foot

= 110,304 gallons/year = ~110,000 gallons per year.

Table I.B-4. Evaporation Measurements for Basin Number 2.

Date	Evaporation measurement (feet)	(inches)
03/31/87	12	4
04/16/87	12	3
05/05/87	12	1
05/12/87	12	0
05/20/87	11	11
05/27/87	11	11
06/02/87	11	10
06/09/87	11	9
06/16/87	11	8
06/23/87	11	7
06/30/87	11	6
07/07/87	11	5
07/14/87	11	3
07/21/87	11	2
07/29/87	11	1
08/05/87	10	11
08/12/87	10	10
08/18/87	10	9
08/25/87	--	--
09/02/87	107	
10/05/87	102	
Total = 128 days	Level reduction = 26 inches	

When the waste level is below the flocculation floor (≤217,000 gallons):

Annual evaporation rate = 5,044/6,515 x 110,000
= 85,163 = ~85,000 gallons per year.

Note: The estimated evaporation rate is subject to variability. A cool summer that reduces the effective season by 2 weeks would reduce the evaporation by about 7 percent. The effect of annual variation in days of sunlight or average daily temperature is not evaluated in this estimate.

I.B-3c. Detailed Description of the Removal of Dangerous Waste Inventory. As required by WAC 173-303-640, this section provides the description of methods to be used for removing, transporting, treating, storing, and disposing of dangerous wastes. The maximum possible capacity for the waste inventory in the 183-H Basins was 2,167,000 gallons (Section I.B-3a).

The remaining inventory of wastes in the 183-H Basins consists of 13,200 cubic feet of crystallized solid material containing some liquid in the interstitial voids in Basin Number 2, and 8,700 cubic feet of the same material in Basin Number 3. In 1986, all liquid was pumped into these basins through a 75 micron filter strainer to separate out all particulate matter (sludge). The liquid waste has now crystallized into a solid mass. For a description of dangerous waste constituents, see Section I.A. The volume of the 183-H Basins structural rubble, if completely demolished, will be 93,000 cubic feet. The remaining structure will be decontaminated as practicable prior to demolition. This would reduce the dangerous waste to a lesser volume of residues consisting of rinsate, scrapings, and abrasive materials (Section I.B-4). Additional reduction of waste volume (liquids) will occur through natural evaporation of liquids, while other closure work is in-progress.

I.B-3c(1). Quantity of Dangerous Waste Sent to 200 West Area. The following data have been presented elsewhere in Section I.B, but in other quantity units. Since 1985, a total of 35,860 cubic feet of sludge has been removed and sent to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility and about 2,060,840 gallons of liquid have been 'removed' through evaporation and solidification.

The waste removal effort consisted of the following sequence of events.

- June through September 1985 - 7,646 cubic feet of sludge removed from Basin Number 1
- July through September 1986 - 8,955 cubic feet of sludge removed from Basin Number 2, and a 36-mil Hypalon liner added. All remaining liquid subsequently transferred from Basin Numbers 3 and 4 into Basin Number 2
- May through September 1987 - 13,000 cubic feet of sludge removed from Basin Number 3
- May through September 1988 - 6,259 cubic feet of sludge removed from Basin Number 4
- June through October 1989 - liquid solidification removed 60,000 gallons from Basin Numbers 2 and 3.

I.B-3c(2). Treatment Performed Prior to Transport. The following two sections describe the waste treatment performed on the solid and liquid wastes

removed from the site and the planned treatment for the remaining crystallized solid material.

Solid Waste Treatment--The removal of solid waste sludge removal (1985 through 1987) consisted of manually shoveling and/or scooping the sludge with a 5-gallon bucket. The sludge was placed into a 90-mil polyethylene 55-gallon drum liner inside a U.S. Department of Transportation Specification 17H 55-gallon drum. Exterior protection of the drum and liner consisted of encasing the drum in a 10-mil polyethylene bag and taping the top of the bag to the drum. The 10-mil polyethylene bag inside the liner was then folded down around the top of the drum and taped. This completely covered all exterior surfaces of the drum. Approximately 1 cubic foot of diatomaceous earth absorbent was placed in the bottom of the liner, and the prepared drum was then moved into the basin for loading.

After 4.5 cubic feet of sludge material was placed in the lined drum, it was covered with 1.5 cubic feet of mixed diatomaceous earth absorbents to ensure absorption of all free liquid. The inner 10-mil polyethylene bag was closed, taped, and tucked inside over the absorbent. The 90-mil liner cover was installed and bolted tight. Using a hoist, the 55-gallon drum was then raised to the top of the basin where a radiation protection technologist carefully peeled the outer 10-mil polyethylene bag from the drum. These outer bags were placed in a separate waste drum. The radiation protection technologist then surveyed all exterior drum surfaces to ensure radioactive contaminated material was not present. A total of four drums were placed on a pallet, banded with 0.75-inch steel bands to secure them together, then drum covers were installed and bolted securely. The palletized drums were set aside onto a paper-covered, roped-off asphalt parking area for temporary storage while awaiting transport to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility. These conservative packaging requirements were predicated on the contained waste being dispositioned for burial and/or long-term storage.

Since the remaining waste (solid and liquid) is designated to undergo long-term storage in a building (200 West Area Central Waste Complex, Retrievable Waste Storage Facility), a simpler packaging method meeting appropriate U.S. Department of Transportation specifications is anticipated.

Liquid Waste Treatment--As of November 1989, there were approximately 21,900 cubic feet of solid wastes remaining in the 183-H Basins, which consisted of a crystalline material that was primarily sodium nitrate. These wastes were distributed between Basin Numbers 2 and 3, and Basin Number 2 contains most of the material. The solid crystalline material is the transformed product from natural evaporation. There is no sludge material in this basin as all the liquid was filtered through a 75-micron filter strainer as it was placed into this lined basin. Currently there is a small quantity of free standing liquid from precipitation on top of this solid crystal formation and an undetermined amount of interstitial liquid within the coarse granular matrix.

In September 1988, the volume of waste in Basin Number 2 was reported as approximately 250,000 gallons of liquid with some crystallized material on the

bottom. Because of the evaporation and solidification, this liquid has transformed into a solid. This essentially ends any further liquid waste treatment, since what remains is essentially considered solid waste. During 1989, 60,000 gallons of liquid wastes have been treated by solidification, and approximately 29,000 gallons of liquid have evaporated; thus, leaving approximately 21,900 cubic feet of crystallized solid material.

The liquid waste treatments consisted of the solidification of all liquids from the basins by solidification of the liquids into a solid, free-standing monolithic form inside polyethylene-lined U.S. Department of Transportation Specification 17H steel drums. The drums were then transported to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility.

The solidification agent selected for the liquids removal was Sorbond LPC-II*. Selection of this material was the result of an 11-month test and evaluation effort in which many solidification agents (13 different materials) were investigated. Samples of each material were obtained and tested in the laboratory using a 40 percent sodium nitrate saturated solution. Various ratios of material to liquid were determined, and then a full-scale field test of three candidate materials was conducted within the confines of Basin Number 3.

The selected material, Sorbond LPC-II, is a mixture of various custom-blended clays consisting of the following chemical formulation (by percent):

Compounds	Range (%)
Silicon dioxide	14.4 - 15.6
Aluminum oxide	3.1 - 3.5
Ferrous oxide	1.6 - 1.9
Calcium oxide	63.2 - 73.2
Manganese oxide	5.1 - 6.0
Sulfate ion	1.4 - 1.8
Potassium	0.4 - 0.7
Sodium oxide	0.8 - 1.2
Calcium carbonate	0.3 - 0.5

The bulk density is 70-80 pounds per cubic foot.

Use of this material provided a high-packaging efficiency with less than a 30 percent volumetric increase. The initial Sorbond test resulted in solidifying 36 gallons of liquid waste in a 55-gallon drum by adding 261.4 pounds of Sorbond LPC-II. This mixing proportion resulted in a liquid volume increase of approximately 6 inches in depth within the drum, leaving 6-3/4 inches of freeboard.

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* Sorbond LPC-II is a trademark of American Colloid Company.

Actual liquid solidification procedures increased the liquid content per drum to 40 gallons, with a corresponding increase of solidifying agent to 290.4 pounds. The proportions result in approximately 2 to 3 inches of freeboard in each drum. Once mixed into the solution, the initial gel was relatively fast (less than one hour after the mixing action had been stopped). Continued mixing extended the setup time, with the normal full cure requiring 3 days. After full cure, the headspace in each drum was filled with an absorbent material to absorb any condensation that might accumulate in the headspace after bolting the lid in place.

To expedite the liquid solidification process, equipment was procured for mixing quantities of 320 gallons of liquid in each batch (eight drums per batch). All equipment used for the liquid solidification process was kept within the confines of the 183-H Basins, and the filled drums were only removed after the 3 day cure period (winter cure time has been about 7 days).

The mixing equipment consisted of a paddle-type batch mixer with a maximum capacity of 62.5 cubic feet (467 gallons). The holding tank was fitted with an overflow device to premeasure each batch of 320 gallons. This holding tank was located above the batch mixer to permit gravity-feeding into the mixer for each batch. The Sorbond LPC-II material quantity of 2,323 pounds was obtained in bulk bags, each containing approximately 2,300 pounds; the exact weight has been stenciled on each bag. Each batch was charged with the contents of one bulk bag and topped off to produce exactly 2,323 pounds. The make-up quantity was less than 50 pounds for each batch. The exact weight of each bulk bag and the makeup quantity was recorded for each batch to control the mixing proportions. After mixing each batch (320 gallons of liquid and 2,323 pounds of Sorbond LPC-II), the mixed solution was gravity fed from the mixer through a bottom discharge valve into polyethylene-lined 55-gallon drums. Each drum was filled within 2 inches of the top then rolled aside on a dolly to permit continued filling of drums. One mixer batch filled eight drums, which when filled, were stored on the opposite side of the basin until fully cured.

After a 3-7 day cure, each drum was hoisted out of the basin onto a paper-covered and roped-off laydown area immediately north of the basin (other side of the chain link fence). The drums were radiologically surveyed to ensure they were clean. Within hours, these drums were relocated to an intermediate storage pad located approximately 100 yards east of the 183-H Basins. The drums were properly labeled and banded together (four drums per pallet) to be transported to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility. Random drum coring tests (leachability and EP Toxicity) and visual inspection have been used to verify acceptability of the solidification process.

During 1989, the liquid removal effort was basically completed. Subsequent solidification will continue to be performed whenever sufficient liquid seeps out of the granular solid waste, precipitation collects, or wash water accumulates. Additional volumes of purgewater will be solidified as it becomes convenient. Some periods of 'in-basin' inactivity will occur during the winter months; however, during these inactive periods, activities such as

waste transportation to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility will continue.

I.B-3c(3). Time Required to Remove Waste to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility. During previous operations, the loaded drums were located temporarily at the storage area alongside the 183-H Basins for various durations as removal work progressed. The average drum residence time for the material removed from each basin was:

Basin Number 1:	3 days average
Basin Number 2:	45 days average
Basin Number 3:	116 days average (shipment of waste drums from Basin Number 3 was delayed until receipt of laboratory results)
Basin Number 4:	10 days average.

Other than for Basin Number 3, during 1988, removal of drummed waste from the 183-H Basins has been within 90 days, which complies with applicable regulations.

I.B-3c(4). Distance to the Final Treatment/Storage/Disposal Facility. The solidified liquid filled drums continue to be trucked from the 183-H Basins to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility, a distance of approximately 17 miles. The route is within the confines of the Hanford Site's restricted area and no public roads are being used. The route continues to be from the 183-H Basins south along the 100-H Area access road to Route 2, south to Route 1, west to Route 4 North, south to Route 11A, west to the 200 West Area access road, and south into the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility (Map H-6-958 in Appendix A and Figure I.A-1).

I.B-3c(5). Description of Treatment or Disposal Methods. All retrievable waste drums are stored on concrete slabs that will be enclosed with a structural cover. A fee is continuously assessed against each drum by the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility, to cover the final disposal cost when the 200 West Area Central Waste Complex, Waste Receiving and Processing facility becomes operational. All dangerous wastes from the 183-H Basins will be retrieved for processing in the 200 West Area Central Waste Complex, Waste Receiving and Processing facility, a multi-purpose waste reduction facility that is scheduled to start in 1996.

During 1986, the drums from Basin Number 2 were banded together on pallets and transported to a 200 West Area shallow waste trench. The drums were covered with polyethylene sheets and plywood, and then backfilled. In 1987, the drums from Basin Number 3 were stacked two pallets high on concrete slabs and left uncovered. These drums will be relocated in covered buildings (under construction) in the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility. Since September 1988, all of the 183-H Basin waste drums have gone directly into the completed Central Waste Storage buildings.

I.B-3c(6). Operating Status of the Treatment, Storage, and/or Disposal Facility. Future wastes will be shipped to the 200 West Area Central Waste

Complex, Retrievable Waste Storage Facility. The drummed wastes will be stored in buildings until treatment/final disposal is completed by the facility. Routinely, the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility, has been issuing storage/disposal acceptance records for the packaging of the 183-H Basins' wastes.

I.B-3c(7). Description of Methods to Protect Surface and Groundwater During Waste Removal. The surface water and groundwater beneath the 183-H Basins continues to be protected during the dangerous waste removal. The only nearby surface water is the Columbia River, which is located about 500 feet away, and the groundwater is about 40 feet below grade. This protection is provided by performing all handling and packaging of wastes within the confines of the basins. The Hypalon liners and basin integrity will not be breached until after basin decontamination. Core drilling to sample soils under the 183-H Basins' floors started in December 1989. Immediately following sampling, each hole/excavation was backfilled to the surface and core holes will be concrete plugged to preclude precipitation infiltration and/or contaminant migration.

I.B-3c(8). Description of Methods to Control Wind Dispersal. All direct handling of the waste, in its various forms, has been done within the confines of the 183-H Basins in order to minimize the potential for wind dispersal of contamination. Typically the solid waste has been packaged into waste drums with the work being done inside the sedimentation basin, which is 13 feet 6 inches below the top of the basin walls, and thus, well protected from the wind. Likewise, the liquid solidification process and basin decontamination have, and will continue to occur within the sedimentation basins.

I.B-3c(9). Methods of Dangerous Waste Removal and Special Handling Procedures Required for Reactive and Ignitable Wastes. The sludge and liquid removed from the 183-H Basins has not been designated as reactive. The presence of nitrate in the liquid and sludge has resulted in a characteristic of ignitability per WAC 173-303-090(5)(a)IV and under the definition of oxidizer in 49 CFR 173.151. However, the water content and high-heat capacity of the wastes as a solution of nitrate, and as sludge with a high-liquid content, prevent localized heating and decomposition with the release of oxygen to support combustion. Typically, handling of strong oxidizers has required avoidance of contact with organics and isolation from sources of ignition and heat. Chemically, the sodium nitrate present in the waste has not been a strong oxidizer. The packaging method has provided the necessary isolation from organics and sources of ignition. Packaging and facility decontamination continues to be performed without the use of combustible organic solvents; therefore, unique or special handling procedures have not been required.

I.B-3c(10). Methods of Loading and Transportation. Descriptions of the methods for loading wastes into drums and capping the drums previously has been under Treatment Performed Prior to Transport [Section I.B-3b(2)]. A description of drum handling performed prior to transport is as follows: (1) the secured drums are placed on a pallet (four drums per pallet) and fastened down with steel banding tape, and (2) the palletized drums are loaded

in one layer on a flatbed truck and fastened down with nylon cargo slings. Typically, a low-boy trailer and a 40-foot flatbed truck are used to transport the drums to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility. The trailer and truck maximum capacities are 48 drums and 72 drums, respectively.

I.B-4. Description of Decontamination and Removal of Dangerous Waste Residues

This section provides information pertaining to decontamination and removal of the dangerous waste residues from the 183-H Basins structures, equipment, and surrounding soils as required by WAC 173-303-610 and -640.

Criteria and methods for the removal of radioactive and dangerous waste residues (contaminants) have been very similar and, generally, removal of inorganic dangerous constituents also has removed radioactive contamination. Therefore, the procedures, techniques, sampling, and testing have been tailored to concurrently provide decontamination for both. Where feasible, decontamination progress has been monitored with the faster, portable equipment for monitoring radioactivity rather than the slower and more costly chemical analysis. However, final determinations will rely on chemical analyses.

To determine whether the structural concrete components and equipment surfaces should be considered contaminated or uncontaminated, a predetermined concentration level for each of the chemicals of concern has been established, ["Methods for Sampling and Testing to Demonstrate Success of Decontamination" (Section I.B-4c)]. Closure will proceed with decontamination of the structural surfaces following the solid and liquid wastes removal from the basins.

The Hypalon liners (double containment) in Basin Numbers 2 and 3 will be removed for disposal as dangerous waste. The liners will be cut into strips, and then rolled to fit into a 55-gallon drum package for disposal (Section I.B-3b). The concrete surfaces with localized areas of the sprayed-on Hypalon coating will be decontaminated to remove as much residue as possible (see Section I.B-1 for a definition of residues). The concrete surfaces, which are in direct contact with the liquid wastes, will be considered contaminated and will require wet sandblasting (decontamination). All other structural surfaces such as walkways and pipe handrails will be decontaminated as required. For day-to-day contaminant determinations, portable low-level radioactive detection equipment will be used for measurement of radioactive contamination, and absorbent swipes will be analyzed for inorganic elements.

The entire interior concrete surfaces of the basins will be marked-off into 5-foot by 5-foot squares. Starting at the uppermost squares, each square will be sandblasted (decontaminated) until a noticeable surface variation can be observed. Each of the upper row of squares will be subsequently decontaminated, inspected, and checked before moving downward to the next row of squares. This process will be repeated until all wall squares have been decontaminated. Next, the basin floor surfaces will be

decontaminated starting with the high end so that the rinsate (wash/rinse water) flows to the basin low point.

If additional decontamination is needed, a sampling and testing effort will be conducted for the purpose of monitoring the effectiveness of the decontamination work. An additional decontamination process will be performed using appropriate technologies such as washing with water, stripping the surfaces by steam cleaning, aquablasting, sandblasting, and mechanical concrete scrubbing and scarifying. The actual equipment used will consist of an appropriate combination of the equipment that is found to be the most effective, as determined by sampling results.

If necessary and appropriate to accomplish clean closure, cracks in the concrete and the seams below the liquid level may be chiseled out to remove some hazardous material. The clean cracks may be filled and sealed using a high-strength non-shrink grout material. The sampling process will consist of removing samples of concrete from random locations along each crack and seam and from various surface locations within the 183-H Basins. The overall sampling and analysis will be performed concurrently with the decontamination work and will monitor effectiveness of the decontamination process. The concurrent analyses are for tracking purposes only. All sludges, rinsates, and abrasive materials (sandblasting grit, garnet, 36-sieve size) generated during the decontamination and sampling process will be handled and disposed of as dangerous waste. All samples will be handled as dangerous waste and will be returned to the 183-H Basins for disposal along with other dangerous wastes (Section I.B-3b). The sampling and testing program as described herein will be used to evaluate the success of decontamination.

I.B-4a. Procedures for Cleaning Equipment and Structures. Because the 183-H Basins' wastes that may collect on the equipment surfaces are either water-soluble or loose-particulate matter, it is not considered necessary to use chemical cleaning agents or solvents. Cleaning or decontaminating the 183-H Basins structures started in 1988 with Basin Number 4, immediately after all sludge had been removed. Attempts to remove the sprayed-on Butyl/Hypalon coating by various means such as aquablasting or wet sandblasting, or scrapers were less than satisfactory. The decontamination equipment was moved to Basin Number 1 (1988) and the results from wet sandblasting the concrete surfaces appeared acceptable. The removed material and sandblasting residue have been disposed of as dangerous waste (Section I.B-3b).

The overall decontamination of the 183-H Basins concrete surfaces typically has been initiated by washing down the upper structures, such as the handrails and, if necessary, using an aquablaster (high-pressure water spray); then handrails have been wiped dry after washing. If an aquablaster were used, the resulting contaminated rinsate drained down into the basins low point where it would be collected. The volume of rinsate liquid has been kept small and contained at the low point of the basins. The rinsate liquids have been solidified (as described in Section I.B-3b) and shipped to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility.

Rinsate loss through hairline cracks has not been observed; however, if encountered, larger cracks would have been sealed with grout prior to

decontamination if leakage were suspected. If necessary, removal of imbedded contamination by the crack cutter, which is a dry process, would have been performed before any decontamination processes that produced a rinsate. Cutter dust would have been vacuumed up as it was produced, and treated as if it were a sludge waste (see Section I.B-3b(2), "Solid Waste Treatment").

The upper basin structures were never exposed to dangerous wastes and should not have required cleaning; however, decontamination sampling will verify this fact by taking smears with gauze or sponge pads. The pads will be extracted with demineralized water and the extractant tested for dangerous waste residues as described in Section I.B-4c.

All equipment used for decontaminating the 183-H Basins has been used exclusively within the basin contamination zone. When all structural decontamination is complete and equipment use is no longer necessary, the equipment will be decontaminated prior to leaving the interior of the basins. All equipment cleaning and decontamination wastes will be collected and analyzed. If these wastes are found to be in excess of the levels described in Section I.B-4c, they will be considered as contaminants, containerized, and solidified prior to shipment to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility.

Decontamination procedures consist of washing the equipment surfaces, aquablasting or wet sandblasting as appropriate. Expendable equipment such as drills, chisels, bits, and for the front-end loader/tractor, the entire tracks will be packaged for disposal as contaminated materials. The liquid resulting from aquablasting continues to be collected and solidified for disposal as liquid waste. The wet sandblasting abrasive continues to be collected and packaged for disposal as solid dangerous waste. Any of these methods, or a combination of them, continue to be used to decontaminate the cleaning equipment.

The testing and analytical procedures used to determine if all contaminated residue has been removed are described in Section I.B-4c. Any equipment and/or structural components that cannot be decontaminated to the acceptable levels (final decontamination) will be demolished and the rubble disposed of as dangerous waste beneath a RCRA landfill cover. Ecology's concurrence will be required.

I.B-4b. Description of Removal of Dangerous Waste Residues and Contaminated Soils. Regulations (WAC 173-303-610) require a detailed description of the steps needed to remove or decontaminate to background levels (or appropriate alternative concentration limits) all of the dangerous waste residues and contaminated soils around and below the 183-H Basins. However, if Ecology agrees that this is not appropriate, the 183-H Basins are expected to be closed as a landfill in accordance with WAC 173-303-665 and -700. As such, removal of contaminated residues on or in the 183-H Basins will be conducted in accordance with appropriate techniques and cleanup standards. All of the contaminated soils may not be removed; however, some removal of highly contaminated pockets will be considered.

The extent and magnitude of contaminated soils beneath the 183-H Basins, where most of the contaminants are likely to reside, cannot be known until the underlying soils can be sampled and analyzed. Based on Ecology's tentative approvals, a phased soil sampling and analysis program is being conducted to assess the extent and nature of contamination. An exact quantification of the contaminated soil volume will not be necessary if the volumetric estimate is sufficiently large to demonstrate that the removal of these soils is impracticable (i.e., when landfill closure with 30 years of post-closure monitoring and maintenance meets the closure criteria and costs less). Results of the sampling program will provide a basis for determining if contamination in the soil column is sufficient to conclude that clean closure is impracticable.

Three criteria will be used to select the method of closure:

- Cost of removing the contaminated soil volume
- Cost of encapsulating the contaminated soil volume
- Cost of storing and disposing of contaminated soils in a 'permitted' treatment, storage, and/or disposal facility.

After the collective costs of clean closure are known with reasonable certainty and compared with costs associated with landfill closure, which include costs of the cover design and installation, and post-closure care; the DOE-RL will recommend an appropriate closure option to Ecology. While cost considerations are a reasonable factor for making decisions about closure options, effective environmental protection remains the primary objective. Section I.B-4c(2) describes how the soils will be sampled to determine the extent of contamination.

The methods to be used for removing the dangerous waste residues consist of those previously stated in Section I.B-4. Methods and location of the final disposal of the residues and/or contaminated soils will be the same as for the sludges and solidified liquid disposal (i.e., in the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility). Other dangerous waste residue considerations are as follows.

- Contaminated residues from decontaminating the concrete structures are estimated at about 500 cubic feet (based on 0.125-inch depth of removed surface area for all concrete surfaces exposed to liquid waste). This material will be packaged for disposal in the same manner as previously described.
- The time required to transport the dangerous wastes to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility will be within 90 days, as previously stated in Section I.B-3b.
- The distance to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility is about 17 miles.

I.B-4c. Methods for Sampling and Testing to Demonstrate Success of Decontamination. The WAC regulation [173-303-610(3)(a)] requires a detailed description of the steps required to perform decontamination as well as the steps required to evaluate the success of decontamination. Procedural steps for decontaminating facility structures and equipment have already been described (Sections I.B-4, I.B-4a, and I.B-4b). This section is divided into two subsections: I.B-4c(1), "Sampling to Assess Decontamination of Structural Components and Equipment", and I.B-4c(2) "Sampling to Assess Contamination in Soils."

I.B-4c(1). Sampling to Assess Decontamination of Structural Components and Equipment. The sampling program has been designed to evaluate the effectiveness of the facility decontamination activities. This will be accomplished for the nonconcrete structural components and equipment by taking swipe samples. Concrete coring and/or groovings (chip samples) will be used to provide samples for evaluating the concrete structural components, such as the basin floors and walls. The sampling results will be used to assess closure options as specified under Ecology regulations (WAC 173-303-610). According to these regulations, two closure options are available:

- Clean closure--Removal and disposal of above-background contamination (or above alternative concentration limits)

- Landfill closure--In-place disposal with long-term landfill monitoring.

The landfill closure option may be exercised only if clean closure can be demonstrated to be impractical. Landfill closure may still necessitate partial removal of contaminated materials, particularly if such materials meet designated extremely hazardous waste designation per WAC regulations.

The 183-H Basins have been included in the 100-HR-1 operable unit and, in accordance with the *Hanford Federal Facility Agreement and Consent Order*, are designated for RCRA Facility Investigation and Corrective Measures Study as a RCRA past practice unit.

Sampling Constituents and Action Levels--Table I.B-5 shows the constituents 'action levels' proposed for decontamination of structural components and equipment.

'Action levels' are defined as threshold concentrations derived from the numerical values of the mean background value and standard deviations for each constituent. The action levels for soil and concrete constituents that do not have suitable background concentrations are based on health-based limits and/or waste designation criteria. The methodology for obtaining the background samples is provided in Section I.B-4c(1), subpart "Concrete Background Samples", and Section I.B-4d, "Interpretations and Statistical Treatment of Data". These sections provide the methodology data analysis to derive the 'action levels'.

The constituents in Table I.B-5 were selected by comparing known chemical constituents of the 183-H Basins' wastes to regulatory lists showing

contaminants of concern. The lists reviewed were those in the *Primary Drinking Water Regulations*, 40 CFR 141 (EPA 1989d); the 'Toxic Pollutants' list shown in Section 307 of the *Clean Water Act of 1977*; the 'Discarded Chemical Products' list, WAC 173-303-9903; and the RCRA 'California List', Section 3004(d) of RCRA and 40 CFR 268.32. Table I.B-6 shows the methods to be used for sample analyses.

Table I.B-5. Decontamination Test Parameters and Cleanup Standards.

Constituent [a]	Action level[b]	Source
Arsenic	> background threshold	1
Barium	> background threshold	1
Beryllium	> background threshold	1
Cadmium	> background threshold	1
Copper	> background threshold	1
Chromium	> background threshold	1
Lead	> background threshold	1
Mercury	> background threshold	1
Nickel	> background threshold	1
Selenium	> background threshold	1
Silver	> background threshold	1
Vanadium	> background threshold	1
Zinc	> background threshold	1
Fluorine ion	> background threshold	1
Nitrate ion	> background threshold	1
Uranium (total)	> background threshold	1
Technetium-99	no applicable threshold	2

[a] 10% of the concrete samples will be tested for deletion of cyanide and formate anion.
[b] Section I.B-4d discusses action levels.
Source 1 - based on concrete background sampling results.
Source 2 - not naturally occurring.

In addition to vanadium pentoxide, two other constituents were added to the basins that were on the 'Discarded Chemical Products' list. These two materials (cyanides and formic acid) were not included on the list of decontamination parameters because they would not be above detection limits in either the concrete or soil based on the quantities known to have been added to Basin Number 1. Random testing for cyanide and formate anions will be performed on 10 percent of the concrete samples to verify that these constituents are not present in detectable concentrations.

Table I.B-6. Analytical Methods for Structural Component and Equipment Sample Analysis.

Parameter	Analytical method[a]
Arsenic	6010
Barium	6010
Beryllium	6010
Cadmium	6010
Copper	6010
Chromium	6010
Lead	6010
Mercury	7740/7421
Nickel	6010
Selenium	6010
Silver	6010
Vanadium	6010
Zinc	6010
Fluorine	ion chromatography
Nitrate	ion chromatography
Uranium	no standard EPA method available
Technetium-99	no standard EPA method available
Cyanide	9010
Formate	ion chromatography

[a] All numbered methods are per SW-846 except as noted.

Equipment and Nonconcrete Structural Sampling-- The 183-H Basins nonconcrete structural components are being cleaned by techniques such as aquablasting and wet sandblasting. Swab sampling will be performed on all equipment before it is removed from the 183-H Basins. The 183-H Basins structural components, other than concrete, will be swab sampled on a simple random basis to collect a minimum of five samples from a 10-foot grid pattern. Prior to swab sampling, freedom from particulate contamination will be verified by visual inspection and signed off by the job supervisor and/or the cognizant project engineer. Surface cleanliness will be confirmed by swiping with wet gauze or sponge pads and analyzing the swipes.

Because the major constituent of basin waste is sodium nitrate, a water-wetted swab over 1 square foot of surface will be extracted and the extract analyzed for nitrates. A second swab wetted with dilute nitric acid will be analyzed for metals and fluoride. Analysis will be according to the methods shown in Table I.B-6.

Quality Assurance and Quality Control--Quality control samples will be collected in accordance with SW-846 guidelines, where applicable. Nomenclature and definition of terms also are consistent with those identified in SW-846. Quality control samples will be duplicates, trip blanks, field blanks, and equipment blanks. At a minimum, one sample in 20 will be divided in the field, appropriately labeled, and treated as a blind duplicate. In the event that the sampling rate is less than 20 samples per week or 20 samples per sampling effort, at least one duplicate sample will be collected per week, or per sampling effort; whichever is greater. All samples will be submitted to the same analytical laboratory. Duplicates of both surface and subsurface samples will be handled in this manner.

At least one trip blank will be collected during each of the sampling efforts. Trip blanks will be brought to the field in sealed containers and transported to the laboratory with the field samples. Since the samples will not be laboratory tested for volatiles, only a limited number of trip blanks will be collected and laboratory grade silica sand will be used as the blank material.

At least one field blank will be transported from the field to the laboratory for each of the sampling efforts. Field blanks will be treated identical to trip blanks except that they are opened in the field for about the same duration as one sample collecting period, closed, properly labeled, resealed, and transported to the laboratory with the field samples. Since the samples will not be laboratory tested for volatiles, only a limited number of trip blanks will be used.

At least one equipment blank will be collected during each of the sampling efforts. Equipment blanks will be identical to trip blanks except that they will be opened in the field and poured over or through the sample collecting equipment before sampling.

The analytical laboratory will provide the specific tabulated information regarding accuracy, precision, and detection limits, or practical quantification limits for each analytical constituent for each of the analytical methods used. Information regarding the accuracy and precision would be data representative of their periodic assessment of the measurement quality indicators, i.e., representative values for the previous several weeks or months. Reported detection limits information will be the measured limits specific to the analytical method over that period in which the samples were analyzed.

183-H Basins' Concrete Structural Component Sampling--The 183-H Basins are four concrete-walled rectangular basins which held liquid wastes and sludges. The sampling, analysis, and characterization of the sludges in Basin Number 1 are described in Appendix B. The sampling, analysis, and characterization of wastes for Basin Numbers 2, 3, and 4 are described in Appendix H. The waste characteristics are summarized from the site characterization reports as follows:

Waste types	Basin Numbers 1	2	3	4
Discarded chemical product	EHW[a]	EHW	EHW	EHW
Dangerous waste mixture	EHW	EHW	EHW	EHW
Dangerous waste characteristics: Liquid (based on chromium)	Toxic WT01	Toxic WT01	Toxic WT01	Toxic WT01

[a]EHW = extremely hazardous waste.

The basin waste sludges and liquids have been removed, stabilized/solidified, and placed in drums for storage. Basin walls and floors are being decontaminated to remove residues. The sampling plan includes samples of the walls and floors to evaluate the effectiveness of decontamination and to document residual decontamination. Sampling of the basin walls and floors will be performed using the 'stratified random' sampling technique described in SW-846. The four identified strata are the sedimentation basin floors, the flocculation basin floors, the basin walls that have been exposed to liquid wastes, and the walls above the liquid wastes high-water mark. These strata were chosen on the basis of the relative exposure to liquids and sludges. Sedimentation basin floors have been exposed to sludge with the hydraulic pressure produced by the highest liquid waste levels above the sludge. Flocculation basin floors in some basins have either not been exposed to heavy sludge deposits or have been exposed to lower liquid waste hydraulic pressure. Basin walls below the 'high-water marks' have been exposed primarily to liquid wastes. Walls above the 'high-water marks' have not been extensively exposed to wastes but may be contaminated due to evaporation vapors.

In each of the four 183-H Basins, a total of 21 concrete samples will be taken as shown in Table I.B-7. Five of the sample locations in the basin floor have been randomly selected. The sixth is an authoritative (nonrandom) point located near each basin's low point. The four flocculation floor samples are all random. A second authoritative point will be field located on a fracture or crack in the floor or wall of each basin. A total of ten randomly selected sample locations have been identified for each of the four walls of each basin; five from the upper portion of the wall, above the high-liquid level, and five from below this mark. Duplicate samples and blanks will be taken as discussed earlier in the Quality Assurance and Quality Control section and shown in Table I.B-7.

Sample locations have been determined by the intersection of vertical and horizontal grid lines (2-foot spacing) for walls and by north-south and east-west grid lines (5-foot spacing) for floors. Random numbers were used to first select a basin wall and then to choose the numbered grid lines for the sample locations in each strata. Intersecting grid lines then uniquely determine the sample locations. The sample locations are shown in Figures I.B-11 through I.B-13.

Table I.B-7. Number of Concrete Samples, Duplicates, and Blanks for 183-H Basins.

	Concrete	Duplicate[a]	Blanks[a] Trip	Field	Equipment	Total
Background	8	1	1	1	1	12
Subtotal	8	1	1	1	1	12
Basin 1						
Sedimentation Floor	6					
Flocculation Floor	4					
Crack	1					
Upper Walls	5					
Lower Walls	5					
Subtotal	21	1	1	1	1	25
Basin 2						
Sedimentation Floor	6					
Flocculation Floor	4					
Crack	1					
Upper Walls	5					
Lower Walls	5					
Subtotal	21	1	1	1	1	25
Basin 3						
Sedimentation Floor	6					
Flocculation Floor	4					
Crack	1					
Upper Walls	5					
Lower Walls	5					
Subtotal	21	1	1	1	1	25
Basin 4						
Sedimentation Floor	6					
Flocculation Floor	4					
Crack	1					
Upper Walls	5					
Lower Walls	5					
Subtotal	21	1	1	1	1	25
Total	92	5	5	5	5	112

[a] SW 846 guidance for representative duplicates and blanks, which Ecology tentatively approved, is minimally 5 percent of total sampling or one set per week. The values shown in this table reflect the minimum number of duplicates and blanks to be taken. Additional duplicates and blanks may be taken at the discretion of the field team leader.

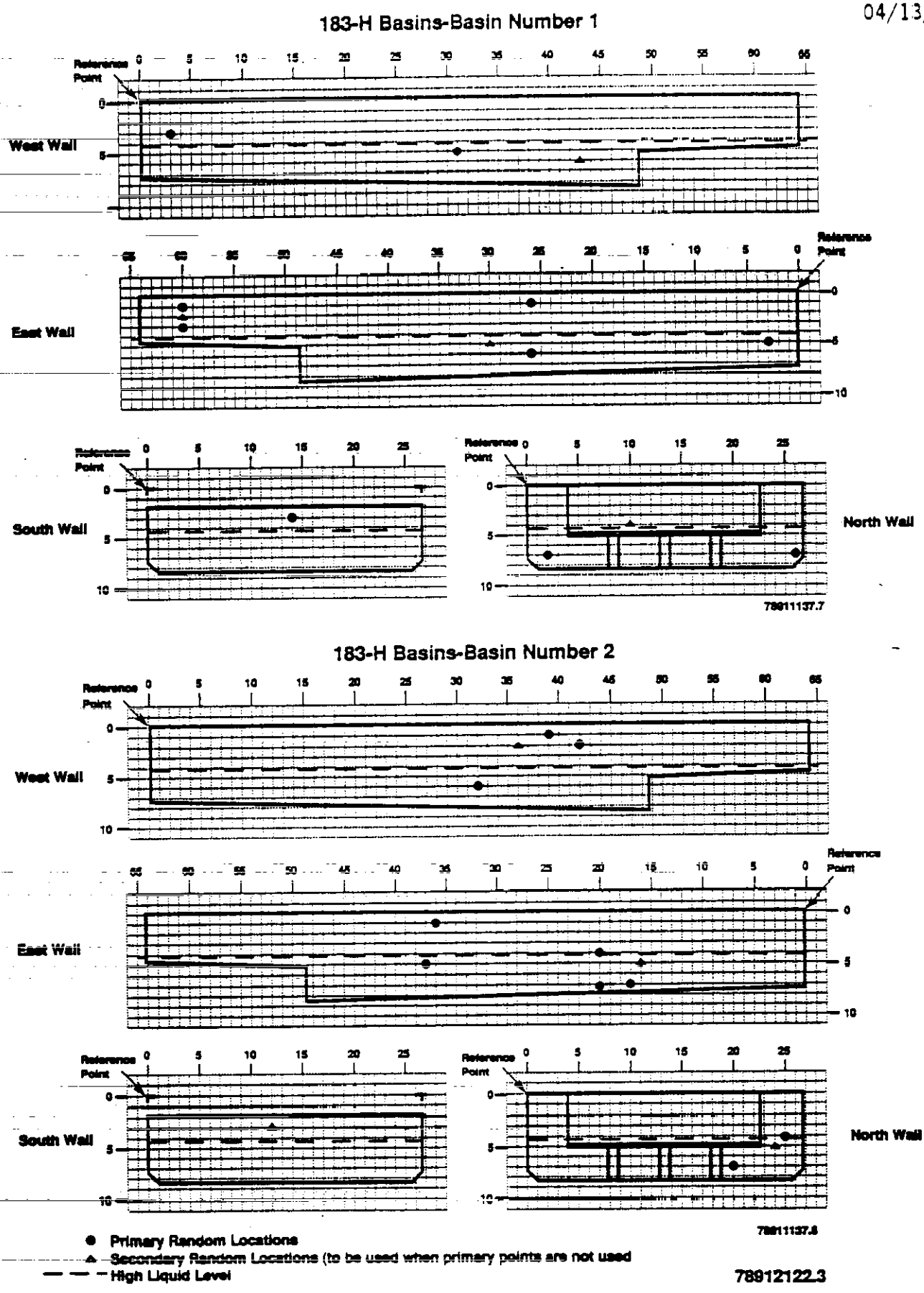

Figure I.B-11. Concrete Wall Sample Locations for Basin Numbers 1 and 2.

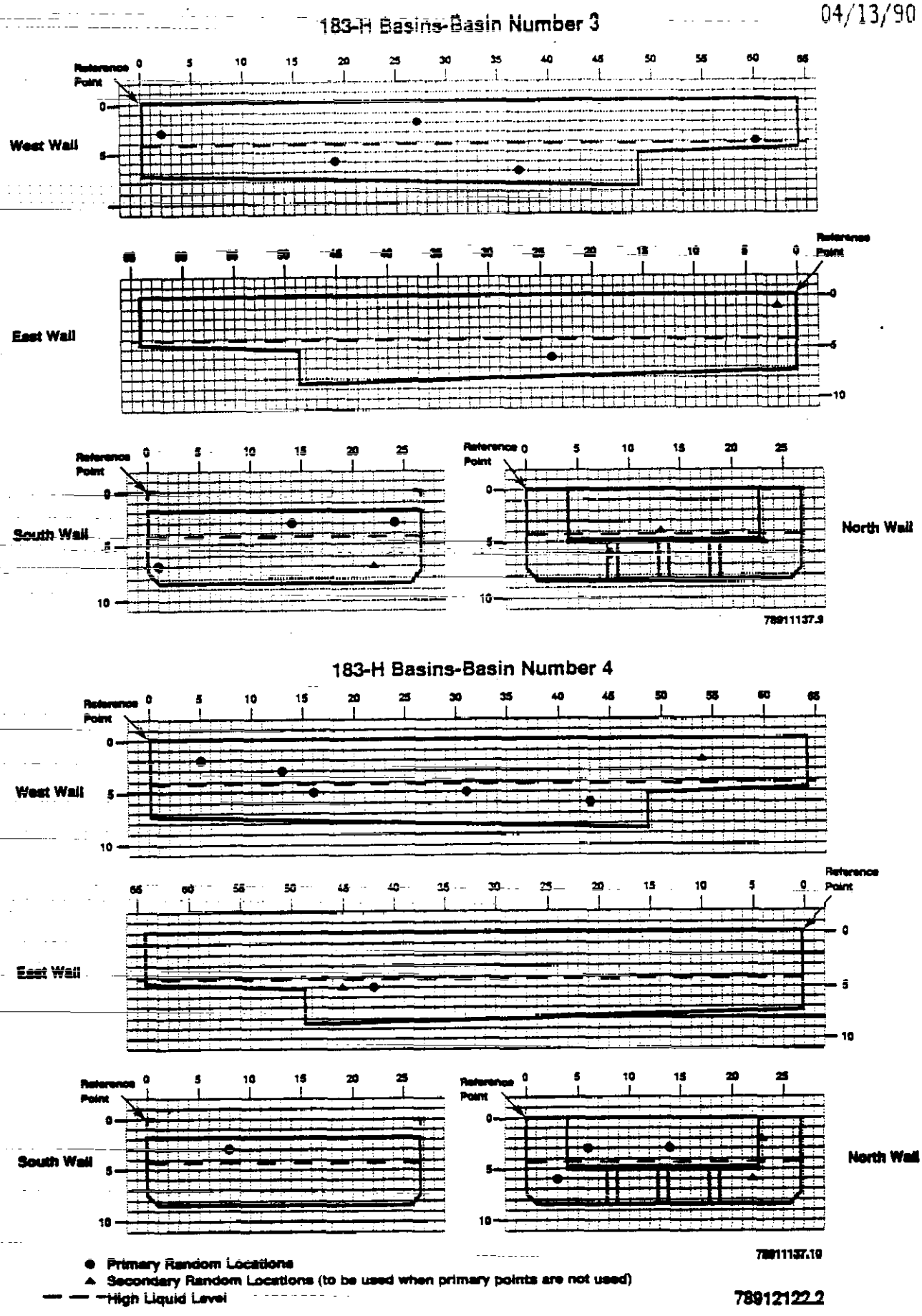

Figure I.B-12. Concrete Wall Sample Locations for Basin Numbers 3 and 4.

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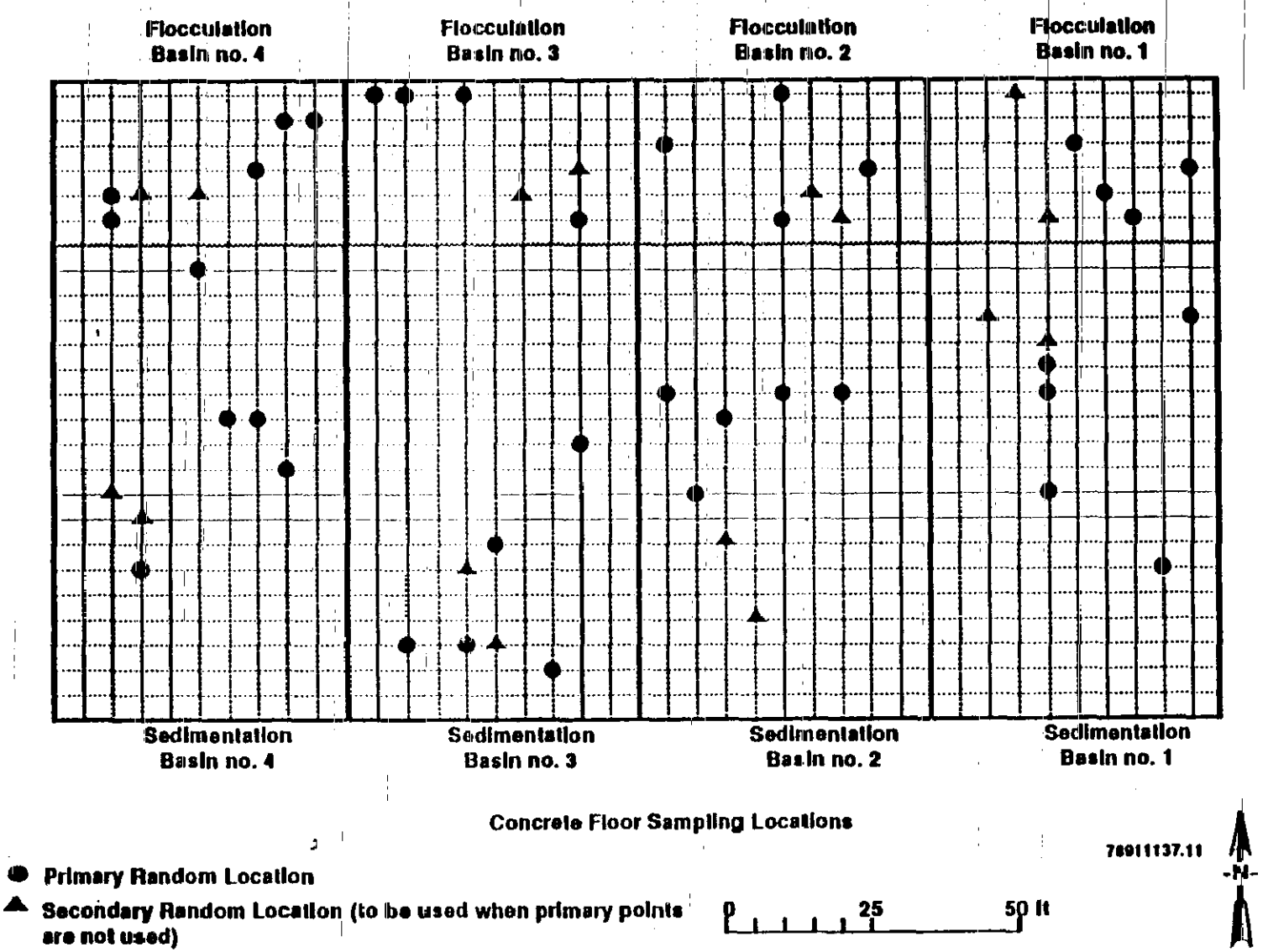

Figure I.B-13. Concrete Floor Sampling Locations for 183-H Basins.

Concrete Background Samples--Concrete background samples will be taken from the exposed south-facing exterior wall at the extreme south end of the basins. The randomly chosen sample locations are shown in Figure I.B-14.

Twelve background samples (including one duplicate sample and three blanks) will be taken. Blanks will be taken as described in the quality assurance section and as shown in Table I.B-7. Background sampling requirements are currently under review by Westinghouse Hanford and the DOE-RL, and a proposed Hanford Site policy for establishing the minimum number of samples is contemplated. For the 183-H Basins, the selection of the number of background samples has been based on standard engineering practices, EPA guidelines, and professional judgement.

The field location of the background sampling area was established by viewing the exterior southwest corner of the 183-H Basins, and it was noted that the southern exterior of Basin Number 4 has a prominent vertical line running the height of the wall from the imprint of the concrete forms. The area from which background samples will be collected, is a rectangle beginning at the top of the wall, extending down the vertical line for 10 feet, and transversing horizontally east for 150 feet; this yields a sample collection area that is 10 feet by 150 feet. Sample locations were selected at the intersection of horizontal and vertical grid line space at 5-foot and 2-foot intervals, respectively. Random numbers were used to select the specific intersections.

The exterior south wall of the 183-H Basins has been justified as the source of the concrete background samples because it is physically separated from the waste containment walls by the effluent flume and the overflow flume, and the concrete was poured at the same time as the basins. The effluent flume and the overflow flume never received basin wastes because the waste levels never reached the lip of the overflow flume, so the background sampling wall was never affected by liquid wastes migrating through the concrete walls. Additionally, it is the exterior side of the wall that will be used to establish background values, so liquid vapor contamination would have been unlikely.

Concrete Sampling Technique--The weight of concrete needed from each sample point is a minimum of 5 ounces. Removal of the concrete samples will be performed 'dry' to eliminate any pre-analysis leach or contamination effects by coring or cutting lubricants. Concrete samples may be collected by chipping or coring. For chipping, a concrete sample will be extracted from the surface by cutting a set of parallel grooves about 1.63 to 2 inches apart and 10.5 inches long in the surface. The grooves will be cut at least 2 inches deep and one groove will be angled at about 30 degrees toward the other to yield a narrow triangular sample segment between the bottoms of the grooves. Cross-grooves perpendicular to the ends of the sample grooves will permit the sample to be broken by prying out from the surface to yield a prism-shaped sample piece with an intact surface layer.

Commercial equipment for cutting grooves is available. The equipment operates dry by pneumatically driven impact bits. The bits are readily cleaned to eliminate cross-contamination between samples. Concrete core

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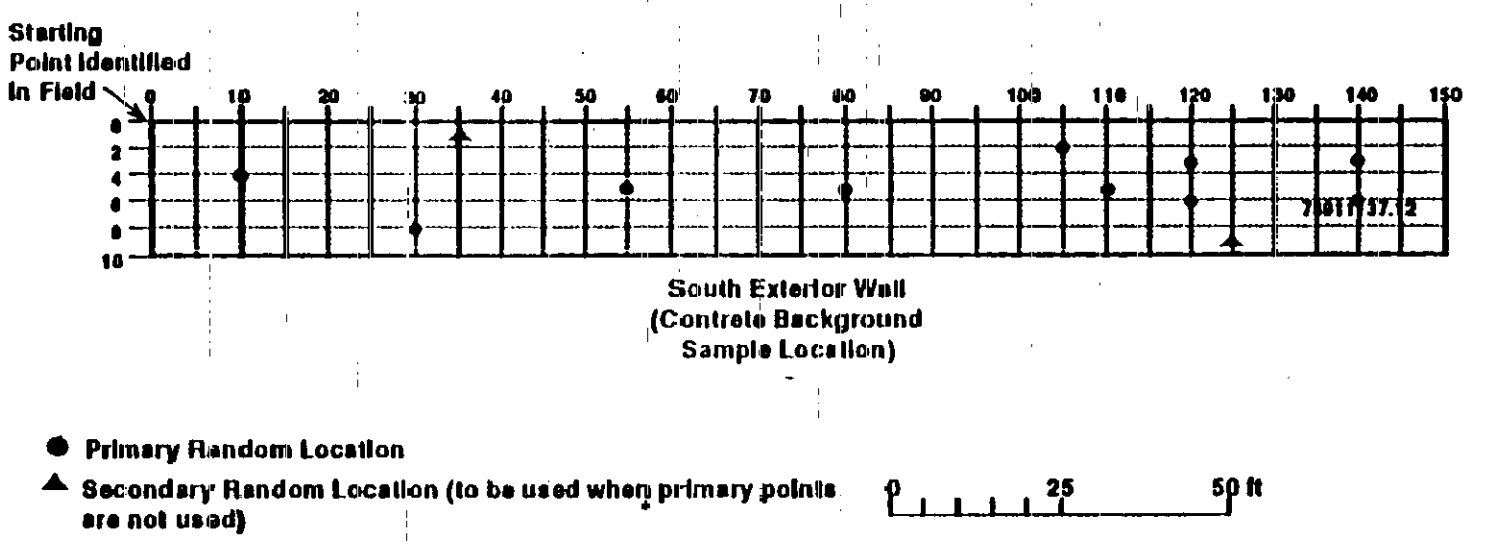

Figure 1.B-14. Concrete Background Sampling Locations.

drilled samples (1-inch to 3-inch diameter) may be taken from the floor or walls. Commercial coring equipment is readily available and can be cleaned to prevent cross contamination between samples.

I.B-4c(2). Sampling to Assess Contamination in Soils. The soil sampling program has been designed to assess the nature and extent of contamination within the vadose zone beneath and surrounding the 183-H Basins. This sampling will be performed to assess closure options as specified under Ecology regulations (WAC 173-303-610). According to these regulations, two closure options are available.

- Clean closure--Removal, as needed, of above action-level contamination.

- Landfill closure--In-place disposal, long-term landfill monitoring.

The landfill closure option would be exercised only if clean closure has been demonstrated to be impractical. Landfill closure may still necessitate partial removal of contaminated soils, particularly, if such soils are designated extremely hazardous wastes under WAC 173-303.

The 183-H Basins have been included in the 100-HR-1 operable unit. In accordance with the *Hanford Federal Facility Agreement and Consent Order*, the 100-HR-1 operable unit has been designated for RCRA facility investigation/corrective measures study. Soil sampling activities will be performed in accordance with Westinghouse Hanford Company's environmental procedures using the *Environmental Investigation and Site Characterization Manual*, WHC-CM-7-7 (WHC 1989).

Conceptual Model of Soil Contamination--The nature of potential soil contamination surrounding the 183-H Basins has been inferred from the operational history of the facility, chemical analyses of solid and liquid wastes contained within the 183-H Basins (Appendices B and H), and examination of groundwater monitoring data (Appendix K). These data indicate that inorganic constituents, including metals, common ions, and low levels of radionuclides, are the contaminants of interest.

In 1978, nitrate levels observed in a downgradient groundwater monitoring well suggested a leak from the 183-H Basins. Because it was the only basin in use at the time, the leak was thought to have been from Basin Number 1. Prior to their use as solar evaporation basins, Basin Numbers 2, 3, and 4 were preparatorily cleaned and a sprayed-on Hypalon internal basin liner was placed in each. Subsequently, the liquid from Basin Number 1 was transferred to the other basins (the sludge was removed in 1985) and further use of Basin Number 1 as a solar evaporator has not occurred. Continuation of groundwater monitoring has shown a general decrease in the concentration of indicator parameters.

Waste constituents within the 183-H Basins' liquids may have migrated into the soil through the concrete floors and walls of the basins. Prior to solar evaporation usage and because basin liners were not used, the concrete walls and floors may have become saturated during the approximate 12-year

period of water filtration operation, thus establishing migration pathways. Also, hairline cracks or other discontinuities in the concrete could have provided preferred pathways for migration of the liquid waste. The concrete and hairline cracks would have filtered the sludges and crystalline precipitates, restricting their migration into the underlying soils. The migration of liquid waste and subsequent distribution of potential soil contamination also would have been influenced by the presence of the layer of asphalt paper immediately beneath the concrete floors of the basins. The relatively impermeable asphalt paper layer would have tended to redistribute any migrating liquid, either toward breaks or seams within the layer, or toward the layer's perimeter (beneath the edges of the 183-H Basins). The present condition of the asphalt paper layer is not known, nor was it ascertained before solar evaporation usage in 1974.

No data have been obtained on the distribution of the waste constituents within the underlying soils. Because the concrete and underlying asphalt paper would have restricted the rate of liquid waste migration, it was likely that the underlying natural soils would have remained unsaturated. However, the soil layer immediately underlying the asphalt paper was constructed with compacted fine sand fill. Since the average pore size of the typical compacted fill was considerably smaller than that of the underlying native Pasco gravels, capillary potential would have been greater within the fill. Consequently, the retained moisture content of the fill layer would be greater, migrating fluids would have tended to be retained, and fluids would have spread laterally in this layer until the fill layer became saturated. Within the underlying coarse-grained Pasco gravels, migration would have been largely controlled by downward gravity instead of lateral capillary forces. Therefore, liquid migration in the Pasco gravels would be predominantly downward, and lateral spreading would be minimal. As a result, the downward migration of liquid wastes would be largely confined to the immediate zone beneath the 183-H Basins until reaching the water table.

The mobile waste (liquid) constituents from Basin Number 1 were inferred to have migrated to the water table, approximately 40 feet beneath the 183-H Basins. Comparison of the chemical analyses of the 183-H Basins' liquid waste (Tables I.A-16 and 17) with those from the groundwater from the neighboring monitoring wells, has indicated that many of the primary constituents of the liquid waste correlated with the downgradient samples.

List of Analytes--Primary potential soil contaminants were identified from tabulations of waste materials discharged to the 183-H Basins; from chemical analyses of the basin sludges, precipitates, and liquids; and from chemical analyses of samples from downgradient groundwater monitoring wells. The source information supporting this selection is presented in Sections I.A and III.A. The following potential contaminants, listed in Table I.B-5, have been selected to serve as sampling parameters for the nature and extent of contamination.

Metallic ions:	arsenic	copper	silver
	barium	lead	vanadium
	beryllium	mercury	zinc
	cadmium	nickel	
	chromium	selenium.	

Non-metallic ions:	fluoride	nitrate.

In addition to the metallic and non-metallic sampling parameters, consideration must be given to radioactive constituents. The concentrations of gross alpha and gross beta have been highest in the groundwater constituents immediately downgradient of the 183-H Basins. Uranium isotopes and technetium-99 concentrations have been measured in the solid and liquid portions of the 183-H Basins' waste, respectively. These have been categorized as low-level, nontransuranic radioactive waste. They also have been identified as groundwater contaminants associated with the 183-H Basins. Strontium-90 and cobalt-60 were also detected in groundwater downgradient of the 183-H Basins (both less than 1 part per million); but the concentrations were extremely low, and thus, were not selected as additional sampling parameters.

Based on this information and the information presented in Sections I.A and III.A, the following radionuclides have been selected as additional sampling parameters.

Radioactive ions:	uranium-total	gross alpha
	technetium-99	gross beta.

Based on the downgradient groundwater well reports, the following constituents have been selected as additional sampling parameters.

Groundwater ions:	manganese	sulfate	sodium.

Although some organic compounds were processed through the 183-H Basins (i.e., vaporized), their volumes were too small to be considered as soil sampling parameters. The field screening of the soil samples and concrete cores for volatile organics will provide a means of checking for the presence of such compounds.

A complete list of the sampling parameters for soil sample analysis is presented in Table I.B-8. A summary of all the soil samples, duplicates, and blanks is presented in Table I.B-9.

Phase I (Shallow) Soil Sampling

The soil sampling plan has been divided into two phases. Phase I evaluates the shallow soil immediately beneath the basins. Phase II looks at the deep vadose zone and delineates the 183-H Basins contaminant plumes. The results of the Phase I soil sampling will be used to guide the Phase II soil sampling locations. The Phase I soil sampling has been divided into three parts: background, internal basins, and perimeter soil sampling.

Table I.B-8. Analytical Methods for Soil Sampling Analysis.

Constituent	Analytical method	Action level	Source
Arsenic	SW-846, 6010	> background threshold	1
Barium	SW-846, 6010	> background threshold	1
Beryllium	SW-846, 6010	> background threshold	1
Cadmium	SW-846, 6010	> background threshold	1
Chromium	SW-846, 6010	> background threshold	1
Copper	SW-846, 6010	> background threshold	1
Lead	SW-846, 6010	> background threshold	1
Manganese	SW-846, 6010	> background threshold	1
Mercury	SW-846, 7471	> background threshold	1
Nickel	SW-846, 6010	> background threshold	1
Selenium	SW-846, 6010	> background threshold	1
Silver	SW-846, 6010	> background threshold	1
Sodium	SW-846, 6010	> background threshold	1
Vanadium	SW-846, 6010	> background threshold	1
Zinc	SW-846, 6010	> background threshold	1
Fluoride	Ion Chromatography	> background threshold	1
Nitrate	Ion Chromatography	> background threshold	1
Sulfate	Ion Chromatography	> background threshold	1
Uranium, total	EPA 600/4-80-032	> background threshold	1
Technetium-99	No EPA or SW 846 method	no applicable threshold	2
Gross alpha	No EPA or SW 846 method	no applicable threshold	2
Gross beta	No EPA or SW 846 method	no applicable threshold	2

Source 1 - Based on background soil sampling results.
Source 2 - Not naturally occurring.

The background soil sample location has been chosen to provide an uncontaminated database. The rest of the Phase I soil sampling has been designed to determine whether contaminants from the 183-H Basins have impacted the shallow soils beneath and immediately surrounding the basin walls and floors. The sampling also focuses on locations where migrating liquids may have been directed by the underlying asphalt paper layer, particularly surrounding the perimeter of the 183-H Basins. A total of 78 samples (including duplicates and blanks) will be taken for analysis during the Phase I sampling effort. All soil sampling operations and procedures will conform to Westinghouse Hanford Company's environmental procedures (WHC-CM-7-7) and will be documented in the field sampling records.

Background Soil Samples--Background soil samples will be collected for comparison with the Phase I and Phase II samples. Because of the wide range of activities conducted throughout the 100-H Area and the associated potential for soil contamination, background soil samples will be collected on unused lands west of the 100-H Area boundary (Figure I.B-15). The area selected for background soil sampling is similar in size to the expected maximum affected soils area of the 183-H Basins.

Table I.B-9. Number of Soil Samples, Duplicates, and Blanks for 183-H Basins.

			Blanks[a]			
	Soil	Duplicate[a]	Trip	Field	Equipment	Total
Phase I (shallow)						
Background	8	1	1	1	1	12
Subtotal	8	1	1	1	1	12
Basin 1[b]						
Sedimentation	6					
Flocculation	4					
Crack	1					
Subtotal	11	1	1	1	1	15
Basin 2						
Sedimentation	6					
Flocculation	4					
Crack	1					
Subtotal	11	1	1	1	1	15
Basin 3						
Sedimentation	6					
Flocculation	4					
Crack	1					
Subtotal	11	1	1	1	1	15
Basin 4[b]						
Sedimentation	6					
Flocculation	4					
Crack	1					
Subtotal	11					11
Basin Perimeter[c]	10					10
Total Phase I	62	4	4	4	4	78
Phase II (deep)						
Background[d]	9	1	1	1	1	13
Internal Basins	24	1	1	1	1	28
External Basins	31	1	1	1	1	35
Total Phase II	64	3	3	3	3	76
Total	126	7	7	7	7	154

[a] SW-846 guidance for representative duplicates and blanks, which Ecology tentatively has approved, is minimally 5 percent of total sampling or one set per week. This represents the minimum number of duplicates and blanks to be taken and, as warranted, the field sampling team may take more.

[b] Basin Numbers 1 and 4 will be sampled concurrently; therefore, sampling duplicates and blanks will be 5 percent.

[c] Basin perimeter sampling may be conducted concurrently with Phase II sampling; therefore, more sampling duplicates and blanks may be required.

[d] May not be necessary (Phase II-Deep Soil Background Samples).

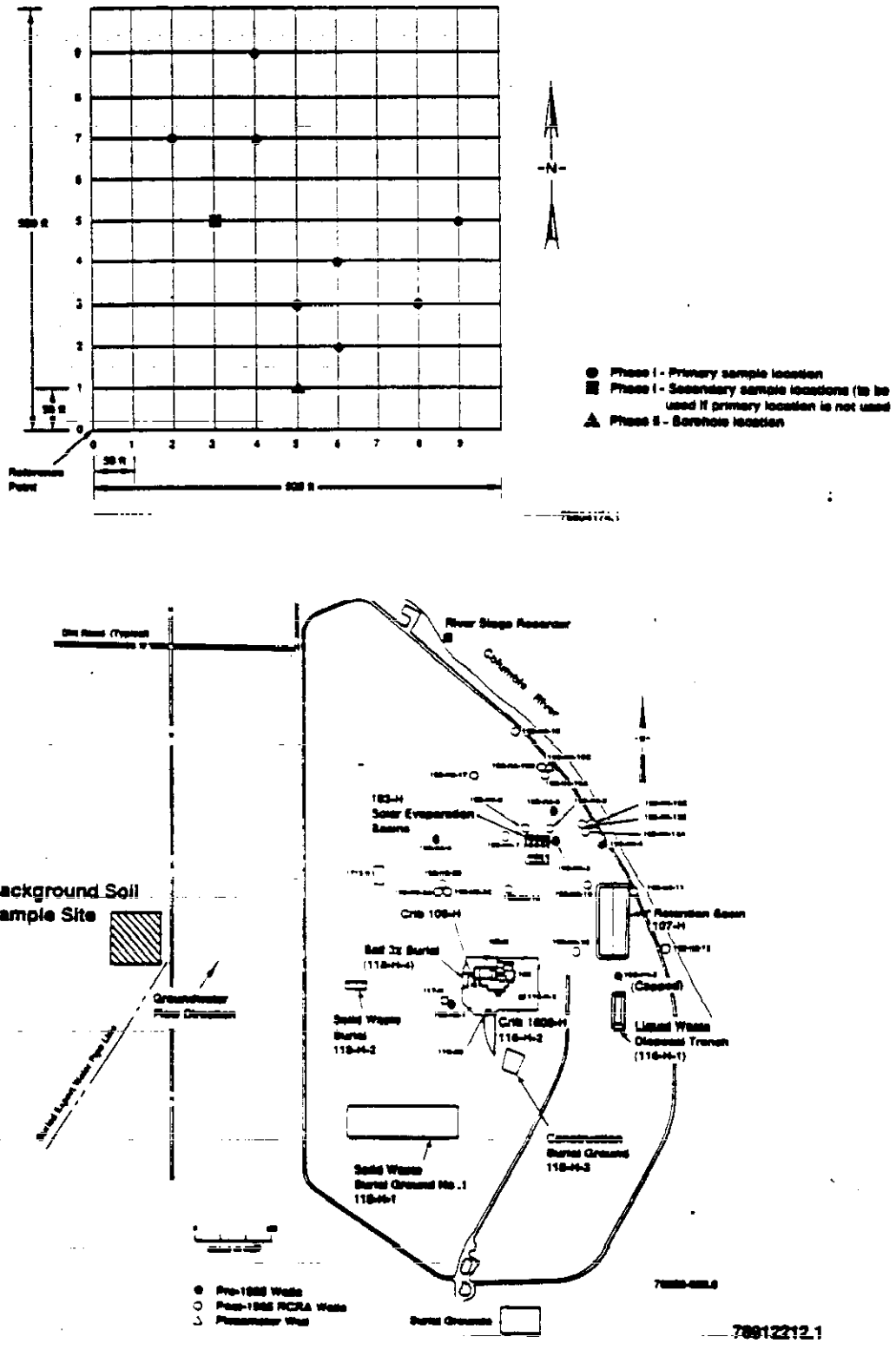

Figure I.B-15. Background Soil Sampling Area and Locations.

The background soil sample locations shown in Figure I.B-15 represent the randomly selected intersections for the background sample points. Background sample locations have been selected at the intersection of grid lines for a 50-foot spacing on the 500-feet by 500-feet sampling area. Secondary locations to be used if sampling at the primary locations are not technically or practicably feasible are also shown. If required, the sampling personnel will have the discretion to collect the samples within a radius of 1/2 grid space (25 feet) from the randomly selected sample points.

The 12 background samples (including duplicates and blanks) will be collected by backhoe or hand excavation from a depth of about 2 feet below the current ground surface. This depth minimizes the influences from the vegetative cover and/or potential airborne contamination. Grab samples of the undisturbed soil will be collected and processed in accordance with the Westinghouse Hanford environmental procedures (WHC-CM-7-7).

Quality control samples will be collected as prescribed by SW 846 guidance. At least one trip blank, field blank, and equipment blank will be collected during background sampling (Table I.B-9). At least one duplicate background sample will be collected for quality assurance purposes, using a random number generating process as for the other samples. Each background sample and blank will be analyzed for the parameters listed in Table I.B-8.

All background soil samples will be field-screened for volatile organic compounds and monitored with hand-held instruments for gamma radiation. These readings will be recorded in the field sampling record. The Hanford Site background soil sampling requirements presently are under review by Westinghouse Hanford and the DOE-RL, and a proposed Hanford Site policy for establishing the minimum required number of samples is anticipated. For the 183-H Basins, the selection of the number of background samples has been based upon standard engineering practice, EPA guidance, and professional judgment. For the 183-H Basins, a total of twelve background samples (including one duplicate and three blanks) will be collected.

Internal Basin Soil Samples--The objectives of the internal basin shallow soil sampling have been to determine whether contaminated liquids escaped the basins, and what distribution such contamination may have had in the immediately underlying soils. This information will be used in selecting the deep soil sampling locations for Phase II sampling.

Access to the underlying soils will be obtained by coring through the 183-H Basins' concrete floors; (Figure I.B-16). The core holes will be drilled to the diameter of 2 to 4 inches using standard concrete coring equipment. From the concrete core hole accesses, grab samples of the underlying soils will be collected with clean, stainless steel sampling tools, and transferred to a clean, stainless steel mixing bowl. When a sufficient amount of sample has been obtained for all of the required analyses, the sample will be thoroughly mixed, placed in appropriate sample containers along with any required sample preservatives, and stored appropriately until sent to the analyzing laboratory under chain of custody procedures. Sampling equipment will be decontaminated between samples and after sample collection. All of the sampling will be performed in accordance with Westinghouse Hanford

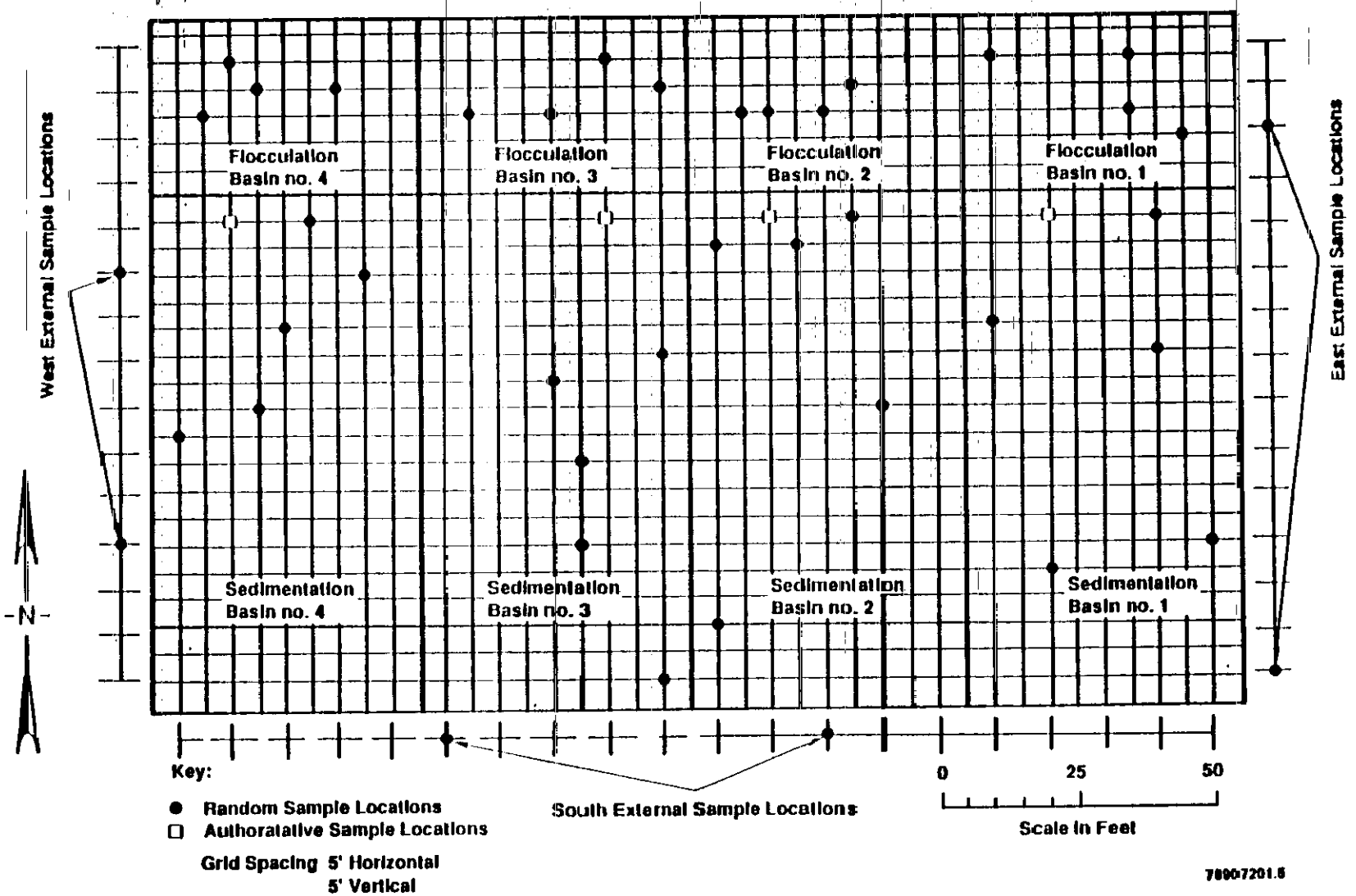

Figure I.B-16. Phase I Soil Sampling Locations (78907201.5).

Company's environmental procedures (WHC-CM-7-7). All the samples and blanks will be analyzed for the parameters listed in Table I.B-8. All soil samples and concrete cores will be field-screened for volatile organic compounds and monitored with hand-held instruments for gamma radiation. These readings will be recorded in the field sampling records. Then the core holes in the 183-H Basins' floors will be backfilled with concrete to prevent infiltration of precipitation.

Because specific points of leakage associated with the high-nitrate levels in 1978 could not be identified, a random sampling scheme has been prepared. Five random sampling points have been selected within the floor of each sedimentation basin (total of 20 sample points). Four random sampling points have been selected within the floor of each flocculation basin (total of 16 sample points). One authoritative (nonrandom) sampling point will be field located near each basins' low point in each of the sedimentation basins (total of four sample points). A second authoritative (nonrandom) sampling point will be field located on a fracture (crack) in the concrete floor of each of the four basins (total of four sample points). Thus, a total of 44 samples will be taken through the floors of the 183-H Basins.

The randomly selected floor sampling points were derived from the 5-feet by 5-feet grid, as shown in Figure I.B-16. The samples will be taken at the intersections of randomly selected grid lines. Two-digit random numbers, produced by a random number generator, were used to select the sample locations. If required, the sampling personnel will have the discretion to collect the samples within a radius of 1/2 grid space (2.5 feet) from the randomly selected sample points.

At each sample point, the concrete floor of the basin will be vertically cored and soil samples will be taken immediately beneath the asphalt paper liner. One soil sample will be collected at each location for analysis. One additional soil samples will be collected for duplicate analysis, from either a sedimentation basin floor location, or from a flocculation basin floor location. The duplicate sample location will be randomly selected at the time of sampling. The duplicate sample will be a field grab sample from the randomly selected location. Quality control samples will be taken as prescribed by SW 846. At least one trip blank, field blank, and equipment blank will be collected during the internal basin sampling (Table I.B-9).

<u>183-H Basin's Perimeter Soil Samples</u>--The objective of the perimeter basin soil sampling will be to determine where contaminants have migrated from the 183-H Basin into the surrounding soil.

Soil samples will be collected adjacent to the exterior surface of the basin walls at six randomly selected locations, two along each of the east, south, and west sides of the 183-H Basins. The linear sampling grids and the randomly selected sampling locations are shown in Figure I.B-16. These sample points were selected by the random selection process. If required, the sampling personnel have the discretion to collect the samples within 1/2 grid space (5 feet) from the randomly selected sample points.

The north, east, west, and part of the south sides of the 183-H Basins have soil bermed against the outside of the basin walls (see Figure I.B-4). The berm on the north side of the basins is more extensive and will be sampled during Phase II with a drill rig. At each sampling location on the east and west sides, two soil samples will be collected. The first will be collected at the interface between the base of the concrete wall and the asphalt paper layer. At each location, a second sample will be collected of the berm soil adjacent to the outer surface of the wall, at a height of 3 feet above the base of the wall. At each sampling location on the south side of the 183-H Basins (where there isn't a berm), one soil sample will be collected 6 inches beneath the base of the basin overflow structure.

The 183-H Basins' perimeter soil samples will be obtained, screened, and stored in the same manner as described for the internal basin samples. All of the samples and blanks will be analyzed for the parameters listed in Table I.B-8. All soil samples will be field-screened for volatile organic compounds and monitored with hand-held instruments for gamma radiation. The readings will be recorded in the field sampling (logbook) record.

Access to the sample locations will be provided, where feasible, by coring through the concrete walls or by external backhoe excavation. Due to the possibility of old foundation or basin floor structures being present on the west and south sides of the basins, additional concrete coring may be required to provide access to the underlying soil. If required, this will be done in the same way as the basin floor coring. The soil excavations will be backfilled with the excavated material to preclude preferential pathways for natural precipitation infiltration.

Quality Assurance and Quality Control--Quality control soil samples will be collected in accordance with SW-846 guidelines, where applicable. Nomenclature and definition of terms also will be consistent with those identified in SW-846. Quality control samples will be duplicates, field blanks, equipment blanks, and trip blanks. At a minimum, one sample in 20 (5 percent) will be divided in the field, appropriately labeled, and treated as a duplicate. In the event that the sampling rate is less than 20 samples per week or 20 samples per sampling effort; at least one duplicate sample will be collected per week, or per sampling effort; whichever is greater. All samples will be submitted to the same analytical laboratory. Duplicates for both shallow and deep soil samples will be handled in this manner.

At least one trip blank will be collected during each of the sampling efforts. Trip blanks (analyte free water) will be brought to the field in sealed containers and transported to the laboratory with the other samples. Since the samples will not be laboratory tested for volatiles, only the trip blanks will be collected and analyzed to identify transportation and laboratory induced contamination. A certified composition silica sand may be used as the blank material.

At least one field blank (analyte free water) will be transported from the field to the laboratory during each of the sampling efforts. Field blanks will be treated identically to trip blanks, except that they are opened in the

field for about the same duration as a typical sample collection, closed, properly labeled, resealed, and transported to the laboratory with the other samples. Since the samples will not be laboratory tested for volatiles, only the field blanks will be used to identify the background field (site) induced contamination.

At least one equipment blank will be collected during each of the sampling efforts. Equipment blanks will be processed identically to trip blanks except that they will be opened in the field and poured over, or through, the sample collecting equipment before sampling to identify the effectiveness of the field sampling decontamination.

The laboratory will ensure the integrity and validity of test results through implementation of an internal quality control program. The program will meet the quality control criteria of EPA guidelines and, as applicable, SW-846, and *The Handbook for Analytical QC in Water and Waste Water Laboratories*, third edition of EPA-600/4-79-019 (EPA 1979a). A system of reviewing and analyzing the results of these samples will be maintained to detect problems due to contamination, inadequate calibrations, calculations, procedures, or other causes. Standard methods will be used and alternative methods that are developed or adapted will be tested and completely documented. All methods and method changes will be approved by the Westinghouse Hanford Company contracts representative.

The quality control procedures for laboratory analyses will include evaluation of blanks, matrix spikes, surrogates, and other quality control samples as appropriate for determination of the quality assurance/quality control (QA/QC) for each matrix and analytical method. Quality control procedures for individual methods will be documented in the laboratory's analytical procedures.

All analytical methods will be in compliance with minimum quality control criteria of standard EPA methods, where such criteria exist (EPA 1986a). The analytical laboratory will have obtained the Westinghouse Hanford Company approval on all methods prior to the analysis of samples.

THE EPA guidelines for the determination and reporting of accuracy, precision, and detection limits of the analytical methods will be met. The analytical laboratory will provide tabulated information representative of accuracy, precision, and detection limits for at least the three month period over which the analyses were performed. Laboratory quality assurance/quality control information will be required on representative constituents for each of the analytical methods used, e.g., those evaluated for the EPA contract laboratory program (CLP), for both soil and groundwater matrices. Accuracy and precision will be determined for, and representative of, the mid-range of the standard working range used for the analysis. Information on accuracy and precision can be determined from the matrix spike and/or surrogate spike recoveries of standard reference samples or EPA control samples, if appropriate. Accuracy and precision will be reported in a manner similar to that indicated in SW-846 (6010-16). The upper and lower limits of the standard working range used for the analysis will be reported in a form comparable to Form XIII (SW-846; ONE-32).

Representative lower limits of detection will not exceed the EPA requirements for detection limits. Detection limits will be reported as one of the following: (1) the lower limit of the standard (linear) working range used for the analysis, (2) the low concentration standard used in the calibration provided that this concentration does not exceed EPA requirements, or (3) the detection limits and/or quantitation limits for each analyte calculated from measured standard deviation of the average background noise level using the criteria outlined in SW-846 (ONE-15; THREE-2), for either the interpolated background beneath analyte peaks in the low-concentration calibration standards, or at the peak spectral positions in a reagent blank. The analytical laboratory will specify the definition of lower limit of detection used. Detection limits will be regarded as the lower limits of reportable concentrations of an analyte. Concentrations less than these limits will be reported as less than detection limits (e.g., <1.0 mg/kg). Representative precision at the detection limits also will be determined and reported in a similar manner as the precision for the mid-range. Precision at the lower limit of detection, as defined above, will be determined from the replicate analyte peak measurements for the low-concentration calibration standards or for the samples used in establishing the lower limit of detection. Representative detection limits and associated precision on the lower limit of detection and precision at this limit, will be reported for each analyte in a form comparable to FORM VIII (SW-846; ONE-25).

A laboratory duplicate and a blank sample will be processed with each sample batch or after every 20 samples, whichever is more frequent. Quality control samples prepared in the same matrix and in the same manner as a mixed calibration standards, at 10 times the instrument detection limits or in the mid-range of the working standard calibration, will be analyzed after every 10 samples (e.g., SW-846, 6010-9,10; 7000-10). Spike recovery will be calculated by the method detailed in ASTM Method D 3856, Section 11.5.4, Annual Book of ASTM Standards, Volume 11.01 (1986). Analytical data on blanks, duplicates, and control samples will be reported in the same manner as samples. Care will be taken to ensure that duplicate samples are representative of the original sample.

Phase II (Deep) Soil Sampling

The 183-H Basins' Phase II soil sampling has been designed to determine the extent and distribution of contamination in the deeper vadose zone soils beneath and surrounding the 183-H Basins; Figure I.B-17. Cable-tool drilling methods will be used to gain access to sample locations. Each boring location will be considered to constitute one sampling site. All soil sampling operations will conform to Westinghouse Hanford environmental procedures (WHC-CM-7-7) and will be documented in the field sampling logbooks. The proposed 9 sampling locations and 76 samples (Table I.B-9) will be reassessed following the Phase I investigation. If the Phase I investigation demonstrates that shallow contamination is more concentrated in certain areas, then the Phase II borings will be relocated to provide additional data within those areas. Ecology's concurrence will be obtained prior to initiating Phase II soil sampling.

Deep Soil Background Samples--A review of historical site lithologic records will be made to determine if enough 'deeper' background chemical and radionuclide data are available to collaborate the (Phase I, shallow) background results. If insufficient data exist, the deep vertical boring will be field located and drilled. The single background boring location has been randomly selected following the same simple random selection procedures as used for the Phase I background sampling (see Figure I.B-16). The background boring will be drilled to the groundwater table (approximately 40 feet). Drilling to the groundwater table should not increase the potential for groundwater contamination since the boring is in an uncontaminated (background) area. Immediately after sampling, the background boring will be properly backfilled/abandoned to preclude preferential precipitation infiltration.

Soil samples will be collected at a depth of 2 feet and at 5-feet intervals (5 feet, 10 feet, 15 feet, etc.). A total of 13 background samples (including one duplicate and three blanks) will be collected. The Hanford Site background soil sampling requirements presently are under review by Westinghouse Hanford and the DOE-RL, and a proposed Hanford Site policy for establishing the minimum required number of samples is contemplated. For the 183-H Basins, the selection of the number of background samples has been based upon standard engineering practices, EPA guidance, and professional judgement.

183-H Basins' Internal and External, Deep Soil Samples--A total of eight vertical borings will be drilled in and surrounding the 183-H Basins. The preliminary boring locations are presented in Figure I.B-17. Four borings will be drilled from inside the basins to provide information on deep vadose zone contamination directly beneath the basins. The borings have been located to provide essentially uniform coverage of the underlying vadose zone. The four remaining borings have been placed around the perimeter of the 183-H Basins to provide information on the extent of contamination both laterally and vertically beneath the 183-H Basins. The boring along the north side of Basin Number 1 (BH-5) has been located within the area originally used for tank truck transfer of wastes to examine the potential for accidental spills during waste transfers.

Except for BH-5, the borings will be terminated about 10 feet above the existing water table to minimize the potential for groundwater pollution. Because the planned location of boring BH-5 is on the north berm, downgradient of the 183-H Basins; and upgradient of the point-of-compliance, Well 199-H4-3; it will be drilled to a depth of 50 feet to ascertain if the contamination extends to the groundwater. The other three external basins' boreholes will be drilled to a depth of about 30 feet and the four internal basins' boreholes will be drilled to a depth of about 25 feet (about 10 feet above the water table). For Phase II sampling, a standard cable-tool drop hammer and sampling tube will be used (WHC-CM-7-7). The cuttings will be removed with a bailer. Immediately after obtaining each boring's samples, the boring will be backfilled by simultaneously withdrawing the casings and backfilling by tremie pipe with bentonite and additional stemming (i.e., cuttings). Additionally, the 183-H Basins' floors will be concrete plugged to preclude precipitation infiltration and/or contaminant migration.

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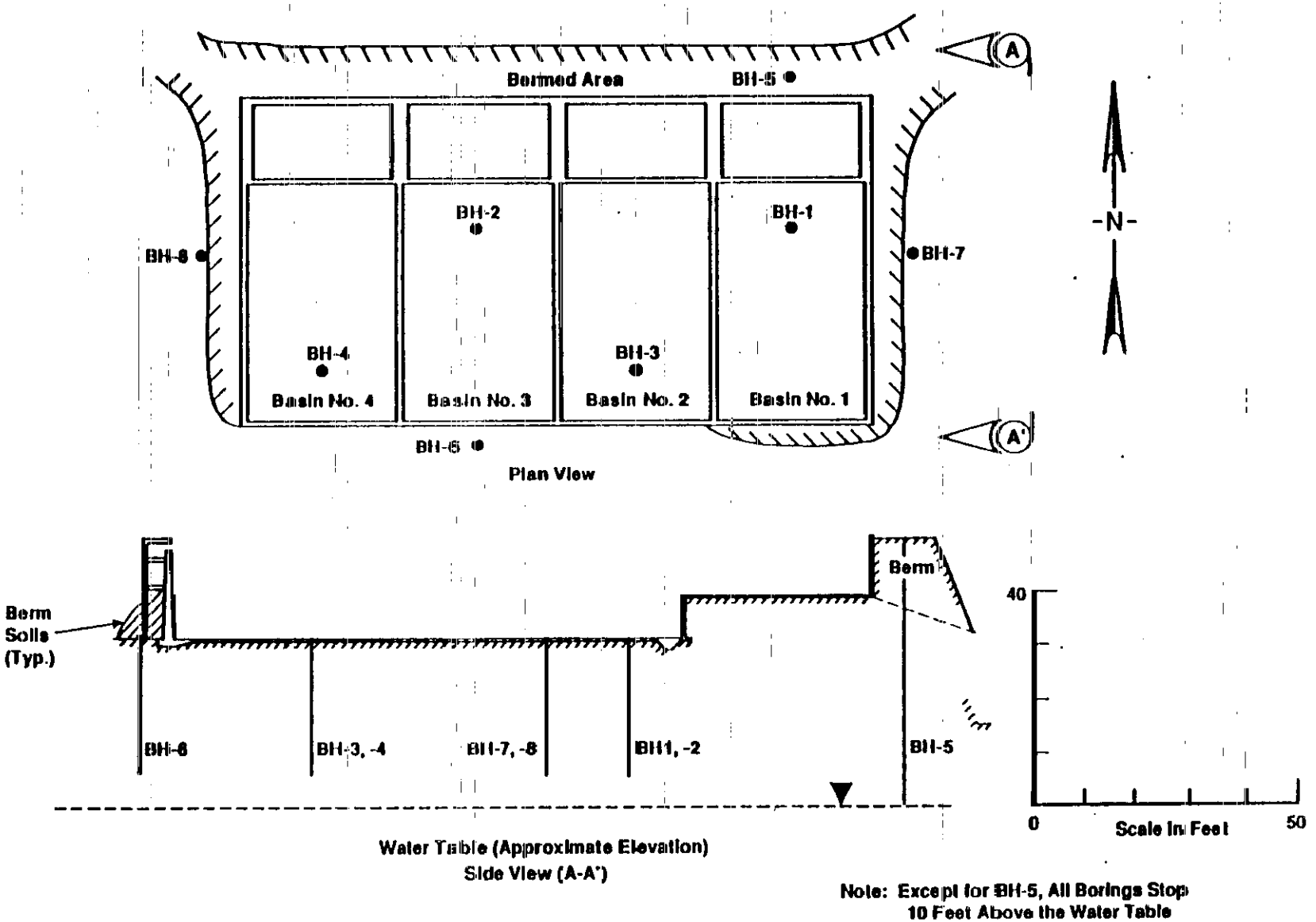

Figure I.B-17. Phase II Soil Sampling Locations.

During the hole starting process, a near-surface soil sample will be collected at a depth of about 2 feet at each boring location (total of eight samples). These samples will be collected following the same procedures used in the Phase I sampling. Then soil samples will be collected at 5-foot intervals within each borehole using an 'advance hole' 2- to 6-inch clean-drive sampler equipped with bore catcher. The drive sampler will be sturdy enough to handle the hard ground conditions anticipated and allow driving with the casings hammer. All cuttings will be cleared from the hole prior to drive sampling. Drive samples of the underlying soils will be transferred to a clean stainless steel mixing bowl. If an insufficient amount of sample is obtained, a second drive sample will be attempted. When a sufficient amount of sample has been obtained for all of the required analyses, the sample will be thoroughly mixed, placed in appropriate sample containers along with any required sample preservatives, and stored appropriately until sent to the analyzing laboratory under chain of custody procedures (WHC-CM-7-7).

At least two deep soil samples will be collected in duplicate from sample locations selected randomly at the time of sampling. In addition, at least two field blanks, trip blanks, and equipment blanks, will be collected (Table I.B-9). All of the samples, including the duplicate and blank samples, will be analyzed for the parameters listed in Table I.B-8. All soil samples will be field-screened for volatile organic compounds and monitored with hand-held instruments for gamma radiation. All readings will be recorded in the field sampling record. Any water added to a borehole (e.g., to maintain hole stability) will be analyzed for the constituents listed in Table I.B-8. The sample parameter list (Table I.B-8) may be altered based on the Phase I sampling results. A total of 76 soil samples will be collected for analysis from the Phase II sampling. This total includes the duplicate samples, blank samples, and the two extra samples for borehole BH-5 because it goes deeper.

Quality Assurance and Quality Control--Phase II quality control samples will be collected as previously described in Phase I, Quality Assurance and Quality Control. At least three trip blanks, field blanks, and equipment blanks will be collected during the Phase II sampling efforts (Table I.B-9). All of the samples and blanks will be analyzed for the parameters listed in Table I.B-8. All soil samples will be field-screened for volatile organic compounds and monitored with hand-held instruments for gamma radiation. These readings will be recorded in the field sampling record.

I.B-4d. Interpretations and Statistical Treatment of Data. All data collected will be analyzed and tabulated for evaluation using the methods described in SW-846 and other guidance documents and statistical references, where applicable (e.g., Barth and Mason 1984; EPA 1986a). Laboratory data will be provided to Ecology upon completion of sampling and analysis. Data for individual constituents will be summarized and will include the following information:

- Number of 'less than' (<) detection limit values
- Detection limit value
- Total number of values
- Mean values
- Standard deviation

- Coefficient of variation
- Minimum value
- Maximum value
- Representative uncertainties (precision).

The compositions of the concrete and soil samples will be used to establish threshold concentrations for soil constituents. These 'action level' values will be based on the mean background value and standard deviations for each constituent. Concentrations based on health based limits and/or waste designation criteria (e.g., WAC 173-303-9906 and 9907) will serve as the action levels for soil and concrete constituents that do not have detectable background concentrations (e.g., technetium).

Figure I.B-18 illustrates a decision tree for closure based upon the concrete and soil sampling results. Background threshold concentrations and significance levels will be based on information including mean concentrations and variance for each constituent. Specific approaches, and the criteria and assumptions implicit in establishing concentration levels that constitute significant deviation from background or other control levels, will be related to Ecology when the issue has been resolved by Westinghouse Hanford and the DOE-RL staff.

Once the sampling results have been deemed to be statistically adequate and their pedigree and documentation is acceptable, the data will be used to construct contaminant contour maps and cross sections. The maps and cross sections will then be used to calculate contaminant volumes and contaminant concentrations, which in turn will be used for decisions about possible removal of contamination and other closure options.

Factors that could affect the construction of the contaminant plume maps and cross sections are:

- Background sampling values for each medium
- Regional groundwater flow direction and flow rate
- Surface waters proximity, direction, and flow rate
- Influence of other hydrologic heads and flow rates
- Closure area specific geological information; e.g., cross-bedded soils or clay lenses
- Geochemical characteristics of the individual contaminants
- Transportational and depositional characteristics for each contaminant for each medium (i.e., soils, surface waters, and groundwater.

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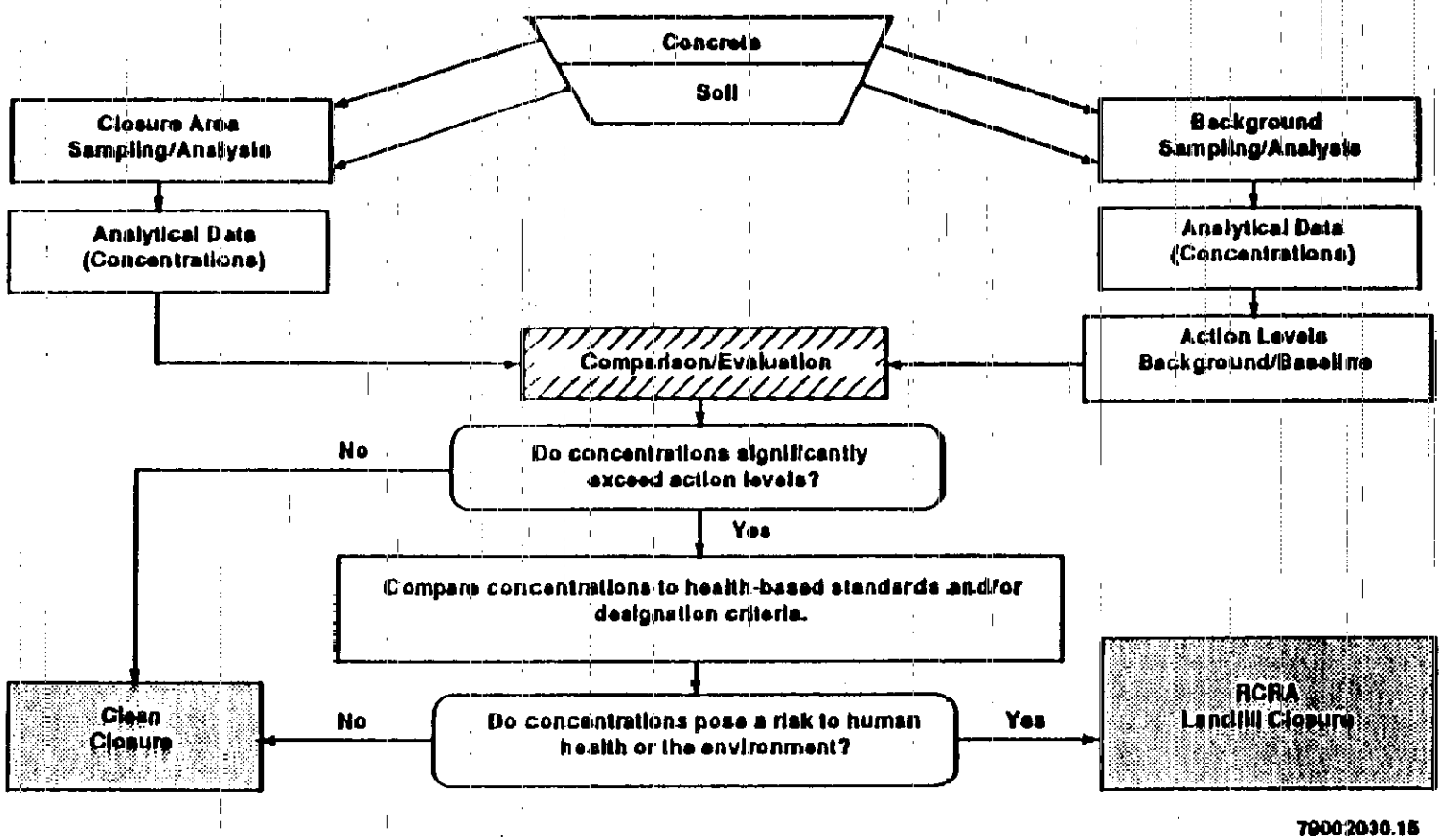

Figure I.B-18. Decision Tree for Closure based upon Soil/Concrete Sampling Results.

I.B-5. Closure with Contaminated Soils Remaining in Place

The 183-H Basins will be closed in conformance with WAC 173-303 regulations. The closure and post-closure care, which will occur when some contaminated soils remaining in place, will also comply with federal landfill regulations per 40 CFR 264 Subpart G (EPA 1989). Contaminated residues on or in the basin structures will be removed according to appropriate techniques and cleanup standards. The full removal of contaminated soils may not be practical whenever the RCRA landfill closure costs are less than the clean closure costs.

The extent and magnitude of contaminated soils beneath the 183-H Basins cannot be precisely known until the underlying soils are sampled and analyzed. A soil sampling and analysis program is being conducted to define the extent and magnitude of contamination. Results of this sampling program will provide a basis for determining the extent of contamination in the soil column and when soil removal becomes impractical. If contamination is to remain in place, the 183-H Basins will be closed with a final RCRA landfill cover. Chapter II of this document addresses landfill closure cover design and Chapter III discusses groundwater monitoring. The following tabulation is a reference as to where each landfill closure and post-closure monitoring criterion can be found.

- Provide long-term minimization of migration of liquids through the closed landfill, Section II.B-2a.

- Function with minimum maintenance, Section II.B-2b.

- Promote drainage and minimize erosion or abrasion of the cover, Section II.B-2c.

- Accommodate settling and sedimentation so that the cover's integrity is maintained, Section II.B-2d.

- Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, Section II.B-2e.

Detailed descriptions of the other closure activities necessary to ensure that the 183-H Basins will satisfy the closure performance standards are discussed and/or referenced below:

- Groundwater Monitoring, Section III.A-2

- Leachate Collection System. No leachate collection system is being designed, nor exists, for the 183-H Basins. The basins are being closed pursuant to the requirements of WAC 173-303

- Run-Off and Run-On Control
  - Erosion and Abrasion, Section II.B-2c
  - Inspection Plan, Section III.A-1
  - Maintenance Plan, Section III.A-3.

I.B-6. Spills and Discharges to the Environment

This section sets forth the requirements for any person responsible for a spill or discharge to the environment as a result of closure activities at the 183-H Basins. This section applies when dangerous wastes or dangerous substances are intentionally or accidentally spilled into the environment such that public health or the environment is threatened.

This section explains the five steps that will be implemented if a spill or discharge occurs.

I.B-6a. Notification. Three types of notifications are described in this section: (1) emergency signals, (2) notification of emergency response organizations, and (3) notification of authorities.

I.B-6a(1) Emergency Signals. Several communication systems exist on the Hanford Site to notify personnel of emergency incidents and to disseminate information about events affecting Hanford Site activities. Three of these systems are as follows:

- Priority message system (management bulletin)--a network of telefax machines used to transmit important messages rapidly across the Hanford Site

- The DOE-RL radio system--links the Hanford Patrol, Hanford Fire Department, safety, and engineering representatives at a network of base stations, mobile units, and portable radios

- Hanford Site emergency signals--emergency signals used to alert personnel in an emergency event are listed in Table I.B-10.

I.B-6a(2) Notification of Emergency Response Organizations. The building emergency director will be responsible for initially assessing any facility emergency situation. Notification of the Hanford Site emergency response organizations will be carried out as detailed below.

- If the situation requires assistance from the Hanford Fire Department, ambulance, or the Hanford Patrol, notification of the Patrol Operations Center will be made via the Hanford emergency response number (811).

- For lesser emergencies necessitating assistance from outside the facility (but not requiring fire, ambulance, or patrol personnel) notification will be given to the emergency duty officer at the Patrol Operations Center business number (373-3800).

Table I.B-10. Hanford Site Emergency Signals.

Signal	Incident/Alarm Type	Response
Gong or bell	Fire	Nonprocess personnel will evacuate Process personnel will wait for directions
Steady siren	Evacuation	Get car keys if time permits and vacate building; report to staging area[a]
Wailing siren	Take cover	Seek shelter indoors Shut windows and doors Await instructions
Ringing bell	CAM[b] alarm	Evacuate immediate area Call for help Remain in one location
CRASH alarm	Emergency communications	Pick up phone and listen; Relay message to building emergency director

[a] Area where facility personnel gather following notification of incident.
[b] Continuous air monitor.

- In the case of a relatively minor abnormal occurrence, the situation will be handled by facility personnel (the building emergency director and line management).

I.B-6a(3) Notification of Authorities. Notification of the DOE-RL, Ecology, and the National Response Center will be performed in the following manner.

- The building emergency director or line management will document all emergencies on an Event Fact Sheet (Figure I.B-19) which must be completed within 24 hours. The Event Fact Sheet will be used to provide Westinghouse Hanford management with facts about an unplanned event and to disseminate information to those responsible for preventing recurrence of similar events. The DOE-RL will be notified by Westinghouse Hanford line management or the assigned overview organization depending on the consequences of the event. A copy of the Event Fact Sheet will be retained at the facility.

Event Fact Sheet

Contractor:

1. **Title:**
2. **Reporting Org:**
3. **Div/Dept/Proj:**
4. **No:**
5. **Rev:**
6. **Event Date:**
   Event Time:

7. **Event Identification:**

   A) **Location of Event:**

   B) **Plant/Facility Status:**

   1. **Alarm: Facility type (False, Fire, Cam, CAS, etc.)**
   2. **Regulatory requirements (CERCLA, RCRA, WAC, DOE-RL, DOE-HQ, etc.)**
   3. **Operating Requirements (OSR, CPS, Tech Spec, Procedure, Administrative, etc.)**
   4. **Release/Spread - Radioactive Contamination/Hazardous Material**
   5. **Radiological - Personnel Contamination, Internal Deposition, Over Exposure, etc.**
   6. **Industrial Safety, Personnel Injury, First Aid, etc.**
   7. **Process Misrouting**
   8. **Utility System - Electrical, Steam, Air, Water**
   9. **Hoisting/Lifting**
   10. **Other**

   C) **Event Type:**

8. **Apparent Cause(s) of Event:**

   - ☐ **Design**
   - ☐ **Personnel Error**
   - ☐ **Material**
   - ☐ **Administrative Control**
   - ☐ **Procedure**
   - ☐ **Other:**

9. **Description of Event:**

10. **Consequences of Event:**

11. **Actions Taken (A) or Planned (B):**

12. **Tentative Disposition:**

    - ☐ **Event meets criteria for a UOR**
    - ☐ **Event meets criteria for a Critique**
    - ☐ **Undetermined: Revised EFS will be issued in 3 working days**
    - ☐ **Above criteria not met: no further report**

13. **Signatures**

    Originator/Date

    Approved Date

    ADC/UCNI Review Official Review date

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Figure I.B-19. Event Fact Sheet.

- The Patrol Operations Center will immediately notify the DOE-RL of all emergency incidents (fires, explosions, releases, etc.) reported via the Hanford Site emergency number (811).

- In the case of any release of dangerous waste, the building emergency director will immediately notify Westinghouse Hanford Environmental Protection. All releases of dangerous waste to the environment will be reported immediately to the DOE-RL by Environmental Protection. The DOE-RL then will notify Ecology of the release.

- In addition, if a spill exceeds the reportable quantities established under CERCLA, according to 40 CFR 302 (EPA 1989), the DOE-RL will notify the National Response Center at (800) 424-8802.

- The DOE-RL report to Ecology and the National Response Center will contain the following information:
  - Name and telephone number of reporter
  - Name and address of facility
  - Time and type of incident
  - Name and quantity of material(s) involved to the extent known
  - Extent of injuries, if any
  - Possible hazards to human health and the environment outside the facility
  - Activity performed to mitigate the situation.

- All environmental releases of hazardous materials, including those that do not exceed a CERCLA or Ecology reporting limit, will be included in a monthly spill report. Facility managers provide information on environmental hazardous material spills to Environmental Protection. Environmental Protection compiles the monthly spill report for submittal to DOE-RL.

- All spills or releases that occur during transportation will be reported by the transporter to the DOE-RL and Ecology. In addition, a written report will be submitted to:

  Director, Office of Hazardous Material Regulations
  Materials Transport Bureau
  Department of Transportation
  Washington, DC 20990.

I.B-6b. Mitigation and Control. The likelihood of a spill or release to the environment occurring at the 183-H Basins is relatively small. All 183-H Basins waste removal and decontamination operations are being performed within the confines of the basins and all wastes are packaged into waste drums prior to drum removal from the basins. In addition, all liquid wastes have been solidified into drums within the confines of the basins prior to drum removal from the basins.

When removed from the basins, and following a radiation scan at the north end of the basin structure, all waste drums are transferred to a less than 90-day temporary storage area east of the basins until the drums can be transported to the 200 West Area Central Waste Complex, Retrievable Waste

Storage Facility. The temporary storage area is roped off with signs to warn personnel. The containers meet the U.S. Department of Transportation specifications and WAC 173-303 requirements for dangerous waste. The waste drums are lidded and bolted-shut prior to removal from the basins.

If a drum is ruptured by a forklift or other heavy machinery, it is very unlikely that a significant release will result because all drums have a separate plastic liner and the liquid and/or wet sludge wastes have been stabilized so that the waste form is a 'dry' solid. Additionally, the Hanford Site routinely handles drums which contain 'health-endangering' materials; thus, very specialized drum handling procedures are routinely used.

I.B-6c. Cleanup of Released Wastes or Substances. If a drum is punctured and the dried waste is released, personnel will immediately transfer the leaking drum into an overpack drum. This overpack drum will be sealed and disposed of with the other waste drums. The released waste and underlying 3 to 4 inches of soil will be manually shoveled into a lined waste drum and disposed of as dangerous waste. It is anticipated that, due to the consistency of the waste, the extent of contamination will be limited to the top few inches of soil. The waste, being radioactive, will be readily detectable so that cleanup to nondetectable levels is easily achievable. Spills onto concrete or other structures will be cleaned as described for cleaning of the basin concrete (see Sections I.B-3 and I.B-4).

All protective clothing and equipment used during the cleanup procedures will be decontaminated and readied for future use. In addition, all cleanup debris will be collected and disposed of as dangerous waste.

I.B-6d. Management of Contaminated Soil, Waters, or Other Materials. If the spill or release of dangerous waste is extensive, and if there is a chance that the cleanup procedures described in Section I.B-6c may not remove all the waste constituents, then a waste/soil sampling plan as described in Section I.B-4c(2) will be implemented and the soil will be cleaned/removed as described in Section I.B-3b. All contaminated soil and dangerous waste will be transported to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility.

I.B-6e. Restoration of Impacted Area. If a spill or release occurs at the 183-H Basins, the contaminated soil will be removed until the soil samples meet the appropriate cleanup standard. After removing the contaminated soil, clean fill dirt will be brought in and the hole filled to the preexisting level. However, it is very unlikely that a spill or release of such great proportions will occur. If, however, a spill were to be very large and revegetation were to be required, then the techniques described in Section II.B-1 would be followed.

I.B-7. Detailed Schedule for Closure

The schedule for closure of the 183-H Basins is presented in Figure I.B-20. This schedule is contingent upon, and subject to, normal weather conditions and continuation of existing manpower and equipment

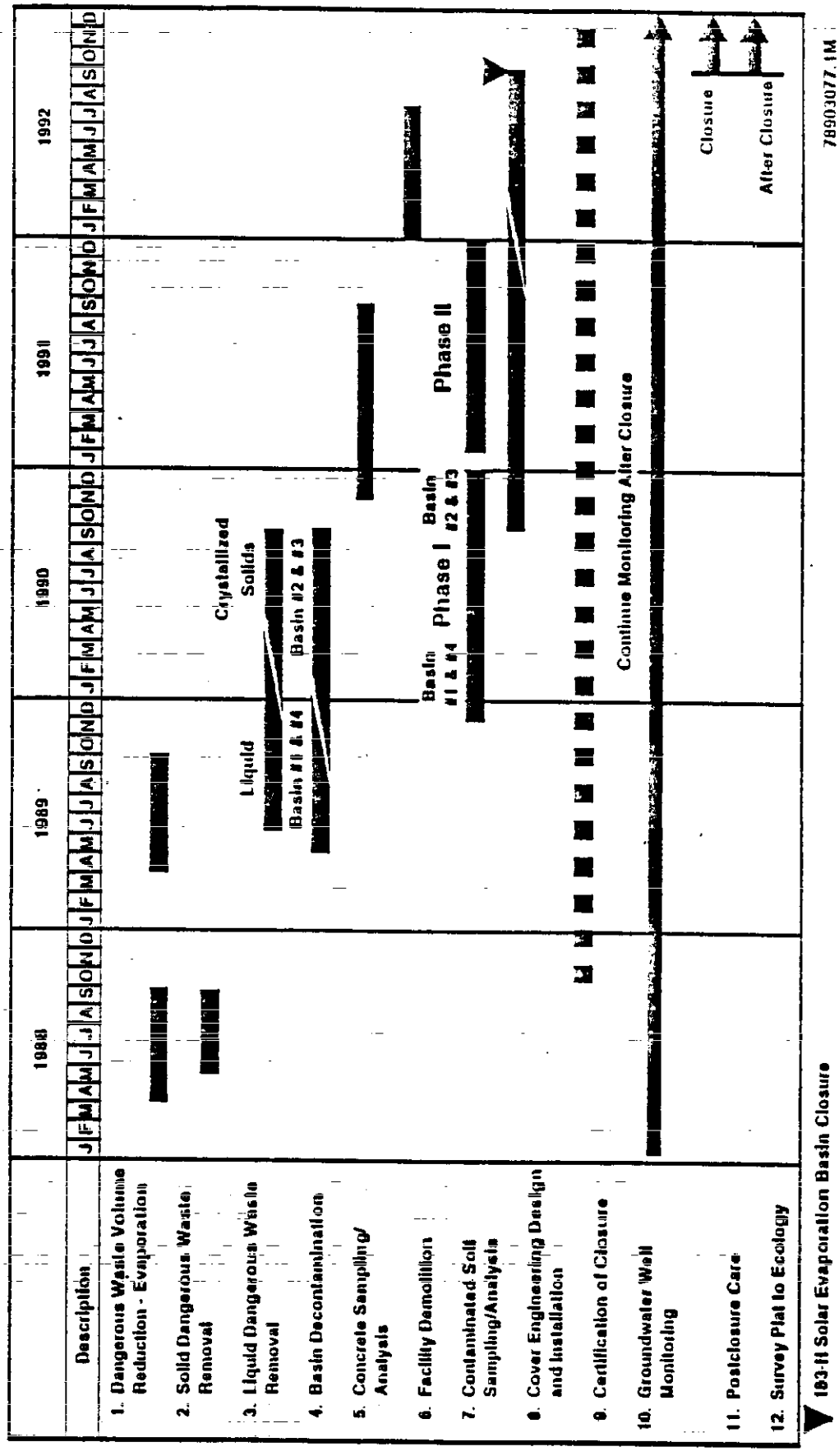

Figure I.B-20. 183-H Basin Closure Schedule.

resources. Final closure, according to the schedule, is October 1992. As acknowledged by Ecology, the multiple four-basin configuration, the sequential activities necessary for waste handling, structural decontamination, soil sampling, landfill cover construction, and independent verification of closure could require an extended time period for closure beyond the 180 days identified in WAC 173-303-610 (4).

As discussed in Section I.B, the flow diagram, Figure I.B-1, '183-H Basin Closure', correlates the sequence of activities with the description item numbers on the closure schedule. The total time required to close this dangerous waste management unit (183-H Basins) will be 54 months, extending from March 1988 to October 1992. This process is divided into 12 activities and the closure schedule shows the time partitions for accomplishment of each activity. The times quoted for completion of each activity are estimated work times.

The following narrative is designed to accompany Figure I.B-20.

Activity 1: Dangerous Waste Volume Reduction by Evaporation--Some of the liquid waste in Basin Number 2 was pumped into the Hypalon lined Basin Number 3 to enhance the evaporation process during the 1989 summer months. This activity has taken advantage of the available time to reduce the waste volume by further evaporation while other activities such as 'liquid waste removal' and 'basin decontamination' were being performed. The evaporation season was from April to October 1989. Because all of the liquid waste has now been evaporated, transformed into a crystallized solid, or solidified and removed; this activity has been completed.

Activity 2: Solid Dangerous Waste Removal--All the remaining sludge was removed from Basin Number 4 and transported to the 200 West Area Central Waste Complex, Retrievable Waste Storage Facility. A total of 6,260 cubic feet of sludge was removed from Basin Number 4. This activity required 5 months and was completed in September 1988. Completion of this activity left only the filtered liquid in the Basin Numbers 2 and 3. This liquid has been transformed into a crystallized solid material, which will be removed as part of the basin decontamination activities.

Activity 3: Liquid Dangerous Waste Removal--This activity consisted of solidification of the filtered liquid in Basin Numbers 2 and 3. The solidification process started in June 1989 and was completed in December 1989. Some liquid absorbed in the granular matrix of the crystallized solids (Activity 2, transformed crystallized solid material) is resultant from evaporation and the liquid solidification processes as a semisaturated crystalline solid material in the bottom of the basins. Thus, some additional solidification will be accomplished periodically to remove any liquid that drains from the solids, occurs from precipitation, or washdown water that is associated with decommissioning activities.

Activity 4: Basin Decontamination-- Cleanup of Basin Number 1 was completed in May 1988 and Basin Number 4 was completed in September 1989. Basin Numbers 2 and 3 will undergo concurrent decontamination/cleanup to

remove the crystallized solid material (liquid waste residual), Hypalon liners, solidification debris, and then wet sandblasting of all concrete surfaces and subsequent cleanup. Removal of the crystallized solid material started in December 1989 and completion of Basin Numbers 2 and 3 is expected by December 1990.

Activity 5: Concrete Sampling and Analysis--Concrete samples will be taken for analysis from each of the cleaned out basins. The purpose of this activity is to accurately determine the contaminant constituents that may remain in the demolished structure under the landfill cover. This sampling and analysis will be performed prior to demolition and will be accomplished over a period of 7 months (March 1991 to September 1991).

Activity 6: Facility Demolition--The facility will be demolished in early 1992. Unless the unit can be clean closed, the 183-H Basins will be reduced to concrete rubble, which will then be compacted to minimize the height beneath the RCRA landfill cover. All clean and decontaminated waste will be moved into the adjoining clearwells for burial. These demolition activities have been scheduled for a five-month period with allowances for wintertime equipment operation (January 1992 to April 1992).

Activity 7: Contaminated Soil Sampling and Analysis--The contaminated soil sampling and analysis will be accomplished in phases. Phase I consists of shallow soil sampling immediately beneath the basins. Basin Numbers 1 and 4 have been cleaned out and sampling started in December 1989. Basin Numbers 2 and 3 will require basin decontamination prior to sampling. Phase II consists of sampling the deeper soil (vadose zone. The soil sampling activities will be accomplished in 25 months (December 1989 through December 1991).

Activity 8: Cover Installation--The total allotted time for installation activities is four months. Cover installation will begin May 1992. This time estimate does not include the evaluation of the soil sampling results for finalizing the cover design's areal extent, nor the mobilizing and material stockpiling activities which can occur concurrently with other closure activities. The last scheduled installation activities (in September 1992) is final inspections before certification of closure, vegetation seeding, and installation of the final perimeter fence.

Activity 9: Certification of Closure--Independent professional engineering services started in October 1988, and are continuing throughout all of the closure activities. It is expected that periodic engineering inspections of continuing progress will be performed, with specific inspections to certify proper completion of activities 1 through 8 as shown in Figure I.B-20. Certification of closure is scheduled for submittal to Ecology in December 1992.

Activity 10: Groundwater Well Monitoring--Since May 1986, monitoring of groundwater is a continuing program, that will continue following closure, unless Ecology directs otherwise. Per Ecology's direction, groundwater remediation will be addressed in the forthcoming revision of the *183-H Solar Evaporation Basins Basins Final Status Post-Closure Permit Application.*

Activity 11: Post-Closure Care--Surveillance and maintenance will be provided after closure as prescribed in the Post-Closure Plan, unless Ecology directs otherwise.

Activity 12: Survey Plat to Ecology--A certified survey plat will be provided within 90 days after closure which specifies the dimensions and location of the closed site.

I.B-8. Notification of Closure and Schedule for Beginning Closure

The WAC regulations require that the owner or operator must submit the closure plan to Ecology at least 180 days prior to the date on which the owner or operator expects to begin closure of the 183-H Basins. The regulations also require that the owners or operators with approved closure plans must notify Ecology in writing at least 60 days prior to the date on which the owner or operator expects to begin closure of the 183-H Basins. The notification requirements are not applicable to the 183-H Basins; since, the closure plan is being revised under Ecology's post-closure direction to address Notice of Deficiency comments. The 183-H Basins Closure Plan has not been approved at this time.

I.B-9. Wastes Treated, Removed, or Disposed of Within 90 Days and Extensions of Closure Time Period

The WAC regulations require that within 90 days after receiving the final volume of dangerous waste at a dangerous waste management unit, or within 90 days after approval of the closure plan, whichever is later, the owner or operator must treat, remove from the unit or facility, or dispose of onsite all dangerous waste in accordance with the approved closure plan. The regulations also state that the regional administrator may approve a longer period if the owner or operator demonstrates that the activities required to comply with the regulations will, of necessity, take longer than 90 days to complete. The schedule for the 90-day requirement will start when the DOE-RL receives Ecology's approval for the 183-H Basins Closure/Post-Closure Plan. The Closure/Post-Closure Plan for the 183-H Basins has not been approved at this time.

If it appears that the scheduled completion of closure (Figure I.B-20) will exceed the 90-day time frame after actual approval of the closure plan, then the DOE-RL will request an extension in accordance with the WAC regulations.

I.B-10. Closure Completed and Extensions of Time Period

The regulatory requirements of WAC 173-303-610 state that closure must be completed within 180 days after receipt of the final volume of waste, or within 180 days of approval of the closure plan, whichever is later.

The schedule for the 180-day requirement will start when the DOE-RL receives Ecology's approval for the 183-H Basins Closure/Post-Closure Plan. The closure/post-closure plan has not been approved at this time.

The following activities may preclude the closure plan meeting the 180-day time requirement as present projections indicate that closure will take until October 1992:

- Basin decontamination
- Soil sampling and analyses
- Facility demolition
- Contaminated soil removal, if needed
- Cover installation.

If the DOE-RL cannot meet the specified time frame, a petition will be filed with Ecology requesting an extension of the closure time.

I.B-11. Amendment of Closure Plan

Detailed sampling and analyses data evaluations, and calculations will be required to document the extent of soil contamination and the subsequent RCRA landfill cover size. These two examples of information are currently not available. If the closure plan is approved by Ecology before this information is available, the DOE-RL will submit a written request to Ecology to authorize a change to the approved closure plan. The written request will include a copy of the amended closure plan for approval.

I.C. CERTIFICATION OF CLOSURE, SURVEY PLAT, NOTICE IN DEED, AND FINANCIAL REQUIREMENTS

The following sections discuss certification of closure, survey plat, notice in deed, and financial requirements.

I.C-1. Certification of Closure

Within 60 days after final closure of the 183-H Basins (October 1992), the DOE-RL will submit to Ecology the certification of closure. This certification will be signed by both the DOE-RL and an independent professional engineer registered in the state of Washington, stating that the 183-H Basins have been closed in accordance with the approved closure plan. The certification will be submitted by registered mail. Documentation supporting the closure certification will be retained and furnished to Ecology upon request. This documentation will be kept by the post-closure contact referred to in Section III.D.

I.C-1a. Owner/Operator Closure Certification. The DOE-RL will self-certify with the following document or a document similar to it:

I, (name), an authorized representative of the U.S. Department of Energy-Richland Operations Office located at the Federal Building, 825 Jadwin Avenue, Richland, Washington, hereby state and certify that the 183-H Solar Evaporation Basins at the 100-H Area, to the best of my knowledge and belief, have been closed in accordance with the attached approved closure plan, and that the closure was completed on (date). (Signature and date).

I.C-1b. Professional Engineer Closure Certification. The DOE-RL will engage an independent professional engineer registered in the state of Washington to certify that the facility has been closed in accordance with this approved closure plan. The DOE-RL will require the engineer to sign the following document or a document similar to it:

I, (name), a certified professional engineer, hereby certify, to the best of my knowledge and belief, that I have made visual inspection(s) of the 183-H Solar Evaporation Basins at the 100-H Area, and that closure of the aforementioned facilities has been performed in accordance with the attached approved closure plan. (Signature, date, state professional engineer license number, business address, and phone number).

I.C-2. Survey Plat

The DOE-RL will file, within 60 days after final closure, the following documents, or similar documents, to the local land use authority and the regulating authorities (Ecology and EPA). The land use authority is the Benton County Planning Department located at the Courthouse Building, Prosser, Washington 99350.

A survey plat indicating the location and dimensions of the 183-H Basins (to the extent the information exists and with respect to permanently surveyed benchmarks) will be submitted. This plat will be prepared by a certified professional land surveyor. The following note will accompany the survey plat:

This plat describes real property in which dangerous wastes have been disposed in accordance with the requirements of 40 CFR 265.116 and 265.119. Although this dangerous waste disposal facility is now closed, regulations issued by the Environmental Protection Agency in 40 CFR 265.119 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 the risk to human health or the environment.

A record of the type, location, and quantity of dangerous wastes disposed of within the facility 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 authorities.

I.C-3. Notice in Deed

If clean closure cannot be accomplished, within 60 days of the certification of closure of the 183-H Basins, the DOE-RL will, in accordance with state regulations, sign, notarize, and file for recording, the notice indicated below. The notice will be sent to the Auditor of Benton County, P.O. Box 470, Prosser, Washington, with instructions to record this notice in the General Index. This document is normally reviewed in title searches for property.

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, Richland, Washington, hereby gives the following notice as required by 40 CFR 265.119(b) and WAC 173-303-610(10), whichever is applicable:

(a) The United States of America is, and since April 1943, has been in possession in fee simple of the following described lands (legal description of the 183-H Solar Evaporation Basins closure site).

(b) The U.S. Department of Energy-Richland Operations Office, by operation of the 183-H Solar Evaporation Basins, has disposed of hazardous and/or dangerous waste under the terms of regulations promulgated by the U.S. Environmental Protection Agency and the Washington State Department of Ecology (whichever is applicable) at the above described land.

(c) The future use of this described land is restricted under the terms of 40 CFR 264.117(c) and WAC 173-303-610(7)(d) (whichever is applicable).

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

(e) The U.S. Department of Energy-Richland Operations Office has filed a survey plat with the Benton County Planning Department, the U.S. Environmental Protection Agency Region 10, and the Washington State Department of Ecology (whichever are applicable) showing the location and dimensions of the 183-H Solar Evaporation Basins site, and a record of the type, location, and quantity of waste treated.

I.C-4. Financial Requirements

It is DOE-RL's understanding that federal facilities are not required to comply with WAC 173-303-620. However, projections of anticipated closure costs will be provided annually during the closure activities (starting October 1991).

II. CLOSURE REQUIREMENTS FOR LANDFILLS

This chapter discusses the requirements for closing the 183-H Basins as a RCRA landfill (i.e., some contaminants will be left within the soil column and capped with an earthen cover to restrict contaminant migration).

II.A. CLOSURE PERFORMANCE STANDARDS

Closure performance standards are addressed under Section I.A.

II.B. CONTENT OF CLOSURE PLAN

The content of the closure plan is divided into two sections as follows:

- Preliminary Cover Design, Section II.B-1
- Cover Considerations, Section II.B-2.

II.B-1. Preliminary Cover Design

This section provides a description of the cover materials, configuration, and installation procedures. The preliminary cover design has been based on the requirements of WAC 173-303-610 and -665. The cover configuration has been developed and evaluated using a number of EPA guidance and design manuals and other technical references as stated herein. Specific cover design calculations are provided in Appendix F. The cover design description also explains how the cover will minimize the migration of liquids in the vadose zone. The cover design and configuration section discusses expectations for limiting the cover system permeability; freeze/thaw cycle effects; potentials for erosion, settlement/sedimentation, and animal intrusion; and describes the necessary maintenance requirements.

The primary objective of the cover system will be to confine waste for a minimum of 30 years and the primary functions of the cover will be to enhance moisture storage and lateral drainage while minimizing water infiltration, erosion, differential settling and sedimentation, and long-term maintenance requirements. Secondary functions that support the primary functions will be to preserve slope stability and minimize deterioration due to thermal extremes. Based on the types of wastes discharged to the 183-H Basins, gas generation will not to be a problem. All of the regulatory required cover functions will be met by this preliminary cover design.

The cover design as presented herein is preliminary in nature; definitive design will be completed when the following information becomes available.

- Source and engineering properties of the cover materials
- Areal extent of the 183-H Basins induced soil contamination
- Extent of anticipated 183-H Basins contaminated soil removal
- RCRA closure/past practices interface for individual contaminant cleanup thresholds for both soil and groundwater
- Effects from other laws (e.g., landban and waste minimization).

The sources and engineering properties of some of the cover materials have yet to be determined. When specific information becomes available for a cover component, the information will be used and properly referenced in the final design. Minimum design standards for most of the cover components have been available from EPA design guidance documents (EPA 1979, 1982a, 1982b, 1984a, 1985, 1986a, and 1986b). Where specific cover component data have not been available, engineering assumptions have been made. These assumptions must be confirmed when the actual data become available. A listing of specific component laboratory data and a schedule for obtaining such data are provided in Table II.B-1 and Figure II.B-1, respectively.

Two factors are yet to be determined, which affect the specific cover design calculations and are independent of the engineering properties of the materials. These are the areal extent of the cover and the overall height of the cover. At the time of preliminary design, the areal extent and level of soil contamination directly below and adjacent to the 183-H Basins are not known. The contamination level at which the subsurface soil does not need a cover laterally has yet to be established; therefore, the exact areal extent of the cover cannot be determined until soil sampling and analyses, coupled with acceptable soil contamination levels, are determined. Also, the degree to which dangerous constituents can be removed from the 183-H Basins during decontamination and decommissioning operations, will affect the cover height. The first scenario is that the 183-H Basins could be completely demolished and removed allowing a cover to be placed at grade. The second scenario leaves concrete rubble on the site requiring a thicker foundation layer for the cover; therefore, the preliminary cover design provided herein is conceptually accurate in that the relative layer thicknesses (except for the foundation layer), layering sequences, and general features of the materials are not expected to change.

The preliminary cover design calculations assume a cover with dimensions of 140 feet by 230 feet (approximately the existing dimensions of the 183-H Basins). The cover height is assumed to be 7 feet at the top edge of the embankment. The cover embankment sideslopes are preliminarily designed at a 3H:1V slope; thus the cover extends an additional 21 feet in all directions from the top of the downslope to the termination of the embankment.

Subsequent to the preliminary design, Ecology has directed that the sideslopes of the cover will be 4H:1V or less. Thus 4H:1V sideslopes will become a specific criterion of the final design. Additionally, impacts from

Table II.B-1. Laboratory Testing Requirements for Cover Materials.

Cover Layer	Atterberg limits	Moisture/ Density (compaction)	Consoli-dation	Triaxial or direct shear strength	Water reten-tion	Permea-bility	Grada-tion curves	pH
Foundation	X	X		X		X	X	
Low-permeability	X	X	X	X		X	X	
Cobble							X	
Drainage	X	X		X		X	X	
Drainage bedding							X	
Topsoil	X	X			X		X	X

Note: Geomembranes and geotextiles must be tested according to specifications given elsewhere in this document.

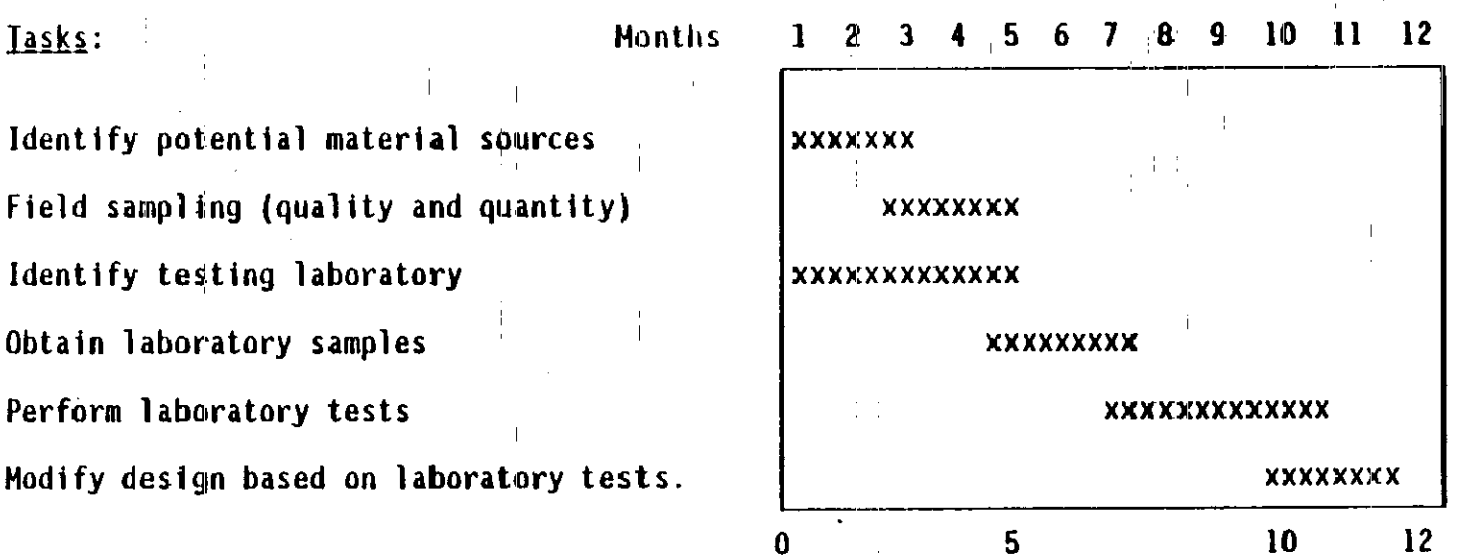

Figure II.B-1. Schedule to Develop Data Needs.

the *Hanford Federal Facility Agreement and Consent Order* future negotiations and interpretations of current laws (landban and waste minimization) may affect the design and areal extent of the final cover.

II.B-1a. Cover Materials Description. The EPA-recommended cover components have been incorporated into the 183-H Basins preliminary cover design (EPA 1979, 1982a, 1982b). Detailed analyses of the components are discussed in subsequent sections. Figures II.B-2 through II.B-5 portray the site topography, cover plan, cover cross section, and cover embankment cross section, respectively. These figures depict the cover layers, thicknesses, slopes, and overall dimensions.

The following paragraphs describe each component's function, engineering properties, quantities required, and source of materials. The description is a narrative with any required design calculations found in Appendix F. Pure clay liners will not be used in the 183-H Basins cover design; however, the use of local soils (sands to sandy silts) admixed with clay has been planned for the low-permeability component of the cover. A discussion of optimizing clay to native soil mixtures for use in covers is presented in Appendix D. The construction sequence for the cover will begin with the bottom components and progress naturally to the cover surface. All soil components of the cover will be compacted in about 6-inch lifts ranging from 90 to 95 percent maximum density. Compaction will be accomplished using rubber-tired or sheepsfoot rollers, depending on the component being compacted. Estimates of cover material volume are provided in Appendix G.

Foundation soil--The function of the foundation soil is to fill-in low spots and cover any rubble remaining after the basin has been demolished and removed. The fill will be compacted to 95 percent maximum density, thus providing a stable foundation for the remainder of the cover. The fill will slope to existing grade at a rate of 3H:1V (preliminary design), beginning at the edge of the cover perimeter. A native sandy soil will be selected in the vicinity of the 183-H Basins for the foundation soil. The soil will be classified and moisture/density relationships (compaction curves) will be determined for preparation of construction specifications and field construction procedures. The foundation fill will be compacted in 6-inch lifts to 95 percent maximum density per Section 2-03.3(14)c of the *Washington State Department of Transportation Manual* M41-10 (WSDOT 1984). No standard for soil permeability is assigned to this layer. The estimated volume of foundation fill required is 1,235 cubic yards.

Local site geology has been documented (ERDA 1975). The subsurface soils at the 183-H Basins (Pasco gravels) consist of unconsolidated, silty sandy gravels (glaciofluvial sediments) to a depth of approximately 650 feet. The first 50 feet of subsurface soils are part of the Hanford formation (local nomenclature). Below that is the Ringold Formation, which is approximately 285 feet thick and extends to the upper basalts. The geology from wells located at the 183-H site, based on well logs 199-H3-1, 199-H4-3, 199-H4-4, 199-H4-5, and 199-H4-6, confirms that a combination of silt, sand, gravel, and cobbles make up the upper 50 feet of glaciofluvial sediment.

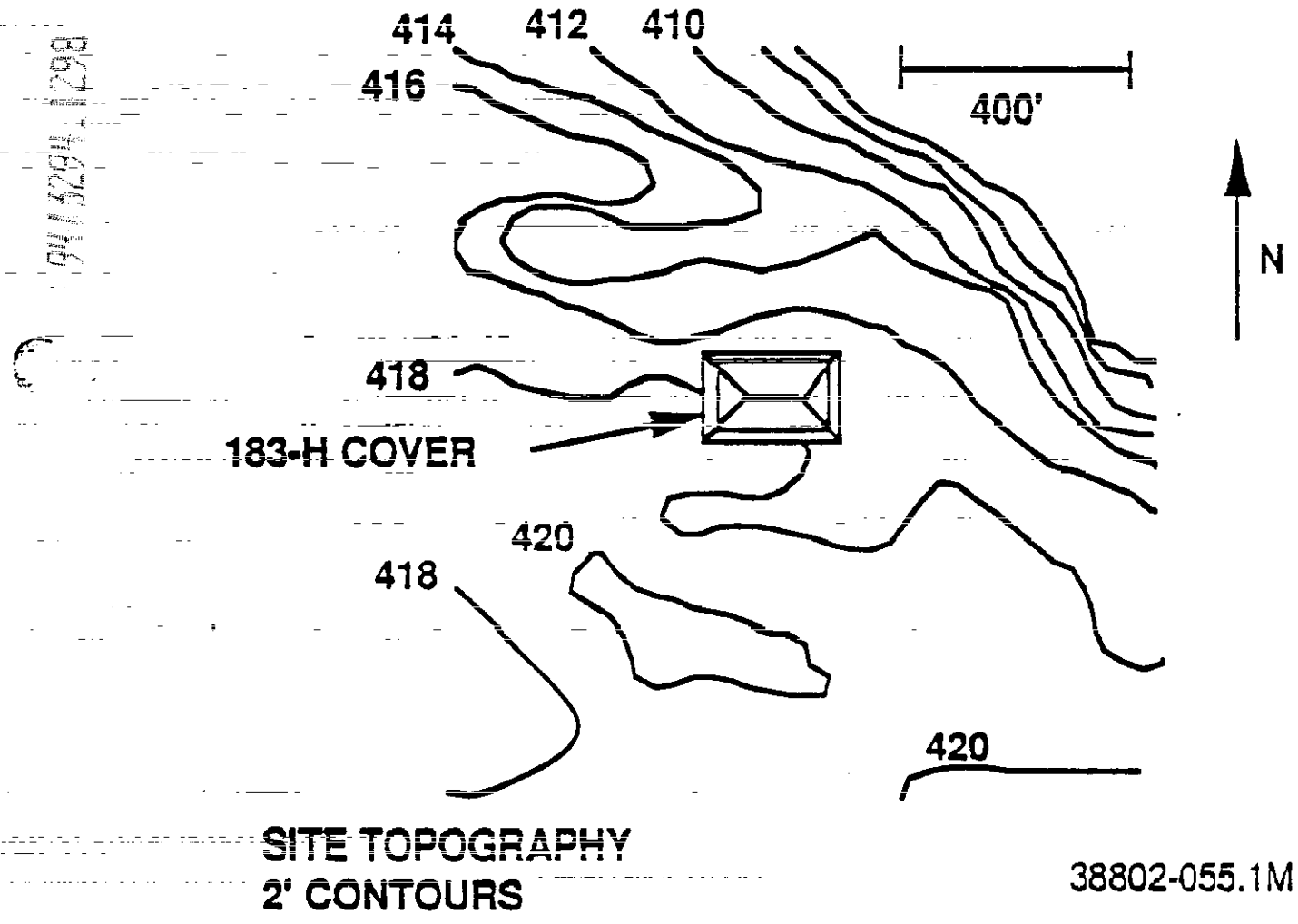

Figure II.B-2. 183-H Site Topography.

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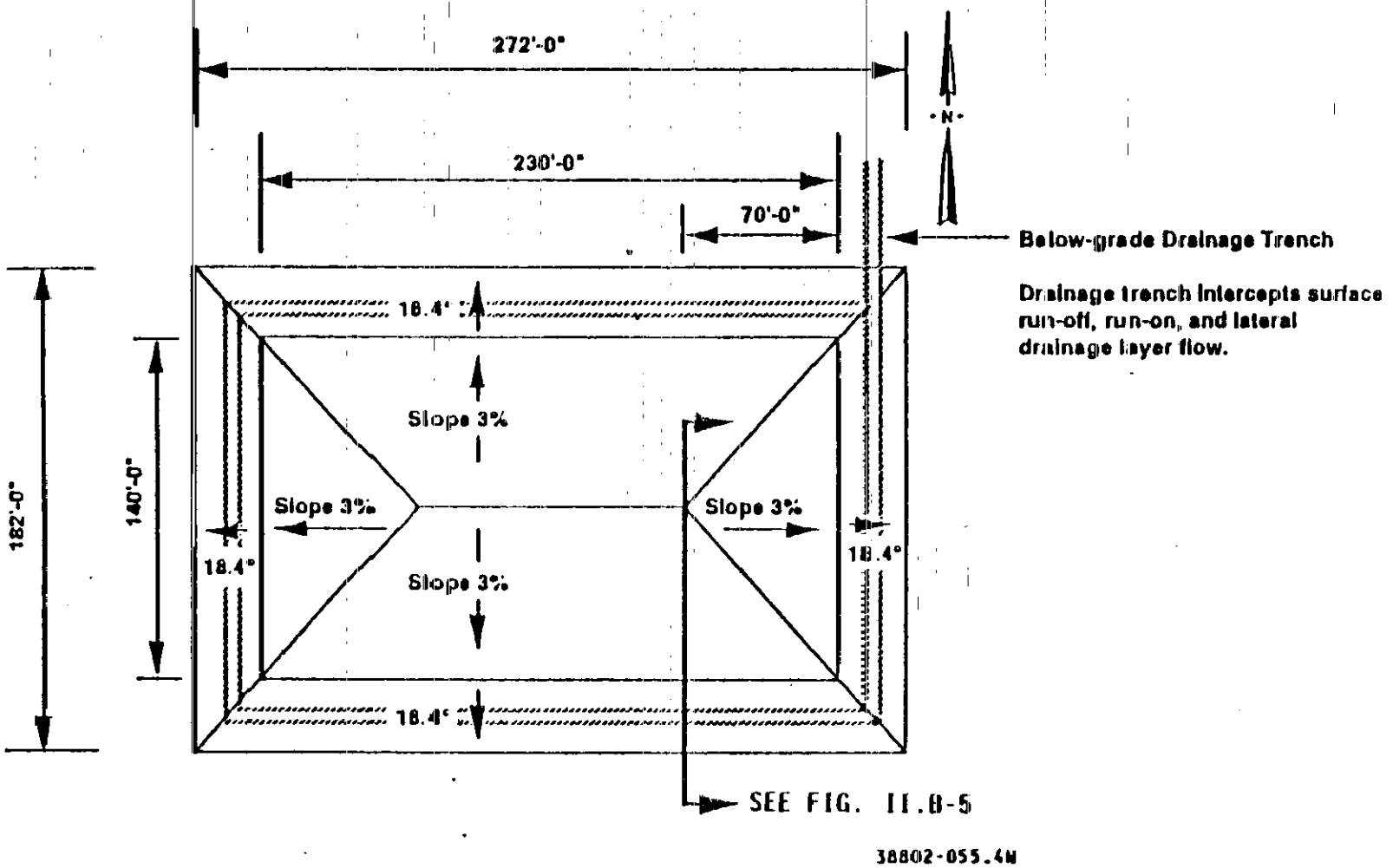

Figure II.B-3. Cover Plan.

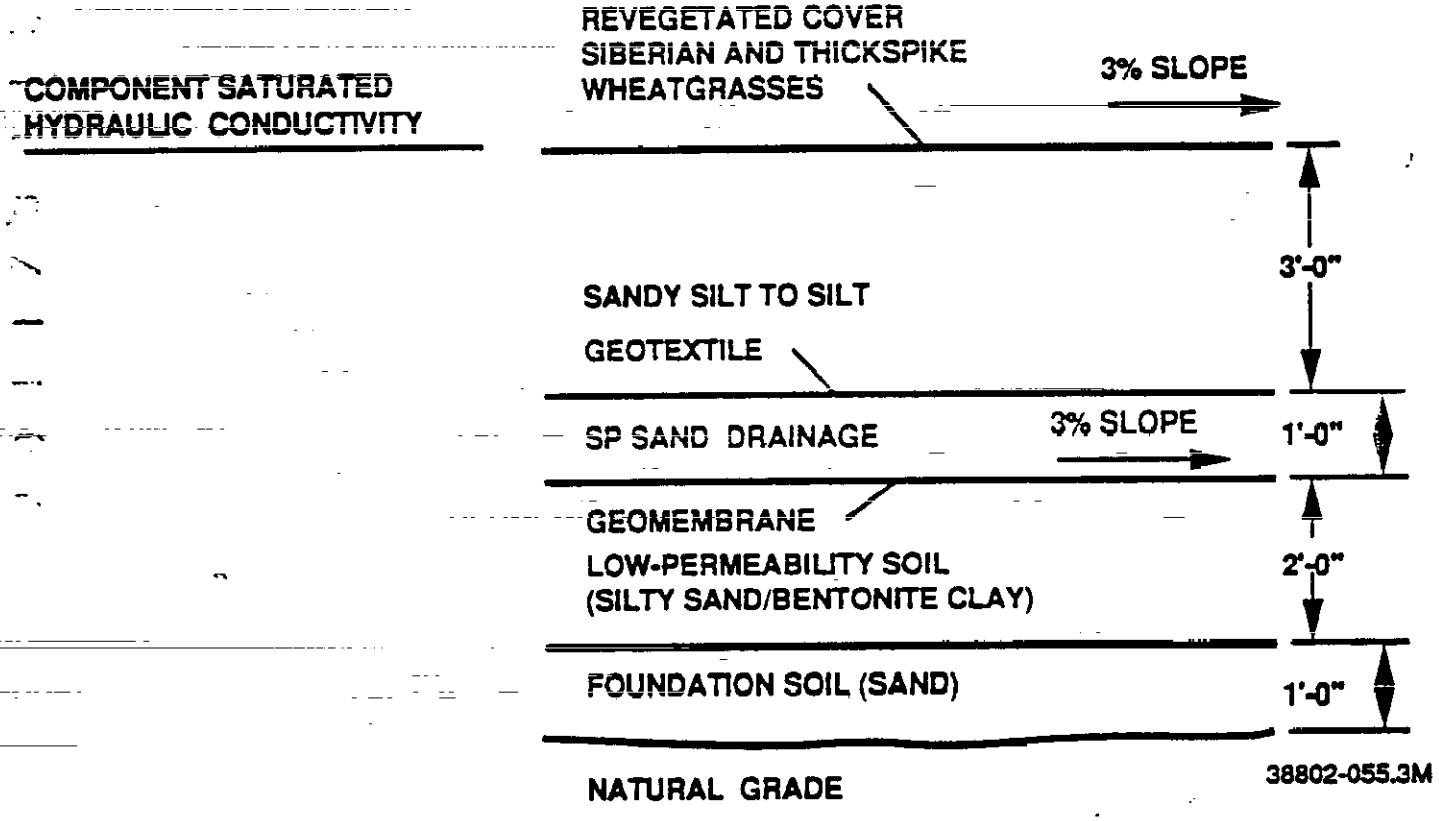

Figure II.B-4. Cover Cross Section.

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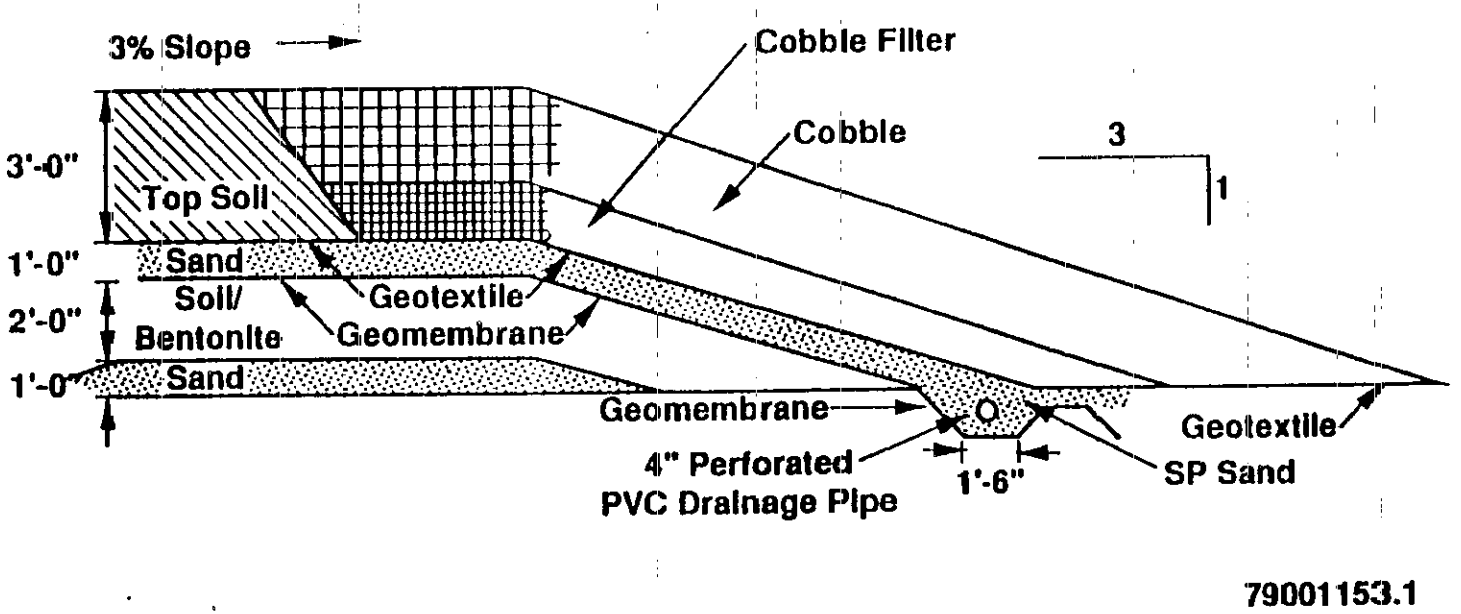

Figure II.B-5. Cover Embankment Cross Section.

Low-permeability soil--The function of the low-permeability (low-hydraulic conductivity) soil is to minimize the long-term infiltration of water through the cover. The term permeability is interchanged with hydraulic conductivity throughout this section. The use of the term permeability is not to be misconstrued as 'intrinsic permeability' or that portion of the hydraulic conductivity function, which considers only the influence of the porous medium on flow. The geomembrane placed directly above and in direct contact with the low-permeability soil will minimize liquid infiltration during the post-closure period. When the geomembrane eventually deteriorates, the low-permeability soil has been designed to limit the infiltration rate through the cover to 1 E-7 centimeters per second (about 1.24 inches per year) for any water that does not evapotranspire, run-off, or laterally drain from the cover.

The low-permeability soil will consist of a silty sand with an admixture of bentonite clay. Depending on the characteristics of the sandy silt, such as particle size distribution and porosity, it is expected that approximately 10 to 15 percent bentonite clay will be required to be added to achieve the 1 E-7 centimeters per second permeability limit. Bentonite clay is available commercially from several sources. The Hanford formation silty sand, which will be free of rock, fractured stone, debris, cobble, rubbish, and roots, will be mixed with the bentonite. The low permeability soil will prevent punctures to the geomembrane, and will be compacted to 95 percent maximum density in 6-inch lifts yielding a 2-foot thick compacted layer. The low-permeability component has been designed to slope at 3 percent to 5 percent to match that of the drainage layer, and at 3H:1V in the embankment sideslopes of the cover (preliminary design). It is estimated that approximately 435 cubic yards of bentonite and 2,465 cubic yards of silty sand at the 15/85 bentonite/sand ratio will be required for the low-permeability component. A detailed discussion of the application of clay liners in semiarid environments such as at the Hanford Site is provided in Appendix D.

Flexible membrane liner--The function of the flexible membrane liner or geomembrane is to minimize the infiltration of water through the cover. Differential settlement at the closed 183-H Basins is expected to be insignificant, and the flexible membrane liner will not come in contact with dangerous materials; only adjacent soils and pore water. The assumption for no differential settlement in the cover is based on the fact that no major rubble will be left in place after decontamination and decommissioning is completed. Also, no appreciable gas is expected to be generated at the site; therefore, regarding strength and deformation properties, the geomembrane is designed for field survivability. The embankment sideslopes are 3H:1V (preliminary design) and, therefore, require a geomembrane with high tensile strength. High-density polyethylene has been recommended for this application (Mitchell 1984). The geomembrane also needs to exhibit high puncture resistance as a safety factor against accidents during construction. The EPA recommends a minimum geomembrane thickness of 20 mils for cover systems (EPA 1982a). To provide a safety factor in the cover system design, a 40-mil thick flexible membrane liner of high-density polyethylene is specified. Standard properties such as density, melt flow index, tensile strength, elongation, tear resistance, thermal expansion, moisture vapor transmission, dimensional stability, etc., have been specified by geomembrane manufacturers

and have been tested to American Society for Testing and Materials or other nationally recognized standards.

The flexible membrane liner installation will require field seaming, therefore, procedures will be prepared for this practice. Seams should be made according to the manufacturer's recommended technique using recommended adhesives, solvents, or welding equipment (Mitchell 1984). Both the low-permeability soil below and the drainage layer above the flexible membrane liner are considered bedding materials and, as such, will contain no materials coarser than silty sand that will be free of rock, fractured stone, debris, cobble, rubbish, or roots. Flexible membrane liners are readily available from a number of manufacturers. The flexible membrane liner will be placed in contact with the entire surface of the low-permeability component. The estimated quantity of a flexible membrane liner is 4,450 square yards.

Drainage layer--The function of the drainage layer is to remove water that has percolated through the topsoil, and thus reduce buildup of the hydraulic head on the geomembrane and low-permeability soil layer. The bottom of the drainage layer has a minimum slope of 3 percent and a maximum slope of 5 percent, which provides a gradient-inducing lateral flow of water out of the cover. The slope of the drainage layer changes to that of the embankment at the edge of the cover. The silty sand, with a minimum permeability of 1 E-2 centimeters per second (about 14 inches per hour) and a thickness of 12 inches, has been designed such that a minimum transmissivity (saturated flow) of 0.3 square centimeters per second (about 1.16 square feet per hour) will be achieved. The silty sand can be provided by a local concrete batch plant. At the base of the drainage and cobble filter layers is a drainage diversion ditch, which encompasses the entire perimeter of the cover. The drainage ditch has been designed to transmit water that drains through the lateral drainage layer and cobble layer of the embankment, away from the perimeter of the cover. The lateral drainage layer that transmits water to the drainage ditch lies physically above the geomembrane and low-permeability soil layer of the cover. Therefore, measurement of flow in the drainage ditch would not be a good indicator of total cover performance. However, a method to monitor the precipitation collected in the run-off system will be provided during definitive design as such information would support cover design. The termination point for the drainage ditch has not been selected for the preliminary design. The drainage ditch may terminate into a french drain or a surface drainage structure located at a lower elevation than the cover. The estimated required volume of drainage layer sand is 1,545 cubic yards.

Geotextile--A geotextile, which is a woven fabric of synthetic materials, will be placed on the sand drainage layer for two reasons. Geotextiles are typically used in construction projects to reinforce soil material and to function as a filter media. First, the geotextile will protect the sand drainage layer during construction. Second, the geotextile will provide a redundant particle filter function at the drainage layer and silty topsoil interface. The geotextile also functions as a granular filter to prevent clogging by fine soil infiltrating into the drainage layer. Detailed calculations regarding the granular filter layer design and geotextile specifications are provided in Appendix F.

Topsoil layer--There are three functions of the topsoil layer. First and foremost, the topsoil must be effective in retaining precipitation for evaporation and transpiration back to the atmosphere. Second, the topsoil must consist of, or be amended to, providing an adequate plant growth medium. Third, the topsoil must be adequately resistant to the forces of wind and water erosion. A detailed site characterization effort to establish the quality and quantity of topsoil regarding water retention characteristics via particle size analysis has been completed (Last et al. 1987). The topsoil, a sandy silt to silt loam is located at the McGee Ranch site, northwest of the Yakima Barricade on the Hanford Site (Figure II.B-6). Water retention characteristics were determined for sandy loams and silt loams from the Hanford Site (Heller et al. 1985). These data were used as input to the hydrologic evaluation of landfill performance model. The hydrologic evaluation of landfill performance model results are discussed in Appendix E. An estimated 3,415 cubic yards of topsoil are required with more than adequate quantities available at the McGee Ranch site. Assistance such as fertilizers and herbicides, may be applied to the topsoil to establish an adequate plant growth medium. Calculations for wind and water erosion characteristics of the topsoil are provided in Appendix F. The topsoil will be compacted to 95 percent maximum density in 6-inch lifts; excluding the top lift, which will not be compacted to aid in the establishment of vegetative cover.

Cobble filter--A filter layer is required to be placed directly beneath the cobble protective layer to stabilize the cobble underflow conditions. The U.S. Bureau of Reclamation method was used to the size cobble, and it has recommended a minimum thickness and largest particle size (Abt et al. 1987). Actual design calculations are found in Appendix F. The cobble filter material will consist of less than 1-inch fine gravel to coarse sand that parallels the particle size distributions of the cobble layer above and the sand drainage layer below. Parallel particle size distributions refer to the slopes of the particle size distribution curves for the cobble, cobble bedding, sand drainage layer, and topsoil, as depicted in Figure F.9 in Appendix F. Specification of parallel sloped particle size distribution curves, coupled with other design criteria, reduces the potential for materials filtering from one layer into lower layers. The thickness of the cobble filter layer will be 1 foot placed directly on the sand drainage layer portions of the embankment slope and horizontally 2 feet onto the cover beyond the upper edge of the embankment. A geotextile will be placed on the sand drainage layer to protect that layer during placement of the cobble filter layer. The estimated volume of cobble bedding material is 505 cubic yards.

Cobble layer--The preliminary designed slope embankment has been designed at 3H:1V, approximately 18 degrees from horizontal. This extends the cover 21 feet horizontally from the edge of the embankment cover to the toe of the embankment. If cobble protection was not provided, a slope of approximately 3 percent would be required, which creates considerable costs and extends the cover an additional 210 feet. The cobble layer will be placed on the surface of the cover embankment slopes only to provide an erosion resistant cover enabling a steeper sideslope design. Selection of the source and type of actual sideslope surface stabilization rock will be performed during definitive design. Fractured basalt, usually termed 'riprap,' has a steeper angle of repose than 'cobble' and may be required to facilitate the

slopes specified during the definitive design. The cobble layer will be 2-feet thick and placed directly on the cobble filter layer. For erosion control, cobble on the order of 2-inch maximum particle size would be required. However, to help reduce the potential of small animal intrusion through the embankment sideslopes, a 4-inch maximum size aggregate will be required (Cline 1980).

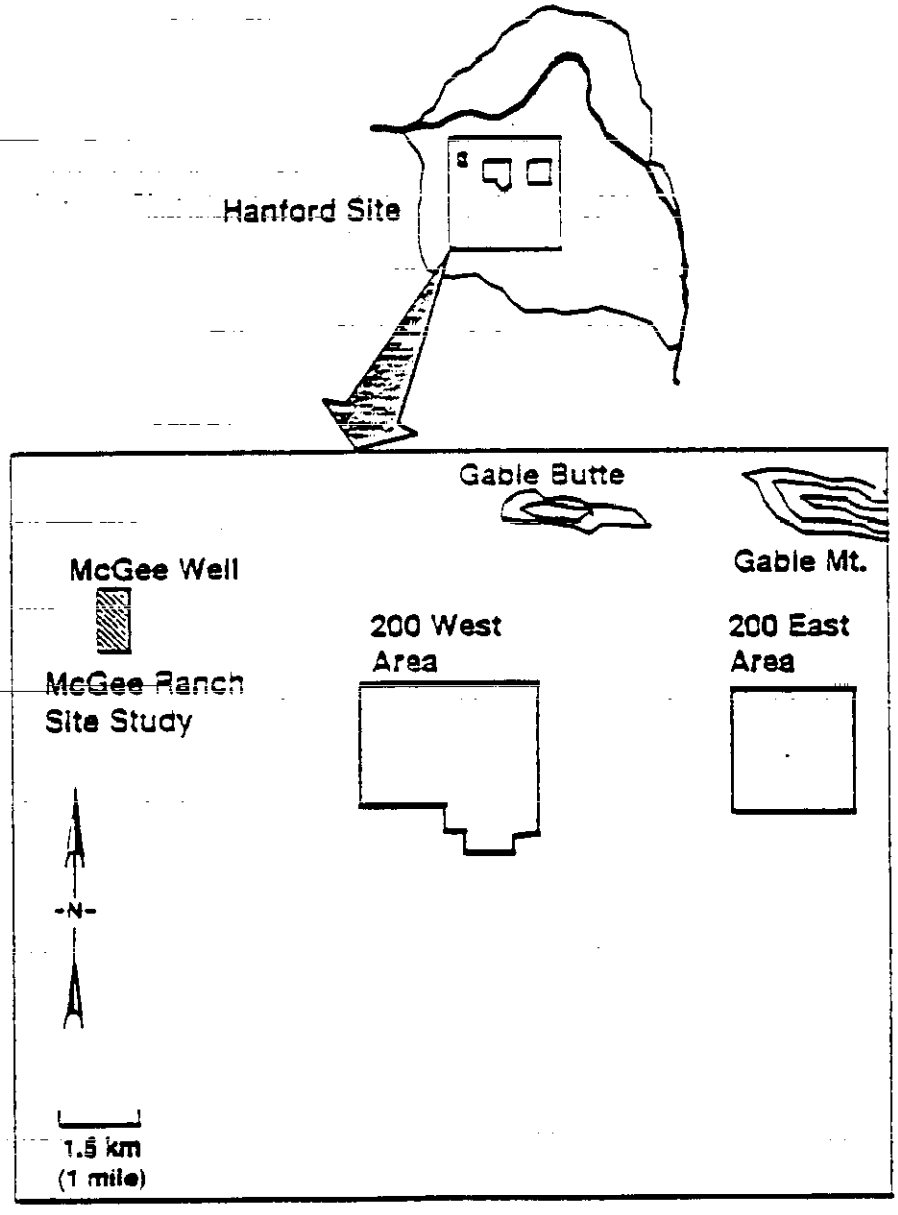

Figure II.B-6. Location map of McGee Ranch.

It is important to note the difference between the need for cobble on the sideslopes to reduce potential small animal intrusion and the absence of a cobble specification for the top of the cover. Since the 183-H Basins' cover will be maintained in conjunction with a security fence constructed around the facility, large mammals are not expected to access the cover. Some level of habitation of the cover topsoil is expected by small mammals such as the Great Basin Pocket Mouse (Paragnathus parvus) that typically reside within the top 3 to 4 feet of subsurface soils. It is not expected that small mammals will burrow through the geomembrane, placed a minimum of 4-feet below grade. Data have indicated that buried 40-mil high-density polyethylene liners were not penetrated by rats, even when they faced starvation (Mitchell 1984). However, the following recommendations for geomembrane design will be addressed during definitive design: 1) avoid installation of free edges on the geomembrane, 2) avoid geomembrane angles greater than 90°, and 3) assure radius of curvature would be greater than 3 inches. There will be no topsoil on the sideslopes of the cover for habitation of small mammals. Therefore, if large size cobbles were not placed on the sideslopes to prevent burrowing, the small mammals would only have a 1-foot sand drainage layer to burrow in to reach the geomembrane. The 1-foot thick sand layer would not be of sufficient thickness or stability to construct a den. In this scenario, the frustrated mammals (only having a 1-foot thick layer below) may preferentially attack the geomembrane although penetration would not be likely. Specific cobble design calculations are found in Appendix F.

Vegetative cover--The vegetative cover plays a significant role in the overall cover function and has two primary functions. First, the vegetation acts to transpire water that has been stored in the topsoil back to the atmosphere. Second, the vegetation helps to reduce the erosion due to wind and water. A Thickspike wheatgrass (Agropyron dasytachyum) and a Siberian wheatgrass (Agropyron sibericum) mix will be seeded in the topsoil. Thickspike wheatgrass is a rhizomatous native grass of the Pasco Basin and well suited for wind erosion control on deep sandy soils (Brown et al. 1984). Siberian wheatgrass is the most abundant of the perennial grasses seeded on the Hanford Site waste burial grounds and has been noted to competitively limit cheatgrass where seeded. The Russian wheatgrasses develop a much larger root density than native wheatgrasses and thus more rapidly extract water from the soil profile (Cadwell et al. 1983).

The wheatgrasses should be planted in fall. If, due to scheduling, the cover construction requires a spring planting, an annual cereal ryegrass is recommended to quickly stabilize the cover, followed by planting of perennial wheatgrasses in the fall.

II.B-1b. Construction Quality Assurance Plan Outline. A construction quality assurance plan will be prepared that will address in sufficient detail activities that pertain to the areas outlined below. This plan will provide verification that the cover will meet or exceed the design specifications. The construction quality assurance plan cannot be prepared until specific construction materials data are known. This plan will ensure that the field data documentation obtained during construction meet the design

specifications. A technical guidance document for preparation of construction quality assurance plans for dangerous waste land disposal facilities will be used for the development of the 183-H Basins construction quality assurance plan (EPA 1986b). The construction quality assurance plan will address, as a minimum, the following areas.

- Responsibility and authority of all organizations and key personnel involved with preparation and implementation of the construction quality assurance plan.

- Personnel qualifications including a description of qualifications of all personnel and demonstration of proper training and experience to fulfill identified responsibilities.

- Monitoring activities listed in detail including observations and tests to ensure quality of each installed component.

- Sampling requirements including a description of sampling and testing activities to ascertain the quality of materials installed during construction. These include the following:

  - Types of sampling activities
  - Types of samples
  - Number and location of samples
  - Frequency of testing
  - Data evaluation procedures
  - Acceptance and rejection criteria
  - Corrective action plans
  - Handling of testing errors.

- A description of procedures to document construction quality assurance activities. Documentation must include the following items as a minimum:

  - Daily summary reports
  - Monitoring data sheets
  - Change orders
  - Meeting memoranda
  - Photographs
  - Problem identification and reports on corrective measures
  - Design acceptance reports
  - Final documentation including record drawings.

- The construction quality assurance plan must address all the cover components including the following:

  - Foundation
  - Low-permeability soils
  - Geomembranes
  - Drainage layers
  - Topsoil layers

- Embankment layers
- Vegetative cover.

- Some elements of consideration for the components listed previously are the following:

  - Method of compaction
  - Special considerations for slope construction
  - Storing and handling of materials
  - Installation of geomembranes
  - Adverse weather
  - Improper materials and techniques.

II.B-2. Cover Considerations

The following six sections summarize the criteria that were considered for this preliminary cover design:

- Minimization of Liquid Migration, Section II.B-2a
- Maintenance Needs, Section II.B-2b
- Erosion and Abrasion, Section II.B-2c
- Settlement, Subsidence, and Displacement, Section II.B-2d
- Cover System Permeability, Section II.B-2e
- Freeze/Thaw Cycle Effects, Section II.B-2f.

II.B-2a. Minimization of Liquid Migration. The primary function of the cover system design is minimization of water infiltration into underlying waste zones where contaminants may be leached into the groundwater. Concerns have been raised over the use of clay as a low-permeability component of the cover. Specific concerns have been related to desiccation resulting in excessive shrinkage, cracking, and ultimate loss of integrity. These concerns are valid only to the degree that improper soil/clay mixtures, design, and construction techniques are applied; however, proper soil/clay mixtures, coupled with competent design features and construction techniques, have allowed successful use of low-permeability clay liners in semiarid environments. A detailed description of clay liner use in semiarid environments is provided in Appendix D.

An EPA recommended cover design (EPA 1979, 1982, 1982a) has been used for the 183-H Basins' cover. The bottom layer of the cover will be a foundation layer to provide a stable base for the cover components. The next component of the cover will consist of a 2-foot thick low-permeability soil layer with a hydraulic conductivity (K) less than or equal to 1 E-7 centimeters per second (about 1.24 inches per year). It will be overlain by an impermeable geomembrane. The impermeable geomembrane will be overlain by a 1-foot thick lateral drainage layer with a minimum hydraulic conductivity greater than or

equal to 1 E-2 centimeters per second (about 14 inches per hour), which will slope at 3 percent to promote flow. The top will be a 3-foot thick sandy silt to silt topsoil capable of supporting a vegetative cover and storing water for evapotranspiration. Perennial grasses consisting of Thickspike and Siberian wheatgrasses will be seeded on the site to provide the long-term transpiration of water that may be stored in the topsoil.

In order to ascertain the effectiveness of the cover design, the hydrologic evaluation of landfill performance computer model was used. The hydrologic evaluation of landfill performance model used five consecutive years of Hanford Site daily precipitation data to estimate annual and peak daily run-off, drainage, and percolation through the cover. The output of the model can be considered conservative to the degree that hydraulic properties of sandy loam soil were input, and a sandy silt to silt soil, available at the McGee Ranch site, is planned for the topsoil material. The sandy silt to silt soil has better water retention characteristics than the sandy loam soil (Heller et al. 1985).

One sample of silt loam (Cold Creek sample) was tested in the laboratory for water retention characteristics with results indicating that 13.7 inches of water can be stored in 3 feet of this topsoil, which is roughly twice the average annual precipitation rate at the Hanford Site and twice the water storage capacity of sandy loam soil. Considerable laboratory hydraulic property data were evaluated for the sandy loam soil, while water retention characteristics for only one sample have been completed to date on the silt loam. The laboratory data are presented in Table II.B-2. Once the moisture characteristics and hydraulic conductivity functions of the silt loam have been determined, the hydrologic evaluation of landfill performance model should use the new data.

Appendix E provides a description of the hydrologic evaluation of landfill performance model and a listing of the input parameters and output values. The average annual percolation rate through the cover, assuming a 10 percent geomembrane failure rate and using the conservative water storage capacity of sandy loam soil, is 0.0735 inch per year. The combination of the water retention characteristics of the topsoil, which stores water for evaporation and transpiration, the lateral drainage layer, and impermeable components of the cover design, provide a cover system that minimizes the migration of water into the waste zone.

II.B-2b. Maintenance Needs. As required by WAC, this section describes how maintenance during the post-closure care period will be minimized by the design and construction of the final cover. Stabilization projects conducted at the Hanford Site since 1978 have shown that very little site maintenance has been required following the successful establishment of a vegetative cover. Of primary concern during the post-closure period will be repair of any damage to the landfill cover due to erosion. In addition, periodic maintenance inspections of the vegetative cover, run-off control structures, and the groundwater monitoring wells and pumps will be necessary during the post-closure period.

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Table II.B-2. Water Retention and Soil Texture Characteristics*.

SAMPLE	DENSITY g/cm^3	0.1 bar g/g	0.1 bar vol/vol	0.3 bar g/g	0.3 bar vol/vol	1.0 bar g/g	1.0 bar vol/vol	3.0 bar g/g	3.0 bar vol/vol	15 bar g/g	15 bar vol/vol	water storage*** (cm)	% passing #10 sieve	% passing #230 sieve	% SAND	% SILT	% CLAY	USDA Soil Texture
GRP 1	1.60	0.1935	0.32	0.1088	0.17	0.0457	0.07	0.0329	0.06	0.0337	0.047	33.0	79.3	26.50	50	38	11	Sandy Loam
GRP 2	1.60	0.1261	0.20	0.0585	0.09	0.0344	0.06	0.0315	0.05	0.0273	0.038	22.5	99.0	24.80	75	17	8	Sandy Loam
GRP 3	1.60	0.1014	0.16	0.0479	0.08	0.0314	0.05	0.0267	0.04	0.0263	0.037	18.0	99.7	16.90	81	9	8	Loamy Sand
GRP 4	1.60	0.1407	0.23	0.0617	0.10	0.0357	0.06	0.0296	0.05	0.0293	0.041	27.0	100.0	25.10	75	16	9	Sandy Loam
GRP 5	1.60	0.1268	0.20	0.0590	0.10	0.0518	0.08	0.0429	0.07	0.0413	0.053	27.0	98.8	25.30	73	17	10	Sandy Loam
GRP 6	1.60	0.1900	0.31	0.1266	0.20	0.0583	0.09	0.0496	0.08	0.0480	0.062	34.5	98.3	28.80	65	24	11	Sandy Loam
34-83.0-10 FT	1.60	0.1556	0.25	0.1135	0.18	0.0614	0.10	0.0515	0.08	0.0446	0.062	25.5	97.9	16.50	80	16	4	Loamy Sand
36-99.0-10 FT	1.60	0.2175	0.35	0.1856	0.30	0.1264	0.20	0.0936	0.15	0.0917	0.114	30.0	97.5	29.90	60	30	10	Sandy Loam
36-89.10-20FT	1.60	0.0634	0.10	0.0602	0.10	0.0340	0.05	0.0265	0.04			9.0	99.9	6.40	87	8	5	Loamy Sand
37-88.0-10 FT	1.60	0.0714	0.11	0.0407	0.08	0.0395	0.06	0.0303	0.05			9.0	99.3	8.00	85	10	5	Loamy Sand
37-89.0-5 FT	1.60	0.2050	0.33	0.1570	0.25	0.1509	0.24	0.0951	0.15	0.1068	0.150	27.0	99.1	25.50	61	27	12	Sandy Loam
37-89.5-10 FT	1.60	0.0601	0.10	0.0415	0.07	0.0365	0.06	0.0295	0.05			7.5	99.9	4.40	90	6	4	Sand
38-88.0-5 FT	1.60	0.1030	0.16	0.0607	0.11	0.0614	0.10	0.0502	0.08	0.0502	0.076	12.0	99.3	7.90	92	4	4	Sand
38-88.5-10 FT	1.60	0.0558	0.09	0.0412	0.07	0.0327	0.05	0.0284	0.05			6.0	98.0	4.70	83	10	7	Loamy Sand
42-88.0-10 FT	1.60	0.1064	0.17	0.0603	0.11	0.0549	0.09	0.0474	0.08	0.0503	0.070	13.5	97.0	16.20	80	15	5	Loamy Sand
45-88.0-5 FT	1.60	0.1485	0.24	0.0735	0.12	0.0571	0.09	0.0434	0.07	0.0480	0.067	25.5	84.8	18.70	75	18	7	Sandy Loam
47-90.0-5 FT	1.60	0.1733	0.28	0.0743	0.12	0.0529	0.08	0.0423	0.07	0.0459	0.064	31.5	99.5	34.60	67	27	6	Sandy Loam
43-88.0-10 FT	1.60	0.1749	0.28	0.1195	0.19	0.0808	0.13	0.0759	0.12	0.0792	0.121	24.0	95.4	27.50	66	26	8	Sandy Loam
43-88, #1	1.40	0.1917	0.27	0.0864	0.12	0.0624	0.09	0.0539	0.08	0.0536	0.077	28.5	98.2	40.68	60	26	6	Sandy Loam
43-88, #2	1.40	0.2473	0.35	0.1031	0.15	0.0709	0.10	0.0575	0.08	0.0555	0.076	40.5	99.4	43.06	60	33	7	Sandy Loam
43-88, #3	1.40	0.2690	0.38	0.1153	0.16	0.0754	0.11	0.0596	0.08	0.0632	0.088	45.0	98.3	40.21	57	36	7	Sandy Loam
43-88, #4	1.40	0.2378	0.33	0.1125	0.16	0.0714	0.10	0.0543	0.08	0.0619	0.087	37.5	99.6	38.40	58	35	7	Sandy Loam
43-88, #5	1.40	0.2279	0.32	0.1097	0.15	0.0766	0.11	0.0574	0.08	0.0648	0.091	36.0	94.5	35.81	64	28	8	Sandy Loam
43-88, #6	1.40	0.1863	0.26	0.0659	0.09	0.0559	0.08	0.0462	0.06	0.0485	0.068	30.0	98.8	32.70	67	25	8	Sandy Loam
43-88, #7	1.40	0.2403	0.34	0.1134	0.16	0.0929	0.13	0.0663	0.09	0.0760	0.103	37.5	95.2	28.88	61	28	11	Sandy Loam
43-88, #8	1.40	0.2015	0.30	0.1058	0.15	0.0816	0.11	0.0559	0.08	0.0687	0.096	46.5	98.7	48.24	46	44	10	Loam
COLD CREEK**	1.40	0.3547	0.50	0.1938	0.27	0.1395	0.20	0.0826	0.12	0.1049	0.147	57.0	92.1	60.45	39	61	12	Silt Loam
FLY ASH	0.68	0.6725	0.67	0.4121	0.28	0.3948	0.21	0.1609	0.11			84.0	68.4	63.42	44	44	12	Loam

*(Heller et al. 1985)
**Cold Creek sample is a Ritzville silt loam.
***Water storage calculated for 150-cm deep profile.

Erosion damage to the 100-H Area may occur as a result of flooding, precipitation, or wind. The probability of serious damage to the 100-H Area due to flooding or precipitation is low; the 183-H Basins lie in an area above the 100-year floodplain (390-foot mean sea level contour). The flow in the Hanford Reach of the Columbia River is controlled primarily by the upstream dams; so the probability of flooding is remote. The combination of an arid regional climate, high evapotranspiration rates, and the 183-H Basin areas minimal local topographical relief, makes precipitation damage highly unlikely from all but the rare, high-intensity rain events. The potential for wind erosion will be offset by the establishment of a perennial grass cover, and as necessary, the use fertilizers, herbicides, and mulching practices.

Successful establishment of a vegetative cover generally requires 2 to 3 years. During this establishment period, the straw mulch applied for initial stabilization and the natural emergence of cheatgrass (Bromos tectorium), which is ubiquitous to southeastern Washington, combine to protect the soil from erosion by wind. Periodic observations by trained personnel will be made to evaluate seedling progress and to recommend necessary corrective actions. Herbicides may be used in the spring to selectively control annual broadleaf species that compete for available moisture and nutrients. Herbicide applications will be discontinued following successful perennial grass establishment, which is estimated to take two to three growing seasons. Fertilizer applications after closure may be needed to stimulate plant vigor during the second or third year. Deep-rooting shrubs that have root systems extending into the waste zones are common to the region. Manual removal of such vegetation may be required during the post-closure period to prevent biointrusion and transport of waste materials.

A literature review will be conducted to determine if geomembrane testing is required due to potential contact with leachate-containing herbicides or pesticides. This literature review will be conducted before definitive design.

Slopes created by the installation of the landfill cover and run-off control structures (drainage pipes and ditches), and the resultant channeling of run-off water, may lead to localized increases in erosion. Although run-off damage is expected to be minimal, regular inspections of areas that could be subject to erosion run-off control structures will be necessary. Drainage pipes will be inspected for blockage. Minor damage to the drainage ditch and cover embankment slopes will be repaired with hand tools. Should there be any major erosion damage, repairs will be made using grading equipment and fill soils.

Settlement, sedimentation, and displacement are not expected to become maintenance problems at the 183-H Basins. The buried wastes will be in compacted bulk form rather than containerized, so large voids, into which the landfill cover could slump, will not exist in the closed landfill. Careful placement and compaction of the cover layers during construction will greatly reduce settlement and sedimentation occurrence. Differential settlement is not expected, and only a very small and insignificant amount of uniform compression/consolidation will occur with time.

The foregoing discussion demonstrates that the preliminary cover design will function properly with only minimal maintenance, if any. When the final cover has been designed, additional refinements in the elimination of long term maintenance needs are anticipated. More information regarding post-closure inspection, monitoring, and maintenance of the final protective cover can be found in Sections III.A-1, A-2, and A-3.

II.B-2c. Erosion and Abrasion. The 183-H Basins cover design has been evaluated for erosion due to wind and water. The erosion rates for water and wind erosion have been calculated using the *Universal Soil Loss Equation and The Wind Erosion Equation*, respectively. Detailed calculations for erosion potential are provided in Appendix F. The estimated total erosion rate for the 183-H Basins cover is 2.8 tons per acre per year, which is equivalent to 1/64 inch per year. To minimize erosion on the cover, the preliminary design used a 3-5 percent cover slope to promote run-off without excessive erosional forces. Also a vegetative cover of Thickspike and Siberian wheatgrasses will be planted on the cover to further reduce erosion.

The steeper embankment slopes were evaluated for gully and sheet erosion. It was determined that the 3H:1V (preliminary design) embankment slopes would require a cobble protective layer to reduce erosion potential. Therefore, a cobble layer was designed to protect the cover embankment sideslopes. A sand drainage layer was designed to horizontally remove water that might percolate through the topsoil. Design calculations for granular and geotextile filter layers to protect the drainage layer and other cover components are provided in Appendix F.

II.B-2d. Settlement, Sedimentation, and Displacement. In accordance with WAC, this section addresses technical accommodations for any potential settling, sedimentation, and displacement of the preliminary designed cover. Settlement, sedimentation, and displacement are not anticipated to be a problem at the 183-H Basins. To ascertain the potential for sedimentation or related features, the mechanisms that cause sedimentation or related problems must be understood. Such mechanisms include consolidation, underground cavities (mining, karst, and landfill), and improper embankment design. Furthermore, accurate characterization of existing subgrade conditions of both soil and cover engineering properties are required to adequately predict sedimentation and settlement.

Consolidation-Related Sedimentation--Immediate settlement (initial consolidation), which is caused by compression and escape of the air in the soil voids that occurs immediately upon loading, has already occurred to the 183-H Basins foundation soils on construction of that facility (about 1949). Therefore, due to cover construction, immediate settlement of the foundation materials underlying the 183-H Basins cover is likely to be inconsequential. Upon demolition and removal of the 183-H Basins, some soil rebound may occur that would immediately settle upon construction of the cover.

Consolidation is categorized as primary and secondary. Consolidation of a soil occurs by expulsion of pore fluids under excessive hydrostatic pore pressure (primary) and by long-term deformation of the skeleton of the soil mass and compression of gases in the voids (secondary). As with initial

settlement, any primary consolidation that would have occurred at the site has already happened; therefore, minimal foundation compression is anticipated due to the loads that will be imposed by the cover materials.

Regarding the cover materials specifically, the most likely candidate for consolidation is the clay/soil, low-permeability component; but consolidation is still considered to be very low. Laboratory analysis of consolidation potential of the low-permeability soil will verify this statement. Secondary consolidation takes place slowly over time and generally is insignificant when compared to primary consolidation. Secondary consolidation is not specifically significant for the types of soils underlying the site or cover construction materials.

No wastes have been buried below the 183-H Basins in containers or by any other method. Therefore, consolidation and compression cannot occur due to dewatering of wastes. Because the Hanford Site is located in an arid-steppe environment where silty sands predominate, the potential for biological oxidation occurring in the soil cover is insufficient to cause consolidation or compression of this cover. No chemical reactions are foreseen that could occur in the foundation materials to cause solids to turn to liquids thus causing consolidation.

Cavity-Related Sedimentation--Cavities as described herein are large voids within a soil or rock mass that have been recognized to cause sedimentation at the ground surface (EPA 1985). Cavity-related sedimentation has been documented as related to mining, natural karstic (solution cavity) areas, and landfills. Mining has not occurred near the 183-H Basins. A review of the subsurface strata indicates that no water-soluble rock such as (limestone, which has been documented to cause karst sedimentation) exists beneath the 183-H Basins. Cavity-related sedimentation in landfills is caused by waste consolidation, decomposition of organic wastes, and collapse into cavities created by random dumping of wastes. These settlement features have been documented to lead to cracks in cover surfaces, collapse of portions of the cover, and ponding of water in depressions in the cover caused by sedimentation of portions of the cover. If the 183-H Basins become a landfill, it will be constructed on the surface with no wastes buried below original grade; therefore, cavity-related sedimentation problems will not occur.

Embankment-Related Displacement--Embankments generally fail due to inadequate strength of soils of either the embankment materials, the foundation materials, or both. Strength testing of the embankment materials will indicate the allowable slope angle for embankment design. Also, seepage, inadequate drainage, freeze/thaw, and dry/soak phenomena affect slope stability. The potential effects of these phenomena have been considered in the embankment design for the 183-H Basins cover as addressed in this section.

Seepage--Seepage in the classical sense has not been a design consideration for this cover, because the embankment will not be used as a dike and the groundwater level is approximately 40 feet below grade. However, fine sands and silts are highly susceptible to seepage, which in turn causes

piping erosion. Seepage from the topsoil layer will be adequately controlled by proper filter design. Both a soil filter (Unified Soil Classification SP sand drainage layer) and redundant (as regards filtration) geotextile filter will be used to control seepage and piping potential in the topsoil. Percolation from the topsoil to the SP sand drainage layer will not be constant, occurring only when over 13 inches of water are stored within the topsoil profile.

Drainage--The cover embankment has been designed to transmit lateral drainage from the cover plus run-off collected over the area of the embankment. The drainage layers consist of a SP sand with a hydraulic conductivity of at least 1 E-2 centimeters per second overlaid by a cobble filter/bedding material and cobble. The transmissivity (T) of the SP sand is equal to the sand layer thickness times the hydraulic conductivity of the sand, therefore,

T = (30-cm thickness SP sand)(1 E-2 cm/s) = 0.3 square centimeters per second.

Volumetric flow (Q) is calculated on a unit width basis where the unit width is defined as 1 ft = 30 cm. Therefore,

$Q = (T)(30\ cm) = (0.3\ cm^2/s)(30\ cm) = 9$ cubic centimeters per second per foot width of drainage layer.

The worst-case flow condition, as calculated in Appendix F, is 1,955 cubic feet per day for the entire cover.

The perimeter (P) of the cover at the top of the embankment is equivalent to the total unit width of SP sand available for drainage, therefore,

$P = (2)(230\ ft + 140\ ft) = 740\ ft.$

Therefore, the drainage capacity of the SP sand drainage layer is calculated as follows:

$(740\ ft\ width)(9\ cm^3/s/ft\ width) = 6{,}600$ cubic centimeters per second

$(6{,}600\ cm^3/s)(in.^3/16.387\ cm^3)(ft^3/1728\ in.^3) = 0.233$ cubic feet per second

$(0.233\ ft^3/s)(3600\ s/h)(24\ h/day) = 20{,}138$ cubic feet per day.

The worst-case required drainage capacity is 1,955 cubic feet per day; therefore, no drainage problems are foreseen that would impact the embankment cover stability.

Freeze/Thaw and Dry/Soak--Neither freeze/thaw nor dry/soak phenomena will be stability problems for the cover embankment as discussed in the following. Surface soil temperatures have been recorded at the Hanford Meteorological Station since 1952. The lowest temperature recorded at 36 inches below the surface was 32 °F, which occurred once over the monitoring period

(Stone et al. 1983). Therefore, the zone of frost penetration does not exceed 3 feet below grade. The only vulnerable component in the embankment susceptible to frost action is the low-permeability soil layer. However, this layer is located 4 feet below grade and 1 foot below the frost penetration depth. Also, the water table is located approximately 40 feet below grade and will not contribute to the availability of water for the formation of ice lenses.

The embankment has been designed to convey water from the cover and embankment areas through the use of the SP sand drainage layer, the cobble filter layer, and the cobble layer. Water velocities have been calculated through the cobble bedding layer and have not been deemed excessively erosive of the SP sand layer.

Strength, Angle of Internal Friction, and Friction Angles--The strength properties of the embankment materials must be evaluated to determine the allowable embankment slope angle. The angle of internal friction for compacted sands generally is greater than 30 degrees (Sowers et al. 1970). Of specific concern in embankment slope design is the friction angle or slip angle of the geomembrane in contact with the SP drainage sand. Analyses of triaxial shear strength data have provided internal friction angles for the embankment materials. The strength tests have evaluated the effect of pore pressure that reduces the strength of the sand. Data indicate that a friction angle on the order of 17 degrees to 18 degrees is likely between the sand and geomembrane (Giroud 1987). However, embossed high-density polyethylene geomembranes in contact with Ottawa sand (angle of internal friction equals 36 degrees) have yielded friction angles of 28 degrees to 30 degrees (Giroud 1987).

It has been concluded from the preliminary design that the 3H:1V or 18.4 degrees embankment slope likely will be stable, but must be evaluated using actual data. To finalize the evaluation, a slope stability analysis needs to be completed while using the actual constructions soils for which the shearing resistance data, provided by the shear strength testing, are used to evaluate the potential of a slope failure by one of several methods available, such as the method of slices (Sowers et al. 1970). Note that Ecology has directed that the final (definitive) design cover' sideslopes will be 4H:1V or less.

Liquefaction--Liquefaction is a term used to identify the shear failure of cohesionless soils, generally caused by incremental increases in neutral stress generated by repeated small loads. However, quick conditions can occur under no increased load if loose sands are impacted by shock waves. Liquefaction can be avoided by properly compacting the SP sand drainage layer, low-permeability soil, and foundation layer upon installation at relative densities above 70 percent (Sowers et al. 1970).

Additional Data Needs--A schedule is provided in Figure II.B-1 that indicates the specific tasks and time elements required to determine cover material data needs. This includes identification of cover materials in the field and laboratory testing of engineering properties. The subsurface soil

at the 183-H Basins can be tested in the laboratory at the same time that the other cover materials engineering properties are determined.

II.B-2e. Cover System Permeability. The cover system permeability is required to be less than or equal to that of subsoils for landfill closure (the terms permeability and hydraulic conductivity are used interchangeably throughout this document). Hydraulic conductivity is a property of the soil and fluid together. Permeability, in its strictest sense, has units of length squared, is often phrased 'intrinsic permeability', and is a property of the porous medium only. The two terms are difficult to separate in practice. Therefore, for convenience, the term permeability is used in this document as equivalent to hydraulic conductivity.

The cover system must provide a permeability less than or equal to the natural subsoils. The intent of the WAC regulations is to control the rate of infiltration through the cover such that it does not exceed the water removal capacity of the liner/leachate collection system or natural subsoils and so cause a 'bathtub effect' to occur. The bathtub effect refers to the retention of water above the liner or natural subsoils such that the water remains in contact with the waste, providing a leaching mechanism for waste transport. The convex shape and slope of the low-permeability layer also prevents the 'bathtub effect'.

The permeability of the natural subsoils at the 183-H Basins has not been tested in the field or laboratory; however, the subsurface soils have been characterized and unconsolidated, silty-sandy gravels of the Hanford formation exist to a depth of approximately 50 feet below the 183-H Basins. Typical permeability ranges of such soils are 1 E-2 to 1 E-5 centimeters per second (about 14 inches per hour to .34 inch per day).

The hydraulic conductivity of the cover system is controlled to some degree by the topsoil, lateral drainage, and low-permeability components of the cover. The topsoil layer, consisting of a sandy silt to silty soil, retains water for evapotranspiration to the environment. A clean, washed, coarse-textured Unified Soil Classification SP sand component underlies the silty topsoil. The interface of these two components functions as the barrier to downward migration of water. This phenomenon is referred to as the 'Richards Effect'. The application behind the 'Richards Effect' is that the water, which has infiltrated the fine-textured topsoil, cannot penetrate into the coarser textured sand layer until sufficient pressure builds at the interface, which equals the topsoil's effective water storage capacity.

The SP sand drainage layer has been designed with a hydraulic conductivity greater than or equal to 1 E-2 centimeters per second and sloped at 3 percent, thus providing a lateral drainage layer within the cover. Two low-permeability components, including a soil layer with a maximum hydraulic conductivity of 1 E-7 centimeters per second and a geomembrane with a maximum hydraulic conductivity of 1 E-11 centimeters per second (about 1.24 inches per 10,000 years), are placed beneath the topsoil and sand drainage layers. The geomembrane is intended to effectively provide an impermeable component to the cover design. However, eventually the geomembrane will deteriorate or unknowingly could become damaged during

construction. In case of a geomembrane failure, the low-permeability soil component has been designed to function as the backup barrier to prevent vertical flow of infiltrating water into the waste zone.

The coupled components of the cover will provide a cover system hydraulic conductivity much lower than the subsurface soils at the 183-H Basins. Estimates of water percolation through the cover are provided in Appendix E. Assuming a 2 percent failure of the geomembrane, the data (Appendix E) indicate that the estimated average annual drainage through the bottom of the cover will only be 51 cubic feet or 0.23 percent of the average annual precipitation. Therefore, the preliminary cover design provides a cover system hydraulic conductivity that meets the intent of the regulations.

II.B-2f. Freeze/Thaw Cycle Effects. Freeze/thaw effects have been considered in the 183-H Basins cover system design. The maximum frost penetration depth, as recorded at the Hanford Meteorological Station, is 3 feet below grade. The average number of annual freeze/thaw cycles is 93 with a range of 25 to 168 days (Stone et al. 1983). A freeze/thaw cycle is defined as a day in which the minimum temperature is below freezing and the maximum temperature is above freezing.

The water table is approximately 40 feet below grade. This, coupled with the subsurface soils of the Hanford formation, indicates that capillary rise from the water table to the cover should not be a problem but could occur. Nothing more than a subsurface lens of sands and/or gravels, free of silt, would provide a capillary break, thus preventing further rise of water. Particle size analyses, coupled with porosity data for the subsurface soils, are required to accurately determine the potential for capillary rise. Samples can be taken during subsurface soil sampling or may be available from previous groundwater well installations for determination of subsurface soil particle sizes. The low-permeability component is the most susceptible component of the cover system to freeze/thaw effects. However, the low-permeability component will be located sufficiently below the frost penetration depth so that water available from capillary rise would not freeze in that component.

A small level of ice lens formation could occur in the silty topsoil component. However, the only water available for such ice lens formation is that stored in the silty soil matrix. The coarse materials underlying the silty topsoil act as a capillary break, thus preventing the upward movement of water into the topsoil. Also, the geomembrane would act as a barrier to upward rise of water if water were available for such a rise. Freeze/thaw effects to the cover embankment are minimal and are addressed in Section II.B-2d.

In summary, considerations of freeze/thaw effects on the cover have been evaluated, and the cover has been adequately designed to prevent deleterious problems due to freeze/thaw cycling.

III. POST-CLOSURE REQUIREMENTS

This chapter is divided into the six post-closure requirements as follows:

- Section III.A, Post-Closure Plan
- Section III.B, Personnel Training
- Section III.C, Procedures to Prevent Hazards
- Section III.D, Post-Closure Contact
- Section III.E, Amendment of Post-Closure Plan
- Section III.F, Certification of Completion of Post-Closure Care.

For purposes of post-closure planning, it has been assumed that the 183-H Basins will be closed as a RCRA landfill with a final cover, per the WAC 173-303 *Dangerous Waste Regulations* (Ecology 1989).

III.A. POST-CLOSURE PLAN

Post-closure care of the 183-H Basins will continue for a period specified by Ecology; however, for planning purposes, a minimum of 30 years has been envisioned. The 30-year time frame has been used throughout this plan to acknowledge the long-term commitment of the post-closure requirements. This section provides details of the post-closure plan and is divided into three parts as follows:

- Section III.A-1, Inspection Plan
- Section III.A-2, Monitoring Plan
- Section III.A-3, Maintenance Plan.

III.A-1. Inspection Plan

As required by regulations, the inspection plan provides details concerning the necessary security equipment, the inspection of erosion and other factors that might affect the integrity of run-on and run-off control measures, and the inspection for gas ventilation, well conditions, and benchmark integrity. A logbook will be kept by the personnel conducting the inspections and maintained for examination by the regulatory agency for the entire 30-year period of post-closure monitoring. The inspector will record any damage to the cover and/or other maintenance needs, as well as the weather conditions at the time of inspection, and will sign and date the logbook. Maintenance actions, as noted in the logbook, will be started/completed within 90 days so that the next logbook entry can document the correction of

the problem. Table III.A-1 depicts the inspection items and their frequencies for the post-closure care period.

Table III.A-1. Inspection Schedule for the 183-H Basins Dangerous Waste Site.

Items	Inspection frequency Quarterly	Annually
Security control devices: fences and wells	X	
Erosion damage	X	
Cover settlement, sedimentation, and displacement	X	
Condition of vegetative cover	X	
Cover drainage system	X	
Well condition and purgewater collection system	X	
River staging facility	X	
Benchmark integrity		X

III.A-1a. Security Control Devices. The 183-H Basins are located within the Hanford Site controlled access area, where roadways are restricted to authorized personnel only and, for national security reasons, the general public is excluded.

Access from the Columbia River is been restricted by federal warning signs. As with the other facilities on the Hanford Site, the 100-H Area has been routinely patrolled by helicopter and vehicle. As part of the closure activities, the 183-H Basins will be bounded by a chain link fence with locked gates and warning signs.

All of the 100-H Area groundwater monitoring wells and the Columbia River recording stations have a locking cap to prevent well tampering. The wells also are surrounded by four steel guardposts to prevent damage from vehicles. The overall well condition, locks, guardposts, pumps, and purgewater collection system will be inspected during each water sampling. Problems and/or damage will be noted on the sampling log and tracked so that repairs can be made. Table III.A-1 contains the inspection schedule for the 183-H Basins. The security procedures to be used during the post-closure care period are described in Section III.C-1a.

III.A-1b. Erosion Damage. The overall erosion control for the closure site will be dictated by the health of the vegetative cover and the slope at the edge of the cover. The 183-H Basins' cover will be inspected quarterly. The inspection will consist of walking over the site to visually check for erosion damage. A quarterly survey is scheduled to observe the site and vegetative cover during different seasonal conditions. Erosion damage for the 100-H Area will be addressed in three components: precipitation, flood, and wind.

Precipitation--The Hanford Site climate has been mild and dry, perhaps best visualized as semiarid. The Hanford Site typically has received 6.3 inches of annual precipitation. Because of the semiarid climate, much of the annual precipitation is lost to evapotranspiration. The 100-H Area is relatively flat (less than 25 feet vertical to 1,000 feet horizontal). The combination of low annual precipitation, high evapotranspiration rates, relatively flat topography, and a stable vegetative cover reduces the possible damage due to precipitation. However, the integrity of the final cover will be inspected quarterly to ensure that no appreciable erosion has taken place either on the sides or on the top portion of the cover.

Flood--The flow in the Hanford Reach (past the 100-H Area) of the Columbia River has been controlled by the Priest Rapids Dam. The present river channel was developed at the end of the last ice age, a time when much higher volumes of water flowed through than are presently flowing. The flood water associated with a regulated (by Priest Rapids Dam) 100-year flood of 440,000 cubic feet per second would not leave the present channel banks (390 feet mean sea level contour). The 183-H Basins are located approximately 50 feet above and 500 feet horizontally from the Columbia River. Therefore, the probability of flood-induced erosional damage to the 183-H Basin final cover is very low.

Wind--The monthly average wind speeds for the Hanford Site have ranged from about 6 miles per hour in the summer to 8 miles per hour in the winter. The prevailing regional winds have been from the northwest. The strongest average winds have occurred during the months of high average precipitation. This combination has decreased the chance of winter wind erosion damage. In the spring, early summer, and late fall the local floral communities have helped control wind erosion. When the floral communities begin to dry out in late summer, the probability of wind erosion has remained low; because winds have usually tended to decrease during this period. At the 100-H Area, winds are typically from the west-southwest (Appendix A, Map 2).

III.A-1c. Cover Settlement, Sedimentation, and Displacement. The 183-H Basins' cover will be inspected quarterly, by physically walking over the site to visually check for settlement, sedimentation, and displacement. Settlement, sedimentation, and displacement are synonymous terms for any surface breach or depressions in the final cover's exterior. Any such breaches or depressions will require an investigation to determine the root cause, evaluate the long-term environmental impacts, and provide a corrective solution. The quarterly inspection surveys have been scheduled to observe the site during different seasonal conditions. The inspections will follow the same logbook procedures as outlined for erosion damage.

Settlement/sedimentation greater than 1 foot will be reported to Ecology within 30 days of observation. Proposed maintenance action may include injecting grout into identified void spaces or other means of reestablishing the integrity of the multilayer cover system, and then reestablishing the vegetative cover as needed [WAC 173-303-390(3)]. If, at the time of maintenance action, new products and/or information are available to perform the needed repair in a comparable manner to the actions listed above, those maintenance actions may be considered in lieu of the above proposed actions.

III.A-1d. Vegetative Cover Condition. The 183-H Basins vegetative cover will be inspected biweekly until the vegetation cover is established, and quarterly thereafter. The inspection will consist of walking over the site to visually check the condition of the vegetation. The vegetative cover is a very important factor for the long-term stability of the landfill cover. The quarterly inspection has been scheduled to observe the site and vegetative cover during the different seasonal conditions. Erosion damage that results in the loss of 1 foot of the fine topsoil layer will be reported to Ecology within 30 days of observation. After evaluation, maintenance actions may include replacement of the fine soil top layer at the affected area, reseeding, and other tasks that were performed during closure to ensure a vigorous vegetative growth, such as the application of fertilizers. No cover damage is expected from inspectors walking over the site in order to perform quarterly inspection duties.

Should a piece of heavy construction equipment be required to ascend the 3H:1V (preliminary design, subsequently Ecology has directed that the cover's sideslopes will be 4H:1V or less) embankment for repair or cover maintenance, a temporary ramp would be constructed to protect the configuration of the embankment materials. If the vegetative cover canopy is less than 50 percent of the achievable cover canopy (nominally 10 percent at the Hanford Site) after 2 years from the closure date, Ecology will be notified. Vegetative cover canopy will be measured using the point intercept method (Floyd and Anderson 1983) or cover class estimation method (Daubenmire 1959). No documentable data exist regarding achievable percent canopy cover for sites that have been revegetated with Thickspike and Siberian wheatgrasses at the Hanford Site. However, observations of revegetated stabilization projects have indicated that a minimum of 10 percent cover is achievable. Maintenance action will include reseeding and the possible application of fertilizer. The inspection of the vegetative cover will follow the same procedures as outlined for erosion damage.

III.A-1e. Integrity of Run-On and Run-Off Control Measures. Inspections of the integrity of the run-on and run-off control system will be performed concurrent with cover inspections. Ecology will be notified within 30 days following identification of any erosion greater than or equal to 1 foot in the areas of the run-on and run-off control systems.

III.A-1f. Cover Drainage System Functioning. The 183-H Basins final cover will be inspected quarterly. The inspection will consist of a walking over the site to visually check the cover drainage system. The main focus will be the integrity of the run-on and run-off precipitation control systems, and the nonvegetated perimeter of the final cover. The quarterly survey has been scheduled to observe the site during different seasonal conditions. Additionally, extra inspections will be made, as dictated by unusual weather occurrences (e.g., heavy thunderstorms, rapid snow melts). The inspections will follow the same procedures as outlined for erosion damage.

III.A-1g. Well Condition and Purgewater Collection System. The well condition and purgewater collection system will be visually inspected during each water sampling/monitoring. Likewise, the river stage gauge will be inspected by checking for water and ice damage, tampering, and normal-stage

recorder operation. Problems and/or damage will be noted in the sampling logbook and duly reported so that repairs can be made. Additionally, any problems noted during the quarterly inspections will be recorded in the inspection logbook. Maintenance actions will be scheduled so that, if possible, the subsequent inspection can document correction of the previous problem.

III.A-1h. Benchmark Integrity. Inspection (surveying) of the 100-H Area benchmarks will be done yearly. The 100-H Area was originally laid out with a benchmark on every node of an 800-foot grid. When the surveyors do any work on the Hanford Site, the standard practice has been to use two or more benchmarks to cross-check the integrity of their measurements. Benchmarks that have been observed to be damaged or out of alignment, will initiate maintenance action. Maintenance action will include replacement of damaged benchmarks and/or resurveying of benchmarks found to be out of alignment.

III.A-2. Monitoring Plan

This section describes the groundwater monitoring network that has been in operation for the 183-H Basins since May 1974. Also included are a summary of analytical results that have been obtained thus far, and a discussion of the groundwater monitoring program to be continued until a final status post-closure permit is issued by Ecology.

The following documents have been prepared by Pacific Northwest Laboratory for the DOE-RL that describe the design of the 100-H Area groundwater monitoring network and summarize the current state of knowledge regarding geohydrologic characteristics beneath the 183-H Basins:

- *Revised Groundwater Monitoring Compliance Plan for the 183-H Solar Evaporation Basins*, PNL-6470, September 1986 (PNL 1986b)
- *Interim Characterization Report for the Area Surrounding the 183-H Basins*, PNL-6471, April 1987 (PNL 1987f)
- *Geohydrologic Characterization of the Area Surrounding the 183-H Solar Evaporation Basins*, PNL-6728, December 1988 (Liikala et al. 1988).

Quarterly and annual progress reports for each RCRA groundwater unit on the Hanford Site have been prepared and forwarded to Ecology. Pacific Northwest Laboratory has prepared these reports for the 183-H Basins in the past, and Westinghouse Hanford will be taking over production of the reports during 1990. The following reports were produced by Pacific Northwest Laboratory and are currently available under the title *Groundwater Monitoring Compliance Projects for Hanford Site Facilities*: Progress Reports:

Period	1986	1987	1988	1989
Jan. 1 to Mar. 31	a	PNL-6467	PNL-6581	PNL-6957
Apr. 1 to Jun. 30	a	PNL-6468	PNL-6675	PNL-7134
Jul. 1 to Sep. 30	PNL-6465	PNL-6469	PNL-6789	PNL-7222
Oct. 1 to Dec. 31	PNL-6466	PNL-6536	PNL-6844	PNL-XXXX
Annual Reports	(none)	PNL-6678	PNL-6852	PNL-XXXX

Note: a=Regular reporting started in May 1986. The initial progress report PNL-6465 covers the period May 1 through September 30, 1986. PNL-XXXX signifies a report 'in progress'.

Revision of this closure plan has drawn extensively from information contained in the *Geohydrologic Characterization Report* (Liikala et al. 1988) released in December 1988, and from the quarterly progress reports (the progress report for the third quarter of 1989 is included in Appendix K). The information contained in this closure plan also has been made consistent with the groundwater monitoring aspects of the *183-H Solar Evaporation Basins Final Status Post-Closure Permit Application* (DOE-RL 1988a).

The reader who is already familiar with the above documents and other background information pertinent to the 100-H Area groundwater monitoring may wish to skip to Section III.A-2f, Groundwater Quality Assessment Plan and Results. A brief summary of background information and water quality data gathered to date is included in this section, and it provides an introduction to the continued interim status and post-closure groundwater monitoring proposed in Section III.A-2g that follows.

III.A-2a. Topographic Maps. A topographic map of the 100-H Area is provided in Appendix A. This map shows a contour interval of 2 feet and the location of each groundwater monitoring well. Maps showing the extent of contaminant plumes attributable to the 183-H Basins, along with narrative descriptions of the concentrations and extent of contamination, are presented in Sections III.A-2d and III.A-2e.

III.A-2b. Design and Construction of 100-H Area Monitoring Wells. This section summarizes the design, construction, and installation history of the groundwater monitoring wells in the 100-H Area. Construction diagrams for each well, including information on depth of screens and casing, water table depth, filter pack and sealing placements, date of construction, lithologic diagrams, and geophysical logs, have been presented in the *183-H Solar Evaporation Basins Final Status Post-Closure Permit Application* (Appendix B of DOE-RL 1988a), and in the *Geohydrologic Characterization Report* (Liikala et al. 1988, Appendix A).

III.A-2b(1). Well Locations. Figure III.A-1 shows the locations of the 25 wells in the 100-H Area. Geographic coordinates for the wells are provided in Table III.A-2. Well 199-H4-2, which was drilled in 1952 to a depth that intercepted the uppermost confined aquifer, has only been included for

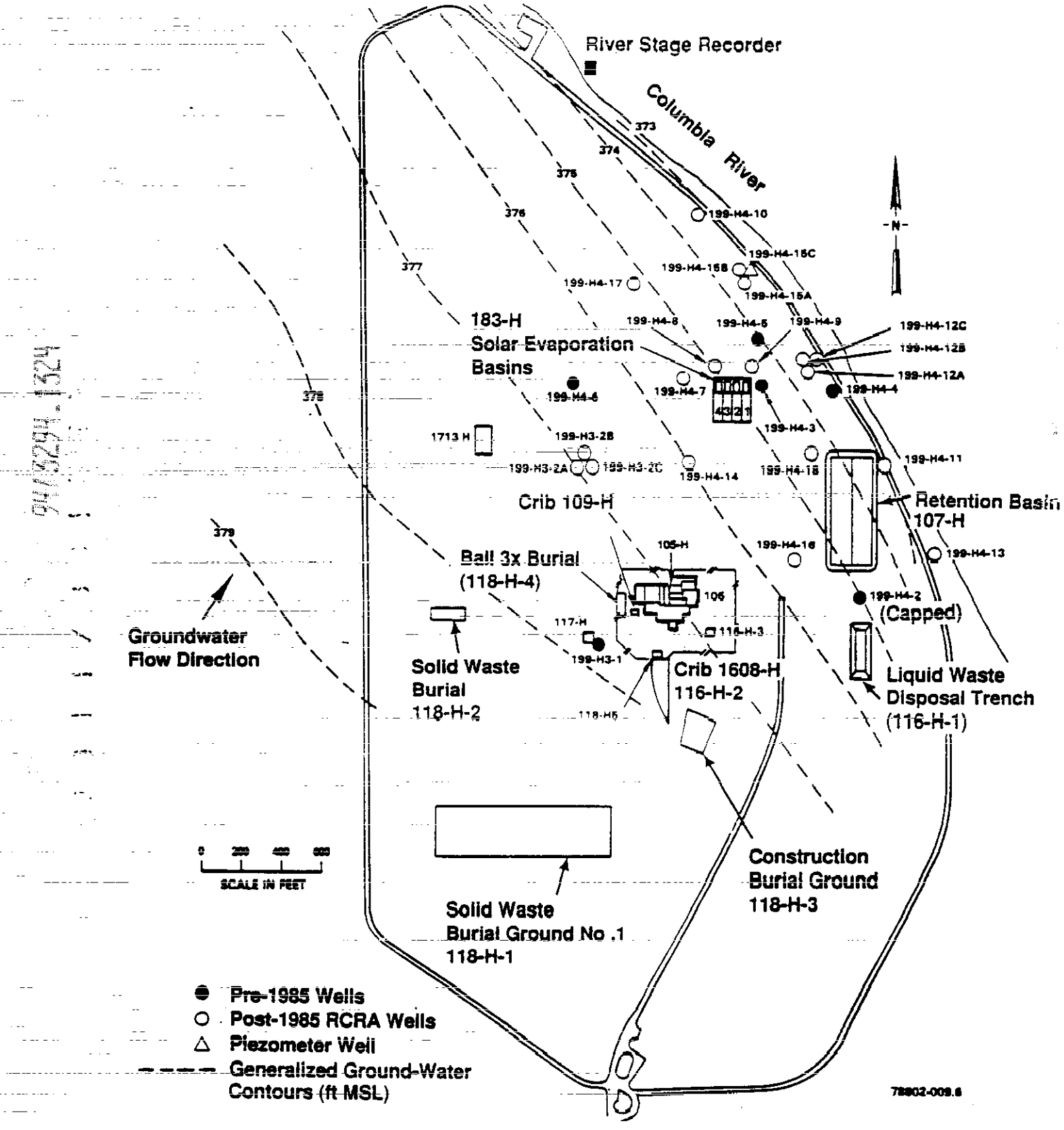


Figure III.A-1. Location Map for 100-H Area Groundwater Monitoring Wells.

Table III.A-2. Completion Data For The 100-H Area Monitoring Wells.

Well number	Completion date	Construction materials: Casing	Construction materials: Screen	Depth (ft relative to land surface): to bottom	Depth: to water	Depth: of screened interval	Depth: of pump intake setting	Hydrostratigraphic unit	Hanford Plant Coordinates	
Original monitoring wells										
199-H3-1	08-60	Carbon steel	Perforated	75	45	29-74	49	Unconfined aquifer	N 94994.3	W 40052.2
199-H4-2	05-52	Carbon steel	Perforated	311	unk	25-50	n/a	Drilled to basalt	N 95200	W 38565
199-H4-3	05-74	Carbon steel	Perforated	55	39	34-55	50	Unconfined aquifer	N 96372.3	W 39079.7
199-H4-4	06-83	Carbon steel	Stainless	50	36	33-43	44	Unconfined aquifer	N 96356.3	W 38684.8
199-H4-5	05-83	Carbon steel	Stainless	60	36	32-42	46	Unconfined aquifer	N 96638.7	W 39064.5
199-H4-6	05-83	Carbon steel	Stainless	54	41	39-49	47	Unconfined aquifer	N 96472.9	W 40245.0
Phase II wells										
199-H3-2A	11-04-86	Stainless	Stainless	51	41	36-51	46	Unconfined aquifer	N 96018.6	W 40117.0
199-H3-2B	11-14-86	Stainless	Stainless	55	40.5	50-55	46	Unconfined aquifer	N 96041.9	W 40104.9
199-H3-2C	10-15-86	Stainless	Stainless	110	41	100-110	45	SS&GSS[a]	N 96019.4	W 40092.5
199-H4-7	09-22-86	Stainless	Stainless	53	43	38-53	48	Unconfined aquifer	N 96479.0	W 39526.7
199-H4-8	09-11-86	Stainless	Stainless	48	44	38-48	47	Unconfined aquifer	N 96580.0	W 39341.1
199-H4-9	09-24-86	Stainless	Stainless	46	43	36-46	45	Unconfined aquifer	N 96488.3	W 39136.2
199-H4-10	09-22-86	Stainless	Stainless	38	29	23-38	33	Unconfined aquifer	N 97348.6	W 39449.1
199-H4-11	10-10-86	Stainless	Stainless	53	43	38-53	48	Unconfined aquifer	N 95943.7	W 38419.8
199-H4-12A	11-04-86	Stainless	Stainless	48	38	33-48	43	Unconfined aquifer	N 96549.5	W 38854.0
199-H4-12B	11-11-86	Stainless	Stainless	50	37	45-50	42	Unconfined aquifer	N 96568.3	W 38869.6
199-H4-12C	10-03-86	Stainless	Stainless	82	36	72-82	41	SS&GSS[a]	N 96572.8	W 38845.3
199-H4-13	11-20-86	Stainless	Stainless	52	42	37-52	47	Unconfined aquifer	N 95506.3	W 38166.9
199-H4-14	12-05-86	Stainless	Stainless	53	43	38-53	47	Unconfined aquifer	N 96024.8	W 39529.2
199-H4-15A	11-11-86	Stainless	Stainless	42	32	27-42	37	Unconfined aquifer	N 97012.0	W 39197.0
199-H4-15B	11-19-86	Stainless	Stainless	42	30	37-42	35	Unconfined aquifer	N 97032.2	W 39212.3
199-H4-15C(P)[b]	10-29-86	Stainless	Stainless	327	Flowing	325-327	N/A	Lower confined aquifer	N 97033.5	W 39185.8
199-H4-15C(Q)[b]	10-29-86	Stainless	Stainless	297	0.25	295-297	N/A	Upper confined aquifer	N 97033.5	W 39185.8
199-H4-15C(R)[b]	10-29-86	Stainless	Stainless	196	27.5	194-196	N/A	SS&GSS[a]	N 97033.5	W 39185.8
199-H4-15C(S)[b]	10-29-86	Stainless	Stainless	80	30.5	78-80	N/A	SS&GSS[a]	N 97033.5	W 39185.8
Phase III wells										
199-H4-16	04-30-87	Stainless	Stainless	57.5	48.5	42.5-57.5	53	Unconfined aquifer	N 95496.0	W 38945.8
199-H4-17	05-08-87	Stainless	Stainless	45	41.5	35-45	43.5	Unconfined aquifer	N 96961.0	W 39607.7
199-H4-18	05-26-87	Stainless	Stainless	51	45	40-50	48	Unconfined aquifer	N 96036.8	W 38825.2

[a] Silty sand and gravelly silty sand.
[b] Piezometers.

geohydrologic characterization purposes. The well was artesian and was capped to prevent it from flowing. Well 199-H4-15C contains piezometers and has been dedicated to hydraulic head measurements. The remaining 23 wells comprise the groundwater sampling network for the 183-H Basins.

III.A-2b(2). Details of Well Design and Construction. The monitoring wells at the 100-H Area were constructed in three phases: (1) those installed before RCRA requirements went into effect (pre-1985 'original monitoring network'), (2) Phase II RCRA monitoring wells installed in 1986, and (3) Phase III additional RCRA wells installed in 1987. All the wells were drilled using the cable-tool method. The completion data for these wells are given in Table III.A-2. The following sections describe the three phases of the monitoring network construction.

Wells Installed Before 1985--Well 199-H3-1 is the oldest well in the groundwater monitoring network and is located upgradient of the 183-H Basins. The well was constructed in 1960 as part of a Site-wide network to monitor tritium and nitrate in the groundwater at the Hanford Site. The well has an 8-inch carbon steel casing. In 1974, Well 199-H4-3 was installed downgradient of the 183-H Basins to monitor the use of Basin Number 1 as a solar evaporation facility. The well has a 6-inch carbon steel casing. Both of these wells were designed to monitor the top of the unconfined aquifer. There is neither a cement nor a bentonite seal around the casings of either of these wells, and neither had a concrete pad around the well head until 1987.

In 1983, Wells 199-H4-4, 199-H4-5, and 199-H4-6 were installed to provide increased monitoring of the 183-H Basins. These wells were constructed with carbon steel casing and telescoping stainless steel screens. Cement seals extending from the ground surface down to a depth of about 20 feet, were placed around the outside of the carbon steel casings.

In 1987, steel posts and concrete pads were installed around all of these pre-RCRA wells to protect the surface casing and to prevent seepage of water down the outside of the well casing.

Phase II--This phase of the monitoring program started in 1986. The groundwater monitoring network was expanded with the construction of 16 new wells, including seven single shallow wells and three well clusters, each consisting of a shallow, intermediate, and deep well. The cluster wells were situated in a triangular arrangement with sides approximately 25 feet in length. The Phase II wells were constructed and completed in accordance with regulations contained in 40 CFR 265 Subpart F, WAC 173-303-160, and WAC 173-303-645(8).

All the Phase II wells, with the exception of 199-H4-15C, were constructed with 6-inch diameter Type 304 stainless steel casing and screening. For each well, a sand filter pack was placed around the screened interval, and the annulus was sealed with bentonite pellets, bentonite slurry (below the water table), granular bentonite (above the water table), and concrete. Also a concrete pad and protective steel posts were placed around each well.

The deep wells within each cluster (199-H3-2C, 199-H4-12C, and 199-H4-15C) were the first to be drilled during Phase II. This strategy allowed the geohydrologic units to be defined and provided information for anticipating geologic conditions at the subsequent well locations. The planned completion zone within the Ringold Formation, which was a gravel unit noted on the drilling log of Well 199-H4-2, was not encountered upon drilling to 220 feet in Wells 199-H4-12C and 199-H4-15C, and 155 feet in Well 199-H3-2C. Therefore, alternate completion strategies, based on information from the drilling logs and geophysical logs, were chosen for Wells 199-H3-2C, 199-H4-12C, and 199-H4-15C.

Well 199-H4-15C was drilled to the top of basalt to characterize the suprabasalt stratigraphy. The well was completed with four piezometers that were emplaced in the following units:

(P)--the Saddle Mountains Basalt,

(Q)--the silty-clayey sand to sandy-silty clay unit of the Ringold Formation,

(R)--the silty-sand unit of the Ringold Formation, and

(S)--the gravelly-silty sand unit of the Ringold Formation.

The piezometers were constructed with 2-inch diameter stainless steel casing and screening. Sand filter packs were placed around each 20-slot screen. The interval between piezometers (P) and (Q) was sealed with bentonite pellets and neat cement. All other intervals between piezometers were sealed with bentonite slurry and bentonite pellets. A ball valve and pressure gauge were installed on piezometer (P) to prevent it from flowing.

Water-bearing zones within the Ringold Formation were chosen for completion of Wells 199-H3-2C and 199-H4-12C. Well 199-H3-2C was completed within the gravelly-silty sand unit of the Ringold Formation. The well was backfilled from its total depth (155 feet) to the completion zone with bentonite slurry, bentonite pellets, and silica sand. A sand filter pack was placed around the screened interval, and the well was sealed with bentonite pellets, bentonite slurry, granular bentonite, and concrete. Well 199-H4-12C was also completed within the gravelly-silty sand unit of the Ringold Formation. The well was backfilled from its total depth with a bentonite slurry seal, bentonite pellet seal, and artificial sand pack. Both wells were completed using 10-slot stainless steel screens.

The intermediate depth cluster wells (199-H3-2B, 199-H4-12B, and 199-H4-15B) were completed at the top of the Ringold Formation to monitor the lower portion of the unconfined aquifer. The completion intervals were shallower than the anticipated depth (approximately 60 feet), because of an unconformity between the Ringold and Hanford formations. The wells were completed with 20-slot stainless steel screens.

The single shallow wells (199-H4-7, 199-H4-8, 199-H4-9, 199-H4-10, 199-H4-11, 199-H4-13, and 199-H4-14) and shallow cluster wells (199-H3-2A, 199-H4-12A, and 199-H4-15A) were completed in the upper portion of the unconfined aquifer. All but two of the shallow wells were completed with 15-foot sections of 20-slot screen. Wells 199-H4-8 and 199-H4-9 were completed with 10-foot sections of 20-slot screening because of their short water columns.

Phase III--Phase III began in 1987 and included the installation of three additional shallow wells: 199-H4-16, 199-H4-17, and 199-H4-18. These wells were installed to further define the contaminant plume north and southeast of the 183-H Basins. Well specifications and installation protocol for these wells were the same as those used for both the single and cluster shallow wells in Phase II.

The Phase II and III wells were constructed and completed in accordance with the well drilling specifications contained in Appendix I. Occasional modifications to the original well design and locations were made as a result of data collected during the drilling of the deep wells.

Well Installation Protocol--All of the wells were drilled by the cable-tool method. The protocol followed for well construction and completion included geologic sampling, analysis of groundwater chemistry, geophysical logging, aquifer testing, and installation of dedicated sampling equipment. These activities are described in more detail in the following paragraphs.

- Geologic Sampling--During drilling operations, geologic samples were collected at 5-foot intervals and at changes in formation lithology. Soil moisture samples were collected above the water table when drilling was done with a drive barrel. Each sample was characterized by the well-site geologist and recorded on a drilling log. The collection and documentation of these samples were performed in accordance with written procedures. Selected samples were analyzed for the following:

  - Grain size distribution (performed on all samples)

  - Soil moisture content and soil moisture retention (performed on all drive barrel samples collected above the water table)

  - Bulk density (performed on six to eight samples from each of the three deep wells)

  - Bulk porosity (calculated for the bulk density samples)

  - Hydraulic conductivity (performed on a total of three split-spoon samples from deep Wells 199-H4-12C and 199-H4-15C).

  The results of these analyses have been reported in the *183-H Solar Evaporation Basins Final Status Post-Closure Permit Application* (Appendix E of DOE-RL 1988a).

- Groundwater Sampling During Drilling--Groundwater samples were collected from the Phase II monitoring wells as drilling progressed. Samples were collected approximately 5 feet below the static water level or when a sufficient amount of water seeped into the hole. A short period of time was allotted for sediment to settle out before sampling. Samples also were collected from the water supplied for drilling and from the flowing piezometer at Well 199-H4-15C prior to capping.

  All samples were collected using a Teflon bailer and were analyzed for selected constituents by U.S. Testing Company, Richland, Washington. The results for these groundwater samples were determined to be of limited use, because sediment in the samples may have reacted with the acid used for sample preparation, thus, increasing the dissolved constituent concentrations. For this reason, similar samples were not collected from the Phase III wells.

- Geophysical Logging--Each new well was logged with geophysical probes following completion. All of the wells were logged with natural gamma, neutron, and density probes. The uncased interval within each of the three deep wells was logged with a caliper probe. A temperature probe was used in Well 199-H4-15C to help locate the top of the bentonite slurry seals during completion. Procedures for the use of these probes have been included in the *Interim Characterization Report for the Area Surrounding the 183-H Basins* (Appendix C of PNL 1987a) and the geophysical logs have been presented in Figures 9 through 24 of that same publication, as well as in the *183-H Solar Evaporation Basins Final Status Post-Closure Permit Application* (Appendix B of DOE-RL 1988a).

- Aquifer Testing--Aquifer tests were performed on selected wells during and after installation. The methods used and preliminary results obtained have been described in the chapter entitled *Hydrogeologic Characterization of the 100-H Area of the Interim Characterization Report* (PNL 1986f). Final results have been reported in the *183-H Solar Evaporation Basins Final Status Post-Closure Permit Application* (Table E.11 of DOE-RL 1988a).

- Sampling Pumps--Piston-type sampling pumps, with water intakes located at the bottom of the pumps, were installed in 18 of the new wells. The remaining well (199-H4-15C) has four piezometers installed and has been dedicated to hydraulic head measurements; it has, therefore, not been fitted with a pump. Table III.A-2 provides information on the pump intake settings and initial depth to water for each well.

III.A-2c. Upgradient and Downgradient Wells. Water level measurements have provided a good description of the general groundwater flow direction through the 100-H Area. Also, water quality analyses to date have resulted in reasonably conclusive evidence for defining the groundwater constituents that are most indicative of contamination attributable to 183-H Basins. Based on these criteria, the wells in the monitoring network have been grouped as follows (Liikala et al. 1988).

Upgradient Wells, Within Flow Path Through the Basins

199-H3-2A	199-H3-2C	199-H4-7
199-H3-2B	199-H4-6	199-H4-14

Downgradient Wells, Within Flow Path Through the Basins

199-H4-3	199-H4-9	199-H4-12B
199-H4-4	199-H4-11	199-H4-12C
199-H4-5	199-H4-12A	199-H4-18

Wells Not Located Directly in the 183-H Basins Flow

199-H3-1	199-H4-13	199-H4-16
199-H4-8	199-H4-15A	199-H4-17
199-H4-10	199-H4-15B	

Well 199-H4-3 is located approximately 75 feet downgradient of the facility (Figure III.A-1) and has exhibited the highest concentrations of contaminants assumed attributable to the 183-H Basins.

III.A-2d. Water Analysis. The following discussion is a summary of groundwater analyses for samples taken from the 183-H monitoring network during the period June 1985 through October 1987, as reported in the Geohydrologic Characterization Report (Liikala et al. 1988). This summary was prepared from data collected through October 1987. Additional data obtained between October 1987 and November 1989 do not significantly change the generalizations made in that report. However, the concentration of contaminants in the groundwater continue to show a general decrease with time. Analytical data, along with quality control information, have been included in quarterly progress reports that have been regularly sent to Ecology. A list of these reports has been provided in Section III.A-2.

III.A-2d(1). Summary of Analytical Results. The groundwater constituents monitored at the 183-H Basins monitoring network have been grouped into the following general classes: contamination indicators, drinking water standards, groundwater quality parameters, and site-specific constituents for the 183-H Basins wastes. Since groundwater monitoring started, the maximum contaminant concentrations for certain constituents have been exceeded in at least sample. These constituents included coliform bacteria, gross alpha, gross beta, strontium-90, cadmium, chromium, mercury, selenium, and nitrate; as well as the constituents in Appendix III of 40 CFR 265.

Pesticides and herbicides from the list of drinking water standards, phenol from the groundwater quality parameters [40 CFR 265.92(b)(2)], and most of the constituents listed in WAC 173-303-9905 generally have <u>not</u> been detected in groundwater samples from the 183-H Basins groundwater monitoring network.

For the following constituents, sufficient data have been available to justify their use in characterizing the contaminated groundwater in the 100-H Area:

- Contamination indicators: specific conductance, field pH, total organic halides, and total organic carbon

- Drinking water standards: gross alpha, gross beta, radium, nitrate, fluoride, filtered and unfiltered barium, and chromium

- Groundwater quality parameters: sulfate, chloride, filtered and unfiltered sodium, manganese, and iron

- Site-specific constituents: chloroform, ammonium, filtered and unfiltered strontium, zinc, calcium, nickel, copper, vanadium, aluminum, potassium, and magnesium.

Of these constituents, nitrate, sodium, gross alpha, and gross beta have been good indicators of contamination in the groundwater due to activities at the 183-H Basins. Chromium also has been a good indicator, but it has additional sources in the 100-H Area. Figure III.A-2 shows the concentrations of nitrate and chromium as a function of time in Well 199-H4-3. Since 1974, this well has provided a continuous record of these constituents. The data shown in Figure III.A-2 are presented as annual average values. Evidence for leakage from Basin Number 1, during the period 1973 to 1978, is reflected by the major peak. Since the use of Basin Number 1 was stopped in mid-1978, the levels of both these contaminants have shown long-term decreases. An assessment of the potential environmental consequences of the 1973-1978 leakage period concluded that the environmental impact from the leakage was negligible (Greager 1982).

Figures III.A-3 through III.A-7 show the concentration and variability of all five of these indicator constituents as a function of time for the period since June 1985 (when Pacific Northwest Laboratory began detailed monitoring of the groundwater at the 100-H Area). Records for four of the monitoring wells have shown that Wells 199-H4-3, 199-H4-4, and 199-H4-5 are downgradient; and Well 199-H4-6 is upgradient. The figures represent data that have been collected on a monthly basis. The distribution pattern for chromium (Figure III.A-7) is influenced by sources in addition to the 183-H Basins.

Between March and August 1986, about 20 constituents selected for further investigation showed significant increases in Well 199-H4-3. These concentration levels have not been repeated since that time. The plots shown in Figures III.A-3 through III.A-6 clearly indicate when this peak occurred. Similar plots for specific conductance, barium, sulfate, strontium, calcium, nickel, copper, and potassium have also revealed marked increases during this particular time period (Liikala et al. 1988). Chromium (Figure III.A-7), although it has not exhibited a concentration peak similar to the other constituents, has remained above the maximum concentration limit of 50 parts per billion for most of the wells in the groundwater monitoring network.

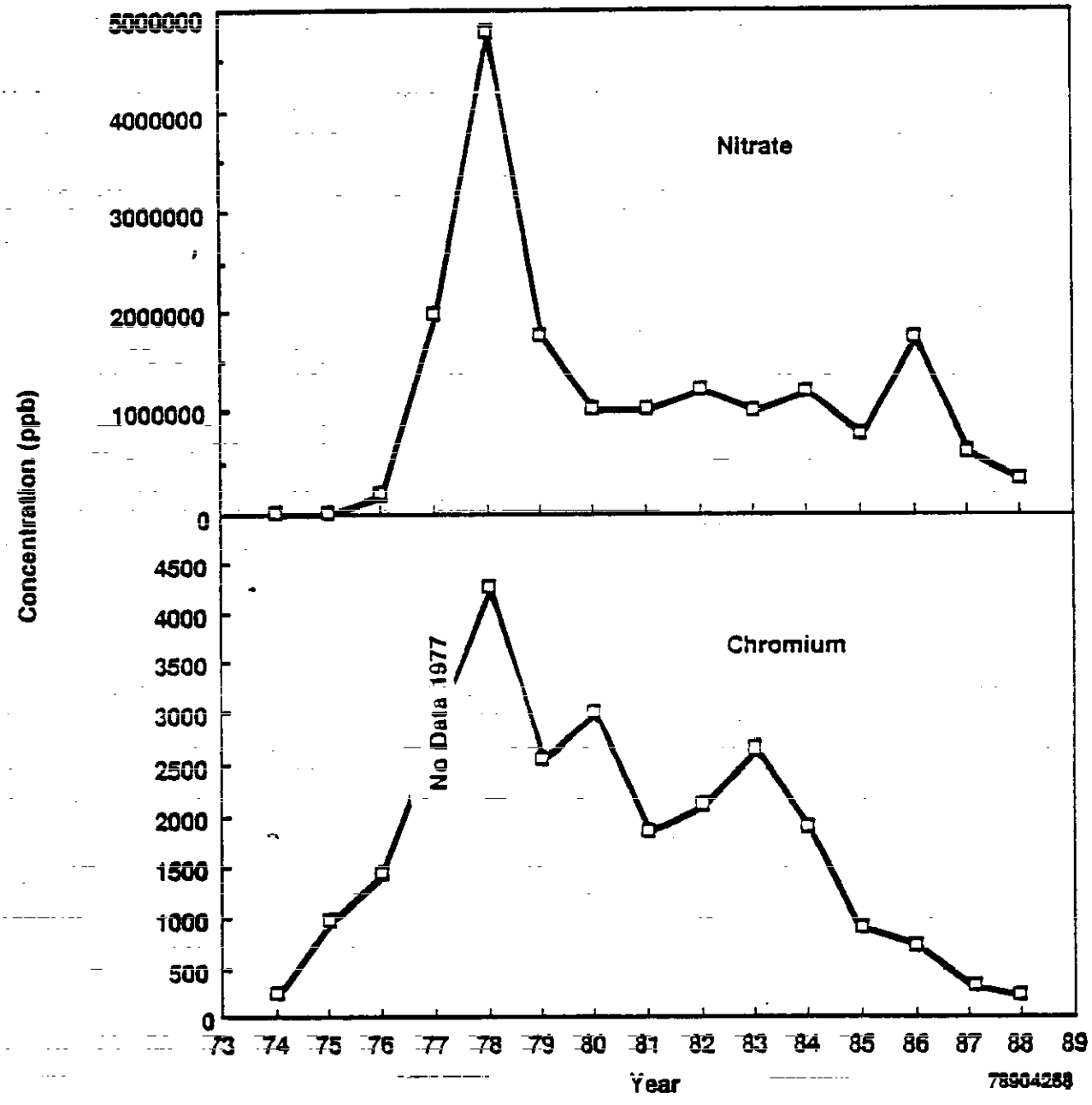
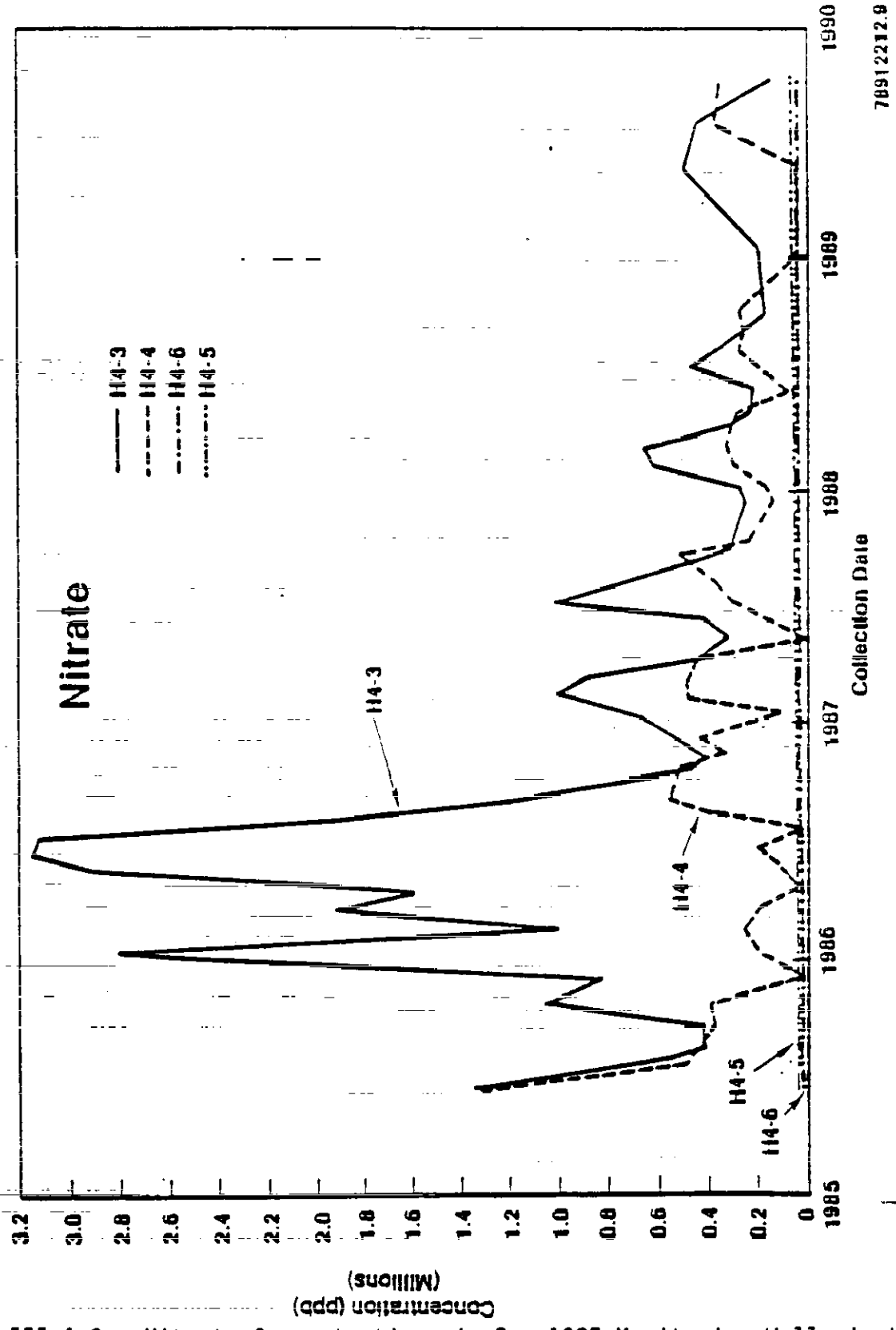


Figure III.A-2. Annual Average Concentration of Nitrate and Chromium (unfiltered samples) in Well 199-H4-3 During the Period 1974 Through 1988. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database.



1 **Figure III.A-3.** Nitrate Concentrations in Pre-1985 Monitoring Wells in the
2 Vicinity of 183-H Basins During the Period 6/85 to 12/88. Data are from
3 Pacific Northwest Laboratory's Hanford Groundwater Database, Constituent
4 Code 115.

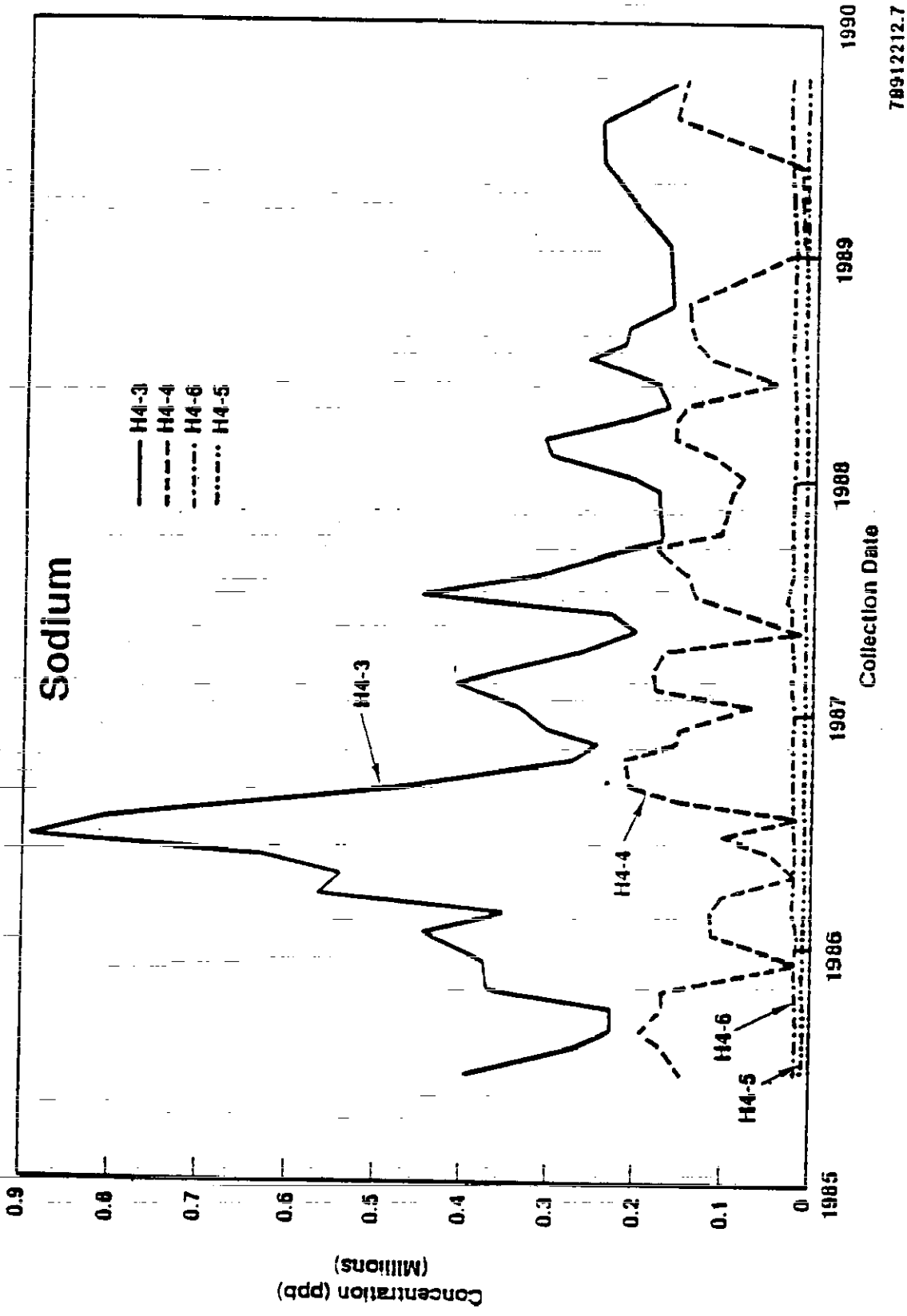


Figure III.A-4. Sodium Concentrations in Pre-1985 Monitoring Wells in the Vicinity of 183-H Basins During the Period 6/85 to 12/88. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database, Constituent Code H24 (filtered samples).

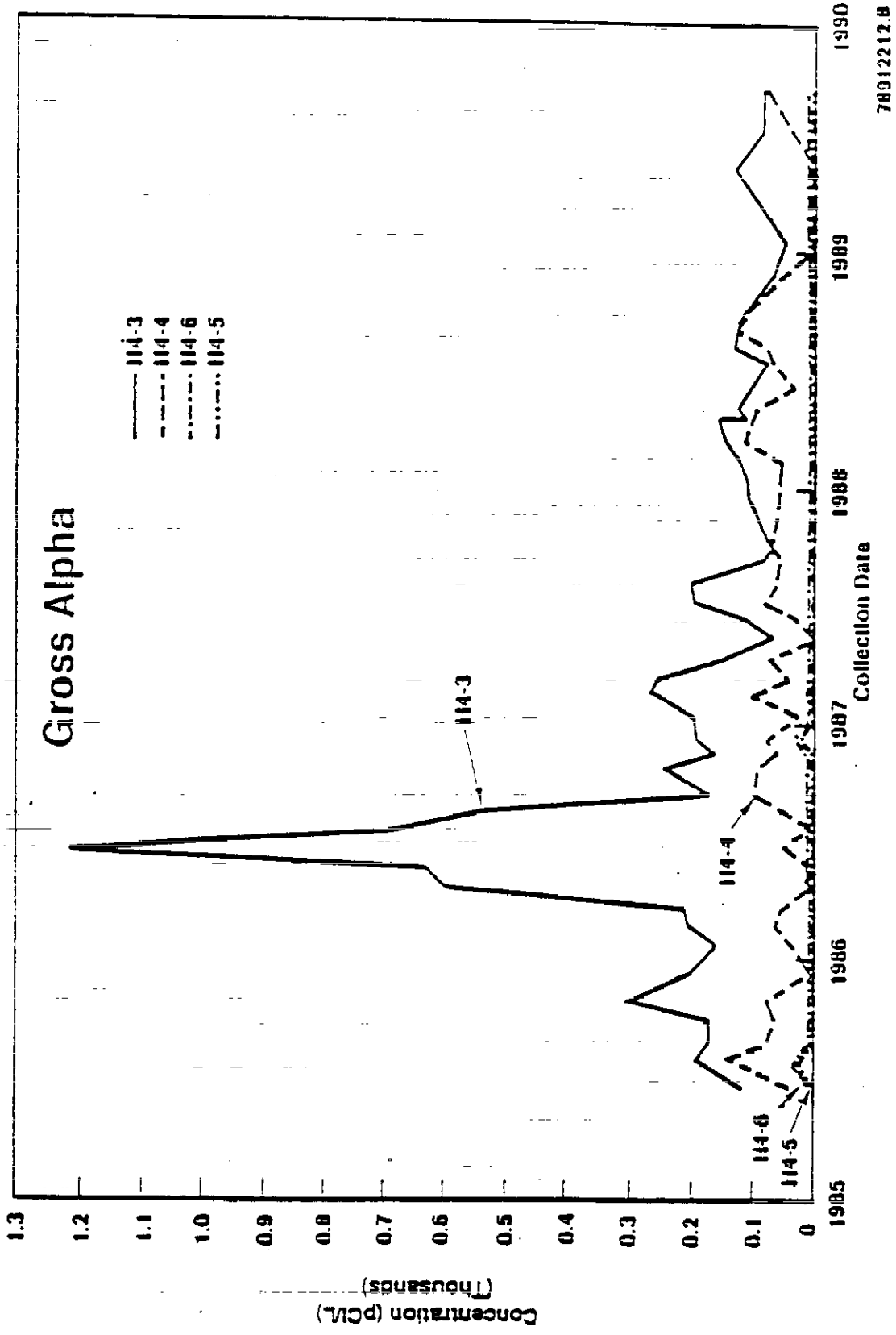


Figure III.A-5. Gross Alpha Concentrations in Pre-1985 Monitoring Wells in the Vicinity of 183-H Basins During the Period 6/85 to 12/88. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database, Constituent Code 212.

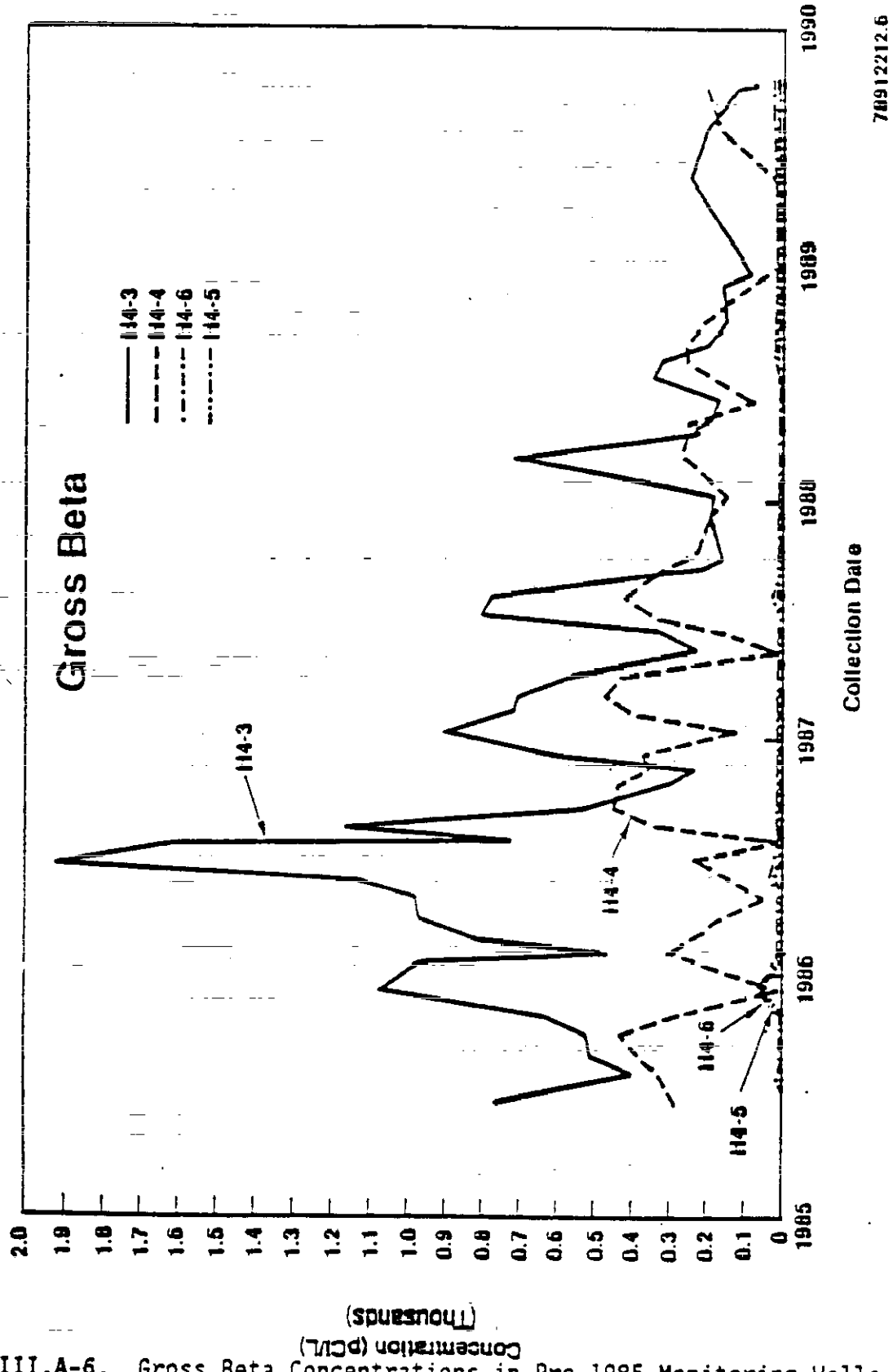


Figure III.A-6. Gross Beta Concentrations in Pre-1985 Monitoring Wells in the Vicinity of 183-H Basins During the Period 6/85 to 12/88. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database, Constituent Code 111.

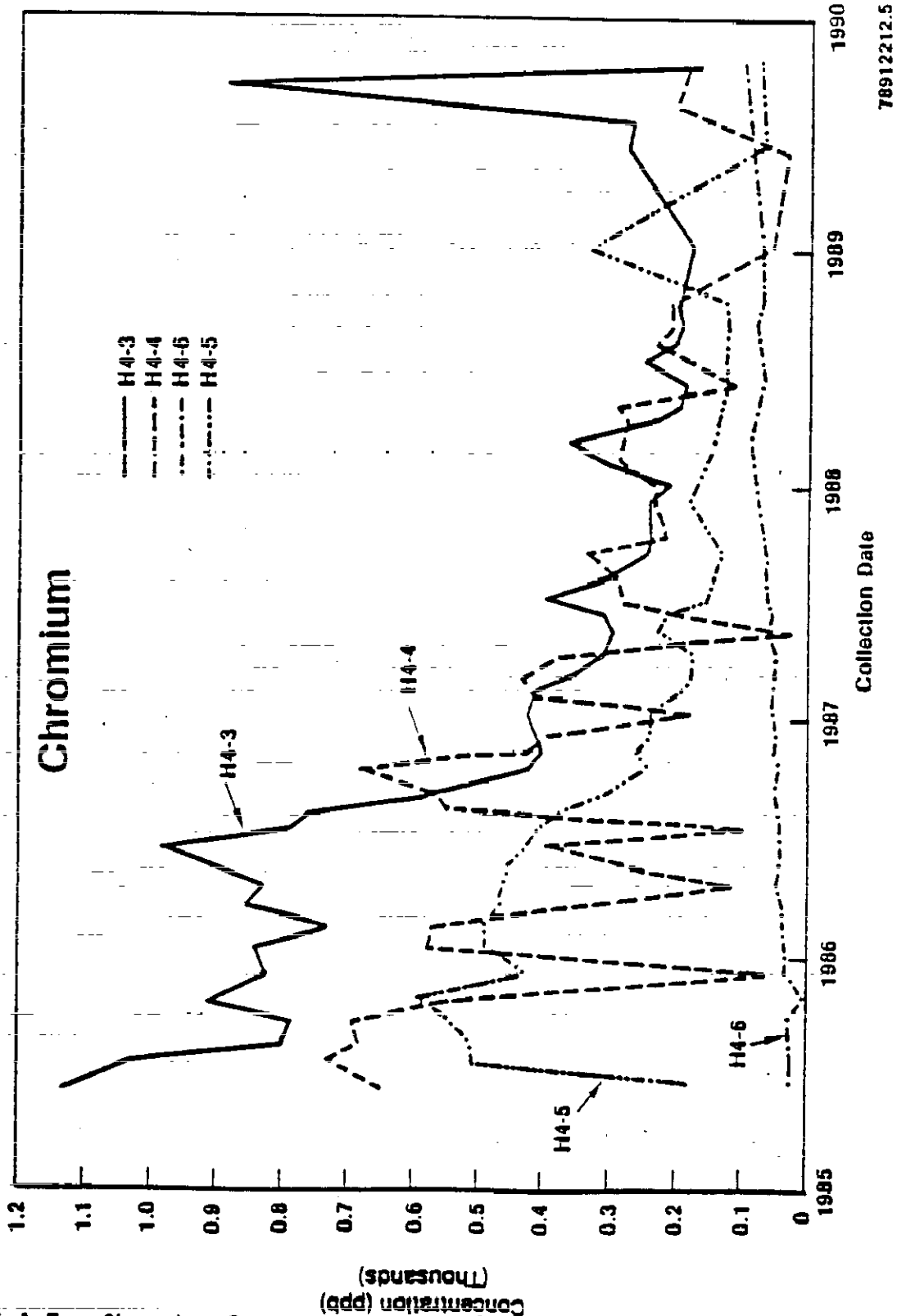


Figure III.A-7. Chromium Concentrations in Pre-1985 Monitoring Wells in the Vicinity of 183-H Basins During the Period 6/85 to 12/88. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database, Constituent Code A08 (unfiltered samples).

No speculation as to the cause of the elevated levels of 183-H indicator constituents was presented in the Geohydrologic Characterization Report (Liikala et al. 1988). Several possibilities are offered in the following paragraphs, although none of these possibilities are conclusively supported by existing data.

The mid-1986 peak in Well 199-H4-3 may have been associated with fluctuating water levels in the Columbia River, although probably not directly. Water quality constituents in 100-H Area wells typically show a negative correlation with water levels in the well, i.e., relatively high concentrations correlate with low-water levels. This is particularly true for wells close to the Columbia River, where the influx of river water into the river bank dilutes groundwater that is flowing towards the river. This phenomenon is an unlikely candidate to fully explain the mid-1986 peak in Well 199-H4-3, since the peak occurred at the same time that water levels in the well were also high (refer to Figure III.A-8 in Section III.A-2d(2).

A second possibility involves remobilization of contaminants that are associated with colloidal-sized particles and stored in the vadose zone beneath the basins (PNL 1987a, p. 66). As the water table rises, due to river water influx or other seasonal influences, soluble contaminants in particulate form are dissolved, or contaminants are desorbed from the surface of fine particles, and remobilized in the groundwater. Data from the proposed soil-sampling program should help confirm or deny this possibility.

A third possibility is that the mid-1986 peak is associated with waste cleanup operations that were being conducted about the same time (see Section I.B-3). Between June and September 1985, sludge was removed from Basin Number 1 and the basin was decontaminated; between July and September 1986, sludge was also removed from Basin Number 2, a Hypalon liner was installed, and all remaining liquids were transferred from Basins Numbers 3 and 4 to Basin Number 2. During these operations, records of the liquid volumes of wastes do not show any significant losses. Heavy equipment was working in and around the basins, and may have remobilized contaminants held in the soils adjacent to the basins by some phenomenon associated with the increased load on the soil column.

The 1986 peak is most apparent in Well 199-H4-3, which is a monitoring well that is most likely to detect leakage from the basins. Fluctuations in nitrate concentration in that well can be correlated with similar fluctuations in Well 199-H4-4, which is located about 600 feet downgradient. If the correlation is valid, a time lag of 1 to 3 months is present. This suggests a groundwater travel time between these two wells that is faster than that estimated by modeling water levels in the 100-H Area (see Section III.A-2e, Groundwater Flow Paths and Travel Times). Also, the greatest time lag occurs when the river levels are highest, i.e., when the water table gradient is lowest.

In addition to the constituents discussed previously, which are good indicators of contamination attributable to the 183-H Basins, several others can also be used. They are total organic carbon, radium, fluoride,

chloroform, and magnesium. Alkalinity, pH, and total organic halogen are useful for geochemical modeling.

While most of the constituents that have been detected in the monitoring network have exhibited a large degree of variability, some have shown very little variability. These constituents include: coliform bacteria, filtered and unfiltered cadmium, silver, arsenic, mercury, selenium, lead, beryllium, phosphate, 1,1,1-trichloroethane, perchloroethylene, thallium, bis(2-ethylexyl) phthalate, total carbon, total dissolved solids, cobalt-60, strontium-90, and uranium. These constituents are either not indicative of contamination attributable to the 183-H Basin, or the existing data are too limited for conclusive statements. A short summary for each of these constituents is as follows:

- Cadmium--sporadically has been reported in several wells usually at or near the detection limit of 2 parts per billion

- Silver--has been reported once in Well 199-H4-3

- Arsenic--consistently has been reported in several wells near the 183-H Basins at levels just above the detection limit of 5 parts per billion

- Mercury--has been reported in several wells in July 1985 but otherwise below the detection limit of 0.1 parts per billion

- Selenium--has been reported in Wells 199-H4-5 (twice) and 199-H4-9 (once)

- Lead--sporadically has been reported in several wells, usually at or near the detection limit of 5 parts per billion

- Beryllium--has been reported twice at the detection limit of 5 parts per billion

- Phosphate--has been reported once above the detection limit of 1,000 parts per billion

- 1,1,1-Trichloroethane--sporadically has been reported in several wells

- Perchloroethylene--sporadically has been reported in several wells

- Thallium--has been reported once above the detection limit of 10 parts per billion in the initial sampling in June 1985

- Bis(2-Ethylexyl) phthalate--has been reported once above the detection limit of 10 parts per billion

- Total carbon--initially was reported in October 1987

- Total dissolved solids--initially was reported in October 1987

- Cobalt-60--limited data, mostly has been less than counting error

- Strontium-90--limited data, has been near 1 picocuries per liter (pCi/L) except one value

- Uranium--limited data, initially was analyzed in March 1988.

The remaining constituents in the total list of analyses do not appear to have been indicative of groundwater contamination attributable to the 183-H Basins and are as follows:

- Manganese--concentrations in Well 199-H4-3 have been lower than in background Well 199-H4-6

- Iron--concentrations have been lower during the '1986 peak'

- Chloride--no discernible increase in concentrations over background

- Zinc--concentrations have been lower than background

- Vanadium--no discernible increase in concentrations over background

- Aluminum--concentrations have been lower during the '1986 peak'

- Ammonium--concentrations have been generally less than background.

III.A-2d(2). Statistical Evaluations. The 183-H Groundwater Compliance Monitoring Program was established in June 1985 because dangerous waste constituents were believed to have entered the groundwater beneath the 183-H Basins. Based on data collected between June 1985 and October 1987, and guidance provided in WAC 173-303-645, the following four statistical evaluations have been performed:

Background Levels--Monthly groundwater monitoring data from 1987 for upgradient Wells 199-H3-2A, 199-H4-6, and 199-H4-7 have been used to calculate background values for selected indicator constituents for the 183-H Basins (Liikala et al. 1988, p. 123-124). The results are shown in Table III.A-3, along with a comparison of background levels for the 183-H Basins relative to the Hanford Site.

The data for these calculations have been pooled as though each were a random sample. The influence of seasonal changes, due to fluctuations in river level, on these values has been minimal relative to the influence on Well 199-H4-3, because of the increased distance from the river. A high degree of spatial variability has been present in the data, as shown by the plus-and-minus ranges; in the comparison with Hanford Site background. In general, the background concentrations of chromium and nitrate in the wells upgradient of the 183-H Basins have been higher than background concentrations elsewhere on the Hanford Site; i.e., indicating other sources for these constituents.

Table III.A-3. Background Concentrations For 183-H Basins.

Constituent	Units	Number of samples	Average	Standard deviation	Variation coefficient
Nitrate	ppb	32	28,740	9,290	32.3
Sodium[a]	ppb	32	15,940	5,872	36.8
Gross alpha	pCi/L	32	2.35	1.23	52.5
Gross beta	pCi/L	32	8.55	4.53	53.0
Chromium[a]	ppb	32	71.3	44.2	62.0
pH (Field)	--	31	7.542	0.4137	5.5
Total organic carbon	ppb	31	62.15	38.73	62.3

Comparison With Hanford Site Background Values:

Constituent	183-H Basins (range)	Hanford Site[b]
Nitrate	28,740 ± 19,000	500 to 2,000
Sodium[a]	15,940 ± 6,000	20,500 ± 6,700
Gross alpha	2.35 ± 1.40	2.5 ± 1.4
Gross beta	8.55 ± 1.70	19 ± 12
Chromium[a]	71.3 ± 74	< 10

[a] Filtered prior to analysis.
[b] (Jacquish and Mitchell 1988).
Note: Background values for 183-H Basins were calculated using monthly monitoring results for 1987 from Wells 199-H3-2A, 199-H4-6, and 199-H4-7 (Liikala et al. 1988, p. 123-124).

Descriptive Statistics--Descriptive statistics have been calculated for the 68 constituents that had at least one value above the detection limit to determine the variability in the data for the sampling period, June 1985 through October 1987 (Liikala et al. 1988, p. 113-114). These statistics have included: the maximum, median, minimum, range, mean, standard deviation, and coefficient of variation.

The standard deviations and coefficients of variation have been relatively large for a number of constituents and wells. Several of these constituents have been changing significantly with time (either increasing or decreasing). The concentrations also have been changing significantly with the water levels in the wells (discussed under Linear Regression Analyses).

Cluster Well Statistics--Descriptive statistics for the three cluster well locations have been reviewed individually to determine statistical differences in constituent concentrations with depth (Liikala et al. 1988, p. 114). The following observations have been made from these data.

- Aluminum, ammonium, iron, and vanadium have generally been detected only in the deep wells (199-H3-2C and 199-H4-12C).

- Barium concentrations have been lowest in the deep wells and highest in the intermediate wells (199-H2-2B, 199-H4-12B, and 199-H4-15B).

- Calcium, chromium, strontium, and sulfate concentrations have been lowest in the deep wells and the same in the shallow Wells 199-H3-2A, 199-H4-12A, and 199-H4-15A; and intermediate wells.

- Chloride has the largest mean but lowest median in the deep wells. No differences have occurred in the shallow and intermediate wells.

- Chloroform has not often been detected in the deep wells.

- Gross alpha and gross beta concentrations have decreased with depth in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C. These constituents have been below drinking water standards at the other cluster well locations.

- Manganese has generally been detected only in the intermediate and deep wells.

- Nitrate concentrations and specific conductance have decreased with depth.

- Potassium and zinc concentrations have increased with depth.

- Sodium concentrations have been highly variable in the deep wells.

Linear Regression Analyses--A series of simple and multiple linear regression analyses have been performed to determine if the chemical constituents in the wells were changing with time and water table elevation (Liikala et al. 1988, p. 115-121). The constituents have been chosen for analysis on the basis of their concentrations having been routinely reported as having been above detection limits in all the wells, with the exception of chloroform and chromium. Analyses were performed for the period June 1985 through October 1987 using 18 chemical constituents in 20 of the network wells, as shown below:

Chemical Constituents Used for Linear Regression

Gross alpha	Specific conductance
Gross beta	Filtered magnesium
Filtered barium	Unfiltered magnesium
Unfiltered barium	Nitrate
Filtered calcium	Filtered potassium
Chloroform	Unfiltered potassium
Chloride	Filtered sodium
Filtered chromium	Unfiltered sodium
Unfiltered chromium	Sulfate

Wells Used for Linear Regression

199-H3-1 (pre- and post-9/1/86)	199-H4-9
199-H3-2A	199-H4-10
199-H4-2B	199-H4-11
199-H3-2C	199-H4-12A
199-H4-3 (pre- and post-9/1/86)	199-H4-12B
199-H4-4 (pre- and post-9/1/86)	199-H4-12C
199-H4-5 (pre- and post-9/1/86)	199-H4-13
199-H4-6 (Pre- and post-9/1/86)	199-H4-14
199-H4-7	199-H4-15A
199-H4-8	199-H4-15B

Wells 199-H3-1, 199-H4-3, 199-H4-4, 199-H4-5, and 199-H4-6 have been divided into two time periods (pre- and post-September 1, 1986: '1986 peak') because of the significant change in concentration levels that have occurred in Well 199-H4-3 at this time. Prior to September 1, 1986, concentrations of all chemical constituents in this well were increasing with time and with increases in the water table elevation (Figure III.A-8 and III.A-9). However, after September 1, 1986, these concentrations have had neither statistically significant increases nor decreases with time, nor with changes in the water table elevation.

Several wells along the Columbia River have been affected by changes in water table elevation. Most of the chemical constituents in Wells 199-H4-4 (Figures III.A-10 and III.A-11), 199-H4-10, 199-H4-12A, and 199-H4-12B have significantly decreased with increases in water table elevation.

Concentrations of chemical constituents in several upgradient wells have also been significantly affected by changes in water table elevation. Concentrations in Well 199-H3-1 have decreased significantly with increases in the water table elevation. Most of the chemical constituents in Wells 199-H3-2A and 199-H3-2B have significantly increased with increases in the water table elevation. Well 199-H4-6 has shown no consistent effects. Well 199-H4-7 has had significant increases in chemical concentrations when the water table elevation increased. All of the chemical constituents in Well 199-H4-6 (pre-) have been increasing significantly with time, except chloroform, which has been significantly decreasing. After September 1, 1986, gross beta, chloroform, calcium, specific conductance, gross alpha, and sulfate have no longer significantly been increasing.

Other wells located adjacent to the 183-H Basins [Wells 199-H4-3 (post-), 199-H4-5 (post-), 199-H4-8, 199-H4-9, and 199-H4-14] have had almost no significant effects caused by changes in the water table elevation. Wells 199-H3-2C and 199-H4-12C have had only a few chemical constituents affected by the water table elevation. However, most of the constituents in these wells have been significantly decreasing over time.

III.A-2e Extent of Contamination. The following sections describe the distribution of contaminants that have been attributed to the 183-H Basins. The horizontal motion of groundwater flow in the uppermost aquifer

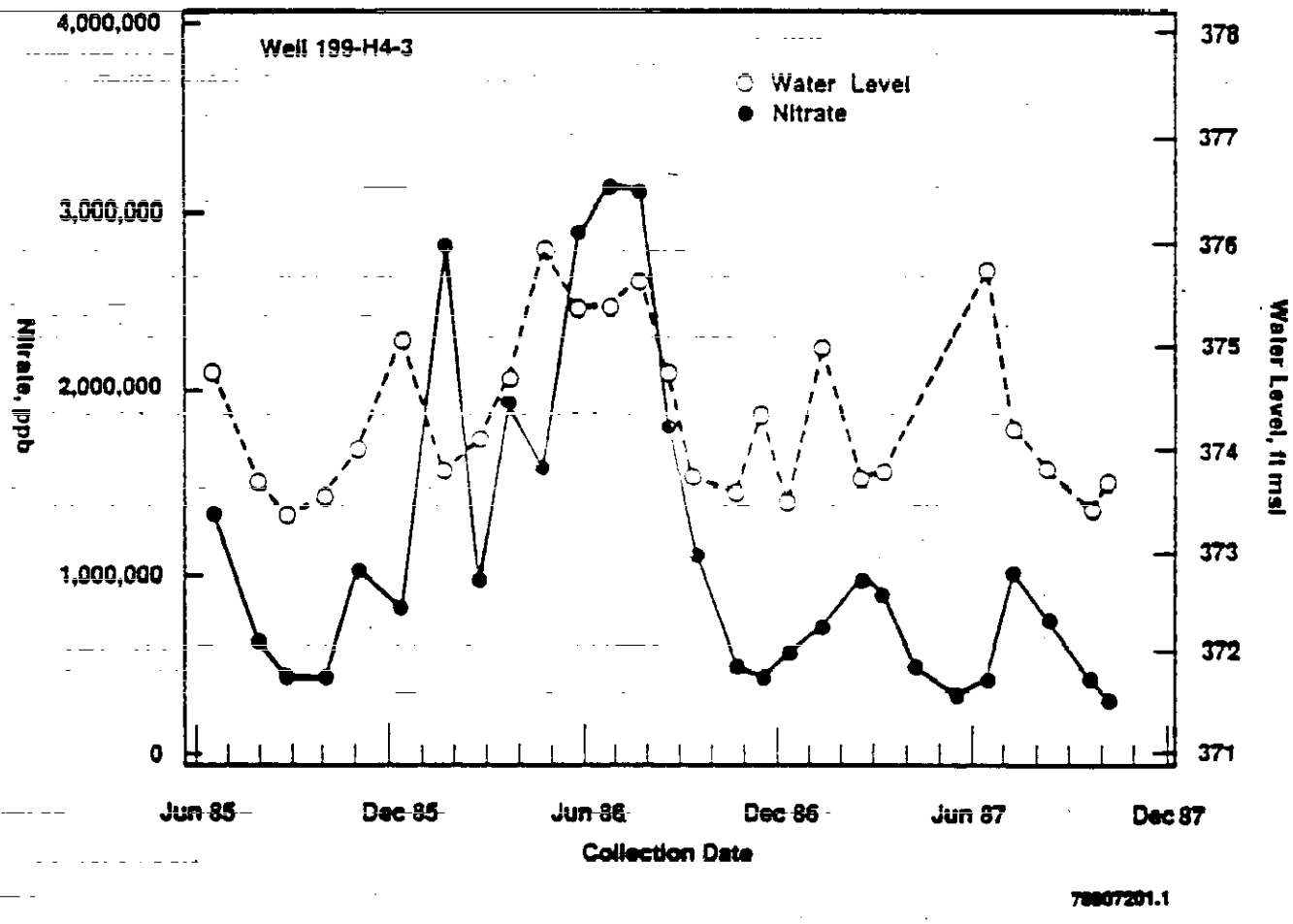


Figure III.A-8. Nitrate Concentrations and Water Levels in Well 199-H4-3 for the 183-H Basins During the Period 6/85 to 10/87. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database, Constituent Code 115; figure is redrafted from Liikala et al. (1988, Figure 59).

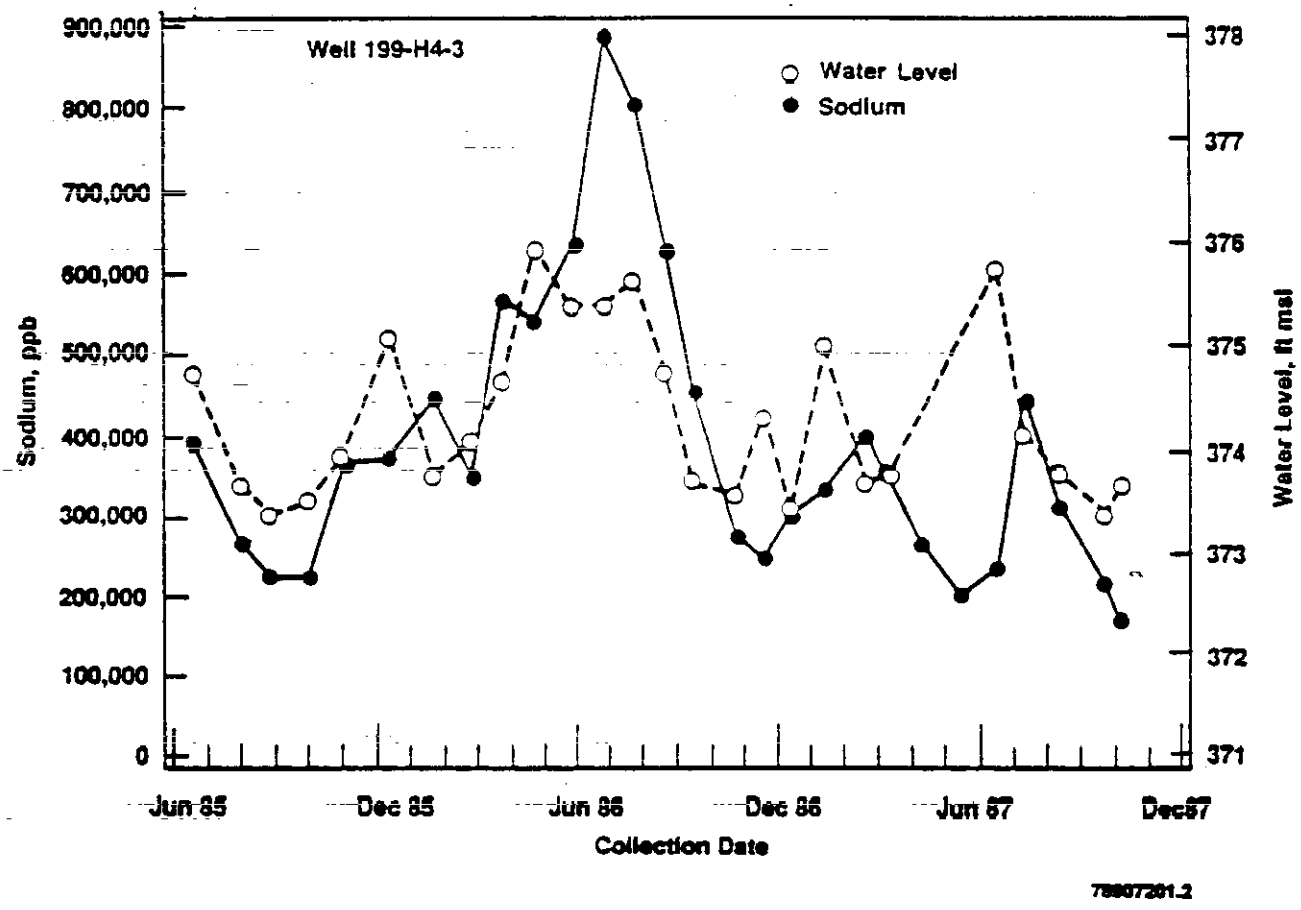


Figure III.A-9. Sodium Concentrations and Water Levels in Well 199-H4-3 for the 183-H Basins During the Period 6/85 to 10/87. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database, Constituent Code H24 (filtered samples); figure is redrafted from Liikala et al. (1988, Figure 60).

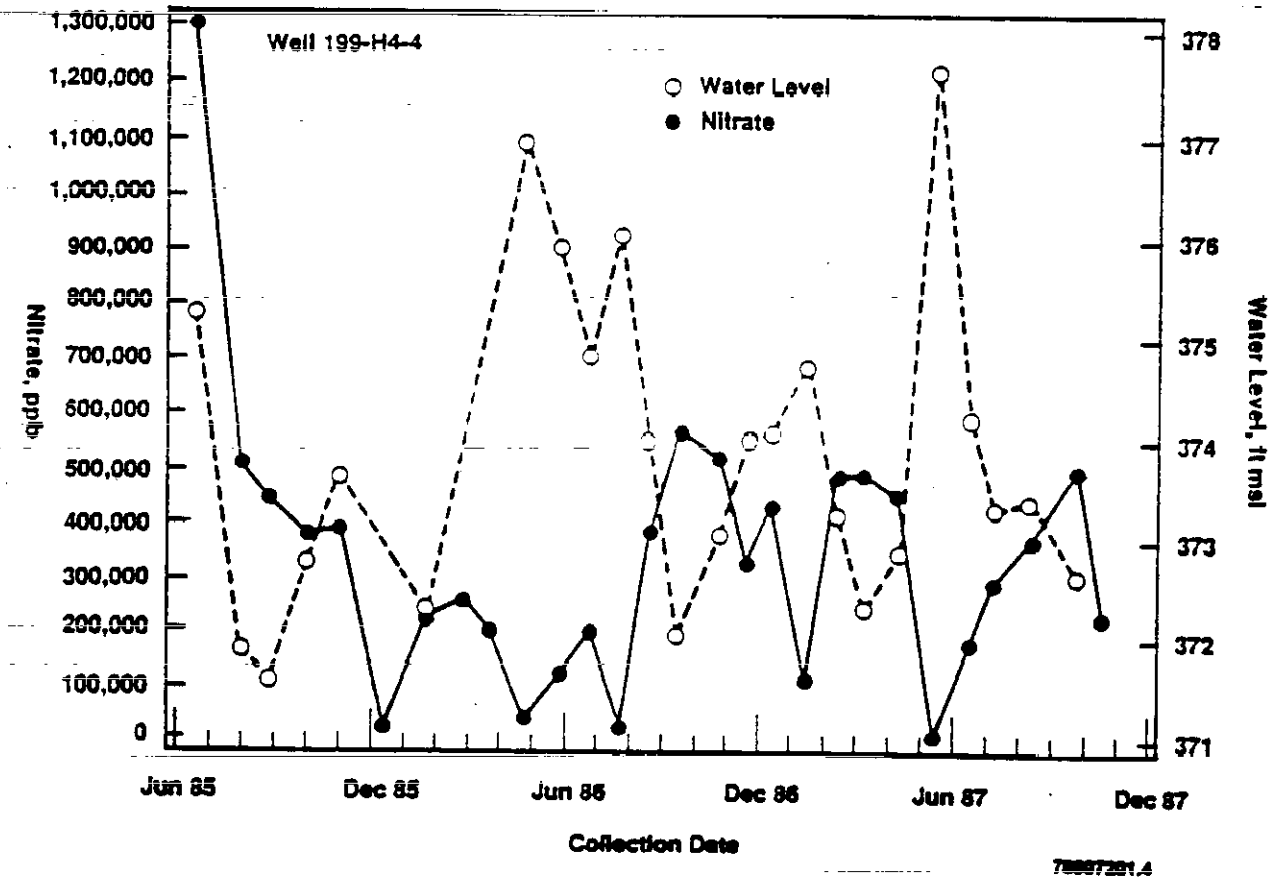


Figure III.A.10. Nitrate Concentrations and Water Levels in Well 199-H4-4 during the Period 6/85 to 10/87. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database, Constituent Code 115; figure is redrafted from Liikala et al. (1988, Figure 61).

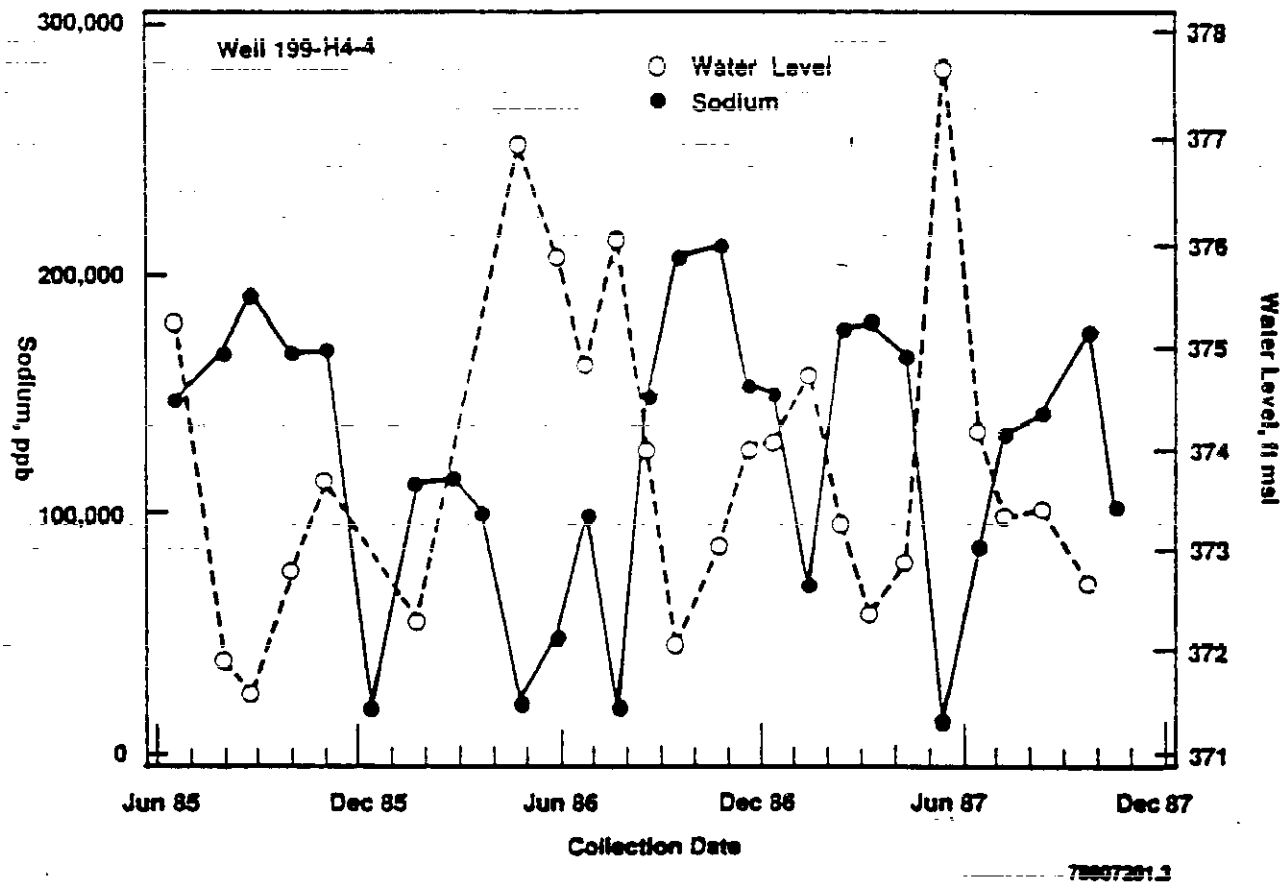


Figure III.A.11. Sodium Concentrations and Water Levels in Well 199-H4-4 during the period 6/85 to 10/87. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database, Constituent Code H24 (filtered samples); figure is redrafted from Liikala et al. (1988, Figure 62).

(i.e., along the water table) also is described from water level data, and from the results of modeling studies. The extent of contamination in the vadose zone and the processes that transported the contaminants to the groundwater are not well known. The results of the soil sampling (Section I.B-4c) will enhance understanding these processes.

III.A-2e(1). Concentration Levels and Horizontal Distribution. The concentration levels and horizontal distributions of contamination are shown by data collected after January 1, 1987. The clearest indicators of contamination attributable to the 183-H Basins have been nitrate, sodium, gross alpha, and gross beta (Figures III.A-12 to III.A-15). Highest concentrations have been measured in Wells 199-H4-3 and 199-H4-9, located immediately downgradient of the 183-H Basins, and in Wells 199-H4-4 and 199-H4-12, located between the basins and the Columbia River.

Specific conductance shows the same general distribution as nitrate, sodium, gross alpha, and gross beta. Other contaminants that had been present in the 183-H Basins, have been detected in Well 199-H4-3, but typically have been below detection limits in wells further downgradient. These have included copper, nickel, and fluoride.

Gross beta contamination also has been evident in Wells 199-H4-11 and 199-H4-13, and, to a lesser extent, in Wells 199-H4-16 and 199-H4-18. These concentrations have not correlated with the distribution of the other major contaminants that have been attributable to the 183-H Basins, and may have been the result of past operational practices at the 107-H Retention Basin.

Chromium concentrations (Figure III.A-16) generally have been found above the maximum concentration limit in all but four wells in the network. These concentrations have not correlated with the distribution of the other major contaminants attributable to the 183-H Basins. Other potential sources of chromium from inactive facilities in the vicinity of the 183-H Basins have been identified and have been discussed in the *183-H Solar Evaporation Basins Final Status Post-Closure Permit Application* (Section I.B of DOE 1988). Most of the major constituents that have not had contamination distributions obviously attributable to the 183-H Basins (e.g., magnesium, sulfate, potassium, and calcium) have shown generally lower values in wells to the south and southeast of the 183-H Basins in comparison to those to the north or east.

III.A-2e(2). Groundwater Flow in the Unconfined Aquifer. Water table maps for the 100-H Area corresponding to low (September 1987), mean (December 1986), and high (May 1987) Columbia River stages are shown in Figures III.A-17 through III.A-19, respectively. As indicated in these figures, groundwater flow has been generally northeast and east toward the Columbia River. The highest water table gradient across the site, about 0.0008 feet per foot (Figure III.A-17), has occurred during low-river stage; and conversely, the lowest gradient, about 0.0005 feet per foot (Figure III.A-19), has occurred at the high river stage. During periods of high stage, the hydraulic gradient to the river has been reversed temporarily all the way to the 183-H Basins as water from the Columbia River has infiltrated the unconfined aquifer as bank storage. During these periods,

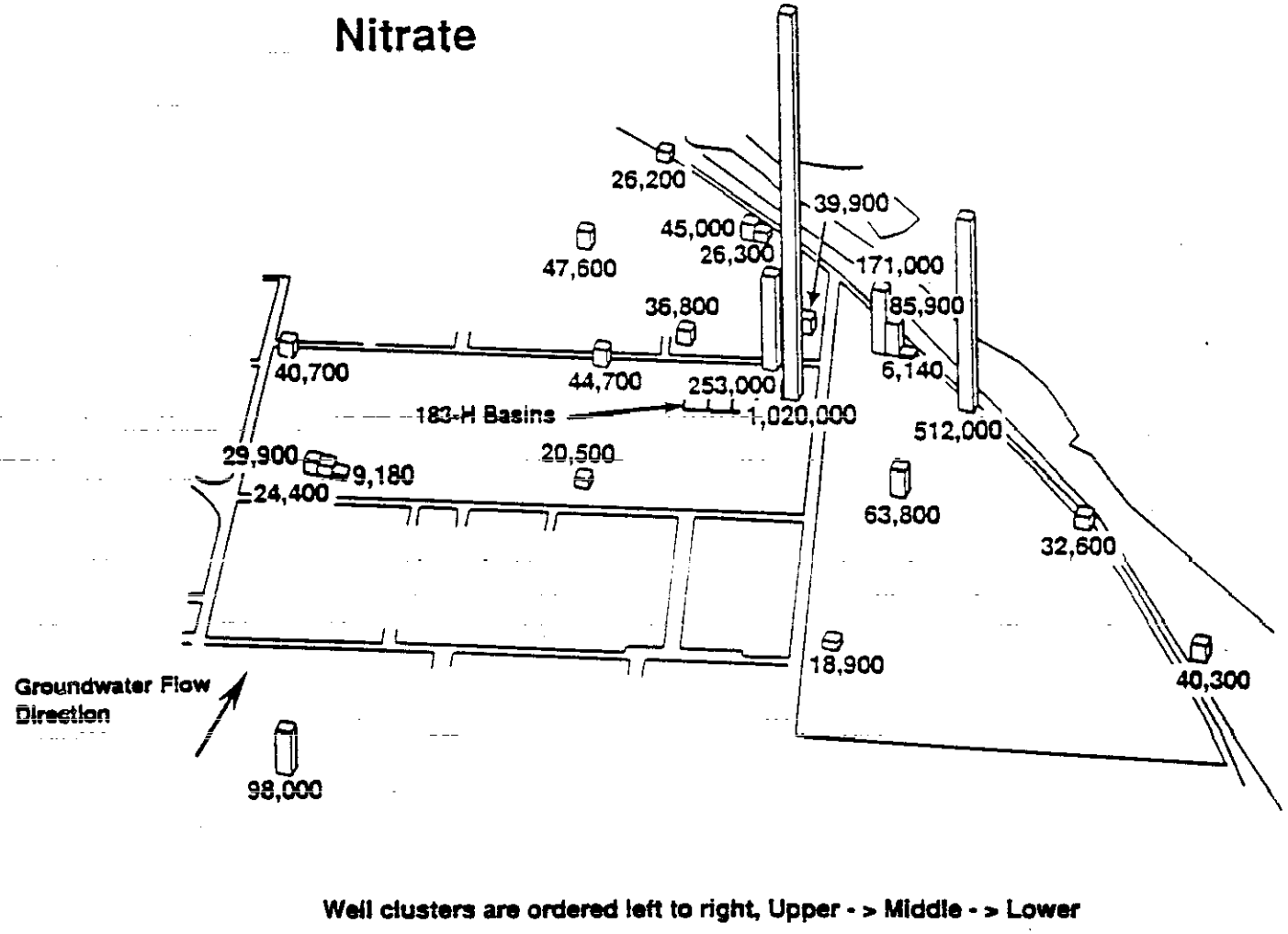


Figure III.A-12. Horizontal Distribution of Nitrate Concentrations. Maximum values between January and October 1987 are plotted. Well clusters are ordered left to right: upper, middle and lower. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database; figure is from Liikala et al. (1988, Figure 75).

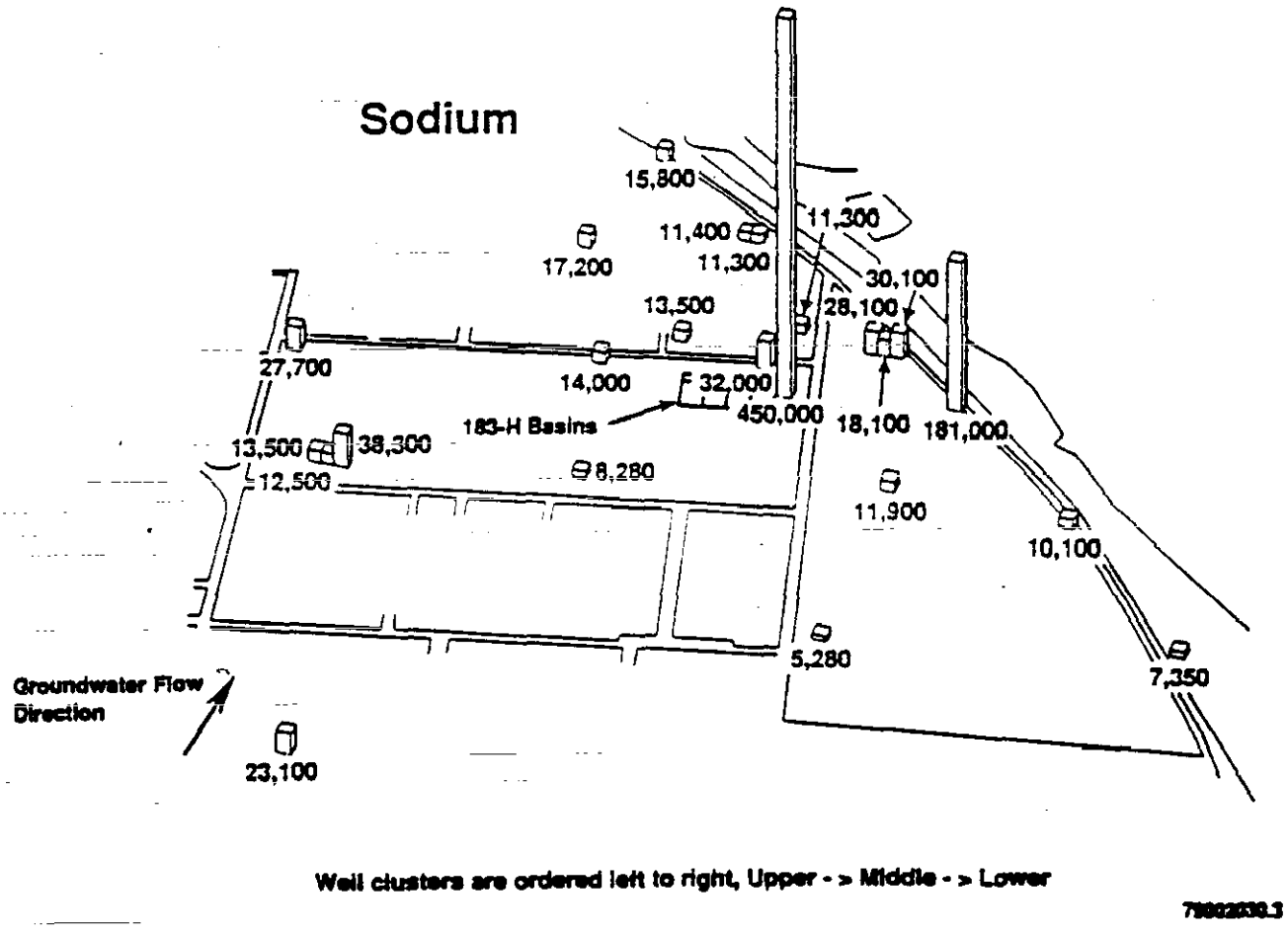
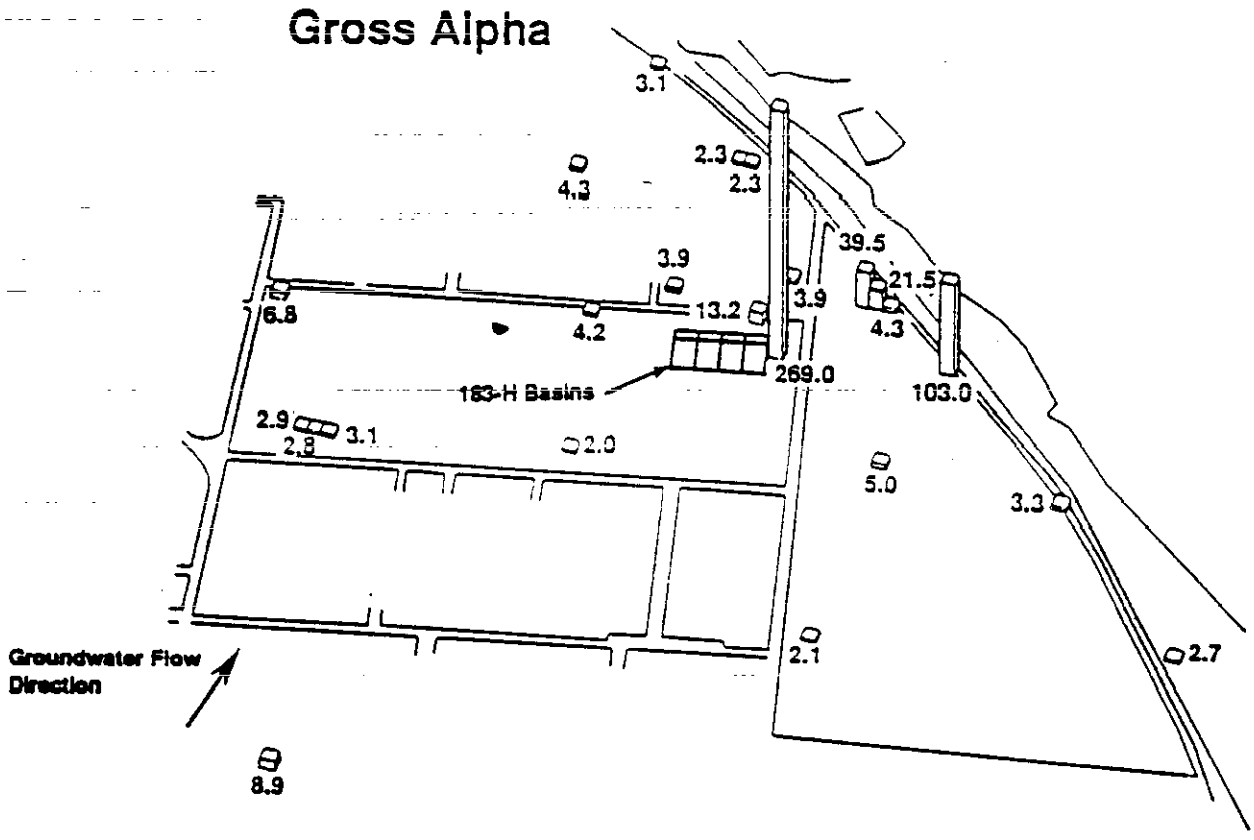


Figure III.A-13. Horizontal Distribution of Sodium Concentrations. Maximum values between January and October 1987 are plotted. Well clusters are ordered left to right: upper, middle and lower. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database; figure is from Liikala et al. (1988, Figure 76).



Well clusters are ordered left to right, Upper - > Middle - > Lower

Figure III.A-14. Horizontal Distribution of Gross Alpha Concentrations. Maximum values between January and October 1987 are plotted. Well clusters are ordered left to right: upper, middle and lower. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database; figure is from Liikala et al. (1988, Figure 77).

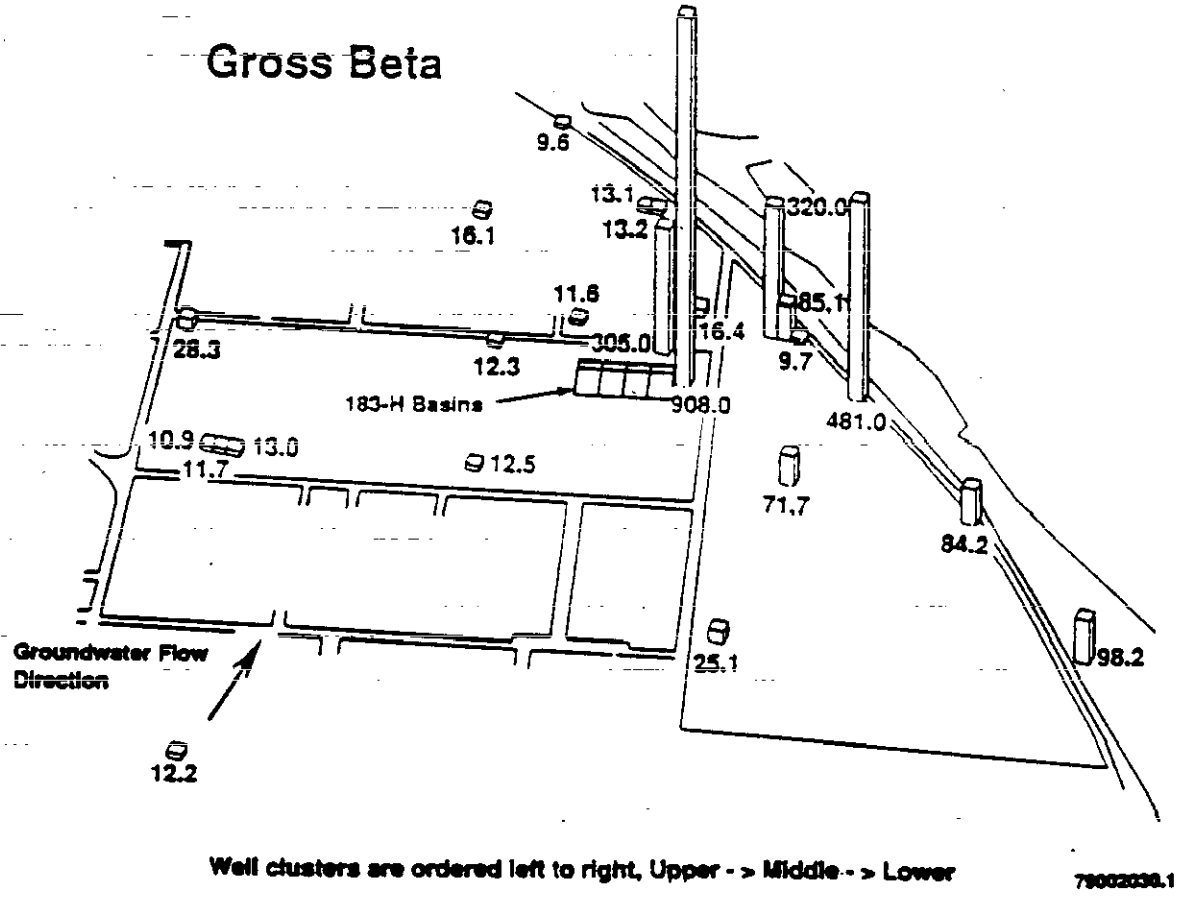


Figure III.A-15. Horizontal Distribution of Gross Beta Concentrations. Maximum values between January and October 1987 are plotted. Well clusters are ordered left to right: upper, middle and lower. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database; Figure is from Liikala et al. (1988, Figure 78).

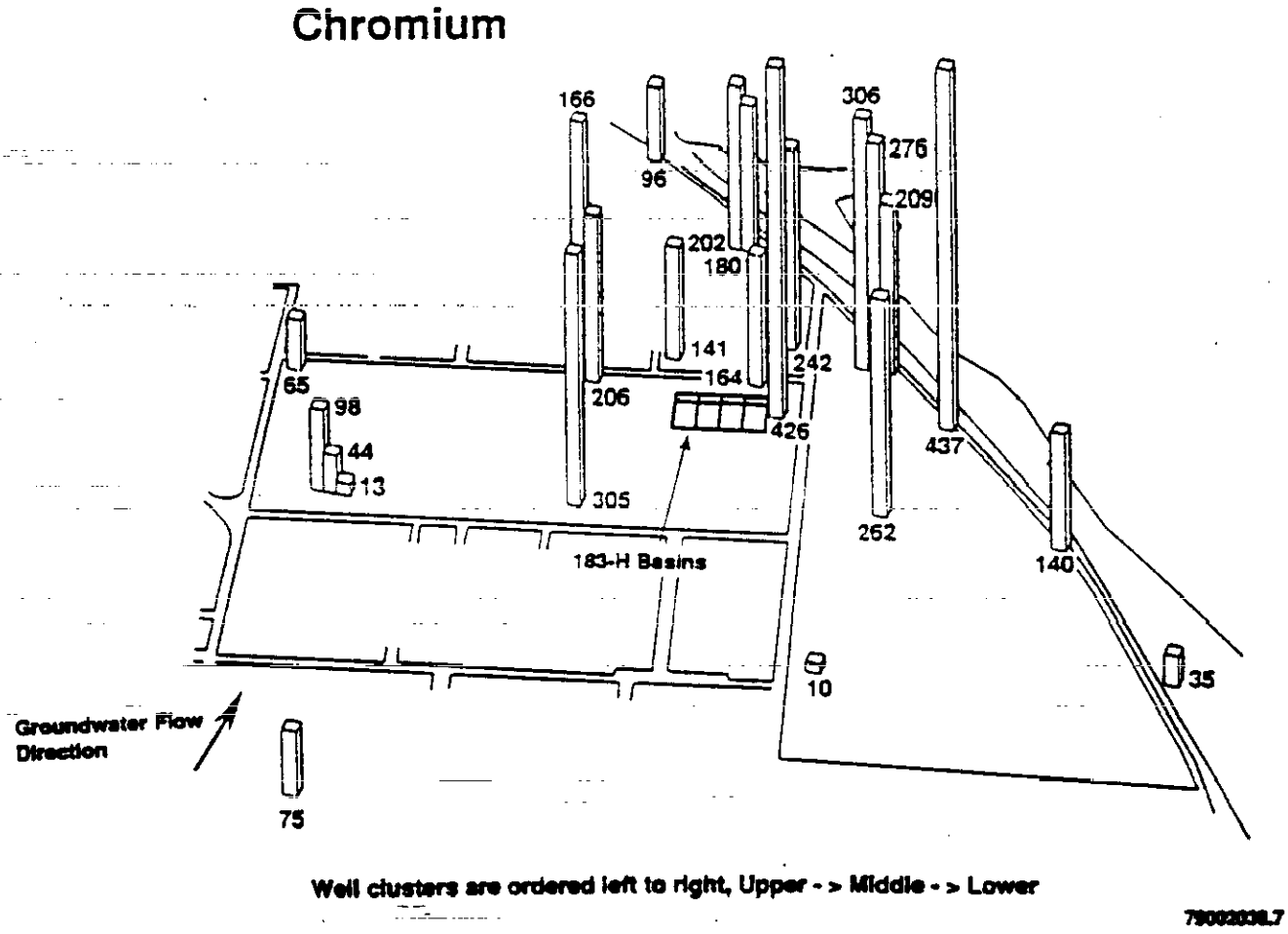


Figure III.A-16. Horizontal Distribution of Chromium Concentrations. Maximum values between January and October 1987 are plotted. Well clusters are ordered left to right: upper, middle and lower. Data are from Pacific Northwest Laboratory's Hanford Groundwater Database: figure is from Liikala et al. (1988, Figure 82).

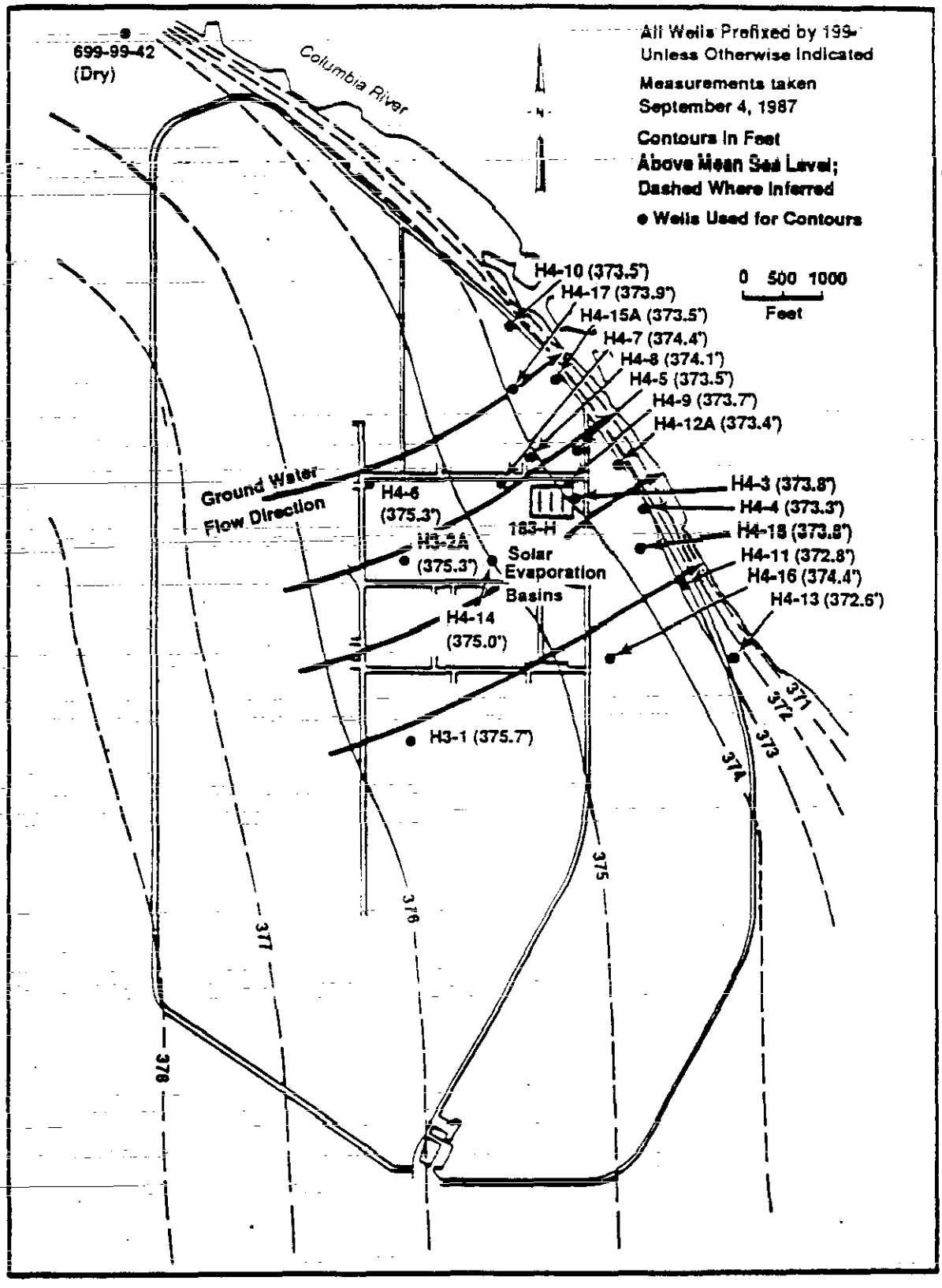


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Figure III.A-17. Water Table Map for the 100-H Area During Low Columbia River Levels (Liikala et al. 1988, Figure 39).

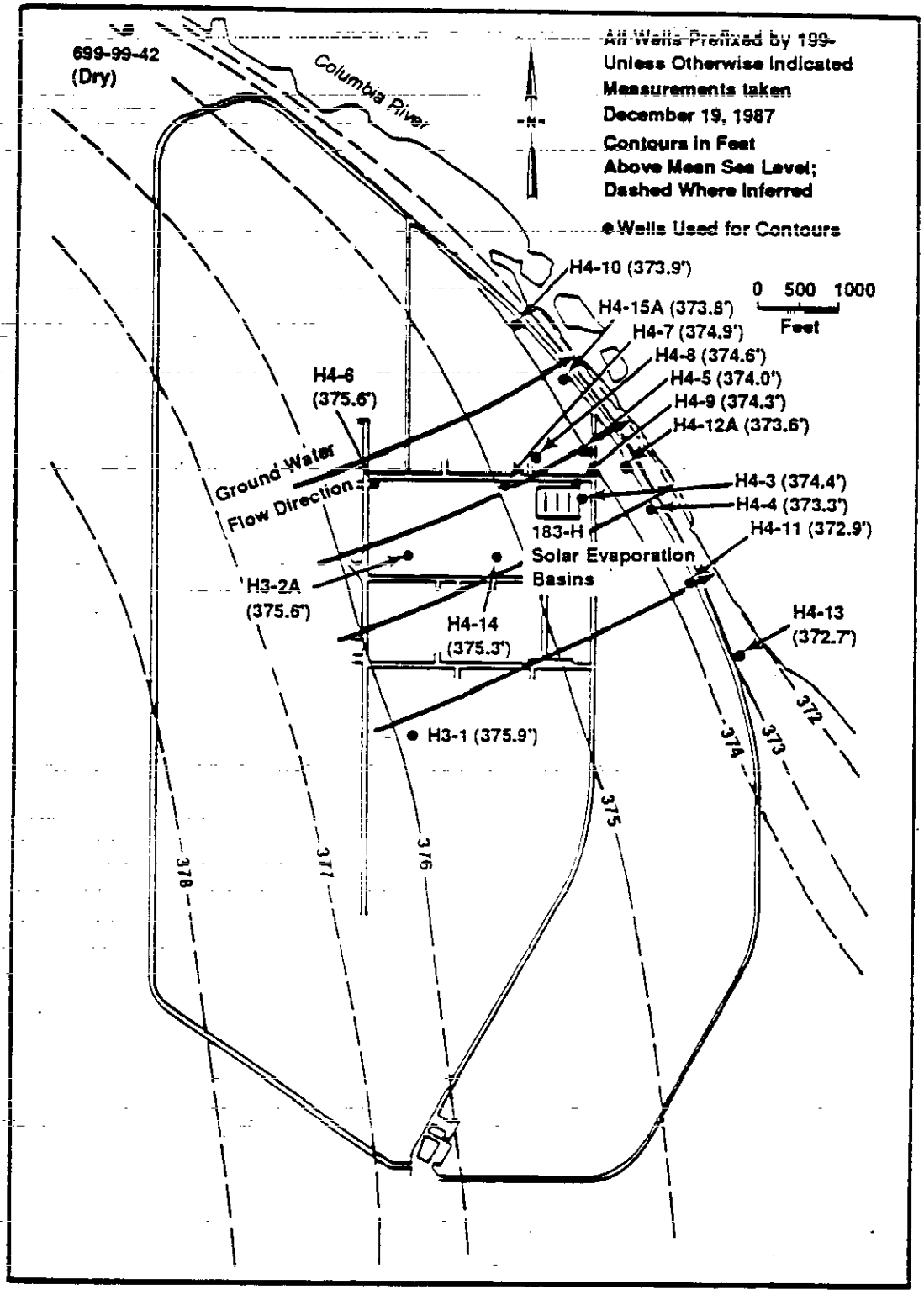

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Figure III.A-18. Water Table Map for the 100-H Area During Mean Columbia River Levels (Liikala et al. 1988, Figure 40).

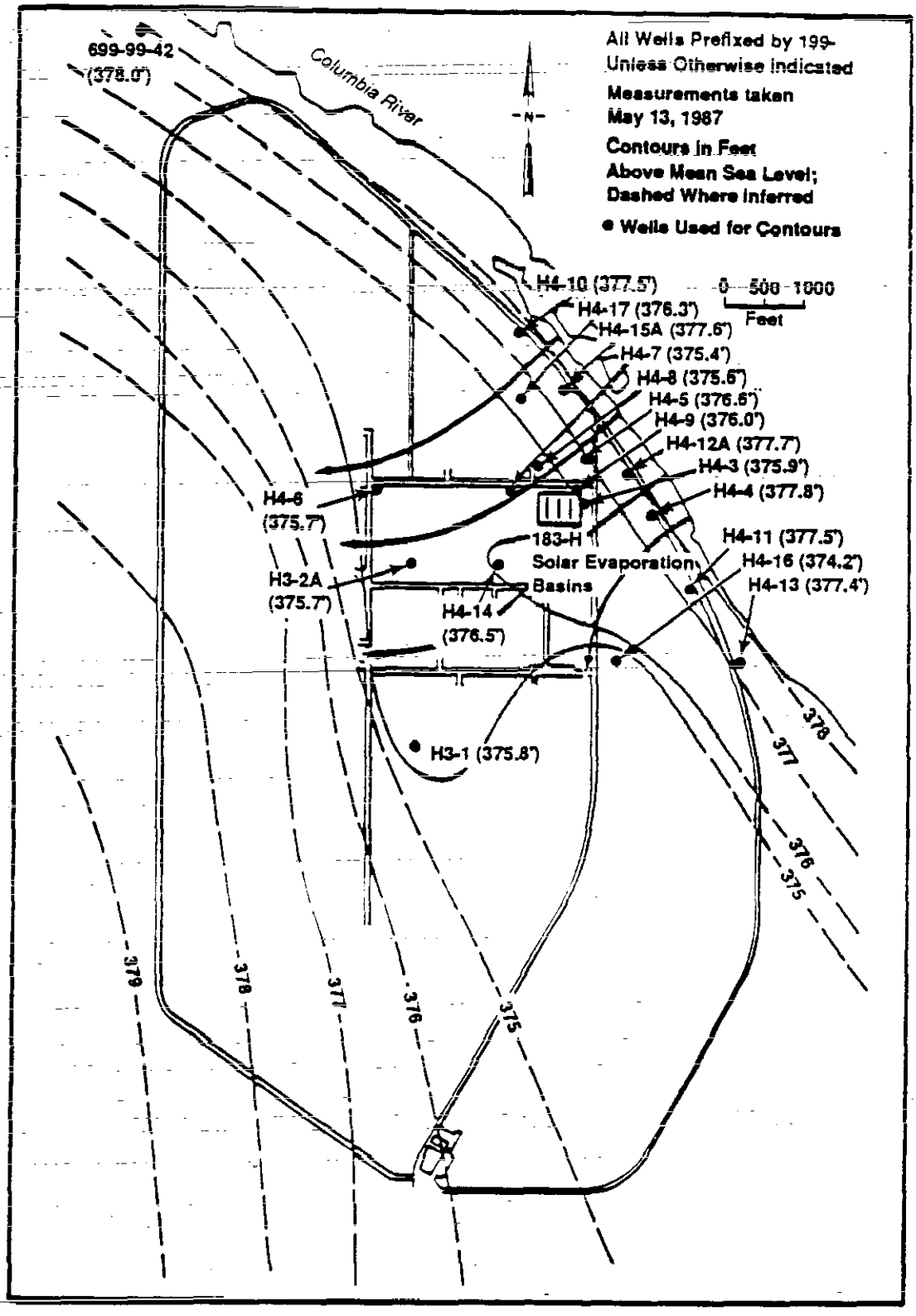

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Figure III.A-19. Water Table Map for the 100-H Area During High Columbia River Levels (Liikala et al. 1988, Figure 41).

contaminant concentrations have generally decreased due to dilution by river water.

In the past, Columbia River water level data have been collected from the Hanford Site Generating Plant at the 100-N Area and, since August 1988, at the 100-H Area just north of the 183-H Basins (river recording station). Prior to August 1988, river stage values for the 100-H Area had been assumed to increase at the same rate as those measured at the 100-N Area. A set timelag has been used to adjust for the distance between the areas. In August 1988, a continuous river-stage recorder was installed adjacent to the 100-H facilities (PNL 1988, p. 23 to 42).

In Figure III.A-20, derived 100-H Area river level data have been plotted along with the water level measurements taken at the 100-H wells. The wells are plotted relative to their distance from the Columbia River. Changes in water table elevation in all wells correspond to changes in river stage, and those wells located nearest the river have shown the greatest fluctuations. Because the unconfined aquifer is hydraulically connected to the Columbia River, groundwater flow direction also has been affected by the river's level.

III.A-2e(3). Contaminant Plume Description. The horizontal distributions of nitrate, filtered sodium, gross alpha, and gross beta are shown in Figures III.A-21 through III.A-24. These constituents have been identified as the clearest indicators of contamination attributable to the 183-H Basins (see Section A-2d, Water Analysis). Since the level of the Columbia River has directly influenced the concentration of constituents in groundwater nearest the river (i.e., generally concentrations increase with decreased river levels), distribution data have been shown for low-river stage. This has provided an indication of the maximum extent of contaminant plumes. Additional distribution plots for other river stages have been presented in Liikala et al. (1988, Figures 63 to 74).

In general, Wells 199-H4-3, 199-H4-4, 199-H4-9, and 199-H4-12A have shown the highest indicator concentrations for all three river level stages. In addition, the basic shape and location of the plumes for a particular river stage have been similar for most of the constituents found in these wells. Gross beta contamination also has been evident in Wells 199-H4-11 and 199-H4-13 and, to a lesser extent, in Wells 199-H4-16 and 199-H4-18. These levels of gross beta have not correlated with the distribution of the other major contaminants assumed attributable to the 183-H Basins, and may have been associated with past operational practices at the 107-H Retention Basin (Figure III.A-24).

Chromium concentrations have not exhibited the same pattern as the other major contaminants attributable to the 183-H Basins (Figure III.A-25). Four other potential sources of chromium from inactive waste disposal facilities at the 100-H Area have been identified. These other facilities, 116-H-1, 116-H-2, 116-H-3, and 116-H-4 (Figure III.A-26; copy of Figure B.2, *183-H Solar Evaporation Basin Final Status Post-Closure Permit Application*), have received high concentrations of sodium dichromate. Further studies of chromium distribution are needed to discriminate the contaminant contributions of each facility.

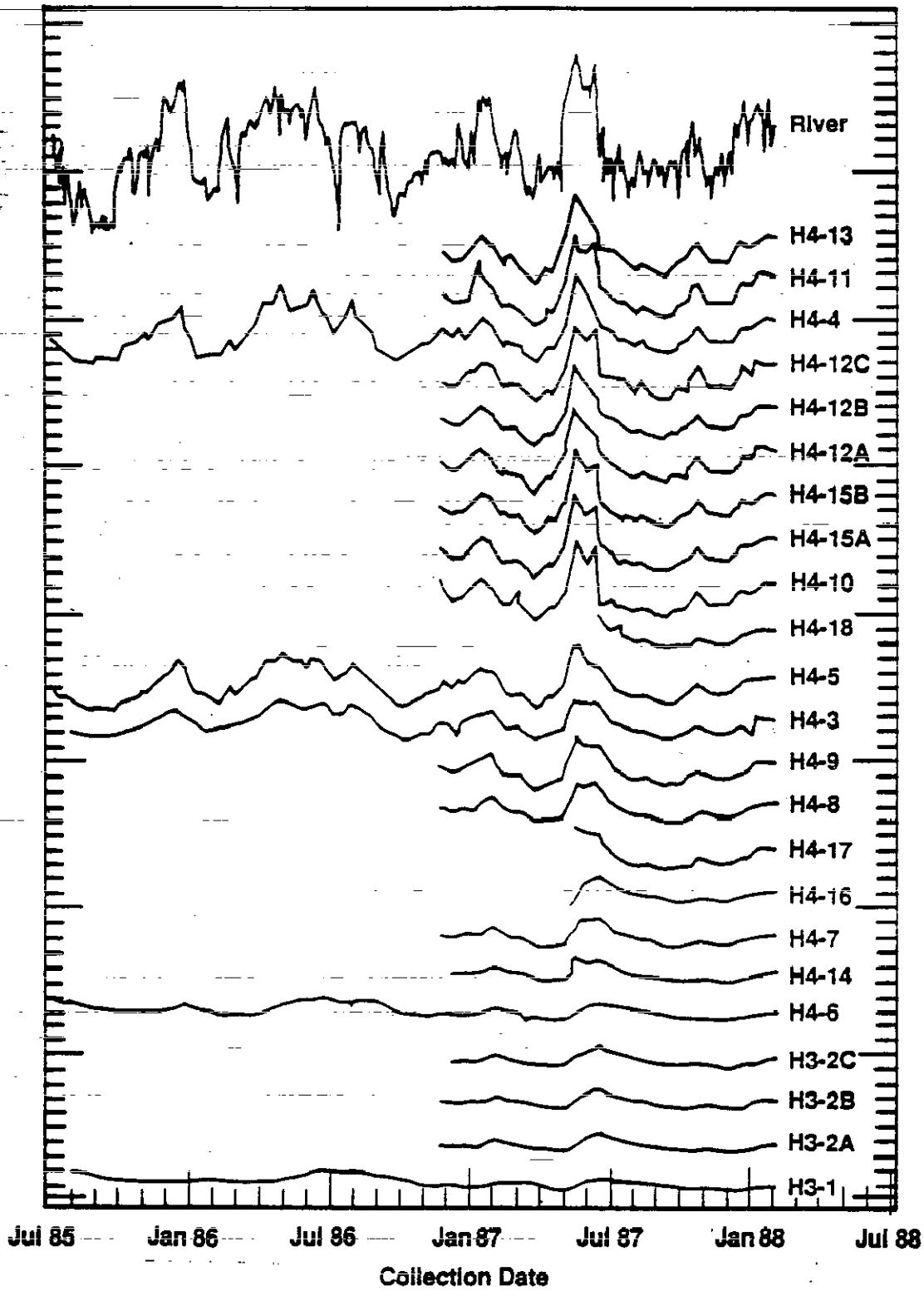

Figure III.A-20. Relative Water Levels in the Columbia River and 100-H Area Monitoring Wells During the Period 6/85 to 2/88. Wells traces are arranged relative to distance from river. Vertical scale is in one-foot increments (Liikala et al. 1988, Figure 38).

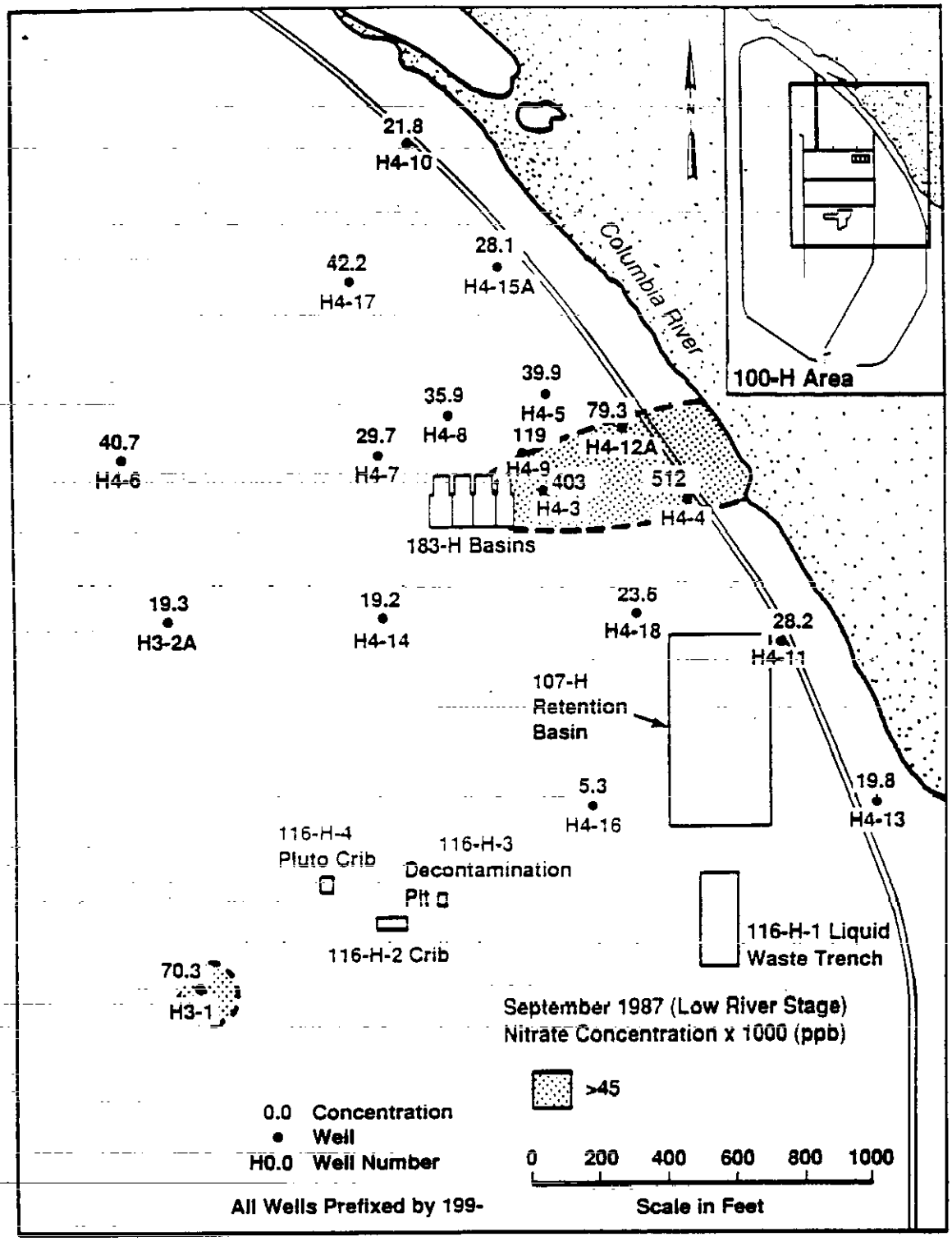

Figure III.A-21. Nitrate Concentrations During Low Columbia River Levels, September 1987 (Liikala et al. 1988, Figure 63). The drinking water standard for nitrate is 45,000 parts per billion.

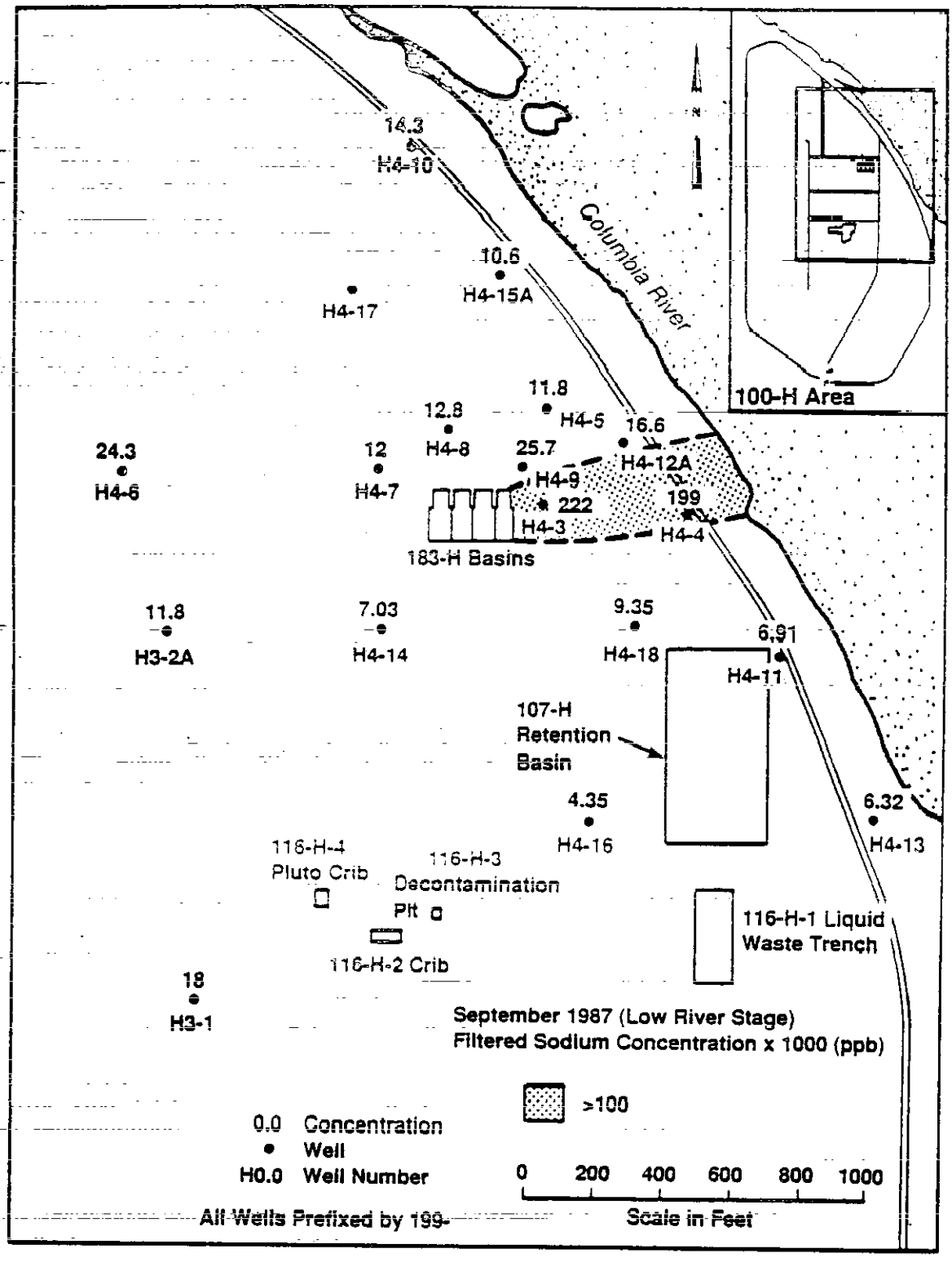

Figure III.A-22. Filtered Sodium Concentrations During Low Columbia River Levels, September 1987 (Liikala et al. 1988, Figure 66).

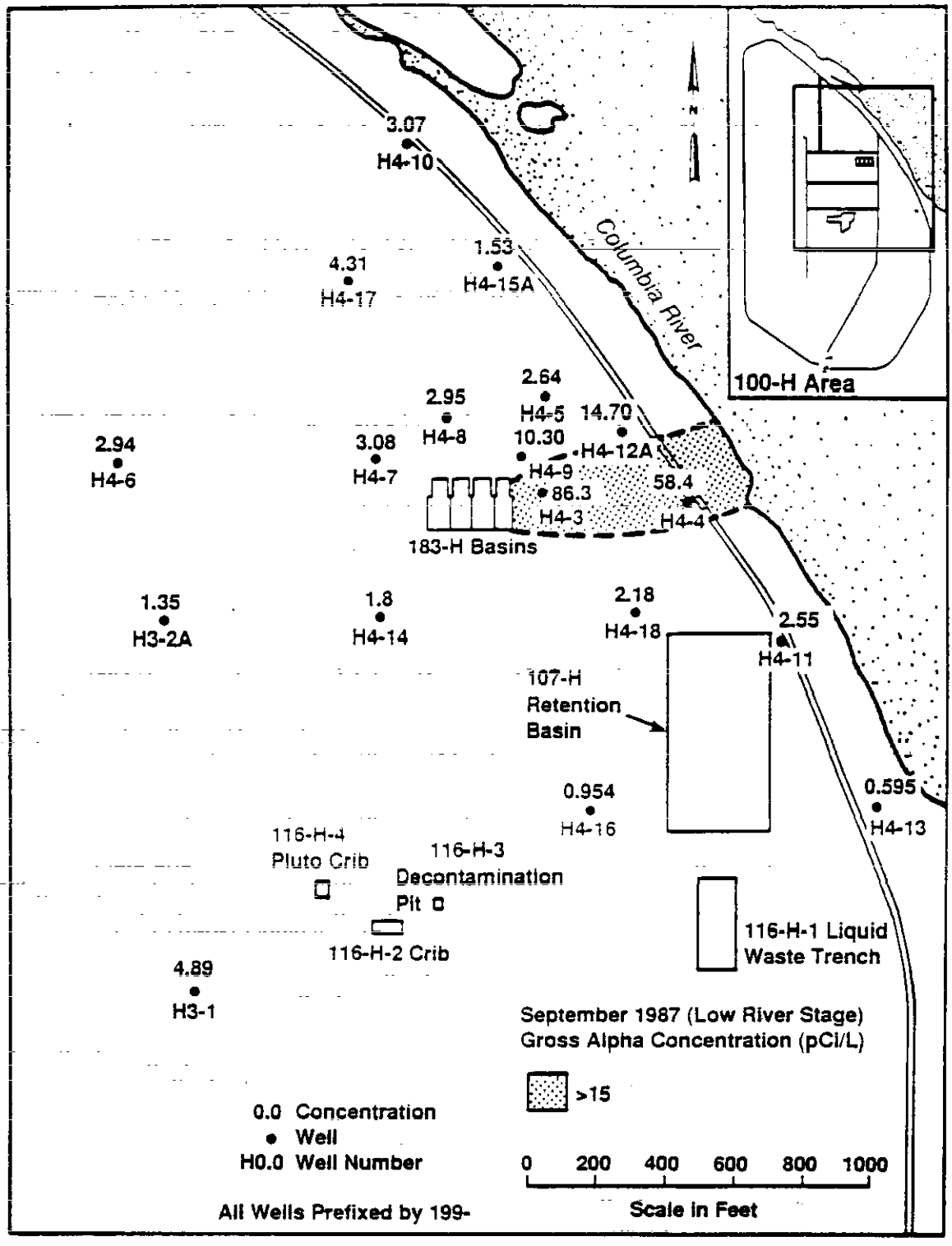

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Figure III.A-23. Gross Alpha Concentrations During Low Columbia River levels, September 1987 (Liikala et al. 1988, Figure 69). Maximum limit of the drinking water standard is 15 picocuries per liter.

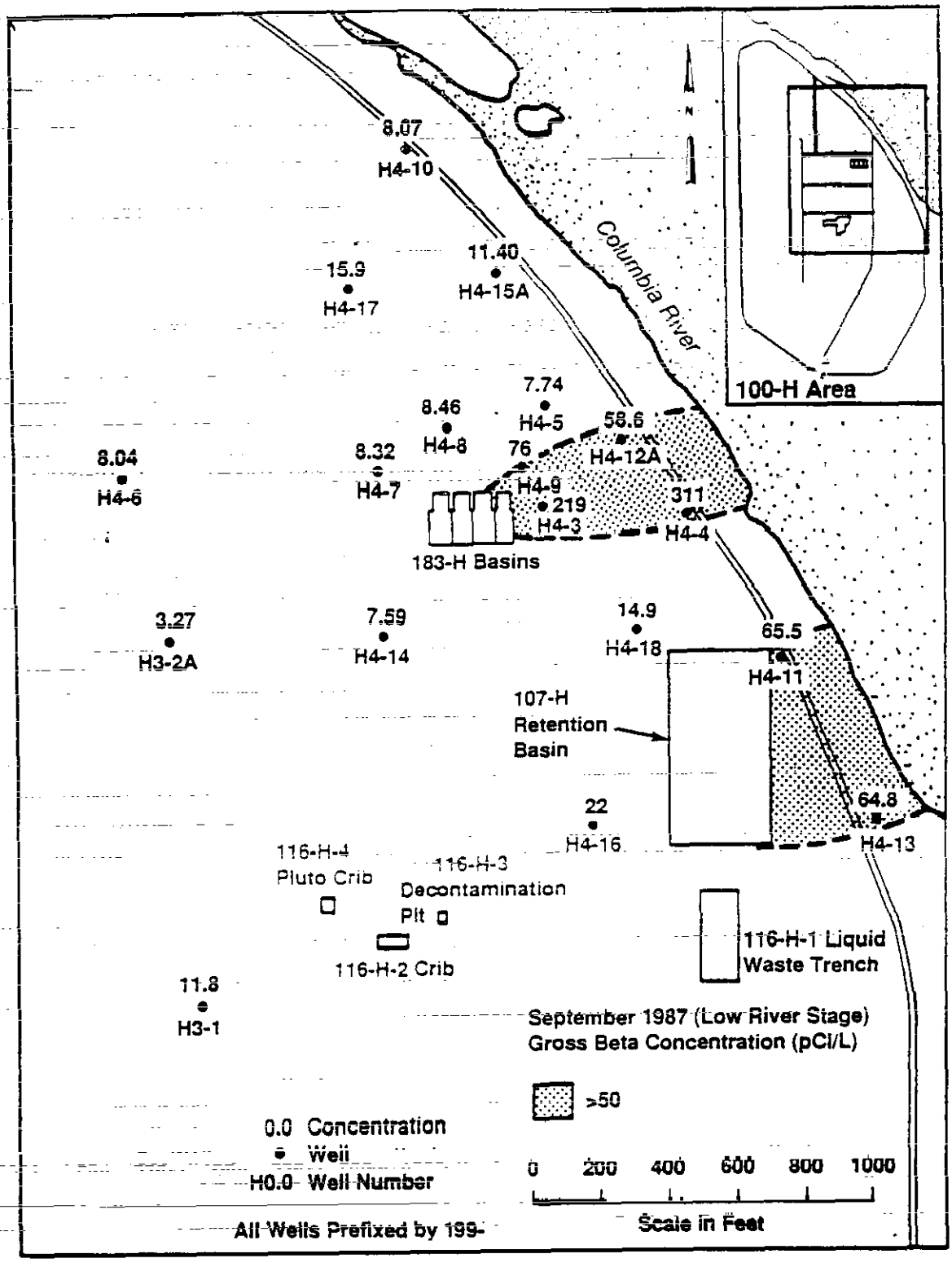

Figure III.A-24. Gross Beta Concentrations During Low Columbia River Levels, September 1987 (Liikala et al. 1988, Figure 72). Maximum limit for drinking water standard is 50 picocuries per liter.

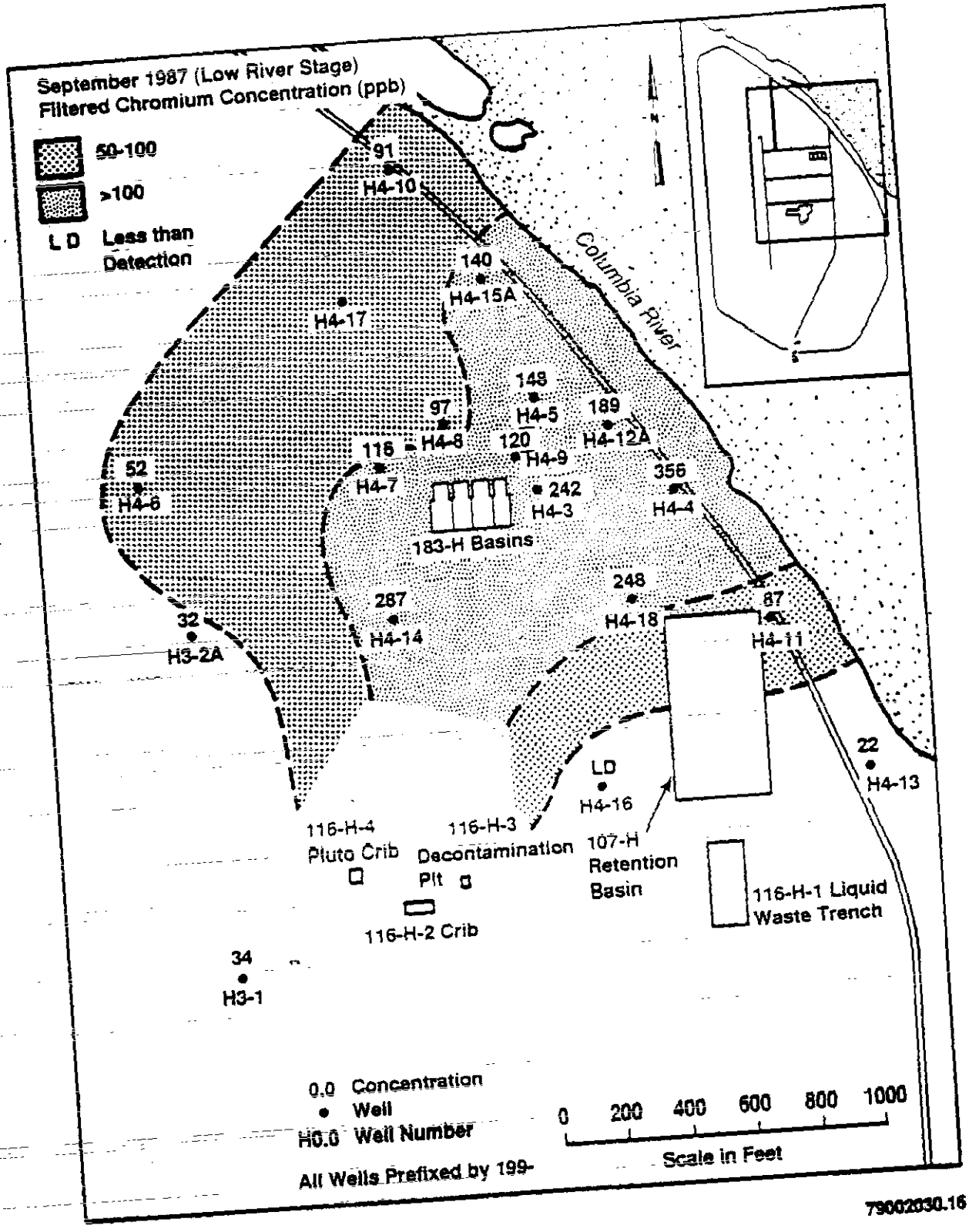

Figure III.A-25. Filtered Chromium Concentrations During Low Columbia River Levels, September 1987 (Liikala et al. 1988, Figure 79). The drinking water standard for chromium is 50 parts per billion.

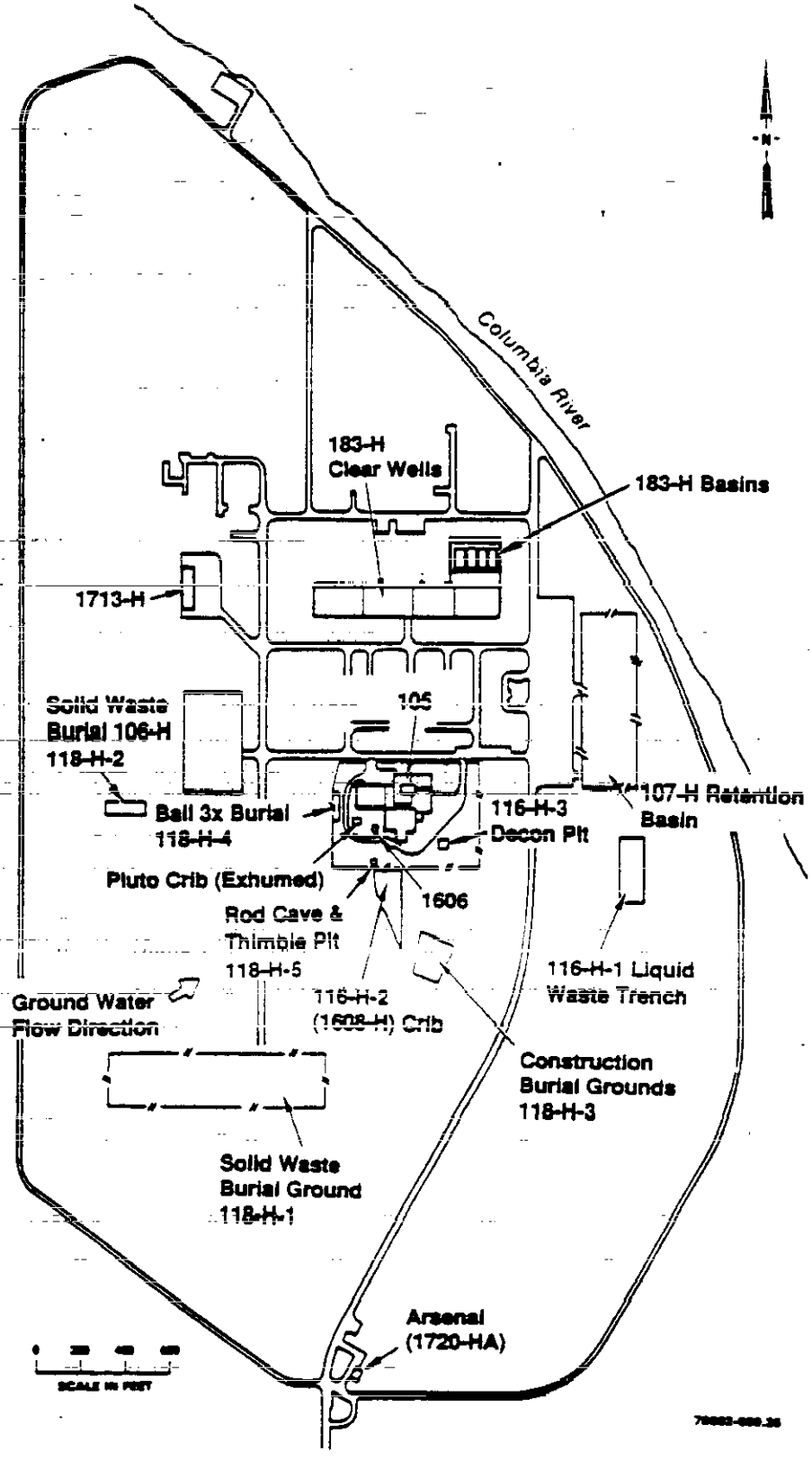

Figure III.A-26. Inactive Waste Disposal Facilities in the 100-H Area that may be Sources for Chromium Observed in the Groundwater (DOE/RL 88-09 1988, Figure E-75).

III.A-2e(4). Groundwater Flow Paths and Travel Times. A pathline analysis has been performed to estimate the flow paths and travel times of nonattenuated contaminants in the groundwater beneath the 183-H Basins (Liikala et al. 1988, p. 154-158). These pathlines have been estimated with a groundwater flow model of the area near the 183-H Basins. The analysis have considered simulated groundwater flow in the unconfined aquifer under the effects of transient Columbia River stage. The modeling was completed using the Coupled Fluid, Energy, and Solute Transport computer code (Gupta, et al. 1982). The model for the unconfined aquifer underlying the 100-H Area consisted of a two-dimensional area with varying thickness. The bottom of the aquifer was assumed to have been the top of the Ringold Formation, and was defined by interpolating the contact elevations obtained from drilling logs. The thickness of the aquifer was defined as the vertical distance from the bottom of the aquifer to the water table.

The northern and southern boundaries for the model were assumed to have been no-flow boundaries, because they were parallel to streamlines defined by the direction of regional groundwater flow. The western boundary was outside of the region estimated to have been influenced by the river level fluctuations and was implemented as a fixed head boundary. The eastern boundary was the Columbia River and was implemented as a time-varying prescribed head boundary. This boundary was changed each time step to simulate the fluctuations in river stage. No areal recharge was assumed to enter the model; therefore, the water table fluctuations resulted entirely from changes in river level. Initial conditions assumed a steady-state water table surface, as were calculated by the Coupled Fluid, Energy, and Solute Transport, using the river level from the first week of September 1986.

A total of eight pathlines were simulated, with starting locations in the unconfined aquifer directly beneath the 183-H Basins. The pathlines were continued until they reached the Columbia River. The maximum travel time had been based on previous modeling results reported in the *Interim Characterization Report for the Area Surrounding the 183-H Basins* (PNL 1987f), which was estimated to be approximately 5 years. Therefore, a transient simulation of groundwater flow spanning 6 years had been used to allow all the pathlines to reach the river. A 6-year digitized record of Columbia River stages had not been available for the 100-H Area; therefore, because of the time frame involved for the pathlines, groundwater flow was modeled using a yearly cycle of river level fluctuations. The river level data from September 1986 to September 1987 were assumed to have been representative for a yearly river stage cycle. These data were repeated to simulate the 6-year cycle.

The travel times and distances for these simulated pathlines are shown in Table III.A-4. The travel times have ranged from 1.2 to 4.1 years, while the distances traveled have ranged from 607 to 1,357 feet. The spread in times and distances traveled have reflected the variable flow paths resulting from changes in the water table; that, in turn, have been caused by the fluctuating river stage. A spread of 173 feet has been observed for the locations where the flow paths entered the river, and it was estimated that most of the other pathlines, originating from the same area, would have reached the river within this spread, under the same transient conditions.

The average travel time was 2.8 years, and the average distance traveled was 1,003 feet. The average seepage velocity based on the travel times and total distances associated with the flow paths was 1 foot per day. The actual flow velocities had varied considerably, especially near the river; because of changes in hydraulic properties and hydraulic gradients that were caused by the fluctuating river level.

Table III.A-4. Travel Time for Contaminants Moving with Groundwater Near the Top of the Unconfined Aquifer Between the 183-H Basins and the Columbia River.

Path	Travel time (year)	Travel time (days)	Distance (feet)	Average Velocity (feet/day)
1	4.09	1,494	1,291	0.86
2	3.02	1,105	974	0.88
3	1.24	452	607	1.34
4	3.53	1,289	1,133	0.88
5	2.11	772	827	1.07
6	2.06	752	996	1.33
7	4.01	1,465	1,357	0.93
8	2.40	877	842	0.96
Average:	2.81	1,026	1,003	1.03

The simulated pathlines have been grouped into a simulated contaminant plume (Figure III.A-27). This plume has generally been consistent with: (1) observed contaminant migration attributed to the 183-H Basins (see Figures III.A-21 through III.A-24), and (2) groundwater flow direction indicated by the water table maps (see Figure III.A-17 through III.A-19). The results have indicated that Wells 199-H4-3, 199-H4-9, 199-H4-12A, 199-H4-12B, and 199-H4-12C are located directly within the flow path related to the 183-H Basins.

III.A-2f. Groundwater Quality Assessment Plan and Results. The groundwater quality assessment plan for the 183-H Basins has been submitted in September 1986 under the title *Revised Groundwater Monitoring Compliance Plan for the 183-H Solar Evaporation Basins* (PNL 1986b). Only a few modifications to the original plan have been required during the construction of the Phase II and III monitoring wells, mostly due to field conditions encountered during drilling.

The results from implementing this plan include 19 new monitoring wells that have significantly refined the geologic information for the 100-H Area, and improved the understanding of the extent and migration of contaminants from the 183-H Basins.

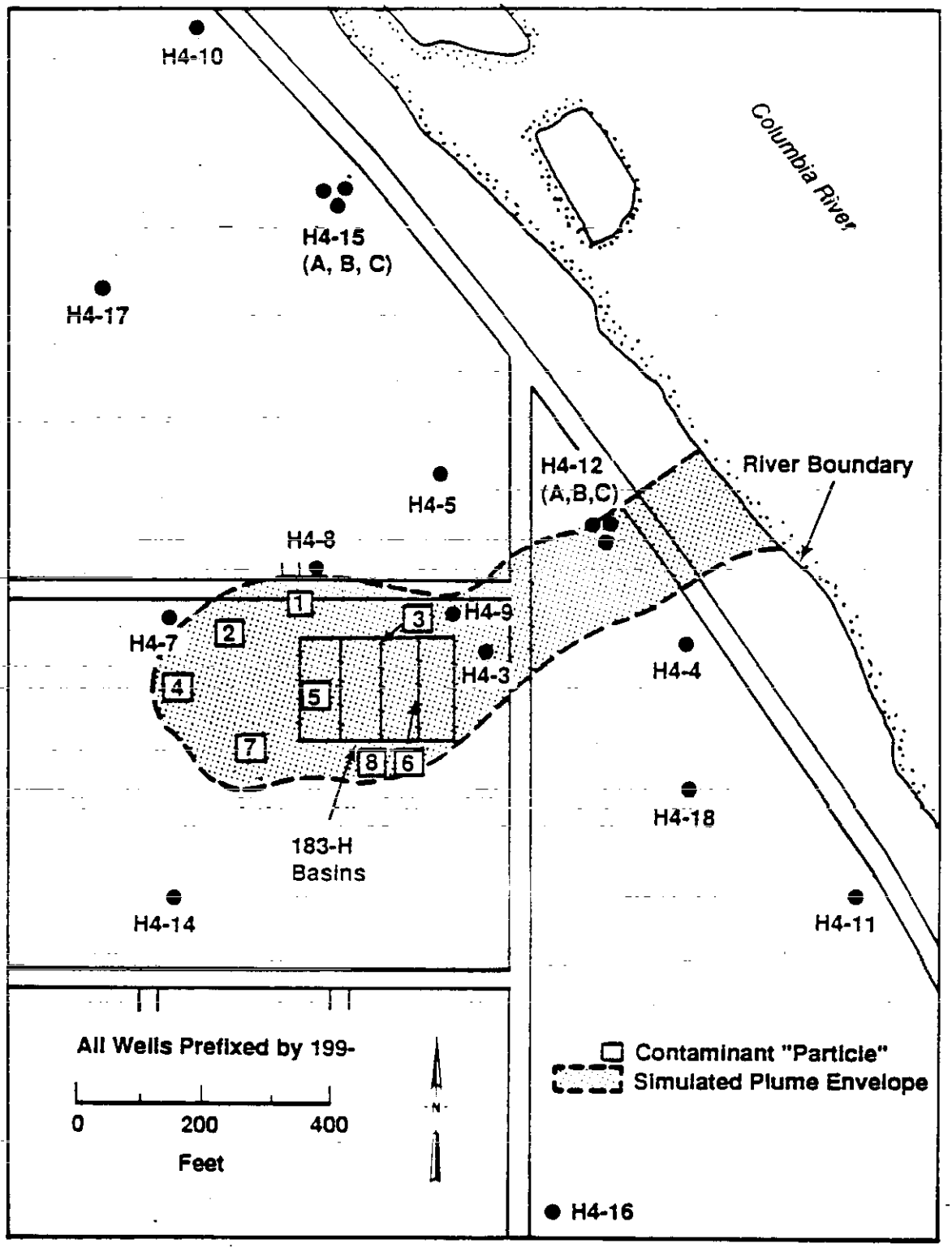

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Figure III.A-27. Simulated Contaminant Plume Based on Modeling Water Level Data to Estimate Groundwater Flow. Computer-derived flow paths for eight contaminant particles in the groundwater converge to form a plume (shaded area) that migrates toward the Columbia River (Liikala et al. 1980, Figure 90).

Summary of Principal Results--The following summary has been taken verbatim from Pacific Northwest Laboratory's *Geohydrologic Characterization of the Area Surrounding the 183-H Solar Evaporation Basins* (pages 159-162 of Liikala et al, 1988).

Geology

- The Elephant Mountain Member of the Saddle Mountains Basalt Formation is the topmost basalt flow in the 100-H Area.

- The sediments of the Ringold Formation beneath the 100-H Area were characterized as section type II, consisting of predominantly sands, silts, and clays. This formation was subdivided into three principal lithologic units, including the silty clayey sand to sandy silty clay, silty sand, and gravelly silty sand.

- The top of the Ringold Formation is an erosional unconformity, with peak elevations located to the east and northeast of the 183-H Basins.

- The Hanford formation at the 100-H Area has been severely modified by past operational and waste management activities. Backfill materials were often indistinguishable from the in situ gravels and sands, resulting in this formation being treated as a single silty sandy gravel unit.

Hydrology

- Five principal hydrostratigraphic units were defined beneath the 100-H Area, including the lower confined aquifer, upper confined aquifer, silty sand and gravelly silty sand units, saturated sediments of the Hanford formation, and unsaturated sediments of the Hanford formation.

- Testing of piezometers (Q) and (R) in Well 199-H4-15C may have altered the integrity of the bentonite seals adjacent to their screened intervals. Observations of the piezometer for several years may be necessary to determine if the annulus reseals.

- The unconfined aquifer occurs within the Hanford formation and ranges in thickness from 3 to 15 feet. This variation is a result of the erosional unconformity at the contact between the Hanford formation and Ringold Formations and the variation in the water table.

- Groundwater flow in the 100-H Area is generally northeast and east toward the Columbia River. Changes in water table elevation in all wells correspond to changes in river stage.

- Variability in aquifer testing results for the unconfined aquifer indicates that this aquifer is heterogeneous at the 100-H Area.

Geochemistry

- Sampling of waste material from Basin Number 1 indicates a wide variability in chemical composition among sampling locations, as a result of the formation of several solid and slurry-like layers.

- Sampling of waste material from Basin Number 2 indicates this material is predominantly a sodium nitrate solution.

- Analytical results from the wastes contained in Basin Numbers 1 and 2 identified chromium, technetium, sodium, uranium, fluoride, nitrate, and sulfate as potential groundwater contaminants associated with the 183-H Basins.

- Retardation factors (in groundwater) for nitrate, chromium, sodium, copper, fluoride, sulfate, and nickel indicate that these constituents are essentially nonattenuated.

Groundwater Monitoring

- Background values for nitrate and chromium in the upgradient wells near the 183-H Basins were higher than the background values for the Hanford Site, indicating other contaminant sources of these constituents located upgradient of the facility.

- Groundwater monitoring results revealed that concentrations of approximately 20 constituents showed very marked increases in the point of compliance, Well 199-H4-3, between April and August 1986. Concentrations of this magnitude have not been repeated since that time.

- Nitrate, sodium, gross alpha, and gross beta were identified as the clearest indicators of groundwater contamination attributable to the 183-H Basins.

- In general, Wells 199-H4-3, 199-H4-4, 199-H4-9, and 199-H4-12A show the highest constituent concentrations. These concentrations are affected by variations in Columbia River stage, increasing during periods of low-river stage and decreasing during periods of high river stage.

- Gross beta concentrations near the 107-H Retention Basin do not correlate with the distribution of the other major contaminants attributable to the 183-H Basins, and may be a result of past operational practices at this facility.

- Chromium concentrations do not correlate with the distribution of the other major contaminants attributable to the 183-H Basins. Four other potential sources of chromium from inactive waste disposal facilities at the 100-H Area have been identified.

- Concentrations of nitrate, gross alpha, gross beta, and chromium in Wells 199-H4-12A, 199-H4-12b, and 199-H4-12C suggest that the extent of contamination for these constituents is limited at depth.

- Standard deviations and coefficients of variation are relatively large for a number of constituents and wells. Concentrations of several of these constituents are changing significantly with time and water table elevation.

Groundwater Modeling

- Pathline analysis results estimated a range of travel times from 1.2 to 4.1 years and an average distance of 1,003 feet from the 183-H Basins to the Columbia River. The average seepage velocity, based on the travel times and total distances associated with the flow paths, is 1 foot per day.

- The simulated pathlines are generally consistent with observed contamination migration attributable to the 183-H Basins and groundwater flow direction.

III.A-2g. Monitoring Plan Proposed to be Conducted Until Issuance of Final Status Post-Closure Permit. The groundwater monitoring network currently in place around the 183-H Basins is described in Section III.A-2b. A determination of which wells are upgradient, downgradient, or not in the contaminant plume attributed to 183-H Basins is presented in Section III.A-2c. Section III.A-2d describes the results of water quality analyses conducted to date, lists the constituents measured, and identifies the indicators of contamination for 183-H Basins. This groundwater monitoring program will continue throughout the closure/post-closure period. Groundwater remediation will be addressed in the forthcoming revision of the *183-H Basins Final Status Post-Closure Permit Application*.

The following paragraphs outline the sampling schedule, sample analyses to be conducted, groundwater monitoring program procedures, and statistical procedures to be used.

The sampling schedule for October 1989 through September 1990 is shown in Table III.A-5. The number of wells to be sampled, the sampling frequency, and the list of constituents to be analyzed are all subject to change, pending results of continuing monitoring and characterization activities at the facility. Wells 199-H3-2A, 199-H4-3, 199-H4-4, 199-H4-5, 199-H4-6, 199-H4-9, 199-H4-12A, 199-H4-12B, 199-H4-12C, and 199-H4-18 are being sampled on a quarterly basis until closure activities are concluded and during the post-closure period, in accordance with WAC 173-303-645(10)(d). Sampling of the other 13 wells in the 100-H Area groundwater monitoring network will be conducted annually. Sampling of several wells will increase to a monthly frequency during selected field closure activities.

III.A-2g(1). Sample Analysis Plan. The standard list of analyses initially conducted on the 183-H Basins groundwater samples is given in Table III.A-6. These analyses include the primary drinking water standards,

Table III.A-5. Groundwater Sampling Schedule For 183-H Solar Evaporation Basins, Year 1990.

Well	1989			1990								
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
199-H3- 1							X					
199-H3- 2A	X			X			X			X		
199-H3- 2B							XRV					
199-H3- 2C							X					
199-H4- 3	XR	A	A	X	A	A	X	A	A	X	A	A
199-H4- 4	X	A	A	X	A	A	X	A	A	X	A	A
199-H4- 5	X			XR			X			X		
199-H4- 6	X			X			X			XR		
199-H4- 7							X					
199-H4- 8							X					
199-H4- 9	X	A	A	X	A	A	X	A	A	X	A	A
199-H4-10							X					
199-H4-11							X					
199-H4-12A	X			X			X			X		
199-H4-12B	X			X			X			X		
199-H4-12C	X			X			X			X		
199-H4-13							X					
199-H4-14							X					
199-H4-15A							X					
199-H4-15B							X					
199-H4-16							X					
199-H4-17							X					
199-H4-18	X			X			X			X		

X=R (See Table III.A-6)
A=A (ICP metals, IC anion suite, gross alpha, and gross beta)
R=R for quality control (e.g., Duplicate sample)
B=B
V=Volatile Organic Analysis blank

water quality parameters, contamination indicators, and specific dangerous waste constituents known to have been discharged to the facility. Appendix K contains a data report that is derived for regular quarterly reporting purposes. Table III.A-6 also contains information on the bottle types used for collection, sample preservation techniques, analytical methods, and detection limits for each of the constituents.

Proposed sample analyses to be conducted on the groundwater samples collected during closure, and throughout the post-closure period for the 183-H Basins are listed in Table III.A-7. These analyses and frequencies are based on current results and are subject to change in the types of constituents and frequency analyzed, pending future characterization activities at the facility.

Table III.A-6. Standard List of Analyses for 183-H Basins Groundwater Samples. (sheet 1 of 3)

Constituent	Preservation[a,b]	Collection and methods[c]	Typical detection limit (ppb)[d]
Induction coupled plasma metals analysis:			
Barium	P, nitric acid to pH < 2	SW-846, #6010	6
Cadmium			2
Chromium			10
Silver			10
Sodium			200
Nickel			10
Copper			10
Vanadium			5
Aluminum			150
Manganese			5
Potassium			100
Iron			30
Calcium			50
Zinc			5
Arsenic	P, nitric acid to pH < 2	SW-846, #7060	5
Mercury	G, nitric acid to pH < 2	SW-846, #7470	0.1
Selenium	P, nitric acid to pH < 2	SW-846, #7740	5
Lead	P, nitric acid to pH < 2	SW-846, #7421	3
Ion chromatography analysis:			
Nitrate	P, none[e]		500
Sulfate			500
Fluoride			500
Chloride			500
Phosphate			1,000
Total organic halides	G, sulfuric acid to pH < 2 no headspace	SW-846, #9020	100
Total organic carbon	G, phosphoric acid to pH < 2	Std. methods[f], #505	1,000
Total carbon	G, none	Std. methods[f], #505	1,000
Ammonium ion	G, sulfuric acid to pH < 2	Std. methods[f], #417 A-E	50
Phenol	G, none	SW-846, #8040	10

Table III.A-6. Standard List of Analyses for 183-H Basins Groundwater Samples. (sheet 2 of 3)

Constituent	Preservation[a,b]	Collection and methods[c]	Typical detection limit (ppb)[d]
Pesticides analysis:			
Endrin			0.1
Methoxychlor	G, none	SW-846, #8080	3
Toxaphene			1
Lindane (4 isomers)			0.1
Herbicides analysis:			
2,4-D	G, None	SW-846, #8150	2
2,5,5-TP silvex			2
Volatile organics analysis:			
Tetrachloromethane	G, no headspace	SW-846, #8240	5
Methyl ethyl ketone			10
1,1,1-trichloroethane			5
1,1,2-trichloroethane			5
1,1,2-trichloroethane			5
Tetrachloroethene			5
Xylene (O,P)			5
Xylene (M)			5
Methylene chloride			10
Chloroform			5
Hexone			10
Radium	P, nitric acid to pH < 2	EPA Method #903.0 EPA/600/4-80-032 (EPA 1980a)	1 pCi/L
Gross alpha	P, nitric acid to pH < 2	EPA Method EPA/680/4-75-001 (EPA 1975)	4 pCi/L
Gross beta	P, nitric acid to pH <2	EPA Method EPA/680/4-75-001 (EPA 1975)	8 pCi/L
Uranium	P, nitric acid to pH < 2	Fluorometric, (hexone extraction)	4 pCi/L
Technetium-99	P, nitric acid to pH < 2		15 pCi/L
Total dissolved solids	P, none	Std. methods[f] #209	--

Table III.A-6. Standard List of Analyses for 183-H Basins Groundwater Samples. (sheet 3 of 3)

Constituent	Preservation[a,b]	Collection and methods[c]	Typical detection limit (ppb)[d]
Coliform bacteria	P, none	Std. methods[f] #908A	2.2 MPN[g]
pH (lab)	P, none	Std. methods[f] #423	--
Temperature		Field measurement	
Specific conductance		Field measurement	
pH		Field measurement	

[a]"P" indicates plastic container and "G" indicates glass.
[b]All samples cooled to 4 °C after collection.
[c]Constituents grouped together are analyzed by the same method.
[d]Units are parts per billion unless otherwise indicated.
[e]Based on EPA-600/4-84-017 (EPA 1984a).
[f]Standard Methods (APHA 1985).
[g]MPN=most probable number.

Table III.A-7. Sampling Frequency and Constituents List During Closure and Post-Closure Groundwater Monitoring in the 100-H Area.

Constituent[a]	Closure Period Frequency	Post-Closure Period Frequency
Nitrate (IC)	Monthly	Quarterly
Chromium (ICP)	Monthly	Quarterly
Gross Alpha	Monthly	Quarterly
Gross Beta	Monthly	Quarterly
Uranium	Quarterly	Annually
Technetium	Quarterly	Annually
Total organic halides	Quarterly	Annually
Alkalinity	Quarterly	Annually
pH	Quarterly	Annually

[a] (IC) and (ICP) analyses methods include additional constituents; see Table III.A-6 for complete list.

Quality control checks on the analytical results from groundwater samples have been described in Pacific Northwest Laboratory's Groundwater Monitoring Projects *Quality Assurance Project Plan* for RCRA groundwater monitoring projects (PNL 1989, Section 12). This program features submission of blind standards, replicates, and blanks, as well as investigation of problems and follow-up with corrective actions. Selected comparisons, routine internal quality control procedures, and corrective actions. The EPA sponsors performance studies.

III.A-2g(2). Groundwater Monitoring Program Procedures. The DOE-RL requires that each of its contractors develops, maintains, operates by, and complies with appropriate procedures. Each contractor's procedures are reviewed by the DOE-RL for equivalency to a predecessor's procedures when necessary. The procedures described below should be viewed as examples of those that will be used for Hanford Site RCRA activities. Specific procedures are maintained by each contractor in accordance with the DOE-RL directives.

In accordance with WAC 173-303-645(8)(d)(i)-(v), the groundwater monitoring program has included the following sampling protocol and procedures.

Sampling Pumps--Dedicated sampling pumps have been installed in each sampling well. The electric submersible pumps and bladder pumps that were present in the five original (pre-RCRA standards) wells were replaced by piston-actuated pumps during the fall of 1989. Piston actuated sampling pumps are now used to obtain groundwater samples from all oft he wells in the 183-H network. These pumps are used for both purging the well and sample collection.

Table III.A-2 (Section III.A-2b) provides information on the screened intervals and initial pump intake settings for each well in the network. Construction diagrams and lithologic logs for each well have been presented in Liikala et al. (1988, Appendix A). The Environmental Field Services Group of Westinghouse maintains updated maintenance and equipment records for each well.

Sample Collection--Groundwater samples have been collected on a routine basis from the 23 wells surrounding the 183-H Basins. The samples have been collected by trained senior environmental radiation protection technologists. Dangerous materials sampling procedures have been developed and specifically designed to ensure the integrity of these samples. These procedures have included pump operation, borehole purging, field measurements (water levels, temperature, specific conductance, and pH), sample collection, sample preservation and shipment, and chain of custody. A brief summary of these procedures follows.

Water level measurements are made each time a well is sampled. These depth-to-water measurements are taken from the designated measuring point on the top of the well casing using a graduated steel tape and are done prior to purging the well. The procedure is repeated until two steel tape measurements

agree within 0.02 feet. The well is purged according to a procedure that is specific to the type of pump installed in the well. A pumping time sufficient to replace at least three borehole volumes of standing water from the well is calculated in advance. After this volume of water has been purged, temperature, conductivity, and pH measurements are made on subsequent purged water as it is removed, and when these three parameters stabilize within limits specified in procedures, the well is considered to be ready for sampling.

Water samples are then collected using equipment appropriate for the type of pump in the well. As each sample container is filled, a seal is placed around the cap. Care is taken at each step in the sample collection procedure to avoid introducing contamination to the sample. A field record form (Figure III.A-28) is completed for sampling activities at each well.

After collection, each sample container is surveyed by a radiation protection technician using a Geiger-Muller meter. If radiation of greater than 200 counts per minute is indicated, this is noted on the field record form, and radiation work procedures go into effect.

Sample Preservation and Shipment--Sample preservation is required for those constituents that are not chemically stable. Methods of sample preservation are intended to: (1) retard biological action, (2) retard hydrolysis, and (3) reduce sorption effects. Specific preservation methods include addition of chemicals, refrigeration, and protection from light.

Sample containers are purchased precleaned and are selectively analyzed to confirm EPA protocols. Chemical additions are performed by the analytical laboratory subcontractor before the bottles are labeled and sent to the field. Procedure manuals containing the sample preservation and handling techniques for each analytical method are maintained by the analytical laboratory subcontractor.

After collection, samples are placed in an ice chest and cooled to 4°C (40°F). Light-sensitive samples are collected in amber glass bottles. Samples are normally delivered directly to the analytical laboratory on the day of collection. If the senior environmental radiation protection technologist returns from the field after receiving hours at the laboratory, the samples are stored overnight in a secured refrigerator and delivered at the beginning of the following business day.

Analytical Procedures--Analytical methods used on the groundwater samples are listed in Table III.A-6, and a Sample Analysis Request Form is shown in Figure III.A-29.

Chain of Custody Control--Chain of custody procedures follow the samples from the time of collection through data reporting. The procedures contain instructions for sample labels, sample seals, field record forms, chain of custody forms, sample analysis request forms, and sample delivery. Laboratory acceptance procedures and copies of the sample log-in forms are also included. A copy of the chain of custody form is provided in Figure III.A-30.

GROUNDWATER SAMPLE REPORT

Well Number _____
Total Purge Volume (gal) _____
Purge Flow Rate (gal/min) _____
Hydrostar (Time On) _____
Submersible (Time On) _____
Bladder (Time On) _____

Date _____ Page ___ of ___

Calculations

SAMPLES COLLECTED

SAMPLE NO.	BOTTLE ID	PUMP	COLLECTOR

TOTAL NUMBER OF BOTTLES _____

FIELD MEASUREMENTS

Previous pH _____
Steel Tape No _____
E-Tape # _____
Pressure No _____
Thermometer No _____

WATER LEVELS (ft)				Time							
Hold				pH							
Cut				Temp (°C)							
Depth Below T.C.				Cond (µS/cm)							

FIELD OBSERVATIONS

Weather _____
General Problems/Unusual Events _____
Equipment Irregularities _____
Container Irregularities _____
Comments _____

Well capped and locked ☐ Yes ☐ No
Samples Surveyed for Gamma Radiation by RPT's _____
Data Recorded By _____
Data Checked By _____
Chain-Of-Custody Form No _____

1 Figure III.A-28. Sample Field Record Form.

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector _____ Date Sampled _____ Time ____ hours

Company Contact _____ Telephone (____) _____

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested

Field Information** _____

Special Handling and/or Storage _____

PART II: LABORATORY SECTION

Received by _____ Title _____ Date _____

Analysis Required _____

*Indicate whether sample is soil, sludge, water, etc.

**Use back of page for additional information relative to sample location.

A-6000-406 (07/89)

Figure III.A-29. Sample Analysis Request Form.

Westinghouse Hanford Company	CHAIN OF CUSTODY

Company Contact _____ Telephone _____

Sample Collected by _____ Date _____ Time _____

Sample Locations _____

Ice Chest No. _____ Field Logbook and Page No. _____

Remarks _____

Bill of Lading No. _____ Offsite Property No. _____

Method of Shipment _____

Shipped to _____

Sample Identification

Chain of Possession

Relinquised by:	Received by:	Date/Time:
Relinquised by:	Received by:	Date/Time:
Relinquised by:	Received by:	Date/Time:
Relinquised by:	Received by:	Date/Time:

A-6000-407 (07/89)

Figure III.A-30. Sample Chain of Custody Form.

III.A-2g(3). Statistical Procedures. Appropriate statistical techniques will be used to determine if there has been a significant increase over background values or otherwise specified concentration limits for each constituent measured at Well 199-H4-3. The statistical techniques proposed for use in evaluating the closure period data, and ultimately the data collected under final status post-closure period, are outlined in the *183-H Solar Evaporation Basins Final Status Post-Closure Permit Application.*

III.A-3. Maintenance Plan

In accordance with WAC 173-303, this section provides a plan for maintenance of the closed facility area throughout the post-closure period. Elements of this maintenance plan include repair of security devices and erosion damage; correction of settlement, sedimentation, and displacement; vegetative cover maintenance; repair of run-on and run-off control structures; and well replacement. The maintenance plan is based on observations made during inspection (III.A-1) and monitoring (III.A-2).

III.A-3a. Repair of Security Control Devices. The 183-H Basins will be bounded by a chain link fence with locked gates and warning signs. Any unauthorized access will result in the immediate notification of the Hanford Site security forces. Repairs will be made upon notification.

Each of the 24 100-H Area groundwater monitoring wells and the river recording station, has a locking cap to prevents well tampering. In addition, the wells are surrounded by four steel guardposts to prevent damage from vehicles. The responsible maintenance organization will be notified of any problems to the locks or guardposts and/or other problems noted during inspections and/or well monitoring activities. All necessary repairs will be made prior to the following inspection period, and so noted in the logbook during the subsequent inspection.

III.A-3b. Erosion Damage Repair. Erosion damage to the 100-H Area may occur as a result of flooding, precipitation, or wind. Because the flow in the 'Hanford Reach' of the Columbia River is controlled by the Priest Rapids Dam, the probability of erosion damage to the basin area from floods is low. There is a potential for erosion from wind, particularly during the period of vegetative establishment. Current mulching practices, that will be implemented during closure, are quite effective at minimizing wind erosion prior to establishment of a perennial grass cover. A stable vegetative cover will reduce possible damage due to wind and water erosion. Soil permeabilities and rainfall intensities at the Hanford Site are such that water-induced erosion will be very minor on the relatively flat area surrounding the 183-H Basins. However, slopes created by the installation of the cap and run-off control structures (drainage pipes and ditches) during closure and the channeling of run-off water may lead to localized increases in erosion. A cobble component in the landfill cover is designed to prevent gully and sheet erosion of the 3H:1V embankment slope of the cap. Further discussion of the possible effects of erosion on the cover appears in Section II.B-2c.

Due to the low probability of serious damage caused by erosion, preventative measures beyond those already described are considered unnecessary. However, any erosion damage will be properly noted and reported to the responsible maintenance organization. Minor damage will be repaired with hand tools. Major erosion damage repairs will be immediately initiated using, as appropriate, grading equipment and fill soils. Maintenance action will be initiated within 90 days of the time of discovery if integrity of the final containment structure can be potentially breached. Repairs will return all slopes to pre-damaged conditions.

III.A-3c. Correction of Settlement, Sedimentation, and Displacement. Settlement, sedimentation, and displacement are caused primarily by the deformation or compression of waste products, fill soils, and voids. Because the buried wastes will be in compacted bulk form rather than containerized, large voids or cavities are not expected to exist in the closed landfill. Careful placement and compaction of intermediate cover layers during construction of the cap will greatly reduce the occurrence of settlement and sedimentation. Differential settlement is not expected; however, a very small and insignificant amount of uniform compression/consolidation will occur with time.

It is concluded in the EPA guidance document (EPA 1985) that even under worst-case conditions (i.e., deep fill, deteriorated drum waste containers, and low-stiffness waste layers), the maximum predicted post-closure landfill cover sedimentation due to compressibility alone is under 12 percent of the total height of the fill and cover at the center of the landfill. Conditions leading to such sedimentation are not expected at the 183-H Basins.

Any sedimentation, settlement, and displacement effects revealed by quarterly inspection (see Table III.A-1) will be repaired as outlined in Section III.A-1. A detailed discussion on the potential for cover settlement, sedimentation, and displacement appears in Section II.B-2d.

III.A-3d. Vegetative Cover Maintenance. Immediately after closure, the area of the 183-H Basins will be fertilized, as necessary, and seeded to initiate growth of a vegetative cover. The area will be covered with a straw mulch during establishment of the grass cover to prevent erosion damage. The suggested mix for revegetation is a 2:1 perennial wheatgrass mixture consisting of Siberian wheatgrass (Agropyron sibericum) and Thickspike wheatgrass (Agropyron dasytachyum). This mix should be planted in the fall. If the area is to be revegetated in the spring, then an annual such as cereal rye (Secale cereale) may be planted. The rye, acting much as a standing mulch during the growth season, will protect the landfill cover from erosion damage. A spring planting of cereal rye should be followed by fall seeding with the perennial wheatgrasses and mulching with straw. Newer cultivated varieties proven to be better suited to the local climate may be substituted for the species listed above. Seeding and mulching of the basin area will be conducted according to standard field practices and procedures. Reseeding of some areas may be necessary during the 2-year vegetative establishment period.

Each spring (generally between March 15 and April 15) for 2 to 3 years following closure, selective herbicides, 2,4-D amine and dicamba (or their

equivalents), 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. Field application rates of 0.57 to 1.32 pounds per acre with 2,4-D amine and 0.19 to 0.44 pounds per acre with dicamba have proven effective in controlling undesirable broadleaf species. Herbicide application will be performed in accordance with regulations promulgated by the *Toxic Substances Control Act of 1976* and the *Federal Insecticide, Fungicide, and Rodenticide Act of 1975*. Selective herbicide applications will be discontinued following successful establishment of the perennial grass cover. Deep-rooting plants (primarily Russian thistle, Salsola kali) having root systems that can extend into the waste zones are common to the region. Manual removal of such vegetation will be required periodically during the post-closure period to prevent biointrusion and transport of covered waste materials.

III.A-3e. Repair of Run-On and Run-Off Control Structures. As discussed in Section III.A-3b, Erosion Damage Repair, the probability of serious damage to the 100-H Area due to flooding or precipitation is low. Run-on and run-off damage are expected to be minimal as a result of the combination of arid regional climate, high evapotranspiration rates, and minimal local slope in the area of the 183-H Basins. Specific run-on structures will not be used in the final cover design for the 183-H Basins. Damage to run-off control structures (ditches surrounding the cover and pipes leading from the cover drainage layer) noted during quarterly inspection periods (Table III.A-1) will be reported to the responsible maintenance organization for action. Pipes will be tested for blockages by visual and physical (probes) inspection. All blockages will be eliminated prior to the next inspection period using methods as little disturbing to the cover as possible. Minor damage to ditches will be repaired with shovels and other hand tools.

III.A-3f. Well Replacement. Of the 24 wells currently in use for the 183-H groundwater monitoring network, 23 are used for collecting groundwater samples and water level measurements, and 1 (199-H4-15c) is a piezometer well that has been dedicated to measuring hydrostatic water levels. The 19 Phase II and III wells, which were built to RCRA standards, are expected to be useable as monitoring wells for the entire post-closure period. The 5 original (pre-RCRA) monitoring wells are the most likely to require replacement, due to degradation of their carbon steel casings. Upgrading of these original wells has already occurred, with the addition of surface concrete pads and protective posts in 1987, and the replacement of submersible pumps with Hydrostar pumps in 1990.

General well conditions are observed during each sampling episode at the well. The integrity of the surface protection for the well, the operating condition of the pump, the purging characterisitics, and the turbidity of the sample collected are all indicators of the need for periodic maintenance. When the field sampling personnel observe the need for maintence, the Environmental Field Services Group (Environmental Division) is notified, and any required maintenance will be completed prior to the next sampling episode.

Long-term preventive maintenance and care of groundwater monitoring wells is described in the Westinghouse Hanford Company's *Environmental Investigations*

and Site Characterization Manual (WHC-CM-7-7, EII 6.4 "Groundwater Resource Protection Well Maintenance" WHC 1989). Nonpriority subsurface maintenance will be performed on wells with a frequency of every 3 to 5 years. At a minimum, this will include (1) removal and re-installation of the pump system; (2) conducting a downhole TV camera survey; and (3) brushing the inner walls of the casing and casing perforations or screen to remove scale deposits. Additional maintenance may include removal of objects that have fallen into the well and removal of sand or other debris that has entered the well. Priority maintenance will be completed whenever a condition exists that would compromise the capability to collect a representative groundwater sample.

III.B. PERSONNEL TRAINING

This section describes the training of personnel required to maintain the 183-H Basins in a safe and secure manner during post-closure care, as required per 40 CFR 265.16 and WAC 173-303-330.

III.B-1. Outline of the Training Program

This section outlines the introductory and continuing training programs necessary to conduct the post-closure activities at the 183-H Basins in a safe manner. It also includes a brief description on how training will be designed to meet actual job tasks as required per 40 CFR 265.16(a). In addition, the mandatory training programs for the senior environmental radiation protection technologist (SERPT) and the site surveillance personnel (SSP) are outlined in Figures III-B.1 and III-B.2, respectively.

Senior Environmental Radiation Protection Technologist--The following outline provides the classroom and on-the-job training programs that will be completed by each senior environmental radiation protection technologist before being allowed to conduct post-closure activities at the 183-H Basins.

- Training for Emergencies
  - Emergency preparedness training
  - Respiratory protection practices and procedures
  - Protective clothing and equipment
  - Emergency response training - all facilities.

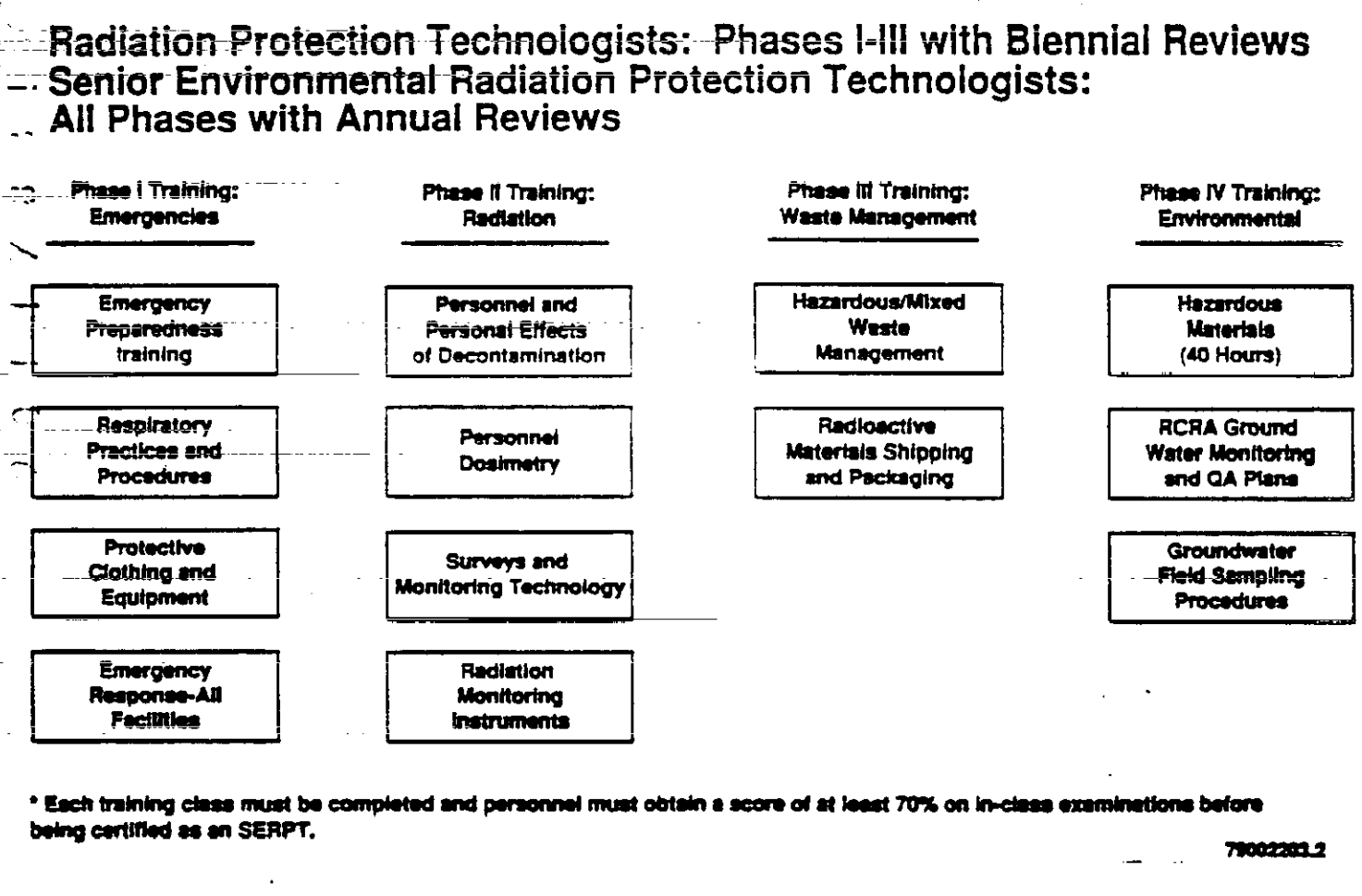

Figure III.B-1. Phases of Training for Radiation Protection Technologists and Senior Environmental Radiation Protection Technologists.

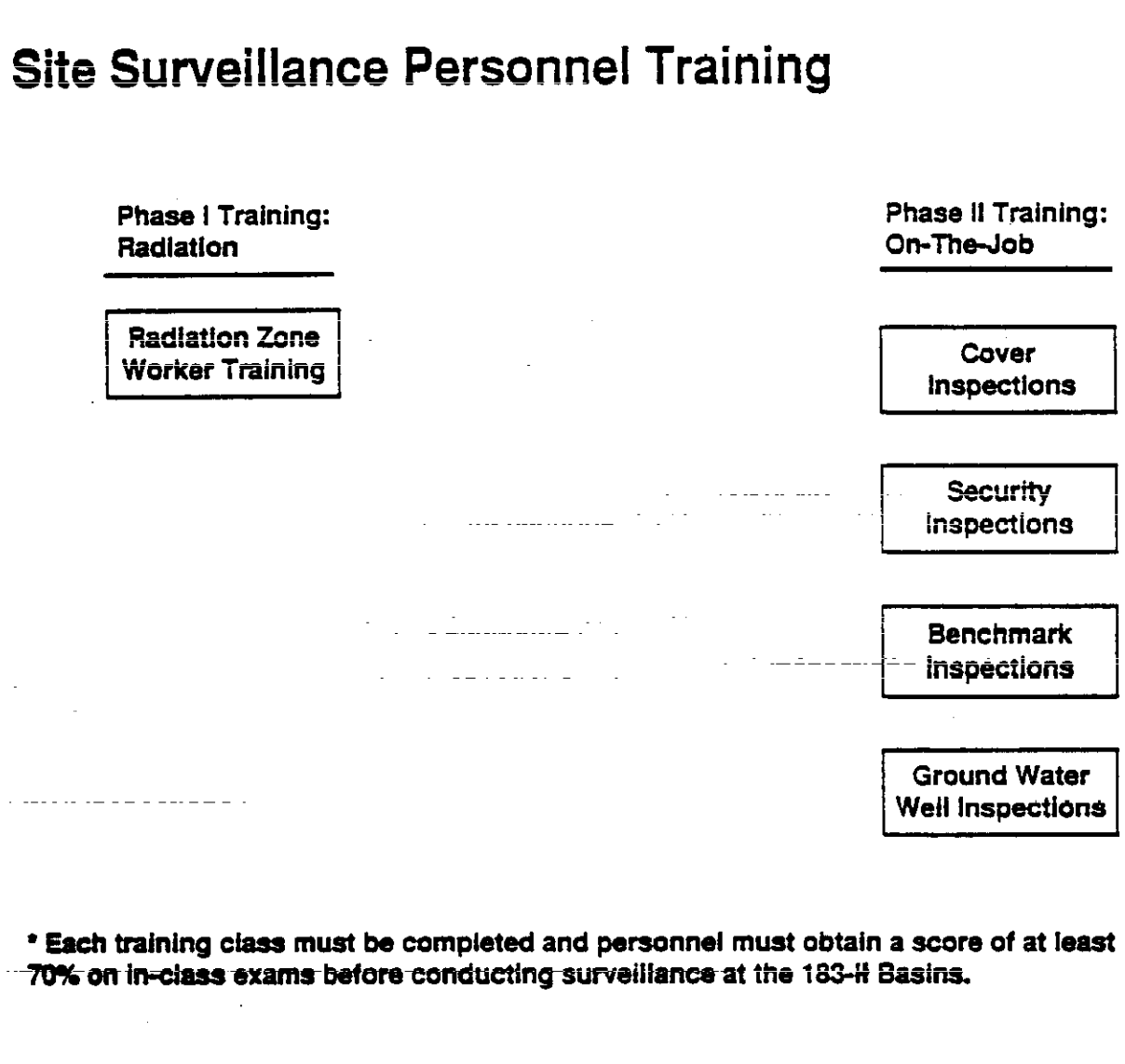

Figure III.B-2. Phases of Site Surveillance Personnel Training. (38802-075.2M)

- Radiation Training
  - Applied radiation monitoring
  - Personnel and personal effects decontamination
  - Personnel dosimetry
  - Surveys and monitoring techniques
  - Radiation monitoring instruments.

- Waste Management Training
  - 40-hour hazardous waste management training
  - Hazardous and mixed waste management
  - RCRA groundwater monitoring scope, organization, and quality assurance plan
  - Groundwater field sampling procedures
  - Radioactive materials shipping and packaging.

Site Surveillance Personnel--The training for the site surveillance personnel is not as extensive as the training for the senior environmental radiation protection technologists because their responsibilities at the 183-H Basins are very limited. The following outline provides information on the classroom and on-the-job training that the site surveillance personnel will complete before conducting site surveillance at the 183-H Basins.

- Radiation Training
  - Radiation zone worker training.

- On-The-Job Training
  - Cover inspections
  - Security inspections
  - Location, integrity, and inspection of benchmarks
  - Location, integrity and inspection of groundwater wells.

III.B-1a. Job Title/Job Description. This section provides the job title and the job description of personnel that will be conducting post-closure activities at the 183-H Basins as required per 40 CFR 265.16(d)(1) and WAC 173-303-330(2)(a).

The post-closure monitoring and inspection will be conducted by personnel operating under two job titles: Senior environmental radiation protection technologist and site surveillance personnel. The job description for these personnel are described below.

III.B-1a(1). Senior Environmental Radiation Protection Technologists. After closure of the 183-H Basins, the senior environmental radiation protection technologists will be responsible for:

- Monitoring and reporting on groundwater well security and maintenance
- Collecting groundwater level data
- Collecting groundwater samples

- Sampling and monitoring equipment operation and maintenance

- Providing sample chain of custody to the laboratory.

III.B-1a(2). Site Surveillance Personnel. After closure of the 183-H Basins, the site surveillance personnel will be responsible for conducting the inspections at the 183-H Basins. The inspections will include:

- Security control devices
- Erosion damage
- Cover settlement, sedimentation, and displacement
- Vegetative cover condition
- Cover drainage system functioning
- Benchmark integrity.

III.B-1b. Training Content, Frequency, and Techniques. The training of a senior environmental radiation protection technologist requires service as a radiation protection technologist for 3 years before being certified as a senior environmental radiation protection technologist. Certification is accomplished by scoring at least 70 percent or above in the following radiation protection technologists biennial job-specific training areas:

III.B-1b(1). Specific Training for the Senior Environmental Radiation Protection Technologist. The following training requirements are required for the senior environmental radiation protection technologist.

Emergency Preparedness Training--May include a review of the building emergency procedures, consisting of listening to standard emergency signals, emergency exit routing, staging areas after evacuation, and reviewing job-specific emergency actions and reporting procedures.

Respiratory Protection Practices and Procedures--May include instruction on risks associated with airborne radioactivity; classification and use of respiratory protection equipment; instruction for obtaining and maintaining a current mask fit and card identification compliance; a review of current government regulations or recommendations concerning respiratory protection; and emergency procedures specific to respiratory protection.

Protective Clothing and Equipment--May include the types, locations, and uses of protective clothing, dressing and undressing procedures, and a review of limits and procedures associated with surveying and handling used protective clothing.

Emergency Response Training - All Facilities--May include emergency response training in the areas of radiation monitoring, criticality, emergency evacuation, response to audible alarms, response to fire, and response to mixed waste spills.

Applied Radiation Monitoring--May include instruction and review of setting priorities, response to work requests and setting up jobs, radiation work procedures, and administrative controls. May also include reports and

recordkeeping, personnel and customer relations, and radiation zone posting and labeling.

Personnel and Personal Effects Decontamination--May include the location and use of decontamination kits, decontamination sinks and showers, other decontamination supplies, and decontamination reports and procedures; a tour and review of the emergency decontamination facility; Hanford Environmental Health Foundation's involvement; nasal smears and irrigations; handling of personal effects; instruction in reporting off-normal events such as radiation zone injuries and radiation occurrences; documentation procedures; and a discussion of previous experiences.

Personnel Dosimetry--May include purpose, distribution, reporting, and recordkeeping associated with various personnel dosimeters; Hanford contractor radiation work controls; and a review of Pacific Northwest Laboratory's in-vivo counting and bioassay program.

Surveys and Monitoring Techniques--May include a demonstration of routine surveys, special surveys (glovebox operations, carcinogen laboratories, and hoods), release surveys, offsite surveys, radioactive shipments, radiation-generating device surveys, sealed source surveys, and dose rate monitoring techniques. Also may include discussion and participation in writing survey reports, radioactive shipping reports and procedures, and recordkeeping.

Radiation Monitoring Instruments--May include a review of portable and stationary instruments and usage, practice demonstration in setting dose rates, source checking, changing continuous air monitoring filters and calibration, inventory control, instrument change out, and recordkeeping.

Dangerous and Mixed Waste Management--May include general requirements for the handling and disposal of solid and liquid radioactive waste, ventilation and effluent systems, and engineered controls.

Radioactive Materials Shipping and Packaging--May include characterization of material and approved containers, packaging procedures, completion of radioactive shipment record application of quality control requirements of inspection and packaging activities, proper survey techniques, and recordkeeping. Also may include procedures for escorting radioactive shipments.

III.B-1b(2). Annual Training for Senior Environmental Radiation Protection Technologists. After a radiation protection technologist has successfully completed the required training courses the individual will be certified as a senior environmental radiation protection technologist. Senior environmental radiation protection technologist personnel will undergo training and at least an annual review in the following areas.

40-Hour Hazardous Materials Activity Training--Includes specific procedures for operation and maintenance of air-purifying respirators, self-contained breathing apparatus, monitoring instruments, sampling equipment, and personal protective equipment. In addition, it will cover toxicology, chemical and physical hazards, respiratory principles, and decommissioning

principles. Areas covered include mask fits, decontamination procedures, risk assessment, site safety, hazard assessment exercises, sampling procedures, quality assurance and quality control, hazard communication standards, and National Fire Protection Association and hazardous materials information system labeling systems.

This training program will satisfy the requirements of WAC 173-303-330, 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response* (OSHA 1989), and the Westinghouse Hanford Company's *Environmental Investigations and Site Characterization Manual*, EII 1.7 "Indoctrination, Training, and Qualification", (WHC 1989).

RCRA Groundwater Monitoring Scope, Organization, and Quality Assurance Plan--May include the documentation requirements included in the chain of custody to the laboratory, how to correct mistakes made on field data sheets, and any applicable manifests or shipping orders required for shipping samples to the laboratory.

Groundwater Field Sampling Procedures--May include pump description and operation of the three types of pumps used by the field personnel, operational procedures for the generators, and pumps used to gather groundwater samples, special requirements for collection of samples containing volatile organic materials, those that require acid preservatives, and those that are specially filtered. Training also will be given in the areas of field data record preparation and chain of custody to the laboratory.

III.B-1b(3). Training for Site Surveillance Personnel. Training content, frequency, and techniques required for the site surveillance personnel who will be conducting post-closure surveillance activities at the 183-H Basins are discussed in this section. Personnel will receive training annually in the following areas.

Radiation Zone Worker Training--This training program is established to give personnel the required training for radiation zone work. It covers the types of radiation experienced at the Hanford Site, the required protective clothing, monitoring devices, dress and undress procedures for radiation zone entry, emergency alarms and appropriate actions to take in such events, and the documentation required for entrance into radiation zones.

Site Cover Inspections--This on-the-job training program is established to ensure that the site surveillance personnel know what to inspect after the final closure of the 183-H Basins. It will include how to inspect for obvious signs of erosion, proper drainage, settlement, and sedimentation. In addition, personnel will be informed about what constitutes proper vegetation coverage.

Site Security Inspections--Personnel will be instructed on how to inspect for obvious signs of a security breach. Signs may include cut fencing, unlocked gates, or cut chains.

Location, Integrity, and Inspection of Benchmarks--Personnel will be shown the location of benchmarks and instructed to report any obvious signs of destruction or deterioration.

Location, Integrity, and Inspection of Groundwater Wells--Personnel will be shown the locations of the groundwater wells and instructed to inspect the cap and casing of each well to ensure that it is locked.

III.B-1c. Training Director. Currently, the hazardous waste management training is conducted by Nuclear Safety Services, Incorporated. This company was selected by the EPA to manage the investigation and remediation activities at the dangerous waste sites in the eastern half of the United States. As a result of this 5-year project, the subcontractor has accrued considerable experience in all aspects of dangerous waste site work, including the protection and training of site personnel engaged in sampling activities. Nuclear Safety Services, Incorporated is a subcontractor to the EPA Environmental Emergency Response Unit contract. Their responsibilities on the project include furnishing greater than 50 percent of the training instructors for the EPA's Office of Emergency and Remedial Response. These instructors provide training to the EPA's environment emergency response teams on a variety of subjects, including personal protective equipment, monitoring potential chemical hazards, and environmental sampling procedures.

The training director for senior environmental radiation protection technologists holds the title at Pacific Northwest Laboratory of Environmental Monitoring Supervisor. This person must meet the required qualifications by serving as a radiation protection technologist and a senior environmental radiation protection technologist. In addition the individual must be fully qualified in the areas of dangerous materials and groundwater sampling and procedures. These qualifications are met as part of the required training as a radiation protection technologist and emergency radiation protection technologist. The qualification documentation is maintained in the Pacific Northwest Laboratory's Radiation Protection Office.

The training director for the site surveillance personnel holds the title at Westinghouse Hanford as Manager of Safety Training. This position requires a Bachelor of Science degree in Science or Engineering with 10 years of experience in the nuclear industry or related areas and 5 years of management experience. The objectives of this position include providing certification, recertification, and continuing training for all Westinghouse Hanford radiation protection technologists and providing general safety training for all Westinghouse Hanford Company personnel and selected other Hanford Site contractors, the DOE-RL, and visiting personnel working on Westinghouse Hanford facilities.

III.B-1d. Relevance of Training to Job Position. Senior environmental radiation protection technologist personnel are trained to collect potentially contaminated groundwater samples that will be analyzed for dangerous waste and radioactive constituents. In addition, they are trained in the areas of collecting field data on groundwater level and reporting on groundwater well security and maintenance. The required training and job description for these personnel are fully described in Sections III.B-1a and III.B-1b.

Site surveillance personnel are trained to perform site surveillance and report on the integrity of security control devices, benchmarks, groundwater wells, and facility cover. The required training and job description for these personnel are fully described in Sections III.B-1a and III.B-1b.

III.B-1e. Training for Emergency Response. This section will demonstrate that facility personnel, who will be conducting post-closure activities at the 183-H Basins, have been fully trained to respond effectively to emergencies and are familiar with emergency procedures and equipment. Additional information on emergency preparedness training is described in Sections III.B-1 and III.B-1b.

III.B-1e(1). Procedures Regarding Emergency and Monitoring Equipment. The procedures for using, inspecting, repairing, and replacing emergency and monitoring equipment are covered as part of personnel training. Both the senior environmental radiation protection technologist and the site surveillance personnel will undergo training in these areas. Additional information can be found in Sections III.B-1 and III.B-1b.

III.B-1e(2). Alarm/Communication Systems. Personnel conducting post-closure activities at the 183-H Basins will be equipped with VHF hand-held radios, and their vehicles will have Hanford-Net radios that may be used to convey emergency information to the appropriate authorities.

As part of the personnel training described in Sections III.B-1a and III.B-1b, personnel will become familiar with the audible alarms established to warn personnel of immediate emergency situations (Table III.B-1).

III.B-1e(3). Response to Fires. After final closure, the 183-H Basins will have no structures remaining and will be covered with a earthen cap. As such, the need for fire equipment at the 183-H Basins is virtually unnecessary. However, if personnel are at the facility when a fire breaks out, they will notify the Hanford Site Fire Department and the 100 Area emergency control director by radio on frequency 164.400 (KFW-624).

III.B-1e(4). Response to Groundwater Contamination. A groundwater monitoring and assessment program has been in effect at the 183-H Basins since 1974. Currently, there are 23 groundwater sampling wells in place at the 100-H Area. The groundwater contamination levels generally have been decreasing since the use of Basin Number 1 was discontinued in 1979. At this time, groundwater contamination beneath the 183-H Basins does not constitute an emergency situation, nor will it become so as a result of closing these basins. Subsequently, emergency response training in this regard is not warranted at this time.

III.B-2. Implementation of Training Program

Senior environmental radiation protection technologists conducting the monitoring requirements established in Section III.B-1 must undergo training for a period of 2 years before being certified as senior environmental

Table III.B-1. Hanford Site Emergency Signals.

Signal	Incident/Alarm Type	Response
Gong or bell	Fire	Nonprocess personnel will evacuate Process personnel will wait for directions
Steady siren	Evacuation	Get car keys if time permits and vacate building; report to staging area[a]
Wailing siren	Take cover	Seek shelter indoors Shut windows and doors Await instructions
Ringing bell	CAM[b] alarm	Evacuate immediate area Call for help Remain in one location
CRASH alarm	Emergency communications	Pick up phone and listen. Relay message to building emergency director

[a] Area where facility personnel gather following notification of incident.
[b] Continuous air monitor.

radiation protection technologists. Only trained or qualified personnel are allowed to perform monitoring duties at the 183-H Basins.

Site surveillance personnel will undergo the required training programs outlined in Section III.B-1 as they pertain to monitoring requirements. Site surveillance personnel will not be allowed to perform inspections at the 183-H Basins until the required training programs have been completed.

Complete training records are maintained at the Pacific Northwest Laboratory Radiation Protection Office and the Westinghouse Radiation Protection Office for the senior environmental radiation protection technologists and the site surveillance personnel, respectively.

III.C. PROCEDURES TO PREVENT HAZARDS

As required by WAC 173-303-310, the closure plan will describe procedures for preventing hazards from occurring at the closed facility. This section describes procedures to be used for ensuring proper security at the

183-H Basins, which includes surveillance measures, intrusion barrier requirements, warning signs, and waiver declarations.

III.C-1. Security

Post-closure security will be maintained by routine surveillance, physical barriers, and warning signs that will remain in effect during the post-closure care period.

III.C-1a. Security Procedures and Equipment. The 183-H Basins facility will be covered with an engineered earthen cap. This cap will be surrounded by a chain link fence with locked gates and warning signs as per 40 CFR 265.14(b)(2)(i).

III.C-1a(1). 24-hour Surveillance System. The 183-H Basins facility will not have a 24-hour surveillance system. Because the closed facility will have an earthen barrier, a fence, and a means to control entry, it will not require 24-hour surveillance.

III.C-1a(2). Barrier, Means to Control Entry, and Warning Signs. The 183-H Basins are located within the Hanford Site controlled access area where roadways are restricted to authorized personnel and cannot be accessed by the general public. Also, the 183-H Basins facility will be surrounded by an 8-foot high chain link fence with three strands of barbed wire above the fence as per 40 CFR 265.14(b)(2)(i) (EPA 1989c).

In addition to Hanford Site-wide controlled access, the gates of the chain link fence surrounding the 183-H Basins will be locked at all times. The only exceptions will be when surveillance and/or repairs are being made. Keys will be kept by the surveillance group and Pacific Northwest Laboratory to access the wells within the fence. The 183-H Basins will have warning signs wired to the fence at each entrance to the facility and along the fence so as to be seen from any approach. The signs will indicate the office and telephone number to contact for site information. The legend on the signs will be written in English and will be legible from a distance of at least 25 feet. The legend on the signs will be:

DANGER. UNAUTHORIZED PERSONNEL KEEP OUT.

III.C-1b. Waiver. Waivers are not anticipated for equipment requirements, injury to intruders, or violations caused by intruders.

III.D. POST-CLOSURE CONTACT

The following offices will be the official contacts for the 183-H Basins during the post-closure care period:

U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

Westinghouse Hanford Company
P.O. Box 1970
Richland, Washington 99352

R. D. Izatt, Director
Environmental Restoration Division
(509) 376-5411

R. E. Lerch, Manager
Environmental Division
(509) 376-5556

III.E. AMENDMENT OF POST-CLOSURE PLAN

This post-closure plan will be amended whenever changes in operating plans or facility design affect the post-closure plan. This plan may be amended any time during the active life of the facility or during the post-closure care period. The facility no longer receives operational wastes, although it continues to evaporate wastes through natural processes. The approved post-closure plan will be amended by submitting a written request to the appropriate regulatory agency to authorize a change in the approved plan. The written request will include a copy of the amended post-closure plan for approval. The modified plan will be submitted at least 60 days prior to the proposed change in facility design or operation.

III.F. CERTIFICATION OF COMPLETION OF POST-CLOSURE CARE

Within 60 days after post-closure care has been completed, the DOE-RL will submit by registered mail to the regulating authority both a self-certification and a certification by an independent registered professional engineer that the 183-H Basins have been closed in accordance with the specification of the approved closure plan.

III.F-1. Owner/Operator Post-Closure Certification

The DOE-RL will self-certify using the following document or a document similar to it:

> I, (name), an authorized representative of the United States Department of Energy-Richland Operation Office located at the Federal Building, 825 Jadwin Avenue, Richland, Washington, hereby state and certify that the 183-H Solar Evaporation Basins at 100-H Area to the best of my knowledge and belief has been closed in accordance with the attached approved post-closure plan, and that the post-closure was completed on (date). (Signature and date).

III.F-2. Professional Engineer Post-Closure Certification

The DOE-RL will engage a professional engineer, registered in the state of Washington, independent from the DOE-RL, to certify that the 183-H Basins have been closed in accordance with this approved post-closure plan.

The DOE-RL will require the engineer to sign the following document or a document similar to it:

I, (name), a certified professional engineer, hereby certify, to the best of my knowledge and belief, that I have made visual inspection(s) of the 183-H Solar Evaporation Basins at 100-H Area and that post-closure of the aforementioned facility has been performed in accordance with the attached approved post-closure plan. (signature, date, state professional engineer license number, business address, and phone number).

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APPENDIX A

TOPOGRAPHICAL MAPS

NOTE: The following two maps are replacements for the prior submittal maps; they incorporate Ecology's Notice of Deficiency comments and 'current' information. The H-6-958 map depicts the current Hanford Site perimeter boundary. Map 2 is an update of the map that was presented in the June 1988, *183-H Solar Evaporation Basins, Final Status Post-Closure Permit Application* (DOE/RL 88-09). The changes are the addition of the river stage recorder, the groundwater flow direction arrow, and the waste site identification nomenclature.

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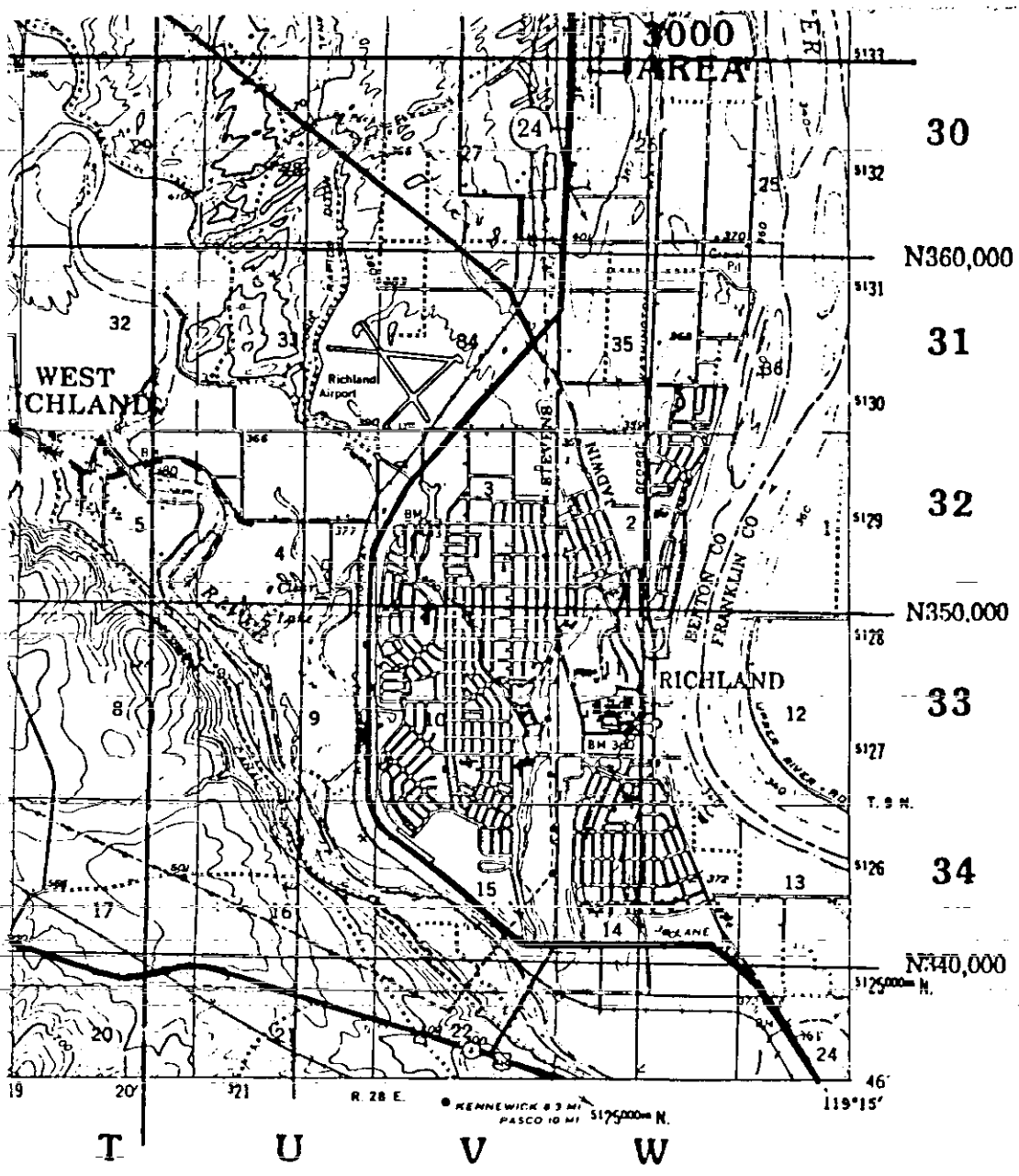

RAWING APPROVALS	DATE
PPD FOR QUALITY ASSURANCE	
PPD	7/89
PPD	
PPD	
SPONSIBLE ENGINEER R.L. MARTELL	3/89
RAFTING APPD	
HECKED	
RAWN K.D. JUNT	3/89

U. S. Department of Energy
Richland Operations Office

Westinghouse Hanford Company

OVERALL HANFORD FACILITIES

SCALE	BLDG. NO.	INDEX NO.
AS SHOWN	600 GEN	0100

CLASSIFICATION	BY	DRAWING NO	SHEET NO.	SHEETS
NONE	NOT REQ'D	H-6-958	1	1

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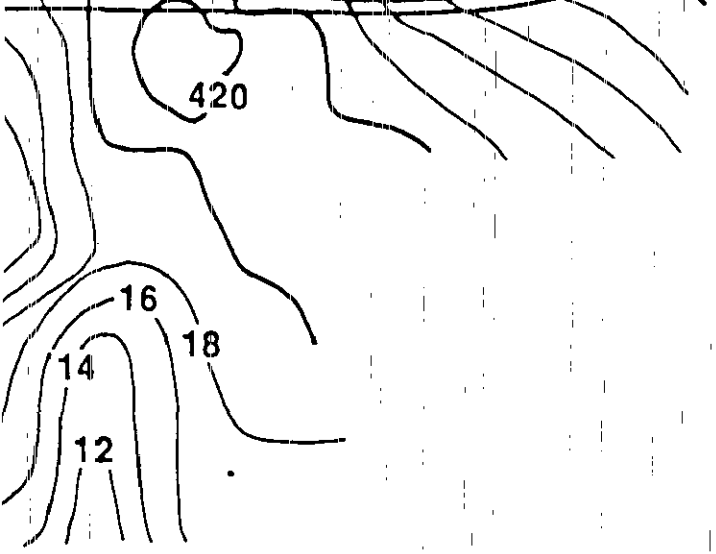

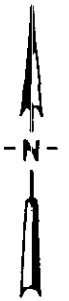

Note:
Information was revised (February 1988)
from original 100-H Area layout dated 1948

N92000

ell
ell Number

Map 2

100-H Area Wells and Contour Map

Hanford Site Wind Rose

Scale 1:200

0 200 400 ft

W39200

W38400

W37600

N91200

June 1988

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APPENDIX B

WASTE CHARACTERIZATION - 183-H BASIN NUMBER 1

NOTE: The following report and its appendices (A-N) (156 pages) are the United Nuclear Industries Report Number 3514 (UNI-3514). It is a historic record of the 183-H Basin Number 1 Waste Characterization.

Review of the actual Chemical Waste Disposal Permits (CWDP) and associated laboratory analyses have disclosed some errors in this report. Therefore, the data provided in the body of the text supercedes this appendix. Because this is an historic record, it will not be changed. It appears exactly as presented in prior submittals.

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Waste Characterization - 183-H Basin No. 1

I. SUMMARY AND CONCLUSIONS

In order to permit removal and disposal of the waste currently stored in basin no. 1 (183-H solar evaporation facility), a sampling and analyses program was established. The goals of this effort were as follows:

(1) Determine the concentrations of the radioactive constituents in the waste.

(2) Determine the concentrations of the chemical constituents in the waste.

(3) Designate the waste in accordance with the Washington Administrative Code Dangerous Waste Regulations (WAC 173-303).

Following completion of the sampling effort in October of 1984 various analyses were undertaken. The liquid and solid phases of the waste were analyzed separately in most cases. This was done with the understanding that as much of basin no. 1 liquid as possible will be pumped into an adjacent basin prior to commencing with cleanout, hence, the packaged waste will consist primarily of material found in the solid portion. By pursuing separate analyses of the liquid and solid phases, mathematical manipulations to simulate actual waste conditions at the time of packaging (e.g., 10% liquid remaining in the waste matrix) are possible.

Radioactive analyses showed that the waste material contained up to 530 ppm (parts per million) uranium in the solid portion; the liquid phase had uranium present in concentrations exceeding 300 μg/ml. Based on an isotopic uranium analysis, the basin No. 1 waste exceeds the "Threshold Quantity" limits for radionuclides and must, therefore, be disposed of as radioactive material (non-transuranic).

Chemical analyses of the waste showed the major constituents of the solids phase to be sodium, copper, water of hydration, and fluoride, nitrate, and sulfate ions. These constituents comprised approximately 90% of the total solid material. The liquid phase consisted primarily of water and sodium, nitrate, and sulfate ions. Table C.2 of Appendix C shows that major chemical composition of the solid samples; Table C.1 lists similar data for the liquid specimens. (Note: For locations of sample points, refer to Figures A.2 and A.3 of Appendix A).

In designating the waste in accordance with Washington Administrative Code requirements, the list designation procedure specified in WAC 173-303-070 was utilized. Specific areas of investigation, and the findings for the basin no. 1 material, are summarized as follows:

(1) Discarded Chemical Products: This section of the regulation does not apply to manufacturing process wastes; hence, the basin no. 1 material is not designated by the discarded chemical products criteria.

(2) Dangerous Waste Sources: Review of the dangerous waste sources lists indicates that the basin no. 1 material is not designated by this regulatory section.

(3) Dangerous Waste Mixtures:

(A) Toxicity: Based primarily on the concentration of fluoride ion in the solid phase material, and presuming this constituent to be present as sodium fluoride, the waste is designated as an Extremely Hazardous Waste (EHW) by the toxicity subsection.

(B) Persistence:

(i) Polycyclic Aromatic Hydrocarbons (PAH):

Grab samples taken at opposite ends of the basin showed that any PAH's present were below the concentration limits requiring designation.

(ii) Halogenated Hydrocarbons (HH):

Grab samples analyzed for halogenated hydrocarbons indicated that such constituents might be present in quantities slightly greater than the designation limit of 0.01%. It is recommended that further sampling and analyses, if required to evaluate packaging materials, be undertaken following transfer of the basin no. 1 liquid phase into an adjacent basin.

(C) Carcinogens: Analyses indicated that the total concentration of carcinogenic constituents was less than the 1.0% designation limit.

(4) Dangerous Waste Characteristics:

(A) Ignitability: Due to the presence of nitrates in both the solid and liquid phases, the waste from basin no. 1 is considered an oxidizer and, as a consequence, is designated as a Dangerous Waste (DW) under the ignitability subsection.

(B) Corrosivity: Measurements of the sample pH's indicate that the material is not designated by the criteria of this subsection.

(C) Reactivity: Although there were some cyanide bearing materials discharged into basin no. 1, it is believed that the small quantities involved (less than 3 pounds of solids and approximately 2 gallons of solution) would not result in designation via the reactivity characteristic.

(D) EP (Extraction Procedure) Toxicity: Of the fourteen contaminants identified in the regulations for EP toxicity testing, six are herbicides or pesticides. Since such materials were never dicharged into basin no. 1, EP toxicity evaluation for these constituents was not performed. Of the eight inorganic contaminants listed, seven were tested for and found to be either not present or present in concentrations less than the designation limits. Analysis for the eighth contaminant (mercury) was not undertaken. Inasmuch as the waste has been designated as an EHW per the toxicity criteria, further testing for determination of the mercury extraction potential is not warranted.

Based on the analyses performed, the basin no. 1 waste would be designated via WAC 173-303 as an Extremely Hazardous Waste and would be assigned a designating waste number of WT01-0001.

II. Background

In 1973, UNC began discharging waste solutions from the fuel fabrication process into the solar evaporation facility at the 100-H Area. The waste solutions consisted mostly of spent acids (primarily nitric, sulfuric, hydrofluoric, and chromic acids) which had been over-neutralized with sodium hydroxide. Metal impurities in the waste included copper, silicon, zirconium, aluminum, chromium and nickel. In addition to the fuel fabrication wastes, small quantities of used and unused chemical materials from other contractors were occasionally discharged to the basin.

By mid-1978, nearby groundwater monitoring wells were showing increased chromium and nitrate levels, indicating a probable leak from the facility. As a consequence, discharges into basin no. 1 were halted. The waste material from the previous usage, totaling approximately 10,000 cubic feet, remains in the facility as a mixture of solution and precipitates. In order to permit determination of removal and disposal techniques, characterization of the radioactive and hazardous constituents was undertaken. The purpose of this report is to document the results of this effort.

III. Sampling Patterns and Methodology

The basic dimensions of the basin are shown in Figure A.1 of Appendix A. The waste material of concern is present only in the lower portion (i.e., 95' x 52' area) of the facility. There are two distinct types of waste in

the basin: (1) the material residing on the bottom of the basin (which constitutes the majority of the waste) and (2) a buildup of solid materials along two sides of the basin. The buildup appears to be the result of precipitation of the saturated salt solution, and forms "ridges" of material along the east and west edges of the facility.

In order to provide representative samples of the material residing on the floor of the basin (called "inner" basin waste and designated by the "I" prefix in the analyses reports), the facility was divided into fifteen theoretical grids as shown in Figure A.2, Appendix A. Samples were then taken from the approximate center of these grids. Due to the presence of several vertical layers of material, liquid nitrogen was used to "freeze" a representative core at each sample location. These samples were then placed in containers and allowed to thaw.

The solid material found in "ridges" on two sides of the basin was also sampled based upon a theoretical grid, as shown in Figure A.3. Samples were taken at the approximate center of four randomly selected locations. Specifically, the grids selected for sampling were those designated O-Ø, O-2, O-5, and O-9. (Note: the "O" prefix is indicative of samples taken from the "outer" basin material.)

IV. Characterization Results - Radioactive Analyses

Of the fifteen "inner" basin samples, five were selected at random for analyses. These samples were those designated I-2, I-5, I-12, I-13, and I-15. Each of the five samples were filtered to separate the solid and liquid phases. These portions were then analyzed separately for radioactive constituents. The reason for segregating the phases and analyzing separately was to simulate the activities planned prior to basin cleanout; i.e., the pumping of as much of the liquid phase as possible into an adjacent basin and the subsequent packaging of the remaining solids. Thus, the packaged waste will resemble the filtered solid material more than it does the liquid phase. Of course, some portion of the liquid will be held by the solid material and will, therefore, be contained within the packaged waste. By analyzing the phases separately, the solid/liquid data can be mathematically combined to duplicate the actual waste mixture.

The results of the uranium analyses for the liquid portions are shown in Table B.1 of Appendix B. The liquid phase showed an average uranium content of 275.9 u g/ml. This relatively high value is probably due, in part, to the formation of carbonate soluble uranium species.

The solid phase material of the inner basin samples showed an average uranium concentration of 420 ppm. It is anticipated that the uranium content of the packaged waste will closely duplicate the concentrations found in the solid phase. Specific results of the analyses are shown in Table B.2.

An isotopic uranium analysis was performed on the I-2 solid sample. Results of this effort are shown in Table B.3. The isotopic concentrations listed should be consistent throughout the basin. Based on evaluation techniques provided from Rockwell Hanford Operations (see Appendix H), the uranium content exceeds the "Threshold Quantity" for soil contamination and must, therefore, be classified as radioactive waste. The calculation of basin no. 1 uranium concentration relative to the allowable limit is shown in Appendix I.

The material discharged into basin no. 1 is also known to contain technetium-99. Results of the analysis for this constituent in the liquid phase is shown is Table B.4 of Appendix B. The concentration of technetium-99 in the solid phase material was found to be below detection limits.

V. Characterization Results-Chemical Constituents Analyses

A. General Chemical Analyses

As with the radioactive analyses, five randomly selected "inner" basin samples were subjected to investigation. In addition, two of the "outer" basin samples (randomly selected) were subjected to chemical analyses. The "inner" basin materials were filtered to separate the solid and liquid phases. Chemical analyses were performed separately for the two phases.

Results of the solid phase analyses are summarized, for major constituents, in Table C.1 of Appendix C. Detailed chemical analyses results are shown in Table C.3 for "inner" solid phase samples and Table C.4 for "outer" basin material. As anticipated, the "inner" solids showed very high concentrations of sodium and sulfate ions. Copper, fluoride, and nitrate ions were also present in substantial quantities. Water, calculated based upon weight loss at 105°C, was found to comprise 22% (average) of the solid material. The two "outer" solid samples also showed the presence of water in large quantity. The major differences between the "inner" and "outer" material was that the "outer" samples showed about half the copper concentration, about one-fifth the nitrate concentration, and about 70% more sulfate than the "inner" samples. The "outer" samples consisted, as would be expected, primarily of sodium sulfate which had crystalized from the salt solution.

The results of the liquid phase analyses for the "inner" samples are summarized (for major constituents) in Table C.2 of Appendix C. Detailed results are listed in Table C.5 (Note: In the table of detailed results, the liquid phase is identified as "supernate".) Water was found to be the major liquid constituent, comprising about 70% of the solution by weight. Sodium and nitrate ions were also present in great abundance. The "outer" basin samples had no filterable liquid, hence, there were no liquid phase analyses for these specimens.

B. Designation per WAC 173-303: General Discussion

Rockwell Hanford Operations had indicated that UNC should designate the basin no. 1 waste in accordance with the Washington Administrative Code Dangerous Waste Regulations (WAC 173-303). These regulations permit designation by either of two methods: (1) list designation or (2) criteria designation. The method selected for evaluating basin no. 1 material was the list designation procedure. This consists of five sections, as follows:

(1) Discarded chemical products
(2) Dangerous waste sources
(3) Infectious dangerous wastes
(4) Dangerous waste mixtures
(5) Dangerous waste charcteristics

C. Designation per WAC 173-303-081: Discarded Chemcal Products

In discussion of characterization via this regulatory section, WAC 173-303-081 identifies a discarded chemical product as a "commercial chemical product or manufacturing chemical intermediate which has the generic name listed in the discarded chemical products list" or as an "off-specification commercial chemical product or manufacturing chemical intermediate which if it had met specifications would have the generic name listed in the discarded chemical products list, WAC 173-303-9903." In addition, containers or liners used for such materials or residues from cleanup of spills of commercial chemical products are included as discarded chemical products. The Resource Conservation and Recovery Act (RCRA) has essentially identical language to that listed in WAC 173-303 with regard to discarded chemical products. Federal Register Vol. 45, No. 98, in which the RCRA regulation is promulgated, provides the following comment on interpreting the discarded chemical product definition: "The phrase 'commercial chemical product or manufacturing chemical intermediate having the generic name listed in ...' refers to a chemical substance which is manufactured for commercial or manufacturing use. It does not refer to a material, such as a manufacturing product waste, that contains any of the substances listed...". Since the material contained in basin no. 1 consists primarily of a waste product from the fabrication of nuclear fuels, it would not be considered a discarded chemical product. It should be noted, however, that in addition to the input from fuels fabrication effort, other Hanford site contractors have occasionally discharged chemical materials into the basin. Some of these discharges included unused chemical products. Specific chemicals discharged to the basin which are listed as Extremely Hazardous Wastes (EHW) in the Discarded Chemical Products list were sodium cyanide, potassium cyanide, copper cyanide, unused cyanide solutions, and unused vanadium pentoxide solution. These discharges were of very small quantity (2 1/2 pounds of total solid material and less than 2 1/2 gallons of liquid). Analyses for

vanadium in the basin samples showed levels to be below detection limits (>2 μg/ml in the liquid phase and >0.01 wt.% in the solid phase). All discharges of non-routine chemicals to the basin were documented via "Chemical Waste Disposal Permits". A summary of these dicharges are shown in Table D.1 of Appendix D; copies of the actual "Chemical Waste Disposal Permits" are included in Appendix J.

D. Designation per WAC 173-303-082: Dangerous Waste Sources

WAC 173-303-082 specifies that wastes from the Dangerous Waste Sources list be designated as Dangerous Waste (DW) or Extremely Hazardous Waste (EHW), as appropriate. The sources list (WAC 173-303-9904) is reproduced in Appendix E of this report. The waste from the fuels fabrication process in basin no. 1 is not designated by this regulatory section.

E. Designation per WAC 173-303-083: Infectious Dangerous Wastes

WAC 173-303-083 on infectious dangerous waste has not yet been written.

F. Designation per WAC 173-303-084: Dangerous Waste Mixtures

The Dangerous Waste Mixtures section has three areas to be considered when evaluating a waste. Specifically, these areas are toxicity, persistence, and carcinogenicity. Each of these categories were evaluated for the basin no. 1 material, with results as follows:

1. Toxicity: The regulation requires evaluation of the toxicity of constituents within a waste mixture. Toxicity data categorization is found in either of two sources: (1) the Spill Table contained in 40CFR 117.3, which lists the toxic category of a chemical directly, or (2) the NIOSH Registry, which lists toxicity data which must be compared with a table in WAC 173-303 for determination of toxic category. Once the toxic categories of the various constituents are known, a formula within the regulations is used to combine the individual material toxicities into a single "Equivalent Concentration" (E.C.). The resultant E.C. and the total waste quantity involved are then located on a graph (provided within the regulations) for determination of designation for toxicity.

   In determining toxicity, certain presumptions must be made concerning the forms of the materials in the waste. For example, knowing the sodium ion concentration is not enough to determine toxicity; instead, the sodium ion must be presumed (or shown) to be in a particular form, e.g., as sodium sulfate. Only when the specific form is identified can the EPA Spill Table or NIOSH Registry be consulted for determination of the toxic category.

Table F.1 of Appendix F lists the presumed forms, toxic categories, and concentrations for the major constituents in the solid phase waste. (Note that the list includes only those materials which, in the presumed form, had toxicity data available. Sodium sulfate, for example, is not listed because toxicity ratings were not found in either the Spill Table or NIOSH Registry. Also, water and other materials which are considered non-toxic are not included.) In determining the presumed form, the tendency was to list the material in the most reasonable and toxic form. Thus, all the nickel in the sample was considered to be in the hydroxide form (Class C toxic) rather than the oxide form (no toxicity data available), even though the waste probably contains both nickel hydroxide and nickel oxide. Similiarily, the calcium is probably present in the waste at least in part as calcium carbonate, however, the calcium hydroxide form is presumed because of the availability of toxicity data. The actual determination of the concentrations of various forms in a material consisting of a multitude of constituents is extremely difficult; by presuming the most toxic and reasonable form, however, a conservative evaluation is provided.

Actually, the form of the first four materials listed in Table F.1 is rather immaterial because the fifth listed item, sodium fluoride, is present in sufficient quantity to result in a designation of Extremely Hazardous Waste (EHW). It should be noted, however, that the presumption that all the fluoride is present as sodium fluoride is probably not completely correct. In actuality, a good deal of the fluoride is probably present as sodium fluozirconate (Na_2ZrF_6), for which toxicity data is not available. Water leaching of the solid phase, however, showed that the resultant solution was high in sodium and fluoride ions, but very low in zirconium. The scenario for explaining the observed behavior is that, in the basin solution, the overabundance of sodium is causing precipitation of Na_2ZrF_6 via the common ion effect. When water leaching the filtered solids, the Na_2ZrF_6 apparently redissolves, followed by reaction of the zirconium with hydroxide ion. Whatever the actual mechanism is, the evidence indicates that the sodium and fluoride ions in the basin no. 1 solids phase behave very similar to sodium fluoride crystals when leached. As a consequence, the material is treated as sodium fluoride when evaluating for toxicity.

Appendix K shows an example of the E. C. calculations for one of the solid samples; Table F.2 lists the E. C. values calculated for each of the samples. Figure F.1 shows the toxic waste mixture graph from WAC 173-303 which is used to designate toxic waste classification. As can be seen, an E.C. greater than 0.01% results in a EHW designation for the basin no. 1 solid material since the batch quantity is greater than 4,000 lbs.

(Note: The waste will be packaged for disposal in 55 gallon drums. These drums will contain less than 4,000 lbs. each, however, all the drums will presumably be disposed of simultaneously as a single "batch" of waste.)

Determination of the forms of the constituents in the liquid phase samples is even more problematical than the determination for the solids. Ionic substances in solution are commonly referred to as a compound associated with the ions (e.g., a solution consisting of sodium and fluoride ions is called a sodium fluoride solution; a solution of hydrogen and fluoride ions is called a hydrofluoric acid solution, etc.). It must be recognized, however, that the substances in solution exist primarily as separate ions and not as actual compounds. In a solution consisting of many different cations and anions (such as the basin no. 1 liquid), it is not technically correct to associate the separate ions with particular compounds. In order to evaluate toxicity per WAC 173-303-084, however, it is desirable to identify a specific form for the ions. In evaluating the basin no. 1 waste, it was assumed that the cations were associated with either nitrate or sulfate ions (in proportion with the molar ratios of the two anions) since these two groups comprise the vast majority of the anions present. Similarily, the anions were presumed to be associated with sodium since this represents the major cation present. Admittedly, assignment of material forms in this matter can result in some rather unlikely combinations; nevertheless, such assignment was viewed as the best method for evaluating toxicity in the absence of actual bioassay testing data.

Table F.3 lists the presumed forms, toxic categories, and calculated concentrations for the major species of the liquid phase. Based on the calculation performed, three of the five liquid phase samples had E. C. values below the limits for toxicity designation; the other two solutions were found to be in the Dangerous Waste (DW) category (see Table F.4).

In an attempt to mathematically combine the solid phase (EHW) and liquid phase (DW) toxicity designation, calculations were made based upon the weight ratios (see Table F.5) for the "inner" basin samples. If 50% of the available liquid is removed prior to packaging, the resultant "inner" samples will be EHW (see Table F.6). As a consequence, a designation of EHW due to toxicity is made for the basin no. 1 waste.

2. Persistence: This subsection of WAC 173-303-084 involves determination of the concentrations of halogenated hydrocarbons (HH) and polycyclic aromatic hydrocarbons (PAH). In evaluating basin no. 1, two grab samples were taken and analyzed to provide a general indication of the potential contaminant levels. These

samples were taken at locations within the grids identified as I-2 and I-14 (see Figure A.2). Following separation of the solid and liquid phases, the samples were extracted using techniques specified within the regulations.

All the extracted residues were well below 1% by weight, which is the limit above which additional PAH analyses are required. Some of the sample phases, however, showed extracted material totals in excess of 0.01% (by weight), which is the limit above which additional HH analyses is required. The presence of halogenated hydrocarbons in the waste would most likely be due to carry-over or discharge of tetrachloroethylene, a substance used in substantial quantities in the fuels fabriction process. Since the basin no.1 material is designated as EHW per the toxicity evaluation, the need for further HH analyses is warranted only if absolutely necessary in order to evaluate adequacy of packaging materials. It is recommended that additional samples (if required) be taken following transfer of the majority of the liquid phase into an adjacent basin. EPA approved methods specified in document SW-846 (entitled "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods") should be consulted prior to undertaking any sampling and analysis effort.

3. Carcinogenicity: Subsection (7) of WAC 173-303-084 requires that a waste be designated as Dangerous Waste (DW) if the total concentration of carcinogenic material exceeds 1.0% of the total waste quantity. Investigation showed that the only carcinogenic material in the liquid phase (based on presumed form) was Na_2CrO_4. As shown in Table F.7, the concentration found in each of the five liquid phase samples was well below the 1.0% limit. Table F.8 shows the concentrations of presumed form carcinogenic materials in the solid phase samples. Again, the values are well below the 1.0% limit.

Summarizing the information gathered relative to the regulatory section, basin No. 1 solid is designated per WAC 173-303-084 as shown in Table F.9.

G. Designation per WAC 173-303-090: Dangerous Waste Characterisitics

Having designated basin No. 1 as EHW per WAC 173-303-084, further investigation and analyses is not required by the regulation. Inasmuch as most of the analyses were being undertaken concurrently, however, most of the information needed to evaluate the waste in accordance with the Dangerous Waste Characteristics section was available. This regulatory section specifies four areas to be considered when designating waste materials. The basin no. 1 waste, when evaluated with respect to these four areas, provided results as follows:

1. Ignitability: The regulatory section on ignitability states that waste is designated for this characteristic if "it is an oxidizer as defined in 49 CFR 173.151." The 49 CFR 173.151 definition, in turn, lists nitrate bearing substances as oxidizers. The analyses of basin no. 1 solid phase material showed nitrate concentrations ranging from 6 to 10% for the "inner" samples and an average of 1.5% for the "outer" samples. The liquid phase samples ranged from 14 to 23% nitrates by weight. As a consequence, basin No. 1 waste is considered to be designated as DW via this regulatory subsection. A waste number of D001 would be assigned due to the ignitability characteristic.

2. Corrosivity: The corrosivity designation procedure for the liquid phase samples involves two tests: (1) a pH measurement and, (2) a measurement of the corrosivity towards steel. Inasmuch as packaged waste from basin no. 1 will contain no free standing liquid, the steel corrosivity testing was not undertaken. A pH measurement of the liquid phase material showed, however, that the solution would not be designated by the criteria specified in the regulation. Table G.1 lists pH data for the liquid phase.

   WAC 173-303 specifies that a solid is designated under the corrosivity subsection if the material, when mixed with an equal weight of water, yields a liquid with a pH greater than 12.5 or less than 2. The "outer" basin sample identified as 0-Ø and 0-9 were subjected to this test, with resulting liquid pH's of 9.3 and 9.6, respectively.

   Based on the tests performed, the basin no. 1 waste is not designated for corrosivity.

3. Reactivity: The criteria for determining whether or not a waste exhibits the characteristic of reactivity are shown in Appendix L. The only potential for basin no. 1 waste designation involves the "cyanide-bearing waste" criteria. Approximately 2 1/2 pounds of solid cyanide and 2 gallons of cyanide-bearing solutions were discharged into the basin (see "Chemical Waste Disposal Permit" No.'s 7-77, 5-77, and 3-76.) Due to the small quantities involved and the probability of decomposition, it is not believed that the cyanide would be found present "in a quantity sufficient to present a danger to human health or the environment"; therefore, the waste is not considered to be designated under reactivity guidelines.

4. EP Toxicity: The EP toxicity characteristic concerns the potential for leaching of heavy metals and certain herbicides and pesticides from a waste material. The specific constituents of concern and concentrations requiring designation are shown in Table G.2.

The procedure for determining the EP toxicity of a material involves separation of the liquid and solid phases, leaching of the solids portion (if >0.5% of the sample matrix) with specified volumes of deionized water and acetic acid, recombination of the filtrate and leachate solution, and chemical analyses for the specified constituents.

In evaluating the basin no. 1 waste, the analyses for the herbicides and pesticides were not pursued since such materials were never discharged to the facility. Also, due to the rigid constraints on sample retention and analyses, the waste was not evaluated for the potential of mercury EP toxicity. Some small quantities of mercury bearing materials were discharged to the basin as authorized by "Chemical Waste Disposal Permits." Since the waste has been designated as EHW via the toxicity criteria of WAC 173-303-084, additional sampling and analyses for mercury contamination is not warranted.

In evaluating the waste for the remaining seven heavy metals, analyses on the "inner" basin filtrate and leachate portions were performed separately rather than on the combined aliquots. Results of the EP toxicity testing for the "inner" basin filtrate and leachate and for the "outer" basin leachate (the "outer" basin samples had no filtrate phase) are shown in Tables G.3, G.4, and G.5, respectively. As can be seen, none of the filtrates or leachates were above the applicable limits for arsenic, barium, cadmium, lead, selenium, or silver. In order to evaluate the overall EP toxicity for chromium VI in the "inner" samples, it was necessary to mathematically combine the results from the filtrate and leachate samples. Since the filtrate shows the highest concentration of chromium VI, the most conservative method of evaluating for EP toxicity was to presume that the volumetric proportion of filtrate present in the samples will also be present in the packaged waste. (In actuality, the packaged material will have substantially less filtrate.) The results of mathematically combining the filtrate and leachate solutions, based on volumetric proportions, are summarized in Table G.6. A sample calculation demonstrating the combination method is shown in Appendix M. Note that the mathematical combination method used is identical to that described in the Washington Department of Ecology document ("Chemical Testing Methods") for evaluating EP extracts containing two liquid phases.

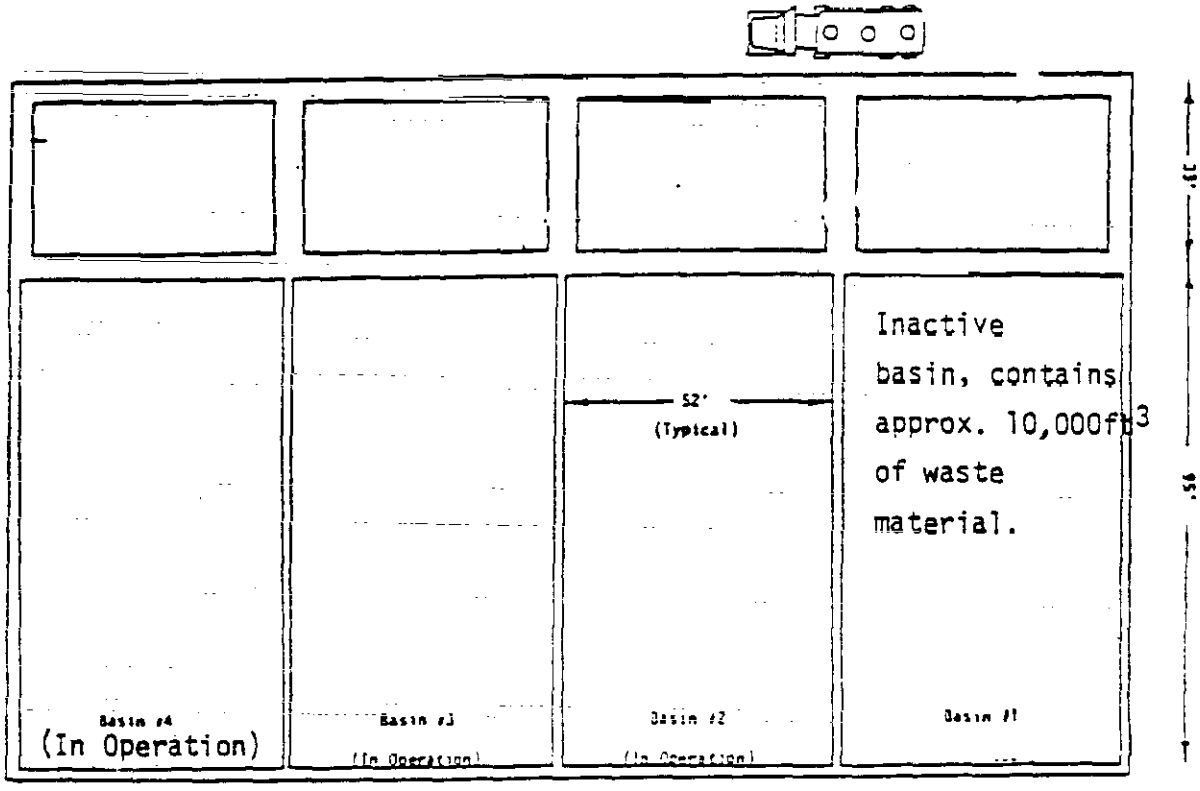
Subjecting the chromium VI concentration results to the statistical interpretation described within the "Test Methods for Evaluating Solid Wastes - Physical/Chemical Methods" manual, the conclusion reached is that the basin no. 1 material would not be designated as EP toxic. Calculations of the statistical evaluation of the chromium VI data are shown in Appendix N.

Table G.7 summarizes the basin no. 1 waste designation per WAC 173-303-090.

APPENDIX A

BASIN DIMENSIONS AND SAMPLE LOCATIONS

TOP VIEW OF 183-H SOLAR EVAPORATION BASIN



SIDE VIEW OF 183-H SOLAR EVAPORATION BASIN

- Wall Thickness:
  - Walls and floor of shallow section are 1' thick
  - Floor of deep section is 6" thick
  - Outside walls and walls between basins are 2' thick at the bottom and 1' thick at the maximum fill level.

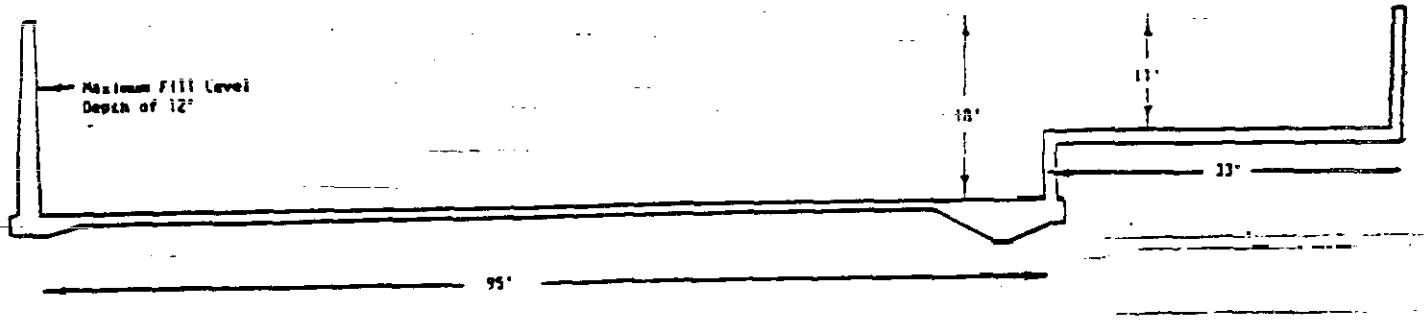


Figure A.1
Dimensions of the 183-H Solar Evaporation Basins

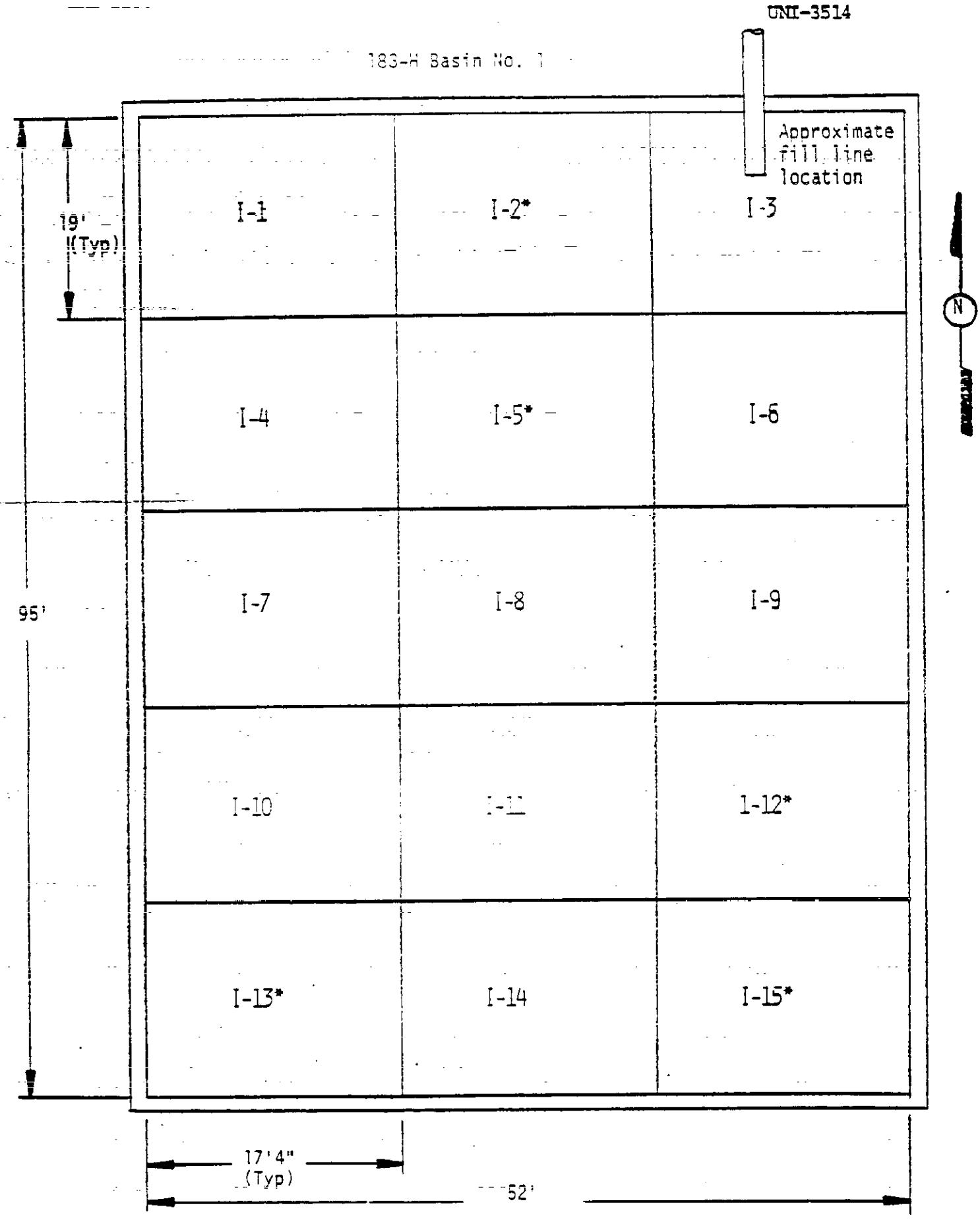


Figure A.2

"Inner" Basin Sampling Grid

(Samples were taken in the approximate center of each grid.)

* Samples randomly selected for analyses

183-H Basin No. 1

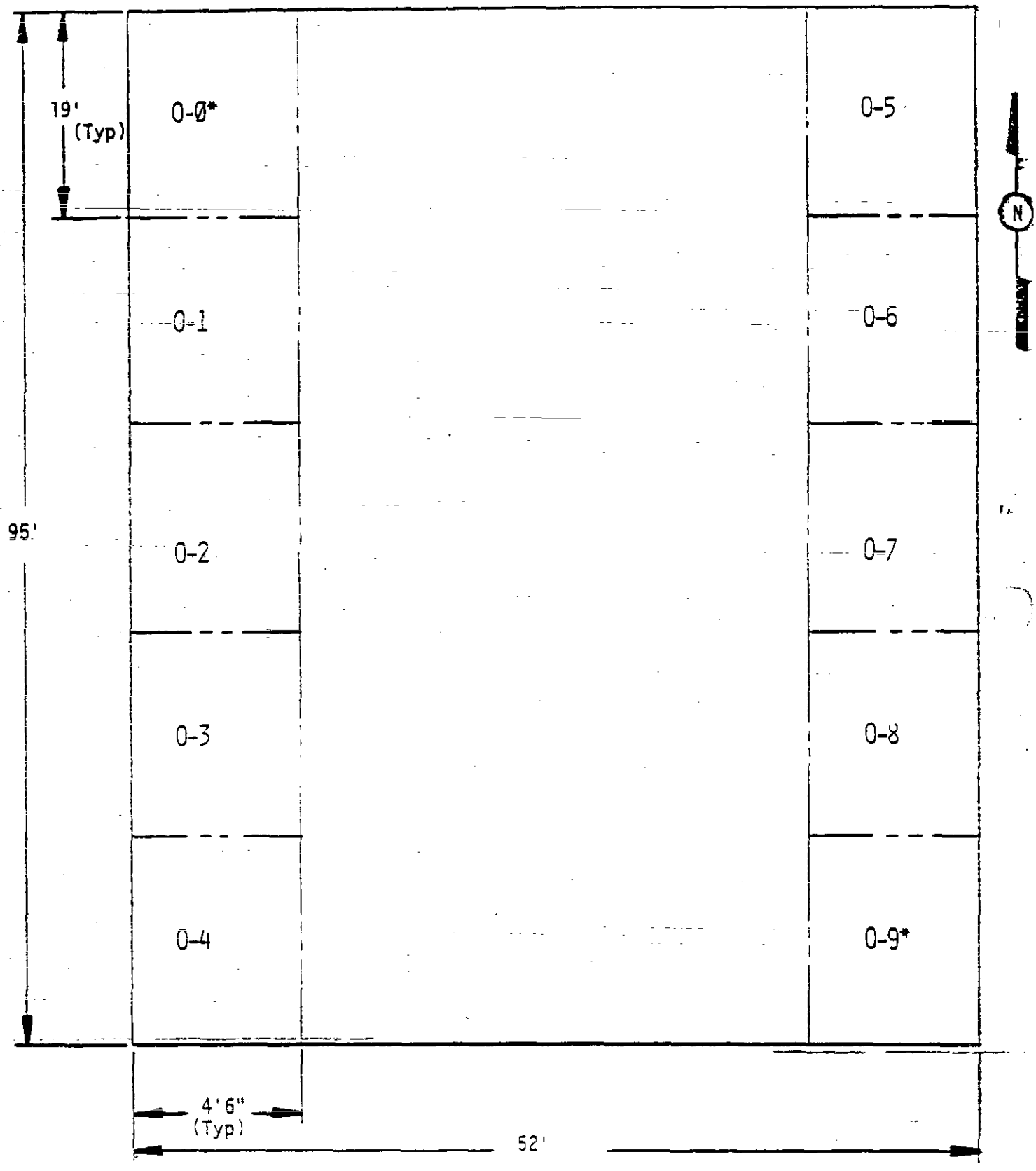


FIGURE A.3

"Outer" Basin Sampling Grid

(Samples were taken in the approximate center of each grid.)

* Samples randomly selected for analyses

9413294.1425

APPENDIX B

RESULTS OF RADIOACTIVE ANALYSES

TABLE B.1

Uranium Analysis - Liquid Phase

Sample No.	Uranium Content (μg/ml)
I-2	328.5 (average)
I-5	329
I-12	234
I-13	250
I-15	238

TABLE B.2

Uranium Analysis - Solid Phase

Sample No.	Uranium Content (wt %)
I-2	0.053
I-5	0.040
I-12	0.039
I-13	0.039
I-15	0.039
0-Ø	0.0082
0-9	0.016

TABLE B.3

Isotopic Uranium Analysis - Solid Sample I-2

Isotope	Content (wt %)
U-238	98.940 ± 0.004
U-235	1.006 ± 0.004
U-236	0.044 ± 0.001
U-234	0.009 ± 0.001

TABLE B.4

Technetium - 99 Analysis - Liquid Phase

Sample No.	Conc. (pCi/L)
I-2	8.90×10^5
I-5	7.00×10^5
I-12	7.88×10^5
I-13	8.68×10^5
I-15	4.94×10^5

APPENDIX C

GENERAL CHEMICAL ANALYSES

Table C.1

183-H Basin No. 1

Summary of Chemical Analyses -

Liquid Phase Constituents > 10 μg/ml

(all results in μg/ml unless noted otherwise)

Constituent	I-2	I-5	I-12	I-13	I-15
Na	130,000	134,000	92,000	92,000	86,000
Zr	520	560	360	280	170
Cu	520	560	360	170	180
F^-	2,700	2,700	4,100	5,100	5,100
Cl^-	900	800	600	600	500
NO_2^-	1,100	1,000	600	700	500
NO_3^-	280,000	290,000	180,000	190,000	160,000
$SO_4^=$	13,000	20,000	24,000	28,000	31,000
$CO_3^=$	2,970	1,380	1,740	2,760	2,580
HCO_3^-	6,500	4,940	4,580	4,700	4,030
H_2O loss (based upon drying at 105° C-wt. %)	64%	63.1%	73.2%	73.8%	75.2%
Al	< 10	13	< 10	< 10	< 10
Cr	53	85	60	63	60
K	180	240	60	60	< 30
Mg	14	18	10	12	10
Ni	17	19	15	17	16
Si	< 10	10	< 10	< 10	< 10
Cr VI	50	81	57	60	54
pH (-log $[H^+]$)	9.53	9.32	9.54	9.66	9.71
Specific gravity (g/ml)	1.28	1.28	1.20	1.19	1.18
Wt. ratio - solids wt. / supernate wt.	1.43	2.14	1.63	2.20	1.90

Table C.2

183-H Basin No. 1

Summary of Chemical Analyses -

Solids Constituents >1 wt. %

(all results in wt. % unless noted otherwise)

Constituent	I-2	I-5	I-12	I-13	I-15	O-0	O-9
Na	23.5	20.3	18.8	19.5	17.7	20.5	22.9
Cu	12.6	12.8	12.7	11.2	10.0	5.44	6.30
Zr	1.90	3.43	3.55	3.32	3.85	1.56	1.82
F^-	5.4	6.2	6.1	6.4	6.1	7.1	6.7
NO_3^-	10.4	9.6	7.4	6.9	6.1	1.4	1.6
$SO_4^=$	19.8	23.5	20.3	19.7	17.7	35.5	32.7
H_2O loss (based upon drying at 105°C)	21.0	18.7	23.5	23.5	24.5	22.8	23.1
Si	<1	<1	<1	<1	<1	2.83	<1
pH when mixed with equal wt. H_2O	-	-	-	-	-	9.3	9.6
Wt. ratio - $\frac{\text{solids wt.}}{\text{supernate wt.}}$	1.43	2.14	1.63	2.20	1.90	-	-

Reported values Wt-%

Table C.3

Solids (total) Fused

183-H Basin No. 1 "Inner" Samples

LAB NO. _____

UNI-3514

Dilution Factor	Detection Limit µg/g	Sludge #2 K/Ni	Sludge #2 Na/Zr	Sludge #2 Ave	Sludge #5 K/Ni	Sludge #5 Na/Zr	Sludge #5 Ave	Sludge #12 K/Ni	Sludge #12 Na/Zr	Sludge #12 Ave
Al	.03	0.21	0.23	0.22	0.20	0.19	0.20	0.23	0.23	0.23
As	.08									
B	.01									
Ba	.002									
Ca	.01	0.06	0.07	0.07	0.06	0.10	0.08	0.065	0.10	0.08
Cd	.004									
Ce	.04									
Co	.01									
Cr	.02	0.06	0.13	0.10	0.097	0.091	0.09	0.089	0.085	0.09
Cu	.004	10.4	14.7	12.6	12.9	12.6	12.8	12.6	12.8	12.7
Dy	.004									
Eu	.002									
Fe	.005	0.14	0.22	0.18	0.15	0.16	0.16	0.18	0.19	0.19
Gd	.1									
K	.3									
La	.008									
Li	.004									
Mg	.06									
Mn	.002	0.09	0.17	0.13	0.11	0.14	0.13	0.13	0.14	0.14
Mo	.01									
Na	.01	23.5		23.5	20.3		20.3	18.8		18.8
Nd	.02									
Ni	.02		0.02	0.02		0.01	0.01		0.01	0.01
P	.1	0.08	0.12	0.10	0.11	0.13	0.12	0.13	0.13	0.13
Pb	.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Ru	.05									
Sb	.05									
Si	.02	0.69	0.85	0.77	0.77	0.76	0.77	0.88	0.88	0.88
Sr	.002									
Te	.06									
Ti	.002	0.009	0.006		0.033	0.007		0.008	0.008	
Zn	.02	0.02	0.04	0.03	0.05	0.03	0.04	0.035	0.035	0.04
Zr	.008	1.90		1.90	3.43		3.43	3.55		3.55
Cs										
	Total			39.6			38.1			36.8

Tr. All tabulated values have been corrected for lab dilution. ( ) values are near the detect. limit.

Corrected values wt %

TABLE C.3 (Cont.)

Solids - Total Fused

LAB NO. _____

UNI-3514

ution factor	Detection limit (µg/ml)	Sludge #13 K/Ni	Sludge #13 Na/Zr	Sludge #13 Ave	Sludge #15 K/Ni	Sludge #15 Na/Zr	Sludge #15 Ave
Al	.03	0.24	0.24	0.24	0.24	0.12	0.18
As	.08		—				—
B	.01		—				—
Ba	.002		—				—
Ca	.01	0.08	0.12	0.10	0.071	0.059	0.07
Cd	.004						
Ce	.04						
Co	.01						
Cr	.02	0.083	0.083	0.08	0.093	0.048	0.07
Cu	.004	10.9	11.5	11.2	13.3	6.74	10.0
Dy	.004		—				—
Eu	.002						—
Fe	.005	0.15	0.18	0.17	0.16	0.09	0.13
Gd	.1						
K	.3						
La	.008						
Li	.004						
Mg	.06						
Mn	.002	0.10	0.13	0.12	0.13	0.07	0.10
Mo	.01						
Na	.01	19.5		19.5	17.1		17.1
Nd	.02						
Ni	.02		0.01	0.01			
P	.1	0.12	0.11	0.12	0.12	0.06	0.09
Pb	.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Ru	.05						
Sb	.05						
Si	.02	0.90	0.96	0.93	0.96	0.48	0.72
Sr	.002						
Te	.06						
Ti	.002	0.009	0.010	0.01	0.009	0.005	
Zn	.02	0.031	0.032	0.03	0.037	0.024	0.03
Zr	.008	3.32		3.32	3.85		3.85
Cs							
	Total			35.8			32.9

Reported values wt %

Solids (total) fused

UNI-3514

TABLE C.3 (Cont.)

	Sludge 2	Sludge 5	Sludge 12	Sludge 13	Sludge 15
Be by flame AA	<0.01	<0.01	<0.01	<0.01	<0.01
Water loss at 105°C	21.0	18.7	23.5	23.5	24.5
Anions by ion chromatography					
F^-	5.4	6.2	6.1	6.4	6.1
NO_3^-	10.4	9.6	7.4	6.9	6.1
SO_4^{2-}	19.8	23.5	20.3	19.7	17.7
(samples H_2O leached)					
U by x-ray fluorescence	0.053	0.0400	0.039	0.039	0.0393
YSL ICP V	<0.01	<0.01	<0.01	<0.01	<0.01

C.L. Matayoshi
1-15-85

Table C.4

ELEMENTAL VALUES wt % element — 183-H Basin No. 1 "Outer" Samples LAB NO. 1670, 167.

UNI-3514

ution factor	Detection limit (µg/ml)		1670 Outer O Sludge KOH/Ni	Na_2O_2/Br	Ave		1671 Outer 9 Sludge KOH/Ni	Na_2O_2/Br	Ave
Al	.03		0.81	0.77	0.79		0.13	0.12	0.13
As	.08								
B	.01		0.01	0.01	0.01		0.009	0.02	0.01
Ba	.002		0.01	0.008	0.01		0.007	0.003	0.005
Ca	.01		0.31	0.31	0.31		0.03	0.06	0.05
Cd	.004								
Ce	.04								
Co	.01								
Cr	.02		0.03	0.04	0.04		0.06	0.03	0.05
Cu	.004		4.81	6.07	5.44		6.97	5.63	6.30
Dy	.004								
Eu	.002								
Fe	.005		0.35	0.33	0.34		0.09	0.10	0.10
Gd	.1								
K	.3								
La	.008								
Li	.004		0.01	0.006	0.01			0.006	
Mg	.06		0.12	0.12	0.12				<0.05
Mn	.002		0.06	0.08	0.07		0.09	0.06	0.08
Mo	.01								
Na	.01		20.5		20.5		22.9		22.9
Nd	.02								
Ni	.02			0.04	0.04			<0.04	<0.04
P	.1								
Pb	.06								
Ru	.05								
Sb	.05								
Si	.02		2.79	2.86	2.83		0.63	0.58	0.61
Sr	.002								
Te	.06								
Ti	.002		0.04	0.03	0.04		<0.01	<0.01	<0.01
Zn	.02		0.03	0.03	0.03		0.03	0.03	0.03
Zr	.008		1.37	1.75	1.56		1.91	1.73	1.82
Cs									
		subtotal			32.14				32.09

TABLE C.4 (Cont.)

	1670 Outer 0 Sludge	1671 Outer 9 Sludge
pH when mixed with equal wt. of H_2O	9.3	9.6
wt. % water	22.8	23.1
Ion chromatography (done by water leaching weighed portion of sludge)		
wt % F^-	7.1	6.7
wt % SO_4^{2-}	35.5	32.7
wt % NO_3^-	1.4	1.6
ICP at PSL		
Be wt%	<0.01	<0.01
V wt%	<0.01	<0.01
U by x-ray fluorescence	32 ppm [illegible]	155 ppm [illegible]

C. L. Matsuzaki
4-15-85

Table C.5
183-H Basin No. 1

LAB NO. 1020-1025

UNI-3514

[illegible] VALUES ug/ml

Supernate

Solution factor	Detection limit (g/ml)	1020 Inner #2 70 ml		1021 Inner #2 270 ml		1022 Inner 5		1023 Inner 12	
		100x	1000x	100x	1000x	100x	1000x	100x	1000x
Al	.03	8		8		15		8	
As	.08	(<10)							
B	.01	4		5		4		3	
Ba	.002	<0.2		<0.2		<0.2		<0.2	
Ca	.01	2		3		3		2	
Cd	.004	<0.4		<0.4		<0.4		<0.4	
Ce	.04								
Co	.01								
Cr	.02	53		53		85		60	
Cu	.004	216		213		220		190	
Dy	.004								
Eu	.002								
Fe	.005	6		<1		1		<1	
Gd	.1								
K	.3	180		180		240		60	
La	.008								
Li	.004	5		4		~~15~~ <1		~~10~~ <1	
Mg	.06	14		14		18		10	
Mn	.002								
Mo	.01								
Na	.01		130,000		130,000		134,000		92,000
Nd	.02								
Ni	.02	18		17		19		15	
P	.1								
Pb	.06	<10							
Ru	.05								
Sb	.05								
Si	.02	(6)		(7)		10		8	
Sr	.002								
Te	.06								
Ti	.002								
Zn	.02								
Zr	.008	520		520		560		360	
Cs									

G. L. Matenzali
4-15-85

REPORTED TO: [illegible]

LAB NO. 1020-1025

TABLE C.5 (Cont.)

UNI-3514

Dilution factor	Detection limit (µg/ml)	1020 Inner 13		1025 Inner 15	
		100x	1000x	100x	1000x
Al	.03	8		8	
As	.08				
B	.01	4		3	
Ba	.002	<0.2		<0.2	
Ca	.01	2		2	
Cd	.004	<0.4		<0.4	
Ce	.04				
Co	.01				
Cr	.02	63		60	
Cu	.004	170		180	
Dy	.004				
Eu	.002				
Fe	.005	<1		<1	
Gd	.1				
K	.3	60		<30	
La	.008				
Li	.004	<1		<1	
Mg	.06	12		10	
Mn	.002	~~12~~		~~10~~	
Mo	.01				
Na	.01		92,000		86,000
Nd	.02				
Ni	.02	17		16	
P	.1				
Pb	.06				
Ru	.05				
Sb	.05				
Si	.02	(7)		8	
Sr	.002				
Te	.06				
Ti	.002				
Zn	.02				
Zr	.008	280		170	
Cs					

G. L. Matsuzaki
4-15-85

Reported values µg/ml

TABLE C.5 (Cont.)

Supernates

1020 - 1025

UNI-3514

	1020 Inner 2-70	1021 Inner 2-270	1022 Inner 5	1023 Inner 12	1024 Inner 13	1025 Inner 15
Cr VI by EPA Proc # 7196	50	49	81.2	57	60.2	54
Hg done by flame AA EPA Proc # 7760	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hg by graphite furnace EPA Proc # 7060	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Be done by flame AA EPA Proc # 3010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Se done by graphite furnace EPA Proc # 7740	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pb done by graphite furnace	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Wt. loss, dried 105°C	64.1	64.0	63.1	73.2	73.8	75.2
U by X-ray fluorescence	330	327	329	234	250	238
Anions by IC						
F^-	2700	2800	2700	4100	5100	5100
Cl^-	900	900	800	600	600	500
NO_2^-	1000	1100	1000	600	700	500
NO_3^-	280,000	280,000	290,000	180,000	190,000	160,000
SO_4^{2-}	13,000	13,000	20,000	24,000	28,000	31,000
By titration with 0.3N HCl						
$CO_3^=$ (alkalinity)	0.051	0.048	0.023	0.029	0.046	0.043
HCO_3^-	0.105	0.108	0.081	0.075	0.077	0.066
PSL ICP						
V	<2	<1	<1	<1	<1	<1

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APPENDIX D

SUMMARY OF CHEMICAL WASTE DISPOSAL PERMITS

Table D.1

SUMMARY OF WASTE DISPOSAL PERMITS

rmit o.	Date	Material Description	Quantity	Toxicity Data	Comments
75	07/21/75	Proprietary sulfamic acid base solution ("Klene-Ox") from film developing process; pH=1.7.	35 gal	Sulfamic acid: oral rat LD_{LO}: 1600 mg/kg; (NIOSH)	Impurities: Cr-684 ppm Fe-34 ppm Al-14 ppm
75	12/11/75	Used chromium plating solution; total acid normality = 1.9.	55 gal	TL_{m96}: 1000-under 1 ppm (Chromic Acid) (NIOSH) Class C toxic per Spill Table (Chromic Acid)	Analysis: Cr->20,000 ppm Cu-2000 ppm Fe-1000 ppm
75	12/12/75	Synthetic salt solution containing: NaOH - 13% $NaAlO_2$ - 5% $NaNO_3$-24% $NaNO_2$ - 8% H_2O - 50% pH = 12	660 gal	NaOH: Class C toxic (Spill Table) $NaNO_2$: Class B toxic (Spill Table)	Spectrochemical analysis showed no heavy metals
76	01/15/76	Unused chemicals:			
		Oxalic acid	70 lbs	Oxalic acid: Oral rat LD_{50}: 375 mg/kg; dermal rabbit LD_{50}:20,000mg/kg; TL_{m96}:1000-100ppm	-----
		Formic Acid	2 lbs	Formic Acid: Oral rat LD_{50}:1100 mg/kg (NIOSH).	
76	01/15/76	Unused chemicals:			
		HBr	19 lbs	Inhalation rat LC_{50}:2,858 ppm/1H (NIOSH)	
		HI	2 lbs	-----	
		$HClO_4$	3 lbs	Oral rat LD_{50}: 1100 mg/kg (NIOSH)	
		H_3PO_4	5 gal	Class D toxic (Spill Table)	

Table D.1

SUMMARY OF WASTE DISPOSAL PERMITS

Permit No.	Date	Material Description	Quantity	Toxicity Data	Comments
		HCl	0.5 gal	Class D toxic (Spill Table)	
		H_3PO_2	1 gal	-----	
3-76	01/15/76	Unused cyanide solutions.	2 gal	Category "A" (WAC 173)	Cyanides are "EHW" per WAC 173-303-9903.
4-76	01/19/76	Used absorbing solution containing:			
		$HgCl_2$ (0.067 lb/gal)	20 gal total	$HgCl_2$: Oral rat LD_{50}: 1 mg/kg (NIOSH)	-----
		EDTA (0.01 lb/total)		EDTA:	
		KCl		Class D toxic (Spill Table)	
5-76	01/30/76	Used battery acid containing H_2SO_4 and Pb.	240 gal	H_2SO_4: Class C toxic (Spill Table)	-----
6-76	02/02/76	Used battery acid containing H_2SO_4 and Pb.	140 gal	H_2SO_4: Class C toxic (Spill Table)	-----
7-76	02/17/76	Used battery acid containing H_2SO_4 and Pb.	52 gal	H_2SO_4: Class C toxic (Spill Table)	Analysis showed [illegible] lbs H_2SO_4/gal and 1 ppm Pb concentration.
8-76	02/20/76	Used battery acid containing H_2SO_4 and Pb.	275 gal	H_2SO_4: Class C toxic (Spill Table)	-----
9-76	03/08/76	Unused proprietary oxalic acid base materials (Turco products also contain citric acid):		Oxalic acid: Oral rat LD_{50}: 375 mg/kg Dermal rabbit LD_{50}: 20,000 mg/kg; Aquatic TL_{m96}: 1000-100 ppm (NIOSH)	-----
		Turco 4521-A	45 lbs		
		Turco 4521-B	30 lbs	Citric Acid: Oral rat LD_{50}: 11,700 mg/kg	
		Turco 4521-F	26 lbs	Aquatic TL_{m96}: 1000-100 ppm (NIOSH)	
		Artel 30	6 gal		

Table D.1

SUMMARY OF WASTE DISPOSAL PERMITS

mit .	Date	Material Description	Quantity	Toxicity Data	Comments
76	03/08/76	Unused proprietary EDTA base chemicals:		EDTA: Class D toxic (Spill Table)	-----
		Hampshire DEG	3 gal		
		Radiowash XRF	3 gal		
		NT-680	35 lbs		
		NT-686	100 lbs		
		NT-688	25 lbs		
76	03/08/76	Unused chemicals:			
		$Na_2S_2O_4.2H_2O$	75 lbs	-----	-----
		Na_2SO_3	10 lbs	-----	
		$Na_2HAsO_4.7H_2O$	7 lbs	-----	
		$(NH_4)_2HPO_4$	25 lbs	Aquatic TL_{m96}: 1000-100 ppm (NIOSH)	
76	03/08/76	Unused proprietary H_3PO_4 base chemicals):			Metal impurities (ppm):
		NT-100	10 gal	H_3PO_4: Class D toxic (Spill Table)	Al: 2000; Fe:50
		NT-121	4 gal		Al: 700; Fe:20; Ni:10
		NTL-121	4 gal		Al: 200; Fe:40
		Oakite OEM 27-AB-56	3 1/2 gal		Al: 600; Fe:20
		Oakite OEM 27-AB-72	2 gal		Al: 600; Fe:20
		Phoenix 116	4 gal		Al: 250; Fe:5; Ni:3
		Phoenix 121	5 gal		Al: 500; Fe:10; Ni:5; V:2; Co:2
		Phoenix 121-1	1 gal		Al: 200; Fe:10; Ni:1; V:1
		Phoenix 121-2	1 gal		Al: 500; Fe:5; Ni:2; V:1
		Phoenix 121-3	1 gal		Al: 300; Fe:5; Ni:3; V:1
		Phoenix 130	4 gal		Al: 350; Fe:7; Ni:3; V:2
		Turco 4512-B	13 gal		Al: 1000; Fe:100
		Turco 4512-C	11 gal		Al: 700; Fe:20

Table D.1

SUMMARY OF WASTE DISPOSAL PERMITS

Permit No.	Date	Material Description	Quantity	Toxicity Data	Comments
13-76	03/08/76	Unused proprietary sulfamic acid base chemicals:		Sulfamic acid: Oral rat LD_{LO}: 1600 mg/kg (NIOSH)	-----
		Turco 4306-D	75 lbs		
		Wyandotte 5061	75 lbs		
16-76	03/17/76	Used battery acid containing H_2SO_4 and Pb.	107 gal	H_2SO_4: Class C toxic (Spill Table)	Analysis showed solution to be 5.7 N(H^+) & contained 2 ppm Pb.
17-76	03/17/76	Used battery acid containing H_2SO_4	70 gal	H_2SO_4: Class C toxic (Spill Table)	-----
18-76	03/25/76	Unused chemicals:		-----	Analysis showed 0.2% B, 10 ppm Co, 40 ppm Mn.
		Ni plating solution	374 gal		
		$CuSO_4$	4 lbs	$CuSO_4$. Class A toxic (Spill Table)	
19-76	03/25/76	Unneeded chemicals:			
		Fuming H_2SO_4	1 gal	HNO_3: Class C toxic (Spill Table)	"Chem-Polish" contains HNO_3 & H_2SO_4. Analysis showed solution to be 9.1 N in [H^+] and contained 200 ppm Cu.
		"Chem-Polishing" proprietary solution	5 gal	H_2SO_4: Class C toxic (Spill Table)	

Table D.1

SUMMARY OF WASTE DISPOSAL PERMITS

rmit o.	Date	Material Description	Quantity	Toxicity Data	Comments
-76	03/25/76	Unused chromic acid.	100 lbs	Class C toxic (Spill Table)	-----
-76	06/24/76	Unused chemicals:			
		$NaAlO_2$	55 gal	-----	Analysis showed: Al: 1000 ppm; Cu: 40 ppm; Fe: 20 ppm; Ni: 200 ppm
		Proprietary caustic materials:			
		Turco Aluminetch #2: Solution	55 gal	-----	Analysis showed: Al: 2 ppm; P: 200 ppm; Pb: 5 ppm
		Powder	125 gal		
		Diversey #202 Al Cleaner	400 lbs	-----	Analysis showed: P: 1%
		American Equipment & Supply All Purpose Synthetic Cleaner	55 gal	-----	Analysis showed: Cu: 10 ppm; Fe: 6 ppm; p: 1000 ppm
		Diversey RX-1288	275 gal	-----	Analysis showed: Al: 20 ppm; Fe: 50 ppm; P: 1%
		Selectron Electrocleaning	1 qt	-----	Analysis showed: Al: 100 ppm; Cu: 4 ppm
		Turco Alkaline Rust Remover	6 lbs	-----	Analysis showed: Al: 10 ppm; Mn: 5 ppm

Table 3.1

SUMMARY OF WASTE DISPOSAL PERMITS

rmit o.	Date	Material Description	Quantity	Toxicity Data	Comments
-76	06/29/76	Unused acid plating solutions:			
		Co Plating solution	1 qt	-----	Analysis showed: Co: >2%; Mg: 2 ppm; Ni: 200 ppm
		Activating Solution #2	1 qt	-----	Analysis showed: Co: 10 ppm; Ni: 100 ppm
		Ni Acid Solution	1 pt	-----	Analysis showed: Co: 300 ppm;; Al: 5 ppm; Cr: 10 ppm; Cu: 100 ppm; Mg: 20 ppm; Mn: 10 ppm; Ni: 3%
		Activating Solution #1	1 qt	-----	Analysis showed: Al: 0.1 ppm; Fe: 0.1 ppm; Ni: 0.2 ppm
		Copper Acid Solution	1 qt	-----	Analysis showed: Cu: 2%; Fe: 10 ppm, Ni: 20 ppm
		Proprietary Chemicals:			
		Unused "Zinctone" containing chromic acid and nitric acid.	20 gal	Chromic acid: Class C toxic (Spill Table) Nitric acid: Class C toxic (Spill Table)	-----
-76	06/29/76	Unused Chemicals:			
		$CuSO_4$	100 lbs	C_uSO_4: Class A toxic (Spill Table)	-----
		$Fe_2(SO_4)_3$	2 lbs	$Fe_2(SO_4)_3$: Class C toxic (Spill Table)	-----
		NaH_2PO_2	1/4 lb	-----	-----

Table D.1
SUMMARY OF WASTE DISPOSAL PERMITS

rmit o.	Date	Material Description	Quantity	Toxicity Data	Comments
		Urea	1 lb	Urea: Oral rat LD_{50}: 14,300 mg/kg; TL_{m96}: over 1000 ppm (NIOSH)	-----
		V_2O_5 saturated aqueous solution	2 pts	V_2O_5: Class C toxic (Spill Table)	V_2O_5 is an EHW per WAC 173-303-9903.
		Proprietary Solution:			
		Selectron, Ltd., Ni, Neutral Solution	3 pts	-----	Analysis showed: Co: 0.1%; P: 1%; Ni: > 2%
76	07/12/76	Caustic materials in drums:			
		Drum No. 14	55 lbs	-----	Analysis showed: Al: 500 ppm; Cu: 1 ppm; Fe: 500 ppm; Mg: 10 ppm; Mn: 5 ppm; Ni: 50 ppm; Pb: 5 ppm; Sr: 50 ppm; U: 100 ppm.
		Drum No. 40	39 lbs	-----	Analysis showed: Al: 1000 ppm; Cr: 10 ppm; Fe: 500 ppm; Mg: 10 ppm; Mn: 5 ppm; Ni: 100 ppm; Sr: 20 ppm.
		Drum No. 31	15 1/2 gal	-----	Analysis showed: Al: 5 ppm; Cd: 6 ppm; Cr: 10 ppm; Cu: > 3000 ppm; Mg: 10 ppm; Ni: 30 ppm.
		Drum No. 39	1/2 gal	-----	Analysis showed: Al: 40 ppm; Cr: 4 ppm; Fe: 90 ppm; Mg: 1 ppm; Mn: 90 ppm; Ni: 1 ppm.

Table D.1

SUMMARY OF WASTE DISPOSAL PERMITS

Permit No.	Date	Material Description	Quantity	Toxicity Data	Comments
5-76	07/12/76	Strong acid solution	1 1/2 gal	-----	Analysis showed: Al: 80 ppm; Co: 40 ppm; Cr: 80 ppm; Cu: 400 ppm; Fe: 4000 ppm; Mg: 8 ppm; Mn: 40 ppm; Mo: 800 ppm; Ni: 800 ppm; V: 4 ppm.
6-76	08/05/76	Used battery acid containing H_2SO_4 and Pb.	60 gal	H_2SO_4: Class C toxic (Spill Table)	-----
7-76	08/17/76	Unused chemicals:			
		Acetic acid	1/4 gal	Class C toxic (Spill Table)	-----
		Diethanolamine	1/4 gal	Oral rat LD_{50}: 710 mg/kg; dermal rabbit LD_{50}: 12,200 mg/kg; TL_{m96}: 1000 ppm	-----
		Mercuric nitrate	1/8 gal	Class A toxic (Spill Table)	-----
		Sodium hydroxide	1/4 gal	Class C toxic (Spill Table)	-----
		Mercaptoacetic acid	1/8 gal	Oral rat LD_{50}: 250 mg/kg; (NIOSH)	-----
		Choline chloride	2 1/4 lbs	Oral rat LD_{50}: 3400 mg/kg; (NIOSH)	-----
		Deoxycholic acid	1/8 lbs	-----	-----
		Phosphomolybdic acid	1 lb	-----	-----
		Sodium chromate	2 lbs	Class C toxic (Spill Table). Human positive carcinogen (NIOSH)	-----
		Trichloroacetic acid	1/4 lb	Oral rat LD_{50}: 5000 mg/kg; (NIOSH)	-----

Table D.

SUMMARY OF WASTE DISPOSAL PERMITS

it	Date	Material Description	Quantity	Toxicity Data	Comments
6	08/17/76	Used P_2O_5 desicant	5 lbs	Inhalation rat LC_{50}: 1217 mg/m^3/1H; (NIOSH)	-----
6	08/17/76	Used EDTA solution.	185 gal	Class D toxic (Spill Table)	Analysis showed: Cu: 0.6%; Fe: 0.6%; Mg: 100 ppm; Mn: 600 ppm; Mo: 100 ppm; Ni: 300 ppm; Pb: 100 ppm.
6	09/02/76	Used HCl solution.	1 qt	Class D toxic (Spill Table). Beryllium is an animal positive carcinogen.	Analysis showed solution to contain 1 gm of Be.
6	10/11/76	Used battery acid containing H_2SO_4 and Pb.	301.5 gal	H_2SO_4: Class D toxic (Spill Table)	-----
6	10/28/76	Used wetting and foaming agent solution.	5 gal	-----	Solution consisted of 106 ml of wetting & foaming agents & 0.003 lbs of uranium.
6	12/14/76	Used inhibited HCl cleaning solution	1500-3000 gal	HCl: Class D toxic (Spill Table)	Solution was used to derust degreasing solvent storage tank. Fresh solution consisted of 20% HCl and 1% amine based inhibitor.
6	09/02/76	Used citric acid and ammoniated citric acid solutions	1319 gal	Citric acid: Oral rat LD_{50}: 11,700 mg/kg; TL_{m96}: 1000-100 ppm (NIOSH) Ammonium hydroxide: Class C toxic (Spill Table)	Solution was used to passivate degreaser solvent storage tank. Solution started with 1/4% citric acid and then had pH adjusted to 8-9 by addition of NH_4OH.

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Table 4-1

SUMMARY OF WASTE DISPOSAL PERMITS

Permit No.	Date	Material Description	Quantity	Toxicity Data	Comments
1-77	01/24/77	Unused 35% H_2O_2 solution.	6 gal	Inhalation rat LC_{50}: 2000 mg/m^3; suspected carcinogen. (NIOSH)	-----
2-77	02/28/77	Unused chemicals:			
		H_3PO_4	1 qt	Class D toxic (Spill Table)	-----
		Acetic acid	2 1/2 gal	Class C Toxic (Spill Table)	-----
3-77	03/01/77	Unused $NH_4F \cdot HF$ crystals.	400 lbs	-----	-----
4-77	03/07/77	Unused chemicals:			
		Nickel chloride	5 lbs	Class D toxic (Spill Table)	-----
		Nickel sulfate	5 lbs	Class D Toxic (Spill Table).	-----
		Sodium phosphate	1 lb	Oral rat LD_{50}: 12,930 mg/kg; (NIOSH)	-----
		Sodium borate	1 lb	Oral rat LD_{50}: 2,660 mg/kg; TL_{m96}: 1000-10 ppm (NIOSH)	-----
		Boric acid	1 lb	Oral rat LD_{50}: 2,660 mg/kg; (NIOSH)	-----
		Cupric sulfate	6 lbs	Class A toxic (Spill Table)	-----
		Lithium fluoride	1 lb	-----	-----
		Aluminum chloride	1 lb	-----	-----
		Sodium fluoride	1 lb	Class C toxic (Spill Table)	

Table D.1

SUMMARY OF WASTE DISPOSAL PERMITS

mit	Date	Material Description	Quantity	Toxicity Data	Comments
7	03/07/77	Unused chemicals:			
		Cuprous cyanide	1 lb	Aquatic TL_{m96}: 10-1 ppm	Copper cyanides are EHW per WAC 173-303-9903.
		Sodium cyanide	1 lb	Class A toxic (Spill Table)	Sodium cyanide is an EHW per WAC 173-303-9903.
7	03/09/77	Unused chemicals:			
		Ammonium fluoride	4 lbs	Class D toxic (Spill Table)	-----
		Sodium fluoride	2 1/2 lbs	Class G Toxic (Spill Table)	
		Sodium chromate	4 lbs	Class C toxic (Spill Table). Human positive carcinogen. (NIOSH)	-----
		Ammonium citrate	3 lbs	Class D toxic (Spill Table).	-----
		Oxalic acid	12 lbs	Oral rat LD_{50}: 375 mg/kg; dermal rabbit: 20,000 mg/kg; TL_{m96}: 1000-100 ppm (NIOSH)	-----
		Citric acid	6 lbs	Oral rat LD_{50}: 11,700 mg/kg; TL_{m96}: 1000-100 ppm (NIOSH)	-----
		Barium perchlorate	4 lbs	-----	-----
		Ammonium ceric sulfate	4 lbs	-----	-----
-77	03/09/77	Unused potassium cyanide.	1/2 lb	Class A toxic (Spill Table)	Potassium cyanide is an EHW per WAC 173-303-9903.

Table [illegible]

SUMMARY OF WASTE DISPOSAL PERMITS

Permit No.	Date	Material Description	Quantity	Toxicity Data	Comments
08-77	03/09/77	Unused chromic acid.	6 lbs	Class C toxic (Spill Table)	-----
11-77	04/13/77	Unused chemicals:			
		KNO_3	2 lbs	-----	-----
		$K_2Cr_2O_7$	2 lbs	Class C toxic (Spill Table). Human positive carcinogen. (NIOSH)	-----
		$Na_2Cr_2O_7$	[illegible] lbs	Class C toxic (Spill Table). Human positive carcinogen. (NIOSH)	-----
		$Na_3C_6H_5O_7$	[illegible]	-----	-----
		$NaC_2H_3O_2$	[illegible]	Oral rat LD_{50}: 3,530 mg/kg (NIOSH)	-----
13-77	05/23/77	Used H_2SO_4 solution.	[illegible] gal	Class C toxic (Spill Table)	Solution was 70% H_2SO_4. Analysis showed: Al: 300 ppm; Cr: 100 ppm; Mo: 500 ppm; Ni: 500 ppm; Zn: 300 ppm; Pb: 10 ppm; Mn: 50 ppm; Cu: 50 ppm.
14-77	06/13/77	Unneeded nickel sulfate solution.	20 gal	Class B toxic (Spill Table)	Analysis [illegible] of nickel sulfate in solution.
15-77	09/13/77	Unused chemicals:			
		Alkaline rust remover (proprietary chemical).	440 lbs	-----	-----
		Wyandotte 5061 (proprietary chemical)	200 lbs	-----	Proprietary chemical is sodium bisulfate base.
		Ammonium persulfate	220 lbs	Oral rat LD_{50}: 820 mg/kg (NIOSH)	-----
		Ethylenediamine	39 gal	Class C toxic (Spill Table)	-----

Table ..1

SUMMARY OF WASTE DISPOSAL PERMITS

Permit No.	Date	Material Description	Quantity	Toxicity Data	Comments
		Nickel oxide	12 lbs	Nickel (II) oxide: animal positive carcinogen (NIOSH)	-----
		Mixed nickel, copper and iron oxides.	66 lbs	Iron (III) oxide: Aquatic TL_{m96}: over 1000 ppm; human suspected carcinogen (NIOSH) Copper (I) oxide: oral rat LD_{50}: 470 mg/kg (NIOSH).	-----
16-77	09/13/77	Used product containing aluminum nitrate and sodium nitrate.	400 lbs	-----	Analysis showed: Mg: 5000 ppm; Fe: 3000 ppm; Cu: 100 ppm; B: 10 ppm; Mn: 10 ppm.
1-78	01/06/78	Used solution containing $NaNO_3$, Na_2SO_4, NaCl, Na_2CO_3.	1500 gal	NaCl: oral rat LD_{50}: 3000 mg/kg Aquatic TL_{m96}: over 1000 ppm (NIOSH) Na_2CO_3: Oral rat LDLo: 4000 mg/kg (NIOSH)	Analysis showed: Al: 16 ppm; Cr: 2 ppm; Fe: 10 ppm; Ni: 10 ppm.
2-78	01/26/78	Used solution containing $NaNO_3$, Na_2SO_4, NaCl, and Na_2CO_3.	1000 gal	NaCl: Oral rat LD_{50}: 3000 mg/kg; Aquatic TL_{m96}: over 1000 ppm (NIOSH) Na_2CO_3: Oral rat LDLo: 4000 mg/kg (NIOSH)	-----
3-78	03/07/78	Used solution containing $NaNO_3$, Na_2SO_4, NaCl, and NA_2CO_3.	3000 gal	NaCl: oral rat LD_{50}: 3000 mg/kg; Aquatic TL_{m96}: over 1000 ppm; (NIOSH) Na_2CO_3: Oral rat LDLo: 4000 mg/kg (NIOSH)	Waste estimated to contain 5% $NaNO_3$.
5-78	05/02/78	Unneeded proprietary chemical "Cimplus-22" containing $NaNO_2$.	55 gal	Class B. toxic (Spill Table)	-----

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APPENDIX E

DANGEROUS WASTE SOURCES LIST

WAC 173-303-9904 Dangerous waste sources list.

DANGEROUS WASTE SOURCES LIST

Dangerous Waste No.	Sources
	Nonspecific Sources
Generic:	
F001	The following spent halogenated solvents used in degreasing: Tetrachlorothylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and the chlorinated fluoracarbons; and sludges from the recovery of these solvents in degreasing operations. (See footnote 1, below.)
F002	The following spent halogenated solvents: Tetrachlorothylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro- 1,2,2-trifluoroethane, o-dichlorobenzene, trichlorofluoromethane; and the still bottoms from the recovery of these solvents. (See footnote 1, below.)
F003	The following spent nonhalogenated solvents: Xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; and the still bottoms from the recovery of these solvents.

Dangerous Waste No.	Sources
F004	The following spent nonhalogenated solvents: Cresols and cresylic acid, nitrobenzene; and the still bottoms from the recovery of these solvents.
F005	The following spent nonhalogenated solvents: Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine; and the still bottoms from the recovery of these solvents.
F006	Wastewater treatment sludges from electroplating operations except from the following processes: (1) Sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc, and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum.
F019	Wastewater treatment sludges from the chemical conversion coating of aluminum.
F007	Spent cyanide plating bath solutions from electroplating operations (except for precious metals electroplating spent cyanide plating bath solutions).
F008	Plating bath sludges from the bottom of plating baths from electroplating operations where cyanides are used in the process (except for precious metals electroplating bath sludges).
F009	Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process (except for precious metals electroplating spent stripping and cleaning bath solutions).
F010	Quenching bath sludge from oil baths from metal heat treating operations where cyanides are used in the process (except for precious metals heat-treating quenching bath sludges).
F011	Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations (except for precious metals heat-treating spent cyanide solutions from salt bath pot cleaning).
F012	Quenching wastewater treatment sludges from metal heat-treating operations where cyanides are used in the process (except for precious metals heat-treating quenching wastewater treatment sludges).
1	Although WAC 173-303-082 states that these wastes are DW, WAC 173-303-070(5), special knowledge, requires generators who know that their waste F001 or F002 contains greater than one percent of these listed halogenated solvents to designate their waste EHW.

Specific Sources

Wood Preservation:

K001	Bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol. (See footnote 2, below.)

Inorganic Pigments:

K002	Wastewater treatment sludge from the production of chrome yellow and orange pigments.
K003	Wastewater treatment sludge from the production of molybdate orange pigments.
K004	Wastewater treatment sludge from the production of zinc yellow pigments
K005	Wastewater treatment sludge from the production of chrome green pigments.
K006	Wastewater treatment sludge from the production of chrome oxide green pigments (anhydrous and hydrated).
K007	Wastewater treatment sludge from the production of iron blue pigments.
K008	Oven residue from the production of chrome oxide green pigments.

Organic Chemicals:

K009	Distillation bottoms from the production of acetaldehyde from ethylene.
K010	Distillation side cuts from the production of acetaldehyde from ethylene.
K011	Bottom stream from the wastewater stripper in the production of acrylonitrile.
K013	Bottom stream from the acetonitrile column in the production of acrylonitrile.
K014	Bottoms from the acetonitrile purification column in the production of acrylonitrile.
K015	Still bottoms from the distillation of benzyl chloride. (See footnote 2, below.)
K016	Heavy ends or distillation residues from the production of carbon tetrachloride. (See footnote 2, below.)
K017	Heavy ends (still bottoms) from the purification column in the production of epichlorohydrin. (See footnote 2, below.)

Dangerous Waste No	Sources
K018	Heavy ends from the fractionation column in ethyl chloride production. (See footnote 2, below.)
K019	Heavy ends from the distillation of ethylene dichloride in ethylene dichloride production. (See footnote 2, below.)
K020	Heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production. (See footnote 2, below.)
K021	Aqueous spent antimony catalyst waste from fluoromethanes production. (See footnote 2, below.)
K022	Distillation bottom tars from the production of phenol/acetone from cumene.
K023	Distillation light ends from the production of phthalic anhydride from naphthalene.
K024	Distillation bottoms from the production of phthalic anhydride from naphthalene.
K093	Distillation light ends from the production of phthalic anhydride from ortho-xylene.
K094	Distillation bottoms from the production of phthalic anhydride from ortho-xylene.
K025	Distillation bottoms from the production of nitrobenzene by the nitration of benzene.
K026	Stripping still tails from the production of methyl ethyl pyridines.
K027	Centrifuge and distillation residues from toluene diisocyanate production.
K028	Spent catalyst from the hydrochlorinator reactor in the production of 1,1,1-trichloroethane. (See footnote 2, below.)
K029	Waste from the product steam stripper in the production of 1,1,1-trichloroethane. (See footnote 2, below.)
K095	Distillation bottoms from the production of 1,1,1-trichloroethane. (See footnote 2, below.)
K096	Heavy ends from the heavy ends column from the production of 1,1,1-trichloroethane. (See footnote 2, below.)
K030	Column bottoms or heavy ends from the combined production of trichloroethylene and perchloroethylene. (See footnote 2, below.)
K083	Distillation bottoms from aniline production.
K103	Process residues from aniline extraction from the production of aniline.
K104	Combined wastewater streams generated from nitrobenzene/aniline production.
K085	Distillation of fractionation column bottoms from the production of chlorobenzenes. (See footnote 2, below.)
K105	Separated aqueous stream from the reactor product washing step in the production of chlorobenzenes. (See footnote 2, below.)
Explosives:	
K044	Wastewater treatment sludges from the manufacturing and processing of explosives.
K045	Spent carbon from the treatment of wastewater containing explosives.
K046	Wastewater treatment sludges from the manufacturing, formulation and loading of lead-based initiating compounds.
K047	Pink/red water from TNT operations.
Inorganic Chemicals:	
K071	Brine purification muds from the mercury cell process in chlorine production, where separately prepurified brine is not used.
K073	Chlorinated hydrocarbon waste from the purification step of the diaphragm cell process using graphite anodes in chlorine production. (See footnote 2, below.)
K106	Wastewater treatment sludge from the mercury cell process in chlorine production.
Petroleum Refining:	
K048	Dissolved air flotation (DAF) float from the petroleum refining industry.
K049	Slop oil emulsion solids from the petroleum refining industry.
K050	Heat exchanger bundle cleaning sludge from the petroleum refining industry.
K051	API separator sludge from the petroleum refining industry.
K052	Tank bottoms (leaded) from the petroleum refining industry.
Iron and Steel:	
K061	Emission control dust/sludge from the primary production of steel in electric furnaces.
K062	Spent pickle liquor from steel finishing operations.
Pesticides:	
K034	Byproduct salts generated in the production of MSMA and cacodylic acid.
K032	Wastewater treatment sludge from the production of chlordane. (See footnote 3, below.)

Dangerous Waste No.	Sources
K033	Wastewater and scrub water from the chlorination of cyclopentadiene in the production of chlordane. (See footnote 3, below.)
K034	Filter solids from the filtration of hexachlorocyclopentadiene in the production of chlordane. (See footnote 3, below.)
K097	Vacuum stripper discharge from the chlordane chlorinator in the production of chlordane. (See footnote 3, below.)
K035	Wastewater treatment sludges generated in the production of creosote.
K036	Still bottoms from toluene reclamation distillation in the production of disulfoton.
K037	Wastewater treatment sludges from the production of disulfoton.
K038	Wastewater from the washing and stripping of phorate production. (See footnote 3, below.)
K039	Filter cake from the filtration of diethylphosphorodithioic acid in the production of phorate. (See footnote 3, below.)
K040	Wastewater treatment sludge from the production of phorate. (See footnote 3, below.)
K041	Wastewater treatment sludge from the production of toxaphene. (See footnote 3, below.)
K098	Untreated process wastewater from the production of toxaphene. (See footnote 3, below.)
K042	Heavy ends or distillation residues from the distillation of tetrachlorobenzene in the production of 2,4,5-T. (See footnote 2, below.)
K043	2,6-Dichlorophenol waste from the production of 2,4-D. (See footnote 2, below.)
K099	Untreated wastewater from the production of 2,4-D. (See footnote 2, below.)
Secondary Lead:	
K069	Emission control dust/sludge from secondary lead smelting.
K100	Waste leaching solution from acid leaching of emission control dust/sludge from secondary lead smelting.
Veterinary Pharmaceuticals:	
K084	Wastewater treatment sludges generated during the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.
K101	Distillation tar residues from the distillation of aniline-based compounds in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.
K102	Residue from the use of activated carbon for decolorization in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.
Ink Formulation:	
K086	Solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead.
Coking:	
K060	Ammonia still-lime sludge from coking operations.
K087	Decanter tank tar sludge from coking operations.

2 These wastes contain or may contain halogenated hydrocarbons. Although WAC 173-303-082 states that these wastes are DW, WAC 173-303-070(5), special knowledge, requires generators who know that their waste contains greater than one percent of these listed halogenated hydrocarbons to designate their waste EHW.

3 These wastes contain or may contain X Category toxic constituents. Although WAC 173-303-082 states that these wastes are DW, WAC 173-303-070(5), special knowledge, requires generators who know that their waste contains greater than 0.1 percent of these listed toxic constituents to designate their waste EHW.

[Statutory Authority: Chapter 70.105 RCW. 84-09-088 (Order DE 83-36), § 173-303-9904, filed 4/18/84. Statutory Authority: Chapter 70.105 RCW and RCW 70.95.260. 82-05-023 (Order DE 81-33), § 173-303-9904, filed 2/10/82.]

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APPENDIX F

DANGEROUS WASTE MIXTURE DATA

TABLE F.1

Toxicity Data for Basin No. 1 Solids

Constituent	Presumed Form	Toxic Category	Concentration of Presumed Form (wt. %)						
			I-[illegible]	I-[illegible]	I-12	I-13	I-15	0-0	0-9
Ca	$Ca(OH)_2$	D (NIOSH)	0.13	0.15	0.15	0.19	0.13	0.57	0.0
Ni	$Ni(OH)_2$	C (Spill Table)	0.03	0.02	0.02	0.02	0.16	0.06	--
P	Na_3PO_4	D (Spill Table)	0.53	0.64	0.69	0.69	0.48	--	--
Si	$Na_2Si_3O_7$	D (NIOSH)	2.21	2.21	2.53	2.67	2.07	8.14	1.75
F	NaF	D (Spill Table)	[illegible].94	13.71	13.48	14.15	13.48	15.69	14.81
B	$Na_2B_4O_7$	D (NIOSH)	--	--	--	--	--	0.05	0.05
Ba	$BaCO_3$	D (NIOSH)	--	--	--	--	--	0.01	0.01

FIGURE F.1

WAC 173-303-9906 TOXIC DANGEROUS WASTE MIXTURES GRAPH.

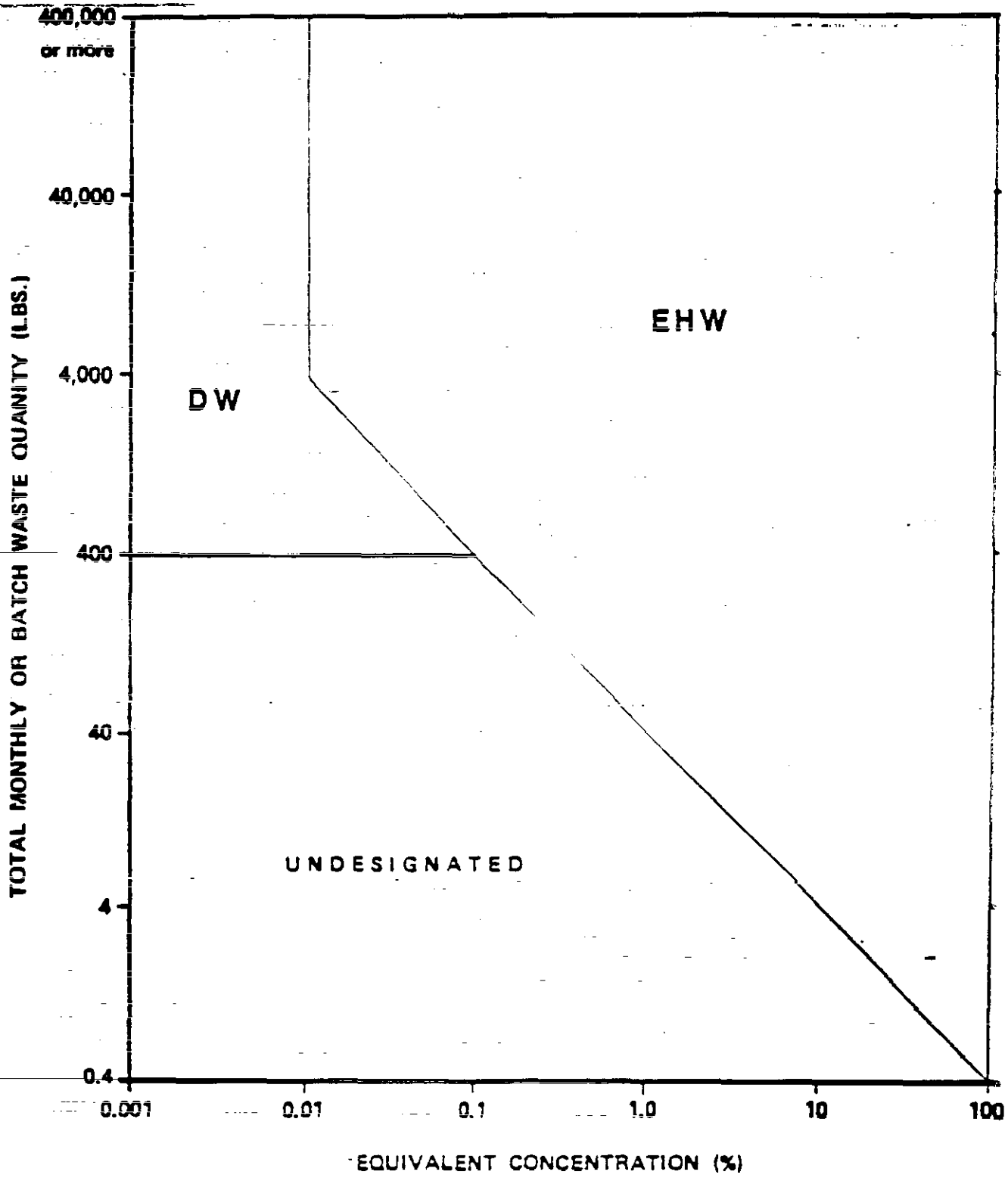

TABLE F.2

Equivalent Concentrations of Toxic Materials

(Solids Samples)

Sample No.	E.C. (%)
I-2	0.012
I-5	0.014
I-12	0.014
I-13	0.015
I-15	[illegible]
0-Ø	0.017
0-9	0.015

TABLE F.3

Toxicity Data for Basin No. 1 Liquid Samples

Constituent	Presumed Form	Toxic Category	Concentration of Presumed Form (wt. %) I-2	I-5	I-12	I-13	I-15
F^-	NaF	C (Spill Table)	0.48	0.55	0.76	0.95	0.96
NO_3^-	$NaNO_3$	--	30.11	31.06	20.56	21.89	18.59
$SO_4^=$	Na_2SO_4	--	1.51	2.31	2.96	3.48	3.89
$CO_3^=$	Na_2CO_3	--	0.41	--	--	0.41	--
HCO_3^-	$NaHCO_3$	D (NIOSH)	0.70	0.53	0.53	0.54	0.47

TABLE F.4

Equivalent Concentrations of Toxic Materials

(Liquid Samples)

Sample No.	E.C. (%)
I-2	< 0.001
I-5	< 0.001
I-12	< 0.001
I-13	0.001
I-15	0.001

TABLE F.5

"Inner" Basin Material Ratios

Sample No.	wt. solid portion/wt. liquid portion)
I-2	1.40
I-5	2.14
I-12	1.63
I-13	2.20
I-15	1.90

TABLE F.6

E.C. (%) of Combined Solids/Liquid Portions

(presumes 50% of initial liquid is removed)

Sample No.	E.C. (%)
I-2	0.009
I-5	0.011
I-12	0.011
I-13	0.012
I-15	0.011
Average	[illegible] %

TABLE F.7

Carcinogenic Materials - Liquid Phase

Constituent	Presumed Form	Carcinogenic Evaluation (per NIOSH)	Concentration of Presumed Form (wt. %)				
			I-2	I-5	I-12	I-13	I-15
Cr VI	Na_2CrO_4	Human positive	0.01	0.01	0.01	0.02	0.01

TABLE F.8

Carcinogenic Materials - Solids Phase

Constituent	Presumed Form	Carcinogenic Evaluation (NIOSH)	Concentration of Presumed Form (wt. %) I-2	I-5	I-12	I-13	I-15	0-0	0-9
Fe	Fe_2O_3*	Human suspected	0.26	0.23	0.27	0.24	0.19	0.49	0.14
Ni	$Ni(OH)_2$	Animal positive	0.03	0.02	0.02	0.02	0.02	0.06	--

*In order to provide conservatism in estimating carcinogenic potential, all the iron is calculated as being present as Fe_2O_3; Fe_3O_4 is not considered carcinogenic.

Table F.9

Summary of Dangerous Waste Mixture Data

183-H Basin No. 1

Criteria	Waste Designation	Waste Number (per WAC-173-104)
Toxicity	EHW (with presumptions as described in body of report).	WT-01
Persistence	Non-designated for PAH; potential designation as D.W. for HH criteria.	(possible assignment of waste number WP02).
Carcinogenics	Non-designated	------

9413294.1467

9413294.1468

APPENDIX G

DANGEROUS WASTE CHARACTERISTICS DATA

TABLE G.1

pH of Samples

183-H Basin No. 1

Sample No.	pH
I-2	9.53
I-5	9.32
I-12	9.54
I-13	9.66
I-15	9.71

9413294.1469

TABLE G.2

MAXIMUM CONCENTRATION OF CONTAMINANTS
FOR CHARACTERISTIC OF EP TOXICITY

EPA Hazardous Waste Number	Contaminant	DW Maximum Concentration (mg/L)	EHW Maximum Concentration (mg/L)
D004	Arsenic	5.0-500	>500
D005	Barium	100.0-10,000	>10,000
D006	Cadmium	1.0-100	>100
D007	Chromium VI	5.0-500	>500
D008	Lead	5.0-500	>500
D009	Mercury	0.2-20	>20
D010	Selenium	1.0-100	>100
D011	Silver	5.0-500	>500
D012	Endrin (1,2,3,4,10,10-Hexachloro-1 6-epoxy-1,4,4a,5,6,7,8,8a-octahydro-4-endo, endo-5,8-dimethanonaphthalene)	0.02-2	>2
D013	Lindane (1,2,3,4,5,6-Hexachlorocyclohexane, gamma isomer	0.4-40	>40
D014	Methoxychlor (1,1,1-Trichloro-2,2-bis (p-methoxyphenyl-ethane)	10.0-1,000	>1,000
D015	Toxaphene ($C_{10}H_{10}Cl_8$, Technical chlorinated camphene, 67-69% chlorine)	0.5-50	>50
D016	2,4-D (2,4-Dichlorophenoxyacetic acid)	10.0-1,000	>1,000
D017	2,4,5-TP (Silvex) (2,4,5-Trichlorophenoxypropionic acid)	1.0-100	>100

TABLE G.3

EP Toxicity Evaluation - "Inner" Basin Filtrate Samples

183-H Basin No. 1

Constituent	Concentration in Sample (mg/L)				
	I-2	I-5	I-11	I-13	I-15
Arsenic	< 0.5	< 0.5	<0.5	<0.5	<0.5
Barium	< 0.2	< 0.2	<0.2	<0.2	<0.2
Cadmium	< 0.4	< 0.4	<0.4	<0.4	<0.4
Chromium VI	50	81	57	60	54
Lead	< 2.5	< 2.5	<2.5	<2.5	<2.5
Selenium	< 0.1	< 0.1	<0.1	<0.1	<0.1
Silver	< 0.5	< 0.5	<0.5	<0.5	<0.5

TABLE G.4

EP Toxicity Evaluation - "Inner" Basin Leachate Samples

183-H Basin No. 1

Constituent	Concentration in Sample (mg/L) I-2	I-5	I-12	I-13	I-15
Arsenic	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Barium	0.03	0.03	< 0.02	0.02	< 0.02
Cadmium	0.06	0.06	0.07	< 0.04	0.06
Chromium VI	1.6	2.2	1.7	0.9	0.8
Lead	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
Selenium	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Silver	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

TABLE G.5

EP Toxicity Evaluation - "Outer" Basin Leachate Samples

183-H Basin No. 1

Constituent	Concentration (mg/L) 0-Ø	0-9
Arsenic	< 0.5	<0.5
Barium	0.05	0.07
Cadmium	0.05	0.05
Chromium VI	1.7	1.7
Lead	< 0.6	<0.6
Selenium	< 0.1	0.2
Silver	< 0.5	<0.5

TABLE G.6

EP TOXICITY - CrVI "INNER" BASIN SAMPLES

183-H BASIN No. 1

Sample No.	CrVI Concentration (mg/L) in Filtrate	CrVI Concentration (mg/L) in Leachate	Volume ratio, Leachate/Filtrate	Calculated combined CrVI concentration (mg/L)
I-2	50	1.6	36.3	2.90
I-5	81	2.2	54.78	3.62
I-12	57	1.7	39.12	3.08
I-13	60	0.9	52.36	2.01
I-15	54	0.8	44.85	1.96

TABLE G.7

SUMMARY OF BASIN NO. 1 WASTE DESIGNATION PER WAC 173-303-90

183-H BASIN No. 1

Characteristic	Waste Designation	Waste Number Assigned
Ingnitability	DW	D001
Corrosivity	non-designated	-
Reactivity	non-designated	-
EP Toxicity	non-designated at this time; confirmation testing of mercury concentrations possible following liquid transfer to adjacent basin.	-

APPENDIX H

RADIOACTIVE ANALYSIS TECHNIQUE

UNI-3514

Rockwell Hanford Operations
Energy Systems Group
P.O. Box 800
Richland, WA 99352

Rockwell International

OCT 31 1983

In reply, refer to letter R83-3977

Mr. E. A. Weakley, Principal Engineer
Fuels Engineering Department
UNC Nuclear Industries
Post Office Box 490
Richland, Washington 99352

Dear Mr. Weakley:

DISPOSAL OF INORGANIC CHEMICAL WASTES FROM THE UNC FUELS OPERATION

Reference:
(a) RHO-MA-222 (Unclassified), May 1980, D. L. McCall, "Hanford Radioactive Solid Waste Packaging, Storage and Disposal Requirements"

(b) Letter, April 22, 1983, E. A. Weakley to J. F. Albaugh and G. F. Boothe, same subject

(c) Letter, June 1, 1983, R. A. Zinsli to E. A. Weakley, same subject

(d) RHO-MA-139 (Unclassified), July 1983, G. F. Boothe, "Environmental Protection Manual

(e) Letter, September 2, 1983, E. A. Weakley to R. A. Zinsli, same subject

(f) Letter, October 7, 1983, G. F. Boothe to H. C. Boynton, "Requirements for Disposal of Inorganic Chemical Wastes from UNC Nuclear Industries Fuels Operation"

Reference (b) requests Rockwell Hanford Operations (Rockwell) to assist in exploring potential disposal options for the UNC Nuclear Industries (UNC) fuels operation dried process waste. Currently, a process waste slurry is deposited in the 100-H Area evaporation basins. Development of a waste solidification facility is in progress. Annually, 1.5 million pounds of dried process waste characterized in Reference (b) is to be produced which contains approximately 0.08% uranium by weight with enrichment up to 1.25%.

The options for disposal of the dried process waste at the Hanford sanitary landfill and the Radioactive Burial Grounds have been reviewed by Rockwell. Reference (c) states that the enriched process waste must be considered Low-Level Waste (LLW) as prescribed by the Department of Energy (DOE) Interim Draft Order 5820 (June 2, 1983).

Rockwell International

Mr. E. A. Weakley
Page 2
OCT 31 [illegible]

Reference (e) requests that Rockwell review further the potential for the development of a "Threshold Quantity" of radioactivity in waste which could be applied to the process waste. The DOE Interim Draft Order 5820 (June 2, 1983) allows for the site specific development of a "Threshold Quantity." This measurement is defined as "a quantity or concentration of radioactivity above which the waste must be managed according to requirements of DOE Order 5820 and below which the waste may be disposed of as a nonradioactive waste at a DOE sanitary landfill."

Rockwell has established in Reference (f) a "Threshold Quantity" as determined by the two criterion described below:

Criterion 1: The activity of radioactive contaminants in the waste material must be below the limits prescribed in Reference (d), Part I, "Standards for Surface Soil Contamination." Since the waste material contains several radionuclides, the test for meeting this activity criterion is defined as a combination of activity limits set for the individual radionuclides utilizing the following formulation:

$$\sum_i \frac{\text{Concentration of radionuclide "i"}}{\text{Soil Standard for radionuclide "i"}} \leq 1.0$$

Where the "Concentration of radionuclide "i"" is the actual measured activity for each constituent radionuclide "i" and where the "Soil Standard for radionuclide 'i'" is the activity limit prescribed in Column I of Table I.1, Part of Reference (d) for radionuclide "i".

An evaluation of the process waste characterized in Reference (b) against Criteria 1 yields the following result: Assuming an isotopic ratio of ^{238}U as 98.695%, ^{236}U as .0452%, ^{235}U as 1.25% and ^{234}U as .0095%, the process waste would have a specific activity of approximately 969 nCi/gm U.

Using the formula in Criteria 1 and Table I.1 of Reference (d),

$$\sum_i \frac{263 \text{ pCi/gm } ^{238}U}{300 \text{ pCi/gm } ^{238}U} + \frac{23 \text{ pCi/gm } ^{236}U}{250 \text{ pCi/gm } ^{236}U} + \frac{21 \text{ pCi/gm } ^{235}U}{250 \text{ pCi/gm } ^{235}U} + \frac{486 \text{ pCi/gm } ^{234}U}{250 \text{ pCi/gm } ^{234}U} = 2.9$$

Since 2.9 is greater than 1.0 the waste characterized in (b) cannot be disposed at the Hanford Central Landfill but must be managed as Low-Level Waste (LLW).

Rockwell International

The formula maybe used to guide efforts for waste stream segregation whereby a non-radioactive waste stream as defined by the two criteria may be eligible for disposal at the Hanford Central Landfill. The corresponding radioactive stream must be disposed as LLW.

Criterion 2: Release of the material for disposal must be provided by Rockwell Radiation Monitoring.

The second criterion would be met by performance of a radiation survey of the waste material by Rockwell Radiation Monitoring in which no detectable radiation dose rates above background are observed.

In the development of waste stream segregation, in addition to radiological criteria, hazardous waste characterization must also be considered. The E. P. Toxicity Test as defined in 40-CFR 261 must be used to determine waste disposition. The Load Lugger disposal method proposed in Reference (e) appears to be acceptable to Rockwell for wastes meeting sanitary landfill disposal criteria. A final burial analysis in accordance with provisions of Reference (e) must be conducted to obtain approval for this method. The burial analysis maybe initiated upon receipt of your final design of the system.

Should you require assistance with this determination, please contact Mr. J. D. Anderson (3-1036).

R. A. Zinsli

R. A. Zinsli, Program Manager
Radioactive Waste Operations

RAZ:HCB:jss

9413294.1480

APPENDIX I

CALCULATION OF RADIOACTIVE DATA RELATIVE TO "THRESHOLD QUANTITY"

Calculation of Uranium Concentration Relative to "Threshold Quantity"

In order to be considered non-radioactive, the following criteria must be met:

$$\sum_i \frac{\text{Concentration of radionuclide "i"}}{\text{Soil Standard for radionuclide "i"}} \leq 1.0$$

For uranium containing U-238, U-236 and U-234, the criteria becomes:

$$\frac{\text{Conc. } U_{238}}{300 \text{ pCi/gm}} + \frac{\text{Conc. } U_{236}}{250 \text{ pCi/gm}} + \frac{\text{Conc. } U_{235}}{250 \text{ pCi/gm}} + \frac{\text{Conc. } U_{234}}{250 \text{ pCi/gm}} \leq 1.0$$

For the waste in basin no. 1, with an "inner" solids phase containing 420 ppm uranium:

$$U_{238} = \frac{420 \text{ gms uranium } (98.94 \text{ gms } U_{238})}{(1 \times 10^6 \text{ gms sample})\ (100 \text{ gms uranium})} = 4.16 \times 10^{-4} \ \frac{\text{gms } U_{238}}{\text{gm sample}}$$

$$U_{236} = \frac{420 \text{ gms uranium } (0.044 \text{ gms } U_{236})}{(1 \times 10^6 \text{ gms sample})(100 \text{ gms uranium})} = 1.85 \times 10^{-7} \ \frac{\text{gms } U_{236}}{\text{gm sample}}$$

$$U_{235} = \frac{420 \text{ gms uranium } (1.006 \text{ gms } U_{235})}{(1 \times 10^6 \text{ gms sample})\ (100 \text{ gms uranium})} = 4.23 \times 10^{-6} \ \frac{\text{gms } U_{235}}{\text{gm sample}}$$

$$U_{234} = \frac{420 \text{ gms } (0.009 \text{ gms } U_{234})}{(1 \times 10^6 \text{ gms sample})\ (100 \text{ gms uranium})} = 3.78 \times 10^{-8} \ \frac{\text{gms } U_{234}}{\text{gm sample}}$$

Taking into account the specific activities of the isotopes:

$$U_{238} = \frac{4.16 \times 10^{-4} \text{ gm } U_{238}\ (3.3 \times 10^{-7} \text{ Ci})(1 \times 10^{12} \text{ pCi})}{\text{gm sample}\ (\text{gm } U_{238})(\text{Ci})} = 137 \ \frac{\text{pCi } U_{238}}{\text{gm sample}}$$

$$U_{236} = \frac{1.85 \times 10^{-7} \text{ gm } U_{236}\ (6.3 \times 10^{-5} \text{ Ci})\ (1 \times 10^{12} \text{ pCi})}{\text{gm sample}\ (\text{gm } U_{236})\ (\text{Ci})} = 12 \ \frac{\text{pCi } U_{236}}{\text{gm sample}}$$

$$U_{235} = \frac{4.23 \times 10^{-6} \text{ gm } U_{235}\ (2.1 \times 10^{-6} \text{ Ci})\ (1 \times 10^{12} \text{ pCi})}{\text{gm sample}\ (\text{gm } U_{235})\ (\text{Ci})} = 9 \ \frac{\text{pCi } U_{235}}{\text{gm sample}}$$

Calculation of Uranium Concentration Relative

to "Threshold Quantity" Continued

$$U_{234} = \frac{3.78 \times 10^{-8}\ \text{gm}\ U_{234}}{\text{gm sample}} \frac{(6.2 \times 10^{-3}\ \text{Ci})}{(\text{gm}\ U_{234})} \frac{(1 \times 10^{12}\ \text{pCi})}{(\text{Ci})} = 234 \frac{\text{pCi}\ U_{234}}{\text{gm sample}}$$

Thus;

$$\frac{137\ \text{pCi}\ U_{238}/\text{gm}}{300\ \text{pCi}\ U_{238}/\text{gm}} + \frac{12\ \text{pCi}\ U_{236}/\text{gm}}{250\ \text{pCi}\ U_{236}/\text{gm}} + \frac{9\text{pCi}\ U_{235}/\text{gm}}{250\ \text{pCi}\ U_{235}/\text{gm}} + \frac{234\ \text{pCi}\ U_{234}/\text{gm}}{250\ \text{pCi}\ U_{234}/\text{gm}}$$

= 1.5, therefore, the "Threshold Quantity" limit is exceeded.

9413294.1482

APPENDIX J

CHEMICAL WASTE DISPOSAL PERMITS

UNI-3514

CHEMICAL WASTE DISPOSAL PERMIT

Date 7-21-75 Permit No. 1-75

Quantity 35 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Used Klene-ox solution for cleaning rolls in the fixer tank on the film developer in 333 Bldg. Solution is known to contain sulfamic acid and the pH of the solution is 1.7.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Cr 684 ppm

Fe 34 "

Al 14 "

Disposal Procedures (By QC & E)

Pump the used Klene-ox solution from the collection barrel into a batch of filter press effluent in Tank 10 (313 Bldg) and pump the mixture to the outside neutralized waste storage tank for disposal to the 183-H Evaporation Basin. No visible reaction took place when the used Klene-ox solution was added to filter press effluent in the Chem Lab.

Submitted By EA Weakley

Approved By Manager, Quality Control & Engineering

Approved By Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Shop Operations

Accepted By Manager, Materials

UNI-3514

CHEMICAL WASTE DISPOSAL PERMIT Completed 12-30-7

Date Dec. 11, 1975 Permit No. 2-75

Quantity 55 gallons (1 drum)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Used chromium plating solution from Tech. Shops, 328 Bldg.

Total acid normality = 1.9

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
Cr, Cu & Fe by spectrochemical analysis.

Disposal Procedures (By QC & E)
Transfer by barrel pump into Tank 12, 14, 15 or 16 in the 313 Cleaning Line and pump into chemical waste storage tanks in 334-A Bldg. Rinse barrel and also transfer to the chemical waste system.

Submitted By LF Lust, HEDL (2-3012)

Approved By [signature]
Manager, Quality Control & Engineering

Approved By [signature]
Manager, Environmental & Radiation Control

Accepted By H.C. Money [signature]
Manager, Shop Operations

Accepted By W. R. Kirk
Manager, Materials

Lab Report - Permit 2-75 CWDP 2-75. UNI-3514

S P _____

SPECTROCHEMICAL ANALYSIS REPORT

DOUGLAS UNITED NUCLEAR, INC.
SPECTROCHEMICAL LABORATORY
BUILDING 3720

CC: SPEC. LAB. 04354

MATERIAL: Chromic Acid

SUBMITTER'S NO.: Chromic Acid

SUBMITTED BY: E. A. Weakley

ANALYZED BY: G. Gee

DATE REPORTED: 12-10-75

ELEMENT		ELEMENT		ELEMENT	
Ag	—	In	—	Sr	—
Al	10	K	—	Ta	—
As	—	La	—	Te	—
Au	—	Li	—	Tb	—
B	—	Mg	—	Ti	—
Ba	20	Mn	—	Tl	—
Be	—	Mo	10	U	—
Bi	—	Na	400	V	—
Ca	40	Nb	—	W	—
Cd	40	Ni	—	Zn	—
Co	—	P	—	Zr	—
Cr	720,000	Pb	—		
Cu	2000	Pd	—		
Fe	1000	Pt	—		
Ge	—	Sb	—		
Hf	—	Si	10		
Hg	—	Sn	—		

TYPE OF ANALYSIS

☐ QUALITATIVE

SYMBOL	MEANING	APP'X. CONC.
VS	MAJOR DETECTABLE CONSTITUENT	
S	STRONG	
M	MODERATE	
T	TRACE	
—	NOT DETECTED	
*	INTERFERENCE	
?	DETECTION UNCERTAIN, INTERFERENCE	

☑ SEMIQUANTITATIVE

SYMBOL	MEANING
G	CONCENTRATION GREATER THAN
L	DETECTABLE CONCENTRATION LESS THAN
—	NOT DETECTED

NUMERICAL VALUES: ☑ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION FACTOR 10

☐ QUANTITATIVE

SYMBOL	MEANING
GX (LX)	CONC. GREATER THAN (LESS THAN) CALIBRATED WORKING CURVE

NUMERICAL VALUES: ☐ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± _____

REMARKS:

Total acid insoluble = 1.9

Spectrum analysis corrected for concentration - 3% liquid sample

REPORT APPROVED: [illegible]

LABORATORY INFORMATION

SPECTROGRAPH AND SOURCE	SIZE OF SAMPLE	METHOD OF ANALYSIS	PLATE NO.
Ebert + Vn arcs	1 g	DC Gee	00982

Completed 1-13-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 12-12-75 Permit No. 3-75

Quantity 660 gallons (12 55-gallon drums)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Synthetic salt solution for pilot evaporator-crystallizer tests, 271-T Bldg.
Basic solution with a pH of 12.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
No heavy metals by spectrochemical analysis. Solution makeup by wt% was: NaOH 13%; $NaAlO_2$ 5%; $NaNO_3$ 24%; $NaNO_2$ 8% and H_2O 50%.

Disposal Procedures (By QC & E)
Transfer by barrel pump into Tank 9 or 10 in 313 Bldg and transfer into outside storage tank in 311-Tank Farm. Barrels must be rinsed with hot water to dissolve crystals in bottom of barrel and then pumped into Tank 9 or 10.

Submitted By DH Miyasaki, ARHCO (2-2757)

Approved By [signature]
Manager, Quality Control & Engineering

Approved By [signature] for
Manager, Environmental & Radiation Control

Accepted By N.A.
Manager, Shop Operations

Accepted By [signature]
Manager, Materials

Lab Report - Permit 3-75 UNI-3514

S P _____

SPECTROCHEMICAL ANALYSIS REPORT

DOUGLAS UNITED NUCLEAR, INC.
SPECTROCHEMICAL LABORATORY
BUILDING 2720

CC: SPEC. LAB.
04056
04097

MATERIAL: ARCHO Liquid Waste #1 & #2

SUBMITTER'S NO.:

SUBMITTED BY: E. A. Weakley

ANALYZED BY: G. Gay

DATE REPORTED: 11-20-75

ELEMENT	#1	#2	ELEMENT			ELEMENT		
Ag	—	—	In	—	—	Sr	—	—
Al	1%	.5%	K	—	—	Ta	—	—
As	—	—	La	—	—	Te	—	—
Au	—	—	Li	—	—	Th	—	—
B	—	—	Mg	—	—	Ti	—	—
Ba	—	—	Mn	—	—	Tl	—	—
Be	—	—	Mo	—	—	U	—	—
Bi	—	—	Na	>10%	>10%	V	—	—
Ca	—	—	Nb	—	—	W	—	—
Cd	—	—	Ni	—	—	Zn	—	—
Co	—	—	P	—	—	Zr	—	—
Cr	—	—	Pb	—	—			
Cu	—	—	Pd	—	—			
Fe	—	—	Pt	—	—			
Ga	—	—	Sb	—	—			
Hf	—	—	Si	.02%	.02%			
Hg	—	—	Sn	—	—			

TYPE OF ANALYSIS

☐ QUALITATIVE

SYMBOL	MEANING	APP'X. CONC.
VS	MAJOR DETECTABLE CONSTITUENT	
S	STRONG	
M	MODERATE	
T	TRACE	
—	NOT DETECTED	
*	INTERFERENCE	
?	DETECTION UNCERTAIN, INTERFERENCE	

☑ SEMIQUANTITATIVE

SYMBOL	MEANING
G	CONCENTRATION GREATER THAN
L	DETECTABLE CONCENTRATION LESS THAN
—	NOT DETECTED

NUMERICAL VALUES: ☐ PARTS PER MILLION ☑ PERCENT ☐ _____

APPR'X. PRECISION ± FACTOR ~~1.5~~ 5

☐ QUANTITATIVE

SYMBOL	MEANING
GX (LX)	CONC. GREATER THAN (LESS THAN) CALIBRATED WORKING CURVE

NUMERICAL VALUES: ☐ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± _____

REMARKS: Density Barrel #1 1.438 g/ml pH 12.1
#2 1.429 g/ml pH 11.95

REPORT APPROVED

LABORATORY INFORMATION

SPECTROGRAPH AND SOURCE	SIZE OF SAMPLE	METHOD OF ANALYSIS	PLATE NO.
Ebert + Varisource	[illegible]	[illegible]	00077

A—5300—079 (12-65)

Completed 2-5-76

UNI-3514

CHEMICAL WASTE DISPOSAL PERMIT

Date 1-15-76 Permit No. 1-76

Quantity 2 weak organic acids and $NaNO_3$ (see list below for quantities)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused chemicals from BNW labs in 1706-KE, 185-D and 242-B Bldgs.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
See list of chemicals below.

Disposal Procedures (By QC & E) The chemicals that UNI cannot use in their process will be mixed with water or filter press effluent in Tank 9 or 10 in the 313 Bldg and transferred into the outside storage tank in the 311-Tank Farm. UNI should be able to use the $NaNO_3$ in derusting steel spacers. Rinse out empty bottles with water and dispose of bottles in waste lugger. Wear approved protective clothing while handling chemicals.

Unneeded Chemical	Pounds
Oxalic Acid	70
Formic Acid	2
$NaNO_3$	180

Submitted By TJ McLaughlin, BNW (86-2737)

Approved By [signature]
Manager, Quality Control & Engineering

Approved By [signature]
Manager, Environmental & Radiation Control

Accepted By N.A.
Manager, Shop Operations

Accepted By [signature]
Manager, Materials

Completed 2-5-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 1-15-76 Permit No. 2-76

Quantity 9 different strong acids (see list below for quantities)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused acids from BNW labs in 1706-KE, 185-D and 242-B Bldgs.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
See list of acids below.

Disposal Procedures (By QC & E) The acids that UNI cannot use in their processes will be poured slowly into water or spent acid solutions in Tank 12, 14, 15 or 16 in the 313 Bldg cleaning line and pumped into the chemical waste storage tanks in 334-A Bldg. UNI should be able to use the HF, HNO_3 and H_2SO_4 as process make-up additions. Rinse out bottles with water and dispose of bottles in waste lugger. Wear approved protective clothing while handling acids.

Unneeded Acid	Pounds	Gallons
HBr	19	
HI	2	
HF	11	
$HClO_4$	3	
HNO_3		3
H_3PO_4		5
H_2SO_4		1.5
HCl		0.5
H_3PO_2		1

Submitted By TJ McLaughlin, BNW (86-2737)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By [signature] Manager, Shop Operations

Accepted By [signature] Manager, Materials

9413791.149

Completed 4-29-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 1-15-76 Permit No. 3-76

Quantity 2 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Unused cyanide solutions from BNW lab in 1706-KE.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Cyanide

Disposal Procedures (By QC & E)

To prevent the cyanide solutions from becoming acidic, which would release HCN gas, the solutions shall be slowly poured directly into the 183-H Evaporation Basin while a load of neutralized waste is being added. (Caution: be sure and not pour into the wind.) Rinse out bottles with water, return empty bottles to 300 Area and dispose of bottles in waste lugger. Wear protective clothing, rubber gloves, acid goggles and face shield while dumping and rinsing out bottles. A second person shall be in attendance during the disposal operation at 183-H.

Submitted By TJ McLaughlin, BNW (86-2737)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Shop Operations

Accepted By [signature] Manager, Materials

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 1-19-76 Permit No. 4-76

Quantity 20 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Used absorbing solution for air sampling. Neutral salt solution of $HgCl_2$, KCl and EDTA.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
Hg content of 0.067 lb/gal or 1.34 lbs total.
EDTA content of 0.01 lb total.

Disposal Procedures (By QC & E)
Mix with water or filter press effluent in Tank 9 or 10 in the 313 Bldg and transfer into the outside storage tank in the 311-Tank Farm. Rinse out plastic containers and return to HEHF.

Submitted By LJ Maas, HEHF (2-7040)

Approved By [illegible] Manager, Quality Control & Engineering

Approved By [illegible] Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Shop Operations

Accepted By [illegible] Manager, Materials

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 1-30-76 Permit No. 5-76

Quantity 240 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Used battery acid from 384 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

H_2SO_4

Pb

Disposal Procedures (By QC & E)

Transfer by barrel pump into Tank 12, 13, 14, 15, or 16 in the 313 Bldg cleaning line and pump into chemical waste storage tanks in 334-A Bldg. Rinse barrels and transfer rinse water to the chemical waste system.

Submitted By JT Kendrick, HEDL (2-3325)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By [signature] Manager, Shop Operations

Accepted By [signature] Manager, Materials

UNI-3514

CHEMICAL WASTE DISPOSAL PERMIT

Date 2-2-76 Permit No. 6-76

Quantity 140 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Used battery acid from 234-5 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
H_2SO_4
Pb

Disposal Procedures (By QC & E)
Transfer by barrel pump into Tank 12, 13, 14, 15 or 16 in the 313 Bldg cleaning line and pump into chemical waste storage tanks in 334-A Bldg. Rinse barrels and transfer rinse water to the chemical waste system.

Submitted By RJ Thomas, ARHCO (2-2542)

Approved By [signature] Approved By [signature]
Manager, Quality Control & Engineering — Manager, Environmental & Radiation Control

Accepted By [signature] Accepted By W. R. Kirk

UNI-3514

CHEMICAL WASTE DISPOSAL PERMIT

Date 2-17-76 Permit No. 7-76

Quantity 52 gallons (Eight 6½ gallon jugs)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Used battery acid from 1171 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

H_2SO_4

Pb

Disposal Procedures (By QC & E)

Slowly pour used acid into water or solution in Tank 12, 13, 14, 15 or 16 in the 313 Bldg cleaning line and pump into chemical waste storage tank in 334-A Bldg. Rinse jugs and transfer rinse water to chemical waste system. Return plastic jugs to ARHCO.

Submitted By WJ Bachmann, ARHCO (2-7169)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By [signature] Manager, Shop Operations

Accepted By [signature] Manager, Materials 2/23/76

Lab Report - Permit 7-76

UNI-3514

SPECTROCHEMICAL LABORATORY WORK SHEET

	00694	695	696	697	698	699	- -	802		817		
	Phenoxa 121	121-1	121.2	Phenoxa 121-3	Phenoxa 116	Phenoxa 130		Tarco #306D		Battery Acid		
Ag	—											
Al	500	200	500	300	250	350				10		
As												
Au												
B												
Ba	5	1	1	1	1	2				2		
Be												
Bi												
Ca	30	10	10	15	10	20		50		5		
Cd												
Co	2											
Cr										5		
Cu										2		
Fe	10	10	5	5	5	7				20		
Ga												
Hf												
Hg												
In												
K												
La												
Li												
Mg	2	1	1	1	1	3				2		
Mn	—											
Mo												
Na	100	100	100	150	100	200		10,000				
Nb	—											
Ni	5	1	2	3	3	3				[illegible]		
P												
Pb										[illegible]		
Pd												
Pt												
Sb												
Si	250	200	250	300	250	350		100		2		
Sn										[illegible]		
Sr												
Ta												
Te												
Th												
Ti												
Tl												
U												
V	2	1	1	1	1	2						
W												
Zn												
Zr												
% Solids	2.4%	1.9%	2.4	2.9	2.5%	3.5				$H^+ = 5.0N = -2$ [illegible] H_2SO_4		

UNI-3514

Completed 11-2-76

CHEMICAL WASTE DISPOSAL PERMIT

Date 2-20-76 Permit No. 8-76

Quantity 275 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Used battery acid from 309 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
H_2SO_4
Pb

Disposal Procedures (By QC & E)
Transfer by barrel pump into Tank 12, 13, 14, 15 or 16 in the 313 Bldg cleaning line and pump into chemical waste storage tanks in 334-A Bldg. Rinse barrels and transfer rinse water to the chemical waste system.

Submitted By JT Kendrick, HEDL (2-3325)

Approved By [signature]
Manager, Quality Control & Engineering

Approved By [signature]
Manager, Environmental & Radiation Control

Accepted By [signature]
Manager, Shop Operations

Accepted By [signature]
Manager, Materials

UNI-3514

Completed 4-12-76

CHEMICAL WASTE DISPOSAL PERMIT

Date 3-8-76 Permit No. 9-76

Quantity 4 weak acid organic acid mixtures. (See list below for quantities)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused proprietary oxalic base decontaminant agents from Chemistry & Waste Treatment Technology.
1 liquid and 3 solid mixtures - granular or powdered.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
Oxalic and citric acid. No heavy metals.

Disposal Procedures (By QC & E) All mixtures were compatible with our caustic filter press effluent.
Dissolve or add the 4 mixtures with filter press effluent or water in Tank 9 or 10 in the 313 Bldg and transfer into the outside storage tank in the 311-Tank Farm. Rinse out empty liquid containers and dispose of all containers in waste lugger. Wear approved clothing while handling chemicals.

Trade Name	Quantity
Turco 4521-A	45 pounds
Turco 4521-B	30 "
Turco 4528-F	26 "
Artel 30	6 gallons

Submitted By CA Richardson, UNI (2-1589)

Approved By [signature] Manager, Quality Control & Engineering

Approved By T E Dabrowski Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Shop Operations

Accepted By 026 W. R. Kirk Manager, Materials

9413294.1499

SPECTROCHEMICAL LABORATORY WORK SHEET

	Phosphoric Acid Base						EDTA Base		Phosphoric Acid Base	
	00684	685	686	687	688	689	690	691	692	693
	Tusco 4512-B	Tusco 4512-C	NT 100	NT 121	NTC 121	ARTEL 30	Kennecott Dec	Kennecott Weak XRF	Oakite 27-AB-56	Oakite 27-AB-57
Ag	1	1	1	1	1		1	1	1	1
Al	1000	700	2000	700	200		20	2	600	600
As										
Au										
B										
Ba	10		5							
Be										
Bi										
Ca	30	20	50	20	20		40	3	20	20
Cd										
Co										
Cr										
Cu										
Fe	100	20	50	20	40				20	20
Ga										
Hf										
Hg										
In										
K										
La										
Li										
Mg										
Mn										
Mo										
Na	300	200	200	100	100	75000	75000	75000	60	100
Nb										
Ni				10						
P										
Pb										
Pd										
Pt										
Sb										
Si	1000	700	2000	700	200	2	10		600	600
Sn										
Sr										
Ta										
Te										
Th										
Ti										
Tl										
U										
V										
W										
Zn										
Zr										
wt % Residue	6%	3.4%	10%	3.5%	2%	4%	18%	3%	3%	3%

pH = 4.0

Phosphoric Acid Base

Plate 00092

SPECTROCHEMICAL LABORATORY WORK SHEET

Lab	677	678	679	680	681	682	683
	Turco 4521-A	Turco 4521-B	Turco 4528-F	Wyandotte 5061	NT 680	NT 686	NT 688
Ag	1						
Al	10 ppm						
As							
Au							
B							
Ba							
Be							
Bi							
Ca	10,000	500	2000	2000	50	50	50
Cd							
Co							
Cr							
Cu							
Fe							
Ga							
Ge							
Hf							
In							
K							
La							
Li							
Mg							
Mn							
Mo							
Na		200	20,000	20,000		200	200
Nb							
Ni							
P							
Pb							
Pd							
Pt							
Sb							
Si		200					
Sn							
Sr							
Ta							
Te							
Th							
Ti							
Tl							
U							
V							
W							
Zn							
Zr							

Concentrations are reported as ppm Factor ± 10

UNI-3514

CHEMICAL WASTE DISPOSAL PERMIT

Date 3-8-76 Permit No. 10-76

Quantity 5 EDTA base mixtures. (See list below for quantities.)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused proprietary EDTA base decontaminant agents from Chemistry & Waste Treatment Technology.
Two liquid mixtures and 3 solid granular or powdered mixtures.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
EDTA. No heavy metals present.

Disposal Procedures (By QC & E) All mixtures were compatible with our caustic filter press effluent.
Dissolve or add the 5 mixtures with filter press effluent or water in Tank 9 or 10 in the 313 Bldg and transfer into the outside storage tank in the 311-Tank Farm. Rinse out empty liquid containers and dispose of all containers in waste lugger. Wear approved clothing while handling chemicals.

Trade Name	Quantity
Hampshire DEG	3 gallons
Radiocwash XRF	3 "
NT-680	35 pounds
NT-686	100 "
NT-688	25 "

Submitted By CA Richardson, UNI (2-1589)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Shop Operations

Accepted By [signature] Manager, Materials

UNI-3514

CHEMICAL WASTE DISPOSAL PERMIT

Date 3-8-76 Permit No. 11-76

Quantity 5 chemical salts. (See list below for quantities.)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused chemicals from Chemistry & Waste Treatment Technology.
Solid granular or powdered materials.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
See list of chemicals below.

Disposal Procedures (By QC & E) Dissolve the Na_2SO_3 and $Na_2S_2O_4 \cdot 2H_2O$ in water or filter press effluent in Tank 9 or 10 in the 313 Bldg and transfer into the outside storage tank in the 311-Tank Farm. The Chem Lab can use the NaCl.
To prevent the $Na_2HAsO_4 \cdot 7H_2O$ from becoming acidic, which would release AsH_3 gas, this compound should be poured directly into the 183-H Evaporation Basin (only contains 1.7 pounds of As). To prevent the release of NH_3 gas in the 313 Bldg from the $(NH_4)_2HPO_4$, this compound should also be poured directly into the 183-H Basin. Wear protective clothing, rubber gloves, acid goggles and face shield while dumping chemicals into 183-H Basin.
A second person shall be in attendance during the disposal operation at 183-H. Clean $Na_2HAsO_4 \cdot 7H_2O$ container before disposal.
Dispose of empty containers in waste lugger.

Unneeded Chemical	Pounds
$Na_2S_2O_4 \cdot 2H_2O$	75
Na_2SO_3	10
NaCl	5
$Na_2HAsO_4 \cdot 7H_2O$	7
$(NH_4)_2HPO_4$	25

Submitted By CA Richardson, UNI (2-1589)

Approved By [signature]
Manager, Quality Control & Engineering

Approved By [signature]
Manager, Environmental & Radiation Control

Accepted By N.A.
Manager, Shop Operations

Accepted By [signature]
Manager, Materials

CHEMICAL WASTE DISPOSAL PERMIT

Date 3-8-76 Permit No. 12-76

Quantity 63.5 gallons of 13 different H_3PO_4 base mixtures. (See list below for quantities.)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Unused proprietary H_3PO_4 base decontaminant agents from Chemistry & Waste Treatment Technology.

All liquid mixtures.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

H_3PO_4

The only heavy metals found are listed below.

Disposal Procedures (By QC & E) All the mixtures were compatible with our waste acid. Add these H_3PO_4 mixtures slowly into water or spent acid solution in Tank 12, 14, 15 or 16 in the 313 Bldg cleaning line and pump into the chemical waste storage tanks in 334-A Bldg. Rinse out containers and dispose of containers in waste lugger. Wear approved protective clothing while handling acids.

Trade Name	Gallons	Metal Content, ppm Al	Fe	Ni	V	Co
NT-100	10	2000	50			
NT-121	4	700	20	10		
NTL-121	4	200	10			
Oakite OEM 27-AB-56	3½	600	20			
Oakite OEM 27-AB-72	2	600	20			
Phoenix 116	4	250	5	3		
Phoenix 121	5	500	10	5	2	2
Phoenix 121-1	1	200	10	1	1	
Phoenix 121-2	1	500	5	2	1	
Phoenix 121-3	1	300	5	3	1	
Phoenix 130	4	350	7	3	2	
Turco 4512-B	13	1000	100			
Turco 4512-C	11	700	20			

Submitted By CA Richardson, UNI (2-1589)

Approved By [signature] Manager, Quality Control & Engineering

Approved By T E Dahlquist Manager, Environmental & Radiation Control

Accepted By [signature] Manager, Shop Operations

Accepted By [signature] Manager, Materials

Lab Report - Permits 12-76, 13-76

SPECTROCHEMICAL LABORATORY WORK SHEET

	00694	695	696	697	698	699		802		817		
	Phenoxx 121	121-1	121.2	Phenoxx 121-3	Phenoxx 116	Phenoxx 130		Turco 4306D		Battery Acid		
Ag	—											
Al	500	200	500	300	250	350				10		
As												
Au												
B												
Ba	5	1	1	1	1	2				2		
Be												
Bi												
Ca	30	10	10	15	10	20		50		5		
Cd												
Co	2									1		
Cr										5		
Cu										2		
Fe	10	10	5	5	5	7				20		
Ga												
Hf												
Hg												
In												
K												
La												
Li												
Mg	2	1	1	1	1	3				2		
Mn	—									1		
Mo	1									1		
Na	100	100	100	150	100	200		10,000		1		
Nb	—											
Ni	5	1	2	3	3	3				5		
P												
Pb										100		
Pd												
Pt												
Sb												
Si	250	200	250	300	250	350		100		2		
Sn										.5		
Sr												
Ta												
Te												
Th												
Ti												
Tl												
U												
V	2	1	1	1	1	2						
W												
Zn												
Zr												
% Sol.	2.4%	1.9%	2.4	2.9	2.5%	3.5				H^+ = 5.0N		

UNI-3514

CHEMICAL WASTE DISPOSAL PERMIT

Date 3-8-76 Permit No. 13-76

Quantity 150 pounds of sulfamic acid base mixture. (See list below for quantities.)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Unused proprietary sulfamic acid base decontaminate agents from Chemistry & Waste Treatment Technology.

Solid granular or powdered materials.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Sulfamic acid (NH_2SO_3H)

No heavy metals present.

Disposal Procedures (By QC & E) All the mixtures were compatible with our waste acid. Dissolve the mixture in water in Tank 12, 14, 15 or 16 in the 313 Bldg cleaning line and pump into the chemical waste storage tanks in 334-A Bldg. Dispose of containers in waste lugger. Wear approved protective clothing while handling acids.

Trade Name	Pounds
Turco 4306-D	75
Wyandotte 5061	75

Submitted By CA Richardson, UNI (2-1589)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By [signature] Manager, Shop Operations

Accepted By [signature] Manager, Materials

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 3-17-76 Permit No. 16-76

Quantity 107 gallons (in 3 and 6½-gallon plastic jugs)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Used battery acid from 1171 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

H_2SO_4

Disposal Procedures (By OC & E)

Pour slowly into Tank 12, 13, 14, 15 or 16 in the 313 Bldg Cleaning Line and pump into chemical waste storage tanks in 334-A Bldg. Rinse jugs and transfer rinse water to the chemical waste system. Return jugs to submittor. Wear approved protective clothing while handling acids.

Submitted By WJ Bachmann, ARHCO (2-7169)

Approved By [signature] Manager, Quality Control & Engineering

Approved By T S Dabrowski Manager, Environmental & Radiation Control

Accepted By [signature] Manager, Prod Operations

Accepted By [signature] Manager, Materials

P

SPECTROCHEMICAL ANALYSIS REPORT

DOUGLAS UNITED NUCLEAR, INC.
SPECTROCHEMICAL LABORATORY
BUILDING 3720

CC: SPEC. LAB. 00956

MATERIAL: Used Pickling Acid

SUBMITTER'S NO.

SUBMITTED BY: E. A. Weaver

ANALYZED BY: G. Gu

DATE REPORTED: 3-23-76

ELEMENT		ELEMENT		ELEMENT	
Ag	.2	Y	—	Sr	—
Al	5	K	—	Ta	—
As	—	La	—	Te	—
Au	—	Li	—	Tb	—
B	—	Mg	.5	Ti	—
Ba	—	Mn	.2	Tl	—
Be	—	Mo	.05	U	—
Bi	—	Na	>100	V	—
Ca	5	Nb	—	W	—
Cd	—	Ni	.5	Zn	.02
Ce	—	P	—	Zr	—
Cr	.05	Pb	2		
Cu	2	Pd	—		
Fe	1	Pt	—		
Ga	—	Sb	—		
Hf	—	Si	.2		
Hg	—	Sn	.1		

TYPE OF ANALYSIS

☐ QUALITATIVE

SYMBOL	MEANING	APP'X. CONC.
VS	MAJOR DETECTABLE CONSTITUENT	
S	STRONG	
M	MODERATE	
T	TRACE	
—	NOT DETECTED	
•	INTERFERENCE	
?	DETECTION UNCERTAIN, INTERFERENCE	

☑ ~~SEMIQUANTITATIVE~~ Quantitative

SYMBOL	MEANING
G	CONCENTRATION GREATER THAN
L	DETECTABLE CONCENTRATION LESS THAN
—	NOT DETECTED

NUMERICAL VALUES: ☑ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± FACTOR 10

☐ QUANTITATIVE

SYMBOL	MEANING
GX (LX)	CONC. GREATER THAN (LESS THAN) CALIBRATED WORKING CURVE

NUMERICAL VALUES: ☐ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± _____

REMARKS: H^+ = 5.7 N in the pickling acid

REPORT APPROVED: FL

LABORATORY INFORMATION

SPECTROGRAPH AND SOURCE	SIZE OF SAMPLE	METHOD OF ANALYSIS	PLATE NO.
~~DC Arc~~ Ebert + Varisource	10 mg	DC Arc	00101

A—6300—070 (12-68)

Completed 9-22-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 3-17-76 Permit No. 17-76

Quantity 70 gallons (14 5-gallon plastic jugs)
(2)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Used battery acid from 284-E and 248-W Power Houses.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
H_2SO_4

Disposal Procedures (By QC & E)
Pour slowly into Tank 12, 13, 14, 15 or 16 in the 313 Bldg Cleaning Line and pump into chemical waste storage tanks in 334-A Bldg. Rinse jugs and transfer rinse water to the chemical waste system. Return jugs to submittor. Wear approved protective clothing while handling acids.

Submitted By BH Clark, ARHCO (2-2355)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By [signature] Manager, Shop Operations

Accepted By [signature] Manager, Materials

UNI-3514 Completed 8-5-76

CHEMICAL WASTE DISPOSAL PERMIT

Date 3-25-76 Permit No. 18-76

Quantity ¾-gallon Ni plating solution & 4 pounds $CuSO_4$

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Unused $CuSO_4$ powder and unneeded Ni plating solution with a pH of 7.0 from the PS Bldg.

Major Pollutants (Heavy metals, Se, U, Cations, Anions, etc.)

Ni solution contains 0.2% B, 10 ppm Co & 40 ppm Mn. Completed 4-12-76

$CuSO_4$ 8-5-76

Disposal Procedures (By QC & E)

Dissolve the $CuSO_4$ in water or filter press effluent in Tank 9 or 10 in the 313 Bldg, add the Ni plating solution and transfer into the outside storage tank in the 311-Tank Farm. Rinse out bottle and dispose of both containers in waste lugger.

Submitted By TJ McLaughlin, BNW (86-2737)

Approved By _____ Manager, Quality Control & Engineering

Approved By _____ Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Shop Operations

Accepted By _____ Manager, Materials

S P _____

SPECTROCHEMICAL ANALYSIS REPORT

DOUGLAS UNITED NUCLEAR, INC.
SPECTROCHEMICAL LABORATORY
BUILDING 2720

CC: SPEC. LAB: 00988 00989

MATERIAL: 1 # Nickel Plating Solution #2 Chem Polishing Soln.

SUBMITTER'S NO.

SUBMITTED BY: E. A. Weakley

ANALYZED BY: G. Gay

DATE REPORTED: 3-24-76

ELEMENT	#1	#2	ELEMENT	#1	#2	ELEMENT	#1	#2
Ag	—	—	In	—	—	Sr	—	—
Al	—	—	K	—	—	Ta	—	—
As	—	—	La	—	—	Te	—	—
Au	—	—	Li	—	—	Th	—	—
B	.2%	—	Mg	—	—	Ti	—	—
Ba	—	—	Mn	.004%	—	Tl	—	—
Be	—	—	Mo	—	—	U	—	—
Bi	—	—	Na	—	2%	V	—	—
Ca	.0004%	.001%	Nb	—	—	W	—	—
Cd	—	—	Ni	>2%	—	Zn	—	—
Co	.001%	—	P	—	—	Zr	—	
Cr	—	—	Pb	—	—			
Cu	.002%	.02%	Pd	—	—			
Fe	—	—	Pt	—	—			
Ga	—	—	Sb	—	—			
Hf	—	—	Si	.0004%	—			
Hg	—	—	Sn	—	—			

TYPE OF ANALYSIS

☐ QUALITATIVE

SYMBOL	MEANING	APP'X. CONC.
VS	MAJOR DETECTABLE CONSTITUENT	
S	STRONG	
M	MODERATE	
T	TRACE	
—	NOT DETECTED	
*	INTERFERENCE	
?	DETECTION UNCERTAIN, INTERFERENCE	

☑ ~~SEMIQUANTITATIVE~~ Qualitative

SYMBOL	MEANING
G	CONCENTRATION GREATER THAN
L	DETECTABLE CONCENTRATION LESS THAN
—	NOT DETECTED

NUMERICAL VALUES: ☐ PARTS PER MILLION ☑ PERCENT ☐ _____

APPR'X. PRECISION ± FACTOR 10

☐ QUANTITATIVE

SYMBOL	MEANING
GX (LX)	CONC. GREATER THAN (LESS THAN) CALIBRATED WORKING CURVE

NUMERICAL VALUES: ☐ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± _____

REMARKS: The pH of the nickel plating solution was ~7.0
Hydrogen ion concentration of the "Chem-Polish" soln was 9.1 N

REPORT APPROVED: [signature]

LABORATORY INFORMATION

SPECTROGRAPH AND SOURCE	SIZE OF SAMPLE	METHOD OF ANALYSIS	PLATE NO.
Ebert + Varisource	10 mm of dried sample	D.C. Arc	00103

Completed 8-4-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 3-25-76 Permit No. 19-76

Quantity 6 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Unneeded acid solutions from PS Bldg.

Pollutants (Heavy metals, Be, U, Cations, [illegible], etc.)

1 gallon fuming H_2SO_4.

5 gallon "Chem-Polish" solution containing HNO_3, H_2SO_4 & 200 ppm Cu.

[illegible] Procedures (By OC & E)

Pour the fuming H_2SO_4 and "Chem-Polish" solution slowly into a water filled Tank 12, 13, 14, 15 or 16 in the 313 B.[illegible] cleaning line and pump into the chemical waste storage tanks in 334-A Bldg. Rinse out containers and dispose of containers in waste lugger. Wear approved protective clothing while handling acids.

Submitted By TJ McLaughlin, BNW (86-2737)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By [signature] Manager, Shop Operations

Accepted By [signature] Manager, Materials

Completed

UNI-3514

CHEMICAL WASTE DISPOSAL PERMIT

Date 3-25-76 Permit No. 20-76

Quantity 100 pounds

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Unused flake chromic acid, CrO_3, from the OC & E Pilot Plant in 313 Bldg.

Pollutants (Heavy metals, Be, U, Cations, [illegible])

CrO_3.

Procedures (By OC & E)

Dissolve the CrO_3 in water or waste acid in Tank 12, 13, 14, 15 or 16 in the 313 Bldg cleaning line and pump into the chemical waste storage tanks in the 334-A Bldg. Dispose of the container in a waste lugger. Wear approved protective clothing while handling acids.

Submitted By EA Weakley, UNI (2-3378)

Approved By [illegible] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By [illegible] Manager, Shop Operations

Accepted By [signature] Manager, Materials

Completed 8.11.76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 6-29-76 Permit No. 21-76

Quantity 165 gallons of solution & 731 pounds of powdered caustic materials.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused proprietary caustic mixtures (cleaning materials) and $NaAlO_2$ left over from the Al-Si process sleeve cleaning.
Materials stored in 303-K, 303-F, 304 & 313 Bldgs.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
See list of metals content below.

Disposal Procedures (By QC & E) All of these solutions and solids are compatible with our neutralized wastes. Dissolve or add the 7 materials in/to filter press effluent or water in Tank 9 or 10 in the 313 Bldg and transfer into the outside storage tank in the 311 Tank Farm. Rinse out empty liquid containers and dispose of all containers in waste lugger. Wear approved clothing while handling chemicals.

			Metal Content, ppm							
	Material	Quantity	Al	Cu	Fe	Ni	P	Pb	Mn	
5	$NaAlO_2$ Solution	55 gal	1000	40	20	200				8-11-76
	Turco Aluminetch #2:		2				200	5		
24	Solution	55 gal								8-11-76
	Powder	~~50~~ 125 lbs					completed 8-7-76			
20	Diversey #202 Al Cleaner	400 lbs					(1%)			8-11-76
28	American Equipment & Supply All Purpose Synthetic Cleaner	55 gal		10	6		1000			8-11-76
30	Diversey RX-1288	275 lbs	20		50		(1%)		2	8-11-76
22	Selectron Electrocleaning	1 qt	100	4			completed 5-7-76			
	Turco Alkaline Rust Remover	6 lbs	10						5	

Submitted By EA Weakley, UNI (2-3378)

Approved By [signature]
Manager, Quality Control & Engineering

Approved By [signature] for T E Dahowski
Manager, Environmental & Radiation Control

Accepted By N.A.
Manager, Shop Operations

Accepted By [signature]
Manager, Materials

Completed 8-3-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 6-29-76 Permit No. 22-76

Quantity 1⅛ gallons of acid plating solutions.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Unused plating chemicals from 304 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Co, Ni & Cu (see below)

Disposal Procedures (By QC & E) All the mixtures are compatible with our waste acid. Add these solutions to water or spent acid solution in Tank 12, 14, 15 or 16 in the 313 Bldg cleaning line and pump into the chemical waste storage tanks in 334-A Bldg. Rinse out containers and dispose of containers in waste lugger. Wear approved protective clothing while handling acids.

Selectron, Ltd.

	Solution	Quantity	Metal Content, ppm Al	Co	Cr	Cu	Fe	Mg	Mn	Ni
23	Co Plating Solution	1 qt		(>2%)				2		200
24	Activiating Solution #2	1 qt		10						100
25	Ni Acid Solution	1 pt	5	300	10	100		20	10	(3%)
26	Activiating Solution #1	1 qt	0.1				0.1			0.2
27	Cu Acid Solution	1 qt				(2%)	10			20

Used Zinc Tank from 304 Pilot Plant 2 qts Completed on 8-4-76

Submitted By EA Weakley, UNI (2-3378)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] for TE Dabrowski Manager, Environmental & Radiation Control

Accepted By [signature] Manager, Shop Operations

Accepted By [signature] Manager, Materials

Completed 8-5-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 6-29-76 Permit No. 23-76

Quantity 103 pounds of chemical salts & 5 pints of chemical solutions.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused chemicals from 304 & 313 Buildings.

Granular or powdered salts and solutions (see below).

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
See list of chemicals below.

Disposal Procedures (By QC & E) **Dissolve the powdered or granular salts in water or filter press effluent in Tank 9 or 10 in the 313 Bldg. Pour in the two chemical solutions. Transfer into the outside storage tank in the 311 Tank Farm. Rinse out the containers and dispose of in waste lugger.**

Chemical	Quantity
$CuSO_4 \cdot 5H_2O$	100 lbs
$Fe_2(SO_4)_3$	2 "
NaH_2PO_2	5 "
Urea	1 "
V_2O_5 Saturated Aqueous Solution	2 pts
Selectron, Ltd., Ni Neutral Solution	3 " (Contains 0.1% Co, 1% P & > 2% Ni)

Submitted By EA Weakley, UNI (2-3378)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Shop Operations

Accepted By OEG [signature] Manager, Materials

Completed 8-5-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 7-12-76 Permit No. 24-76

Quantity 94 pounds of powdered and 16 gallons of solution

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Solid and solutions of caustic materials found in 3 drums on pad east of 333 Bldg and in a container in 303-K Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
See list below.

Disposal Procedures (By QC & E) Add water to dissolve solid caustic materials in Drum No. 14 & 40. Transfer solutions into Tank 9 or 10 in 313 Bldg. Add caustic solutions from Drum No. 31 & 39 into Tank 9 or 10. Transfer into the outside storage tank in the 311 Tank Farm. Rinse out containers and save for reuse. Wear approved clothing while handling chemicals.

		Metal Content, ppm										
Drum No.	Quantity	Al	Cd	Cr	Cu	Fe	Mg	Mn	Ni	Pb	Sr	U
14	55 lb	500			1	500	10	5	50	5	50	100
40	39 lb	1000		10		500	10	5	100		20	
31	15½ gal	5	6	10	>3000		10		30			
39	½ gal	40		4		90	1	90	1			

Completed 8-5-76

Submitted By EA Weakley, UNI (2-3378)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Prod Operations

Accepted By [signature] Manager, Materials

Completed 8-3-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 7-12-76 Permit No. 25-76

Quantity 1½ gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Strong acid solution found in a drum on pad east of 333 Bldg.

(37)

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Metal Content, ppm

Al	Co	Cr	Cu	Fe	Mg	Mn	Mo	Ni	V
80	40	80	400	4000	8	40	800	800	4

Disposal Procedures (By QC & E) This acid solution is compatible with our waste acid. Add this solution to water or spent acid solution in Tank 12, 14, 15 or 16 in the 313 Bldg cleaning line and pump into the chemical waste storage tanks in 334-A Bldg. Rinse out container and save for reuse. Wear approved protective clothing while handling acid.

Submitted By EA Weakley, UNI (2-3378)

Approved By [signature]
Manager, Quality Control & Engineering

Approved By [signature]
Manager, Environmental & Radiation Control

Accepted By [signature]
Manager, Shop Operations

Accepted By [signature]
Manager, Materials

Completed 8-17-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 8-5-76 Permit No. 26-76

Quantity 60 gallons (10 plastic jugs)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Used battery acid from 1171 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
H_2SO_4
Pb

Disposal Procedures (By QC & E)
Slowly pour used acid into water or solution in Tank 12, 13, 14, 15 or 16 in the 313 Bldg cleaning line and pump into chemical waste storage tank in 334-A Bldg. Rinse jugs and transfer rinse water to chemical waste system. Return plastic jugs to ARHCO. Wear approved protective clothing while handling acid.

Submitted By WJ Bachmann, ARHCO (2-7169)

Approved By _____ Manager, Quality Control & Engineering

Approved By _____ Manager, Environmental & Radiation Control

Accepted By _____ Manager, Shop Operations

Accepted By _____ Manager, Materials

Completed 9-10-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 8-17-76 Permit No. 27-76

Quantity 1½ gallons of liquid and 5 5/8 pounds of solids.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Unused chemicals from BNW labs (see buildings below)

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

See list of chemicals below.

Disposal Procedures (By QC & E) Mix the chemicals with water or filter press effluent in Tank 9 or 10 in the 313 Bldg and transfer into the outside storage tank in the 311 Tank Farm. Rinse out empty bottles with water and dispose of bottles in waste lugger. Wear approved protective clothing while handling chemicals.

Material	Building	Gallons	Pounds	
Acetic acid, CH_3COOH	331	¾		9-9-76
Diethanolamine, $HN(CH_2CH_2OH)_2$	331	¼		
Mercuric nitrate, $Hg(NO_3)_2$	3720	¼		9-9-76
Sodium hydroxide, NaOH	LSL-2	¼		
Mercaptoacetic acid, $HSCH_2CO_2H$	331	¼		9-9-76
Choline chloride, $(CH_3)_3NCH_2CH_2O_2CCH_3Cl$	LSL-2		2½	
Deoxycholic acid, $C_{23}H_{36}(OH)_3CO_2H$	LSL-2		½	
Phosphomolybdic acid, $H_3[P(Mo_3O_{10})_4]$	LSL-2		1	
Sodium chromate, Na_2CrO_4	331		2	
Trichloroacetic acid, Cl_3CCO_2H	LSL-2		½	

Submitted By TJ McLaughlin, BNW (86-2737)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Shop Operations

Accepted By [signature] Manager, Materials

Completed 9-22-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 8-17-76 Permit No. 28-76

Quantity 6 pounds (5 lbs)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
P_2O_5 used as a desiccant from BNW labs in the LSL-2 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
P_2O_5

Disposal Procedures (By QC & E) Slowly add the P_2O_5 into water in Tank 12, 14, 15 or 16 in the 313 Bldg cleaning line to form H_3PO_4 and pump into the chemical waste storage tanks in 334-A Bldg. Rinse out containers and dispose of containers in waste lugger. Wear approved protective clothing while handling acid.

Submitted By TJ McLaughlin, BNW (86-2737)

Approved By [signature] Approved By [signature]
Manager, Quality Control & Engineering — Manager, Environmental & Radiation Control

Accepted By [signature] Accepted By [signature]
Manager, Shop Operations — Manager, Materials

Completed 7 22-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 8-17-76 Permit No. 29-76

Quantity 185 gallons in ~~5~~ 4 55-gallon drums.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Used EDTA (ethylenediaminetetraacetic acid) solution from BNW lab in the 1717 KEL Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
EDTA and the following metallic impurities:
Cu 0.6%; Fe 0.6%; Mg 100 ppm; Mn 600 ppm; Mo 100 ppm; Ni 300 ppm; Pb 100 ppm

Disposal Procedures (By QC & E) Mix the EDTA solution with water or filter press effluent in Tank 9 or 10 in the 313 Bldg and transfer into the outside storage tank in the 311 Tank Farm. Rinse drums, transfer rinse water to chemical waste system and save drums for reuse. Wear approved clothing while handling chemicals.

Submitted By TJ McLaughlin, BNW (86-2737)

Approved By [signature]
Manager, Quality Control & Engineering

Approved By [signature]
Manager, Environmental & Radiation Control

Accepted By N.A.
Manager, Shot Operations

Accepted By [signature] for [signature]
Manager, Materials

Lab Report - Permit 29-76

UNI-3514

S F

SPECTROCHEMICAL ANALYSIS REPORT

DOUGLAS UNITED NUCLEAR, INC.
SPECTROCHEMICAL LABORATORY
BUILDING 3720

CC: SPEC. LAB. 02025

MATERIAL: Used EDTA Soln

SUBMITTER'S NO.

SUBMITTED BY: E.A. Weekley

ANALYZED BY: G. Gray

DATE REPORTED

ELEMENT		ELEMENT		ELEMENT	
Ag	—	In	—	Sr	—
Al	30 ppm	K	—	Ta	—
As	—	La	—	Te	—
Au	—	Li	—	Th	—
B	—	Mg	100	Ti	—
Ba	—	Mn	600	Tl	—
Be	—	Mo	100	U	—
Bi	—	Na	1000	V	—
Ca	100	Nb	—	W	—
Cd	—	Ni	300	Zn	10
Co	—	P	—	Zr	—
Cr	10	Pb	100		
Cu	6000	Pd	—		
Fe	6000	Pt	—		
Ga		Sb	—		
Hf	—	Si	60		
Hg	—	Sn	—		

TYPE OF ANALYSIS

☐ QUALITATIVE

SYMBOL	MEANING	APP'X. CONC.
VS	MAJOR DETECTABLE CONSTITUENT	
S	STRONG	
M	MODERATE	
T	TRACE	
—	NOT DETECTED	
•	INTERFERENCE	
?	DETECTION UNCERTAIN, INTERFERENCE	

☑ SEMI-QUANTITATIVE Qualitative

SYMBOL	MEANING
G	CONCENTRATION GREATER THAN
L	DETECTABLE CONCENTRATION LESS THAN
—	NOT DETECTED

NUMERICAL VALUES: ☑ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± FACTOR 10

☐ QUANTITATIVE

SYMBOL	MEANING
GX (LX)	CONC. GREATER THAN (LESS THAN) CALIBRATED WORKING CURVE

NUMERICAL VALUES: ☐ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± _____

REMARKS: $100 for lab work

(4 hrs charged against C-81036 for lab work + Exp.)

REPORT APPROVED

LABORATORY INFORMATION

SPECTROGRAPH AND SOURCE	SIZE OF SAMPLE	METHOD OF ANALYSIS	PLATE NO.
Ebert + Varsonics	Non-fixed single	DC Arc	00123

A-5208-079 (12-62)

completed 12-16-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 9-2-76 Permit No. 30-76

Quantity 1 quart

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

< 1 N HCl solution

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

one gram of Be

Disposal Procedures (By QC & E)

This acid solution is compatible with our waste acid which contains Be. Add this solution to water or spent acid in Tank 12, 14, 15 or 16 in the 313 Bldg cleaning line and pump into the chemical waste storage tanks in 334-A Bldg. Rinse out container and dispose of in waste lugger. Wear approved protective clothing while handling acid.

Submitted By Maureen Hamilton, HEHF (2-6980)

Approved By [signature] 9-3-76
Manager, Quality Control & Engineering

Approved By [signature]
Manager, Environmental & Radiation Control

Accepted By H. C. McNeely
Manager, Shop Operations

Accepted By [signature]
Manager, Materials

CHEMICAL WASTE DISPOSAL PERMIT

3-8-77

UNI-3514

Date 10-1-76 Permit No. 31-76

Quantity 150 pounds

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Sodium nitrate ($NaNO_3$) contaminated with dirt. Stored in a garbage can in 303-F Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

$NaNO_3$

Disposal Procedures (By OC & E)

Mix the $NaNO_3$ with filter press effluent or water in Tank 9 or 10 in the 313 Bldg and transfer into the outside storage tank in the 311 Tank Farm. Rinse out garbage can for reuse.

Submitted By EA Weakley, UNI (2-3378)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Shop Operations

Accepted By [signature] Manager, Materials

CHEMICAL WASTE DISPOSAL PERMIT

3-25-77

UNI-3514

Date 10-11-76 Permit No. 32-76

Quantity Up to 300 gallons to be received over several months time.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Used battery acid from 1171 Bldg. in plastic jugs.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

H_2SO_4

Pb

Disposal Procedures (By QC & E)

Slowly pour used acid into water or solution in Tank 12, 13, 14, 15 or 16 in the 313 Bldg cleaning line and pump into chemical waste storage tank in 334-A Bldg. Rinse jugs and transfer rinse water to chemical waste system. Return jugs to ARHCO. Wear approved protective clothing while handling acid.

Gal	Date
84 1/2	11 2 76
57	12 3 76
[illegible]	2-15 77
[illegible]	3 7 - 77
52	3-25-77

Submitted By WJ Bachmann, ARHCO (2-7169)

Approved By [signature] 10-11-76
Manager, Quality Control & Engineering

Approved By ALC [signature]
Manager, Environmental & Radiation Control

Accepted By [signature]
Manager, Shop Operations

Accepted By [signature]
Manager, Materials

UNI-3514

CHEMICAL WASTE DISPOSAL PERMIT

completed 11-17-76

Date 10-28-76 Permit No. 33-76

Quantity 5 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Waste solutions from testing the corrosion rate of bare uranium with different Fire Dept. wetting and foaming agents used in fire fighting. (From 1706-KE Bldg.)

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
U = 0.003 pound. (0.95% Enrichment)
Wetting and foaming agents = 106 ml = 0.05 pint.

Disposal Procedures (By QC & E)
Mix the waste solutions with water or filter press effluent in Tank 9 or 10 in the 313 Bldg. and transfer into the outside storage tank in the 311 Tank Farm. Rinse out the bottles and dispose of in waste lugger.

Submitted By CA Richardson, UNI (2-1589)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By [signature] Manager, Shop Operations

Accepted By [signature] Manager, Materials

Completed 12-16-76

CHEMICAL WASTE DISPOSAL PERMIT

DNI-3514

Date 12-14-76 Permit No. 34-76

Quantity 1500-3000 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Inhibited HCl solution used to derust the 10,000 gallon degreaser solvent storage tank.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
HCl - 20% starting solution and about 5% in used solution.
Amine based inhibitor - 1%.
$FeCl_3$ and rust.

Disposal Procedures (By QC & E)
Dow Industrial Services personnel will spray the inside surfaces of the tank with the HCl solution. The used solution will be pumped through degreaser solvent supply line from the storage tank into the 313 Bldg and into Tank 14 or 15. From Tank 14 or 15 the solution will be pumped into the chemical waste storage tanks in the 334-A Bldg or High Tank #4. Wear approved protective clothing when working around Tank 14 or 15.

2000 gallons

Submitted By EA Weakley, DNI (2-3378)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By [signature] Manager, Shop Operations

Accepted By [signature] Manager, Materials

Completed 12-16-76

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 12-14-76 Permit No. 35-76

Quantity 1000-1500 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Used citric acid and ammoniated citric acid solutions for passivating and neutralizing the 10,000 gallon degreaser solvent storage tank after derusting.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.) Fe & Cl.
About 500 gallons of ½% citric acid solution.
About 500 gallons of ½% citric acid solution adjusted to a pH of 8-9 using NH_4OH.

Disposal Procedures (By QC & E)
The used citric acid and ammoniated citric acid solutions will be pumped directly into the 3000-gallon tank trailer by:

1. Parking the trailer on the east side of the 313 Bldg near the door behind the cleaning line.
2. Installing the hose from the end of the degreaser solvent line to an inlet line on the trailer.
3. Pumping the used solutions and the rinse water into the trailer.
4. Measure the depth of solution in the trailer and obtain a grab sample for analysis before filling the trailer with the normal neutralized chemical waste solution.

1319 gallons

Submitted By EA Weakley, UNI (2-3378)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Shop Operations

Accepted By [signature] Manager, Materials

Completed 2-4-77

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 1-24-77 Permit No. 1-77

Quantity ~~8~~ 6 gallons of hydrogen peroxide solution.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused 35% H_2O_2 solution from sign painting operation. 3713 & 3734-A Bldgs.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
H_2O_2

Disposal Procedures (By QC & E)
The H_2O_2 solution is compatible with our neutralized waste solutions. Slowly pour the H_2O_2 solution into the filter press effluent in Tank 9 or 10 in the 313 Bldg and transfer into the outside storage tank in the 311 Tank Farm. Rinse out empty containers and dispose of containers in waste lugger. Wear approved clothing and eye protection while handling chemicals. EA Weakley, QC & E, should be present during start of disposal operation.

Submitted By EL House, UNI (2-3775)

Approved By [signature]
Manager, Quality Control & Engineering

Approved By ALC [signature] 1/31/77
Manager, Environmental & Radiation Control

Accepted By N.A.
Manager, Shop Operations

Accepted By [signature]
Manager, Materials

CHEMICAL WASTE DISPOSAL PERMIT completed 4-13 77

UNI-3514

Date February 28, 1977 Permit No. 2-77

Quantity 75 pounds of solid and 5 gallon of liquid.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused chemicals in original containers from 308 Building.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
2 1/8 gallon concentrated H_2SO_4; 1 quart concentrated H_3PO_4
2 1/2 gallon concentrated acetic acid; 75 pounds of crystal
$Al(NO_3)_3 \cdot 9H_2O$.

Disposal Procedures (By QC & E)
The H_2SO_4 can be used in regenerating the deionizer or in the Chem Mill Tank and the $Al(NO_3)_3 \cdot 9H_2O$ crystals can be used in Tank 16.

Dispose of the H_3PO_4 by pouring slowly into water or acid solution in Tank 12, 13, 14, 15 or 16 in the 313 Building cleaning line and pump into chemical waste storage tanks in 334-A Building.

Mix the acetic acid with water or filter press effluent in Tank 10 in the 313 Building and transfer into the outside storage tank in the 313 Tank Farm.

Rinse out empty bottles with water and dispose of bottles in waste lugger. Wear approved protective clothing while handling chemicals.

Submitted By W. W. Stevens, HEDL (2-3122)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] 3/8/77 Manager, Environmental & Radiation Control

Accepted By [signature] Manager, Shop Operations

Accepted By [signature] Manager, Materials

5-2-71

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 3-1-77 Permit No. 3-77

Quantity 400 pounds

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused $NH_4F \cdot HF$ crystals. The shipping bags have deteriorated until it is unsafe to excess the material.

Major Pollutants (Heavy Metals, Be, U, Cations, Anions, etc.)
$NH_4F \cdot HF$

Disposal Procedures (By QC & E)
Dissolve the $NH_4F \cdot HF$ crystals in water in Tank 15 or 16 in the 313 Bldg cleaning line. Pump directly to the neutralizer -- DO NOT PUMP TO 334-A Bldg.
PWR B-124 was written to use the 550 pounds of excess $NH_4F \cdot HF$ to clean Zr-2 in the 313 Bldg cleaning line. However, after using 150 pounds, there was so many problems in flushing out the precipitate (NH_4ZrF_5) from the bottom of the tank and in plugging the holes in the air sparger with precipitate that the PWR was discontinued and HF was used again.

Submitted By EA Weakley, UNI (2-3378)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] 3/8/77 Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Plant Operations

Accepted By [signature] Manager, Materials

B-127

CHEMICAL WASTE DISPOSAL PERMIT Completed 4-20-77

UNI-3514

Date March 7, 1977 Permit No. 4-77

Quantity 36 pounds of solids and 1/4 gallons of liquid.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused chemicals from 308 Building.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
See list of chemicals below.

Disposal Procedures (By QC & E) Mix the chemicals listed below with water or filter press effluent in Tank 10 in the 313 Building and transfer into the outside storage tank in the 311 Tank Farm. Rinse out empty bottles with water and dispose of bottles in waste lugger. Wear approved protective clothing while handling chemicals. In addition to the list below, there are 3 pounds of $KMnO_4$, 10 pounds of NaOH and 1 pound of Li_2CO_3 that can be used by Shop Operations, Materials or QC&E.

Solid Material	Pounds	Liquid Material	Gallons
Nickel Chloride, $NiCl_2$	5		
Nickel Sulfate, $NiSO_4$	5		
Sodium Phosphate, $NaPO_3$	1	*Ethylene Glycol, $HOCH_2CH_2OH$	1/8
Sodium Borate, $Na_2B_2O_4$	1	*Diethylene Glycol, $(HOCH_2CH_2)_2O$	1/8
Boric Acid, H_3BO_3	1		
Cupric Sulfate, $CuSO_4$	6	* Can be used in pipe trench anti-freeze	
Lithium Fluoride, LiF	1	solution in 303-F Bldg.	
Aluminum Chloride, $AlCl_3$	1		
Sodium Fluoride, NaF	1		

Submitted By W. W. Stevens, HEDL (2-3122)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] 3/..77 Manager, Environmental & Radiation Control

Accepted By N/A Manager, Shop Ops.

Accepted By [signature] Manager, Mat'l

B-128

UNI-3514

completed 5-9-77

CHEMICAL WASTE DISPOSAL PERMIT

Date March 7, 1977 Permit No. 5-77

Quantity 2 pounds of solids.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused Chemicals From 308 Building.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
1 pound cuprous cyanide, $Cu_2(CN)_2$
1 pound sodium cyanide, NaCN

Disposal Procedures (By QC & E)
To prevent the cyanide salts from becoming acidic, which would release HCN gas, the salts shall be slowly poured directly into the 183-H Evaporation Basin while a load of neutralized waste is being added. (Caution: be sure and not pour into the wind.) Rinse out bottles with water, return empty bottles to 300 Area and dispose of bottles in waste lugger. Wear protective clothing, rubber gloves, acid goggles and face shield while dumping and rinsing out bottles. A second person shall be in attendance during the disposal operation at 183-H.

Submitted By W. W. Stevens, HEDL (2-3122)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] 3/17/77 Manager, Environmental & Radiation Control

Accepted By N/A Manager, Shop Operations

Accepted By [signature] 3/31/77 Manager, Materials

UNI-3514 4-20-77

CHEMICAL WASTE DISPOSAL PERMIT Completed

Date March 9, 1977 Permit No. 6-77

Quantity 43 1/2 pounds of solids

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused chemicals from 3720 Building

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
See list of chemicals below.

Disposal Procedures (By QC & E) Mix the chemicals listed below with water or filter press effluent in Tank 10 in the 313 Building and transfer into the outside storage tank in the 311 Tank Farm. Rinse out empty bottles with water and dispose of bottles in waste lugger. Wear approved protective clothing with handling chemicals. In addition to the list below, there are 4 pounds of $KMnO_4$ that can be used by Shop Operations.

Solid Material	Pounds
Ammonium Fluoride, NH_4F	4
Sodium Fluoride, NaF	2 1/2
Sodium Chromate, Na_2CrO_4	4
Ammonium Citrate, $(NH_4)_3C_6H_5O_7$	3
Oxalic Acid, HO_2CCO_2H	12
Citric Acid, $HOC(CH_2CO_2H)_2CO_2H$	6
Barium Perchlorate, $Ba(ClO_4)_2$	4
Ammonium Ceric Sulfate, $(NH_4)_4Ce(SO_4)_4$	4

Submitted By F.T. Hara, BNW (2-3186)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] 3/15/77 Manager, Environmental & Radiation Control

Accepted By N.A.

Accepted By [signature]

9013294.1535

PNL-3514

CHEMICAL WASTE DISPOSAL PERMIT

Completed 5-9-77

Date 3-9-77 Permit No. 7-77

Quantity 1/2 pound solids

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused chemical from 3720 Building

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
1/2 pound potassium cyanide, KCN

Disposal Procedures (By QC & E)
To prevent the cyanide salt from becoming acidic, which would release HCN gas, the salt shall be slowly poured directly into the 183-H Evaporation Basin while a load of neutralized waste is being added. (Caution: be sure and not pour into the wind.) Rinse out bottle with water, return empty bottle to 300 Area and dispose of bottle in waste lugger. Wear protective clothing, rubber gloves, acid goggles and face shield while dumping and rinsing out bottle. A second person shall be in attendance during the disposal operation at 183-H.

Submitted By F.T. Hara, BNW (2-3186)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] 3/17/77 Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Shop Operations

Accepted By [signature] 3/21/77 Manager, Materials

Completed 4-13-77

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 3-9-77 Permit No. 8-77

Quantity 6 pounds of solids

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unused chemicals from 3720 Building

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
6 pounds of chromic acid, CrO_3

Disposal Procedures (By QC & E)
Dispose of the CrO_3 by pouring slowly into water or acid solution in Tank 12, 13, 14, 15 or 16 in the 313 Building cleaning line and pump into chemical waste storage tanks in 334-A Building. Rinse out empty bottles with water and dispose of bottles in waste lugger. Wear protective clothing while handling chemicals.

Submitted By F.T. Hara, BNW (2-3186)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] 3/15/77 Manager, Environmental & Radiation Control

Accepted By [signature] Manager, Shop Operations

Accepted By [signature] Manager, Materials

4-19-77

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 4-13-77 Permit No. -77

Quantity 7 pounds of solids

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Unused chemicals from 3720 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

See list of chemicals below

Disposal Procedures (By QC & E) Mix the chemicals listed below with water or filter press effluent in Tank 10 in the 313 Building and transfer into the outside storage tank in the 311 Tank Farm. Rinse out empty bottles with water and dispose of bottles in waste lugger. Wear approved protective clothing when handling chemicals.

Solid Material	Pounds
Potassium Nitrate, KNO_3	2
Potassium Dichromate, $K_2Cr_2O_7$	2
Sodium Dichromate, $Na_2Cr_2O_7$	
Sodium Citrate, $Na_3C_6H_5O_7$	
Sodium Acetate, $NaC_2H_3O_2$	

Submitted By F. T. Hara, BNW, 2-3-86

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiation Control

Accepted By N A Manager, Shop Operations

Accepted By [signature] Manager, Materials

completed 3 10 78

CHEMICAL WASTE DISPOSAL PERMIT

UNI-3514

Date 5-23-77 Permit No. 13-77

Quantity 450 gallons of liquid.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Concentrated H_2SO_4 solution used for acid digestion development studies in the 324 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

70% H_2SO_4. 300 ppm Al, 100 ppm Cr, 500 ppm Mo, 500 ppm Ni, 300 ppm Zn, 10 ppm Pb, 50 ppm Mn & 30 ppm Cu.

Disposal Procedures (By QC & E)

Pump waste acid slowly into Tank 15 or 16 in the 313 Bldg. cleaning line. Pump directly to the neutralizer -- DO NOT PUMP TO 334-A Bldg. Rinse out drums and jugs and transfer rinse water to chemical waste system. Return drums and jugs to HEDL.

+50 gallons of waste [illegible]

Submitted By RG Cowan, HEDL (2-5215)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] 5/25/ Manager, Environmental & Radiation Control

Accepted By N.A. Manager, Shop Operations

Accepted By [signature] Manager, Materials

9413294.1539

13-177

UNI-3514

SPECTROCHEMICAL ANALYSIS REPORT

DOUGLAS UNITED NUCLEAR, INC.
SPECTROCHEMICAL LABORATORY
BUILDING 3720

CC: SPEC. LAB. 01481

MATERIAL: Sulfuric Acid Waste from HEDL

SUBMITTER'S NO.:

SUBMITTED BY: E. A. Werkley

ANALYZED BY: G. Gan

DATE REPORTED: 5-18-77

ELEMENT		ELEMENT		ELEMENT	
Ag	.00002	In	—	Sr	—
Al	.03	K	?	Ta	—
As	—	La	?	Te	—
Au	—	Li	—	Th	—
B	—	Mg	.001	Ti	.0003
Ba	.001	Mn	.005	Tl	—
Be	—	Mo	.05	U	—
Bi	—	Na	.001	V	.0005
Ca	.003	Nb	—	W	—
Cd	—	Ni	.05	Zn	.03
Ce	.0005	P	—	Zr	—
Cr	.01	Pb	.001		
Cu	.003	Pd			
Fe	.03	Pt			
Ga	—	Sb			
Hf	—	Si	.005		
Hg	—	Sn	.00003		

TYPE OF ANALYSIS

☒ ~~SEMI-QUANTITATIVE~~ Qualitative ☐ QUANTITATIVE

QUALITATIVE SYMBOL	MEANING	APP'X. CONC.	SYMBOL	MEANING	SYMBOL	MEANING
VS	MAJOR DETECTABLE CONSTITUENT		G	CONCENTRATION GREATER THAN	GE (LE)	CONC. GREATER THAN (LESS THAN) CALIBRATED WORKING CURVE
S	STRONG		L	DETECTABLE CONCENTRATION LESS THAN		
M	MODERATE		—	NOT DETECTED		
T	TRACE					
—	NOT DETECTED					
•	INTERFERENCE					
?	DETECTION UNCERTAIN, INTERFERENCE					

NUMERICAL VALUES: ☐ PARTS PER MILLION ☒ PERCENT ☐ _____

APPR'X. PRECISION ± FACTOR 10

NUMERICAL VALUES: ☐ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± _____

REMARKS: Residue upon evaporation to dryness is 2.5% by weight

The hydrogen ion concentration of the sample is 23 N. This would be equivalent to a 70% sulfuric acid solution.

REPORT APPROVED: B Hu

LABORATORY INFORMATION

SPECTROGRAPH AND SOURCE	SIZE OF SAMPLE	METHOD OF ANALYSIS	PLATE NO.
Jarrett & Varisource	10 mg of dried residue	DC Arc	00162

CHEMICAL WASTE DISPOSAL PERMIT

Complete 6-27-77

UNI-3514

Date 6-13-77 Permit No. 14-77

Quantity 20 gallons of solution

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unneeded nickel sulfate solution, 62 g/l (0.52 lb/gal), in LSL-2 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
$NiSO_4$

Disposal Procedures (By QC & E)
Mix the $NiSO_4$ solution with water or filter press effluent in Tank 9 or 10 in the 313 Bldg. and transfer into the outside storage tank in the 311 Tank Farm. Rinse containers and transfer rinse water to Tank 9 or 10. Dispose of containers as indicated by BNW.

Submitted By TJ McLaughlin, BNW (86-2737)

Approved By [signature]
Manager, Quality Control & Engineering

Approved By [signature] for
Manager, Environmental & Radiological Control

Accepted By N.A.
Manager, Shop Operations

Accepted By [signature]
Manager, Materials

CHEMICAL WASTE DISPOSAL PERMIT

Completed 7-25-78

UNI-3514

Date 9-13-77 Permit No. 16-77

Quantity 1257 pounds of solid and 39 gallons of liquid.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Chemicals stored in 1717-K. See list below.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
Spectrochemical analysis of the 2 proprietary chemicals showed no heavy metals (only Al, Mg and Fe in small amounts).

Disposal Procedures (By QC & E) Mix Items 1, 2 & 3 (below) with water or filter press effluent in Tank 9 or 10 in the 313 Bldg and transfer into the outside storage tank in the 311 Tank Farm. Item 4 is used by Materials for derusting steel reactor spacers; so save as many of the 1 Kg jars as needed and dispose of the remainder by dissolving with water or filter press effluent in Tank 9 or 10 or dump directly into the 100-H Solar Basin. Mix Item 5 with water or filter press effluent in Tank 9 or 10 (but not at the same time as Item 3). Items 6 & 7 should be dumped directly into the 100-H Solar Basin since they are not water soluble.

Item	Material	Amount
1	Alkaline Rust Remover	440 pounds of solid
2	Wyandotte 5061	440 " " " ($NaHSO_4$)
3	Ammonium Persulfate, $(NH_4)_2S_2O_8$	220 " " "
4	1,3 diethyl-2-thiourea	79 " " "
5	Ethylenediamine	39 gallons of liquid
6	Nickel Oxide	12 pounds of solid
7	Mixed Ni, Cu & Fe Oxides	66 " " "

Submitted By ND Stice, BNW (2-1336)

Approved By [signature]
Manager, Quality Control & Engineering

Approved By [signature]
Manager, Environmental & Radiological Control

Accepted By N.A.
Manager, Shop Operations

Accepted By [signature]
Manager, Materials

Material Description	Quantity	Type Container
Ammonium Persulfate	100 Kg	1 - 250# Paper Drum
1-3 Diethyl - 2-thiourea (Pract Grd.)	36 Kg	36 - 1 Kg Jars 4 jars/cse
Wyandotte 5061 (sodium bisulfate)	200 Kg	1 - Paper Drum
Alkaline Rust Remover	200 Kg	1 - 55 gal Steel Drum
Ethyeleninediamine (Liquid)	100 Kg	3 - Kg Bottles 4 each per cardboard case
Metal Oxides Powders (Pure)		
Cuppric Oxide (Black)	2.7 Kg	1 - Paper Drum
Cupprous Oxide (Red)	4.5 Kg	1 - Paper Drum
Ferric Oxide (Red)	4.5 Kg	1 - Paper Drum
Ferric Ferrous Oxide (Black)	36.3 Kg	1 - Paper Drum
Nickel Oxide	5.4 Kg	1 - Paper Drum
Mixed Metal Oxides		
Cuppric, Cupprous, Ferric/Ferrous, Nickel — used dry powder	30 Kg	1 - Paper Drum

9413294.1543

Lab # 02588

SPECTROCHEMICAL ANALYSIS REPORT

DOUGLAS UNITED NUCLEAR, INC.
SPECTROCHEMICAL LABORATORY
BUILDING 3720

CC: SPEC. LAB.

MATERIAL: A R Stripper

SUBMITTER'S NO.

SUBMITTED BY: McN Dowell BNW

ANALYZED BY: G. G.

DATE REPORTED: 8-16-77

ELEMENT		ELEMENT		ELEMENT	
Ag		In		Sr	
Al		K		Ta	
As		La		Tr	
Au		Li		Th	
B		Mg	10	Ti	
Ba		Mn		Tl	
Be		Mo		U	
Bi		Na	100	V	
Ca		Nb		W	
Cd		Ni		Zn	
Co		P		Zr	
Cr		Pb			
Cu		Pd			
Fe		Pt			
Ga		Sb			
Hf		Si	5		
Hg		Sn			

TYPE OF ANALYSIS

☒ QUALITATIVE

SYMBOL	MEANING	APP'X. CONC.
VS	MAJOR DETECTABLE CONSTITUENT	
S	STRONG	
M	MODERATE	
T	TRACE	
—	NOT DETECTED	
*	INTERFERENCE	
?	DETECTION UNCERTAIN, INTERFERENCE	

☒ ~~SEMIQUANTITATIVE~~ QUALITATIVE ☐ QUANTITATIVE

SYMBOL	MEANING
a	CONCENTRATION GREATER THAN
b	DETECTABLE CONCENTRATION LESS THAN
—	NOT DETECTED

NUMERICAL VALUES: ☒ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± FACTOR 10

SYMBOL	MEANING
GE (LE)	CONC. GREATER THAN (LESS THAN) CALIBRATED WORKING CURVE

NUMERICAL VALUES: ☐ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± _____

REMARKS:

REPORT APPROVED

LABORATORY INFORMATION

SPECTROGRAPH AND SOURCE	SIZE OF SAMPLE	METHOD OF ANALYSIS	PLATE NO.
Ebert + Varisource	10 mg	dc-arc	00180

Lab Sp# 02589

SPECTROCHEMICAL ANALYSIS REPORT

DOUGLAS UNITED NUCLEAR, INC.
SPECTROCHEMICAL LABORATORY
BUILDING 3720

CC: SPEC. LAB.

MATERIAL: Wyandotte 5061
SUBMITTER'S NO.:
SUBMITTED BY: McDonald BNW
ANALYZED BY: G. G.
DATE REPORTED: 8-16-77

ELEMENT		ELEMENT		ELEMENT	
Ag		In		Sr	
Al	20	K		Ta	
As		La		Te	
Au		Li		Th	
B		Mg	20	Ti	
Be		Mn		Tl	
Bi		Mo		U	
Bi		Na	> 100,000	V	
Ca	2000	Nb		W	
Cd		Ni		Zn	
Co		P		Zr	
Cr		Pb			
Cu		Pd			
Fe	500	Pt			
Ga		Sb			
Hf		Si	5		
Hg		Sn			

TYPE OF ANALYSIS

☒ QUALITATIVE — Qualitative ☐ QUANTITATIVE

SYMBOL	MEANING	APP'X. CONC.
VS	MAJOR DETECTABLE CONSTITUENT	
S	STRONG	
M	MODERATE	
T	TRACE	
—	NOT DETECTED	
•	INTERFERENCE	
?	DETECTION UNCERTAIN, INTERFERENCE	

SYMBOL	MEANING
G	CONCENTRATION GREATER THAN
L	DETECTABLE CONCENTRATION LESS THAN
—	NOT DETECTED

NUMERICAL VALUES: ☑ PARTS PER MILLION ☐ PERCENT ☐ _____

APP'X. PRECISION ± FACTOR 10

SYMBOL	MEANING
GX (LX)	CONC. GREATER THAN (LESS THAN) CALIBRATED WORKING CURVE

NUMERICAL VALUES: ☐ PARTS PER MILLION ☐ PERCENT ☐ _____

APP'X. PRECISION ± _____

REMARKS:

REPORT APPROVED: F Hu

LABORATORY INFORMATION

SPECTROGRAPH AND SOURCE	SIZE OF SAMPLE	METHOD OF ANALYSIS	PLATE NO.
Ebert & Varsamex	10 mg	dc-arc	00180

A—0300—070 (10-65)

UNI-3514

Completed 7-27-78

CHEMICAL WASTE DISPOSAL PERMIT

Date 9-13-77 Permit No. 16-77

Quantity 400 pounds of solid in 2 55-gallon drums

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Drum dryer product from 202-S Pilot Plant containing aluminum nitrate and sodium nitrate.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Spectrochemical analysis showed the following impurities: 5000 ppm Mg; 3000 ppm Fe; 100 ppm Cu; 10 ppm B & 10 ppm Mn.

Disposal Procedures (By QC & E)

Dissolve the crystals in hot water in Tank 9 or 10 in the 313 Bldg and transfer into the outside storage tank in the 311 Tank Farm.

Submitted By JM Thurman, RHO (2-2416)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] Manager, Environmental & Radiological Control

Accepted By N.A. Manager, Shop Operations

Accepted By [signature] Manager, Materials

Lab # 02590

SPECTROCHEMICAL ANALYSIS REPORT
DOUGLAS UNITED NUCLEAR, INC.
SPECTROCHEMICAL LABORATORY
BUILDING 2730

CC: SPEC. LAB.

MATERIAL: Drum Dryer Product

SUBMITTER'S NO.:

SUBMITTED BY: Mr. E. A. Weakley

ANALYZED BY: G. G.

DATE REPORTED: 8-16-77

ELEMENT		ELEMENT		ELEMENT	
Ag		In		Sr	
Al	30,000	K		Ta	
As		La		Te	
Au		Li		Th	
B	10	Mg	5000	Ti	
Ba		Mn	10	Tl	
Be		Mo		U	
Bi		Na	100,000	V	
Ca	50,000	Nb		W	
Cd		Ni		Zn	
Co		P		Zr	
Cr		Pb			
Cu	100	Pd			
Fe	3,000	Pt			
Ga		Sb			
Hf		Si	20		
Hg		Sn			

TYPE OF ANALYSIS

☑ QUALITATIVE ☑ ~~SEMI-QUANTITATIVE~~ QUALITATIVE ☐ QUANTITATIVE

SYMBOL	MEANING	APP'X. CONC.
VS	MAJOR DETECTABLE CONSTITUENT	
S	STRONG	
M	MODERATE	
T	TRACE	
—	NOT DETECTED	
*	INTERFERENCE	
?	DETECTION UNCERTAIN. INTERFERENCE	

SYMBOL	MEANING
G	CONCENTRATION GREATER THAN
L	DETECTABLE CONCENTRATION LESS THAN
—	NOT DETECTED

NUMERICAL VALUES: ☑ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± FACTOR 10

SYMBOL	MEANING
GE (LE)	CONC. GREATER THAN (LESS THAN) CALIBRATED WORKING CURVE

NUMERICAL VALUES: ☐ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± _____

REMARKS:

REPORT APPROVED: F. Hann

LABORATORY INFORMATION

SPECTROGRAPH AND SOURCE	SIZE OF SAMPLE	METHOD OF ANALYSIS	PLATE NO.
Ebert & Vincaura	11 mg	dc-arc	00180

CHEMICAL WASTE DISPOSAL PERMIT

Completed 1-16-78

UNI-3514

Date 1-6-78 Permit No. 1-78

Quantity 1500 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Clean waste from shake-down tests of acid digestion system in 234-5 Bldg. pH = 12.45.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

$NaNO_3$, $NaSO_4$, NaCl, $NaCO_3$

16 ppm Al; 2 ppm Cr; 10 ppm Fe; 10 ppm Ni

Disposal Procedures (By QC & E)

The empty 3000-gallon tank trailer will be sent to the 234-5 Bldg and the waste solution will be pumped by HEDL personnel into the tank trailer using a hose inserted through one of the top openings. The depth of the tank will be monitored by a measuring stick to assure that the tank trailer is not overloaded.

The loaded waste solution will be transfered and dumped into the 183-H Evaporation Basin.

Submitted By RG Cowan, HEDL (2-5215)

Approved By [signature] Manager, Quality Control & Engineering

Approved By ACC [signature] Manager, Environmental & Radiological Control

Accepted By N.A. Manager, Shop Operations

Accepted By [signature] 1/13/78 Manager, Materials

S.P. 20045

SPECTROCHEMICAL ANALYSIS REPORT

DOUGLAS UNITED NUCLEAR, INC.
SPECTROCHEMICAL LABORATORY
BUILDING 3720

CC: SPEC. LAB.

MATERIAL: Special Waste

SUBMITTER'S NO.:

SUBMITTED BY: Huckley

ANALYZED BY: G. W. Guy

DATE REPORTED: 1-5-78

ELEMENT		ELEMENT		ELEMENT	
Ag		In		Sr	
Al	16	K		Ta	
As		La		Te	
Au		Li		Th	
B		Mg		Ti	
Ba		Mn	<1	Tl	
Be		Mo		U	
Bi		Na	16,000	V	
Ca	10	Nb		W	
Cd		Ni	10	Zn	
Co		P		Zr	
Cr	2	Pb			
Cu		Pd			
Fe	10	Pt			
Ga		Sb			
Hf		Si	10		
Hg		Sn			

TYPE OF ANALYSIS

☑ QUALITATIVE

SYMBOL	MEANING	APP'X. CONC.
VS	MAJOR DETECTABLE CONSTITUENT	
S	STRONG	
M	MODERATE	
T	TRACE	
—	NOT DETECTED	
*	INTERFERENCE	
?	DETECTION UNCERTAIN, INTERFERENCE	

☐ ~~SEMIQUANTITATIVE~~ Qualitative ☐ QUANTITATIVE

SYMBOL	MEANING
G	CONCENTRATION GREATER THAN
L	DETECTABLE CONCENTRATION LESS THAN
—	NOT DETECTED

NUMERICAL VALUES: ☑ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± FACTOR 10

SYMBOL	MEANING
GE (LE)	CONC. GREATER THAN (LESS THAN) CALIBRATED WORKING CURVE

NUMERICAL VALUES: ☐ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± _____

REMARKS: pH 12.45

REPORT APPROVED

LABORATORY INFORMATION

SPECTROGRAPH AND SOURCE	SIZE OF SAMPLE	METHOD OF ANALYSIS	PLATE NO.
Ebert + Varicomic	10 mg	DC-arc	0001

A—[illegible]—079 (12-65)

CHEMICAL WASTE DISPOSAL PERMIT Completed 1-27-78

UNI-3514

Date 1-26-78 Permit No. 2-78

Quantity 1000 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Clean waste from shake-down tests of acid digestion system in 234-5 Bldg.
pH > 10

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
$NaNO_3$, $NaSO_4$, NaCl, $NaCO_3$

Disposal Procedures (By QC & E)
The empty 3000-gallon tank trailer will be sent to the 234-5 Bldg and the waste solution will be pumped by HEDL personnel into the tank trailer using a hose inserted through one of the top openings. The depth of the tank will be monitored by a measuring stick to assure that the tank trailer is not overloaded.

The loaded waste solution will be transfered and dumped into the 183-H Evaporation Basin.

Submitted By RG Cowan HEDL (2-5215)

Approved By [signature] Manager, Quality Control & Engineering

Approved By [signature] 1/26/78 Manager, Environmental & Radiological Control

Accepted By N.A. Manager, Shop Operations

Accepted By [signature] 1/26/78 Manager, Materials

UNI-3514

CHEMICAL WASTE DISPOSAL PERMIT

1- on 3-7-78
2- on 5-23-78
3- on 6-15-78 - Complete
4- on 9-6 full tank

Date 3-7-78 Permit No. 3-78

Quantity 3000 gallons in 3 loads.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Clean waste from shake-down tests of acid digestion system in 234-5 Bldg.
pH > 10

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
$NaNO_3$, $NaSO_4$, NaCl, $NaCO_3$
estimate of 5% $NaNO_3$ of the 3000 gals

Disposal Procedures (By QC & E)
The empty 3000-gallon tank trailer will be sent to the 234-5 Bldg and the waste solution will be pumped by HEDL personnel into the tank trailer using a hose inserted through one of the top openings. The depth of the tank will be monitored by a measuring stick to assure that the tank trailer is not overloaded.

The loaded waste solution will be transfered and dumped into the 183-H Evaporation Basin. Two other loads have been disposed of already as covered by Permit Nos. 1-78 & 2-78.

Submitted By RG Cowan, HEDL (Z-5215)

Approved By [signature] Manager, Quality Control & Engineering

Approved By ALC [signature] Manager, Environmental & Radiological Control

Accepted By N.A. Manager, Shop Operations

Accepted By [signature] Manager, Materials

UNI-3514

Completed 5-25-78

CHEMICAL WASTE DISPOSAL PERMIT

Date May 2, 1978 Permit No. 5-78

Quantity 55 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Unneeded "Cimplus-22," rust prevention material

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
$NaNO_2$

Disposal Procedures (By QC & E)
Mix with water or filter press effluent in Tank 9 or 10 in the 313 bldg. and transfer into the outside storage tank in the 311 tank farm. Rinse out barrel into Tank 9 or 10 and place barrel at barrel pick-up area near 3710-A building.

Submitted By E. A. Weakley - 2-3378

Approved By [signature] Manager, Fuels Engineering

Approved By [signature] 5/5/78 Manager, Environmental & Radiological Control

Accepted By N. A. Manager, Shop Operations

Accepted By [signature] Manager, Materials

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APPENDIX K

SAMPLE CALCULATION - EQUIVALENT CONCENTRATION (E.C.) FOR TOXICITY ANALYSIS

SAMPLE CALCULATION:

EQUIVALENT CONCENTRATION (E.C.)

Per WAC-173-303-084;

$$E.C.(\%) = \sum X\% + \frac{\sum A\%}{10} + \frac{\sum B\%}{100} + \frac{\sum C\%}{1{,}000} + \frac{\sum D\%}{10{,}000}$$

For sample I-2, analyses shows:

Class X constituents: None
Class A constituents: None
Class B constituents: None
Class C constituents: NaF- 11.94%; $Ni(OH)_2$ - 0.03%
Class D constituents: $Ca(OH)_2$ - 0.13%; Na_3PO_4 - 0.53%; $Na_2S_{13}O_7$ - 2.21%

Thus,

$$E.C.(\%) = 0 + \frac{0}{10} + \frac{0}{100} + \frac{11.94 + 0.03}{1{,}000} + \frac{0.13 + 0.53 + 2.21}{10{,}000}$$

E.C. = 0.012%

APPENDIX L

REACTIVITY CRITERIA

CHARACTERISTIC OF REACTIVITY

A solid waste exhibits the characteristic of reactivity if a representative sample of the waste has <u>any</u> of the following properties:

C1. It is normally unstable and readily undergoes violent change without detonating.

C2. It reacts violently with water.

C3. It forms potentially explosive mixtures with water.

C4. When mixed with water, it generates toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment.

C5. It is a cyanide-or sulfide-bearing waste which when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment.

C6. It is capable of detonation or explosive reaction if it is subjected to a stong initiating source or if heated under confinement.

C7. It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.

C8. It is a forbidden explosive as defined in 49 CFR 173.51, or a Class A explosive as defined in 49 CFR 173.53 or a Class B explosive as defined in 49 CFR 173.88.

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APPENDIX M

SAMPLE CALCULATION: Cr VI

E.P. TOXICITY EVALUATION

SAMPLE CALCULATION

EP Toxicity Evaluation:
CrVI Concentration in Composite Filtrate/ Leachate Sample
183-H Basin No. 1

For Sample I-2, if the initial sample size (including solid and liquid phases) was 100 gm, the filtration step would result in:

$$100 \text{ gm sample} \cdot \underbrace{\frac{(1.43 \text{ gms solid})}{(2.43 \text{ gms sample})}}_{\text{measured wt. ratio}} = 58.85 \text{ gms solid}$$

and: 100gm sample - 58.85 gms solid = 41.15 gms filtrate.

Using the measured specific gravity:

$$\frac{41.15 \text{ gms filtrate} \cdot (\text{ml filtrate})}{(1.27 \text{ gms filtrate})} = 32.40 \text{ ml filtrate}$$

According to the E.P. toxicity procedure, the total volume of deionized water and acetic acid to be added for extraction of the solid is 20 times the weight of solids obtained from a 100 gram starting (pre-filtration) sample. In the case of sample I-2:

$$(58.85 \text{ gms solid obtained}) \frac{(20 \text{ ml solution to be added})}{(\text{gm solid obtained})} = 1177 \text{ ml solution}$$

Thus, following filtration of the solid sample, approximately 1177 ml. of leachate would be obtained, which is to be combined with the 32.40 ml of filtrate sample previously collected. Since the basin no. 1 "inner" sample liquids (filtrate and leachate) were analyzed separately for Cr VI, mathematical recombination to calculate the resultant combined concentration is needed:

$$\frac{(X \text{ ml filtrate} \cdot \text{CrVI concentration in filtrate}) + (Y \text{ ml leachate} \cdot \text{CrVI concentration in leachate})}{(\text{Filtrate volume} + \text{Leachate volume})}$$

$$= \text{CrVI content of combined liquids}$$

Thus, for sample I-2:

$$\frac{32.4 \text{ ml } (50 \text{ µg/ml}) + (1177 \text{ ml}) (1.6 \text{ µg/ml})}{32.4 \text{ ml} + 1177. \text{ ml}}$$

$$= 2.90 \text{ µg/ml or } 2.90 \text{ µg/l}$$

APPENDIX N

STATISTICAL ANALYSIS OF

"INNER" BASIN OF VI DATA

STATISTICAL ANALYSIS OF CrVI DATA FOR "INNER" BASIN SAMPLES

In analyzing per the simple random sampling method described in the "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods" document, the sample mean ($\bar{x}$) and standard deviation (s) must first be calculated. Thus:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{2.90 + 3.62 + 3.08 + 2.01 + 1.96}{5} = 2.71$$

Number of Samples

$$s^2 = \frac{\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2 / n}{n-1} = \frac{38.88 - 36.83}{4} = 0.51$$

$$s = \sqrt{s^2} = \sqrt{0.51} = 0.71.$$

Since the value of $\bar{x}$ is greater than that of s^2, the calculations may continue. (If s^2 were greater than or equal to $\bar{x}$, data transformation would be required.) The next step is to calculate the standard error ($s\bar{x}$):

$$s = s/\sqrt{n} = 0.71/\sqrt{5} = 0.32$$

Then, the Confidence Interval (C.I.) for a probability of 0.20 is calculated:

$$C.I. = \bar{x} \pm t_{.20}\, s_{\bar{x}} = 2.71 \pm 1.533\ (0.32)$$

(From Table 2 of "Test Methods for Evaluating Solid Waste - P/C Methods")

Since the upper limit of the C.I. (3.20 mg/L) is less than the regulatory threshold (R.T.) limit of 5.0 mg/L, it is concluded that CrVI is not present in the waste at a hazardous concentration.

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APPENDIX C

183-H SOLAR EVAPORATION BASIN WASTE DESIGNATIONS

NOTE: This appendix (63 pages, labelled C-3 through C-66) is unchanged from prior submittals.

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183-H SOLAR EVAPORATION BASIN WASTE DESIGNATION

1.0 INTRODUCTION

A sampling and analysis plan (see Attachment A) was prepared that described the sampling and analysis methods that would be utilized to generate the data necessary to fully characterize and designate the 183-H Solar Evaporation Basin Wastes in accordance with the Washington Administrative Code (WAC-173-303) Dangerous Waste Regulations. After the Washington Department of Ecology (WDOE) concurred with the sampling and analysis plan, samples were taken from the solar basins and analyzed in accordance with the sampling and analysis plan (see Attachment B for sample Codes, Attachment C for analysis results).

Following waste sampling and analysis, the solar evaporation basin wastes were designated as follows.

2.0 WASTE DESIGNATION

For the purposes of designation, since the quantity of waste in the various sampling strata and each basin is greater than 4,000 lbs., the overall waste designation will be based on the "worst case" designation derived from individual stratum. The liquid wastes in basin number 2 will be designated separately. The current plan for the liquid waste is to dispose of the waste after all of the water has evaporated and the waste has reached a near solid form. As a result, the liquid waste in basin number 2 will be designated in its current form and its final disposal form.

When applicable, the upper limit (UL) of the confidence interval was utilized to determine when regulatory threshold values were exceeded. The UL values were calculated utilizing the statistical techniques described in EPA document SW-846. When "less than" values were the only values available, the highest "less than" value was utilized to represent that particular waste characteristic or constituent concentration. When a mixture of "less than" and quantified values were available, the "less than" values were included in the calculation of the UL values. However, the UL values were reported as "less than" values since these values would be biased high.

2.1 Ignitability

All of the 183-H Solar Evaporation Basin solid wastes contain substantial quantities of nitrates. Per DOT definition, nitrate-bearing materials are oxidizers. Therefore, the 183-H solid wastes would be designated per the WAC-173-303 ignitable criteria. A waste number of D001 will be assigned to all wastes as a result of this criterion. The liquid waste would not be designated per this criterion. However, following evaporation, the liquid waste would be designated per this criterion and assigned a D001 waste number.

2.2 Corrosivity

Based on the pH values, none of the wastes in the solar evaporation basin are designated due to corrosivity.

2.3 Reactivity

Based on the analytical data, the basin wastes are not designated due to reactivity.

2.4 EP Toxicity

Based on the UL values calculated for the individual waste strata (see Attachment D), only the liquid waste in basin number 2 would be designated due to EP toxicity. The chromium UL concentration value indicated that the liquid waste would be EP toxic for chromium. After evaporation, the EP toxicity test consists of an acetic acid leach of the solid material. Because of dilution factors, this test method will cause a reduction in the EP toxicity chromium values. Therefore, following evaporation, this waste will not be designated EP toxic. The following example illustrates the calculations utilized to estimate the EP toxicity chromium values for the liquid waste following evaporation:

$$\text{EP Tox Value} = \frac{C}{(1-W)20}$$

Where: C = Upper Limit Chromium Value for the liquid waste (see ICP results in Appendix C)

W = The average fraction of water in the liquid waste

20 = Weight Ratio of solid material to leachate utilized in the EP toxicity test

Substituting the liquid waste data values:

Chromium EP Tox Value for evaporated liquid waste $\frac{21.6}{(1-.57)(20)} = 2.51$ ppm

2.5 Toxicity

Based on the analytical data, and making some presumptions concerning the form of the ions (i.e., $Cu(NO_3)_2$, $CuSO_4$, NaF, etc.), all of the basin wastes would be designated due to toxicity. Given the large quantities of copper, it seems likely that the wastes would exhibit the properties of EHW toxic wastes. Therefore, a waste designation number of WT01 will be assigned to all wastes as a result of this criterion.

2.6 Persistance

The WDOE extractive residue results clearly indicate that the liquid wastes would not be designated due to this characteristic. Because a few of the WDOE extraction residue results for the basin number 3 and 4 sludge samples were greater than 0.10%, halogenated hydrocarbon analyses were performed on these samples. The results of the halogenated hydrocarbon analyses clearly indicate that the basin sludge would not be designated due to this characteristic. Therefore, none of the basin wastes are designated per this characteristic.

2.7 Carcinogenicity

Based on the analytical data, the basin wastes are not designated due to carcinogenicity.

3.0 CONCLUSION

The 183-H Solar Basin wastes will be assigned the following waste designation numbers:

Basin Number 3 and 4 (Sludge and White Crystalline Material)

D001 - Ignitability
WT01 - EHW, Toxic

Basin Number 2 - Liquid

D007 - EP Toxic, Chromium
WT01 - EHW, Toxic

Basin Number 2 - Liquid (Following Evaporation)

D001 - Ignitability
WT01 - EHW, Toxic

Attachment A

183-H Solar Evaporation Basin Sampling and Analysis Plan

1.0 Introduction

1.1 Purpose

The purpose of this plan is to describe the sampling and analysis methods which will be utilized to generate that data necessary to fully characterize the physical and chemical properties of the wastes currently located at the 183-H Solar Evaporation Facility. Following characterization, the data will be utilized to designate the waste in accordance with the Washington Administrative Code (WAC-173-303) Dangerous Waste Regulations.

1.2 Scope

This plan will fully describe the design basis of the sampling plan, sample collection methods, chain of custody requirements, analytical requirements, and the quality assurance/control requirements.

2.0 Waste Description

2.1 History

The four basins that comprise the 183-H Solar Evaporation Basin are the remaining portion of the 183-H Filter Plant Building. The head house, chemical building, pump room and flocculation equipment have all been removed, leaving the clearwells and the remaining four subsidence basins. These four basins were converted to solar evaporation basins for disposal of liquid wastes from the 300 Area Fuels Operations(see figure 3).

In 1973, UNC began dumping waste solutions from the fuel fabrication process into basin #1 at the 183-H facility. These solutions consisted of spent acids (HNO_3, H_2SO_4, HF, H_2CrO_4) containing copper, zirconium, manganese, and uranium, which had been over neutralized with NaOH. Over neutralization of the waste formed a two phase waste. The liquid phase consisted primarily of water and Na^+, NO_3^-, and $SO_4^=$ ions. The solid phase consisted primarily of water and Na^+, Cu^{++}, F^-, NO_3^-, and $SO_4^=$ ions.

In 1978, basins #2 and #3 were sealed with a polyurethane coating and began to receive fuel fabrication wastes. Use of basin #1 for waste disposal was halted.

In 1982, basin #4 was sealed with a butyl-hypalon coating and began to receive fuel fabrication wastes.

In 1985, UNC halted all shipments of waste to the 183-H facility and removed all of the solid wastes from basin #1.

In 1986, UNC pumped the liquid in basin #2 into basins #3 and #4 and removed all of the solid wastes in basin #2. Following removal of the solid wastes, basin #2 was lined with a hypalon liner and all of the liquid present in basins #3 and #4 was pumped into basin #2.

2.2 Current Status

At this time, liquid still present in basins #3 and #4 is being pumped into basin #2. All of the liquid pumped into basin #2 was pumped through a 75 micron filter to insure that no solid phase wastes are present in basin #2. The solid phase wastes remaining in basins #3 and #4 consists primarily of a black sludge material and a solid white crystalline material (see figures 1 and 2). The white crystalline material is believed to consist mostly of sodium sulfate salt which has precipitated from the liquid waste as evaporation caused the liquid to become supersaturated. The black sludge material consists primarily of copper oxide and sodium sulfate and sodium nitrate salts. UNC has assumed the sludge in basins #3 and #4 to have the characteristic of Extremely Hazardous Waste (EHW) due to toxicity.

3.0 Sampling Plan

3.1 Design

A. Basin #2

The waste in basin #2 consists entirely of liquid phase waste. The waste has been transferred on a couple of occasions between basins. As a result, the liquid should be fairly homogeneous. Because of this homogeneity, only a minimum number of samples is considered to be necessary. The basin was partitioned to yield 40 grid intersection points. A random number table was then utilized to select five grid intersection points from which samples will be taken (see figure 3).

B. Basin #3 and #4

The wastes in basins #3 and #4 consists of solid phase wastes. Two obvious waste strata exist. A white crystalline stratum exists around the walls and around miscellaneous debris which has fallen into the basins (i.e., tumbleweeds). For unknown reasons, basin #4 contains more white crystalline material than basin #3 (see figures 1 & 2). The other stratum is a black sludge material with a fairly high liquid content. The black sludge material is distributed between hard crystalline salt layers. It is believed that this hard salt layer is similar in composition to the highly visible white crystalline stratum mentioned above. Because the waste was discharged into the basins in batches it is assumed that these strata are themselves vertically stratified. In addition, it is assumed that some plume effects must be present at the waste fill locations (see figure 3).

Because of the stratification mentioned above, it is extremely difficult to design an appropriate sampling plan for these wastes. Although vertical stratification of the waste exists, it is impossible to define sampling strata based on depth because of the uneven depth distribution of the sludge. Visual identification of different strata is virtually impossible because the black sludge tends to obliterate all other strata with its intense black color. In addition to these difficulties, plume effects are impossible to identify because the basin fill locations were moved (see figure 3).

Given the above sampling design problems, it was decided that several compromises and assumptions would have to be made. The wastes were assumed to be distributed in only two strata (white crystalline and black sludge). Plume effects and vertical stratification effects would be minimized if fairly large samples were taken.

Based on the above, each basin was partitioned to yield 40 grid intersection points in each basin (see figure 3). An initial sampling point was selected for each basin from a random number table. The other sampling locations were selected by systematically proceeding to every fourth grid intersection point. In this manner, a total of ten sampling points were identified for each basin.

From historical data it is known that any halogenated hydrocarbons or volatile organics, if present in the basin waste, will be present at very low levels. Since low concentrations of halogenated hydrocarbons or volatile organics would remain in solution, it is assumed that these materials would be uniformly distributed throughout the basin by the liquid phase wastes and would only be present in the high liquid content black sludge stratum. As a result, only 5 sampling points for each basin from the above mentioned 10 were randomly selected for persistance testing (see figure 3).

Based on previous characterization data ten samples should yield a standard error of between 7 to 16 percent of the mean. This was considered adequate. The analytical lab will prepare composite samples by combining samples from the individual basins and the same stratum in pairs of two in equal proportions by weight. Although reducing the number of samples analyzed, the variabilities between samples will also be reduced. Because of this reduction in variability between samples, it is expected that combining samples will not affect the magnitude of the standard errors mentioned above.

3.2 Sample Collection

A. Sampling Equipment

1- 2L Glass Beaker
1- 2L Stainless Steel Beaker

2- Polycarbonate Sludge Samplers/Coliwasas
1- 12 inch diameter by 4 foot long steel or PVC pipe
1- 12 inch diameter by 2 foot long steel or PVC pipe
- Misc. shovels, scoops, etc.
1- Steel rod with point marked at 4 inch intervals for measuring depth
2- 5 gallon polyethylene buckets
1- Concrete Mixer
40-1L wide mouth amber glass bottles with teflon lined lids.
5- 1L narrow mouth amber glass bottles with teflon lined lids.
30-40 ml amber glass vials with teflon lined lids.
1- Sample logbook
1- Hammer and chisel
1- Glass funnel
1- 8 inch gas auger

B. Preparatory Work

In order do facilitate sludge sampling, distribute the black sludge material in basins #3 and #4 where obvious mounds of material exists (i.e. mound of material formed when liquid was transferred from basin number 2) so that the sludge is no deeper than 3.5 feet. This will make the sludge sampling easier and will decrease the non-homogeneity of the sludge strata.

Pump the free standing liquid in basins #3 and #4 into basin #2. The liquid in basins #3 and #4 might differ slightly in composition from the liquid in basin #2 due to dilution by rainwater,etc. Therefore, all liquid transfers to basin #2 should be completed approximately 1 week prior to sampling so that natural convection, etc. will have plenty of time to homogenize the liquid in basin #2.

Sandblast the inside of the cement mixer to remove all paint and concrete residue. Thoroughly scrub and rinse the inside of the mixer with soap and water.

Thoroughly scrub and rinse all sampling tools (shovels,scoops,etc.) with soap and water.

Measure the depth of the liquid in basin #2 and profile the depth and thickness of the strata in basins 3 and 4, and record the results in the sample logbook.

C. Liquid Sampling

Using a coliwasa, obtain a full column of liquid waste from one of the sampling points depicted in figure 3 for basin #2.

Transfer the liquid from the coliwasa to a 2 liter glass beaker in such a manner that the number of air bubbles that pass through the sample is minimized.

Fill 2-40 ml amber vials from the 2L beaker in such a manner that the number of air bubbles that pass through the sample is minimized. Seal the vials so that no air bubbles are entrapped.

Fill a 1L narrow mouth amber bottle with the liquid remaining in the 2L glass beaker. Seal the bottle.

Place the appropriate chain of custody seals and labels (see attachment 1) on the bottles. Record the sample no., collector, date and time sampled, and any appropriate field information on the sample labels and seals.

Record the above and any other pertinent information in the sample logbook.

Seal the sample bottles in plastic bags and place the 40 ml vials on ice in a cooler.

Thoroughly rinse the coliwasa with tap water. The rinse water shall be collected and discharged into basin no. 2.

Repeat the above steps for all sampling locations in basin #2. After sampling is completed, thoroughly rinse all sampling tools with tap water. All tap water used for the rinsing should be discharged into basin #2.

D. Solid Samples

1.0 White crystalline material.

Using a hammer, chisel, or other appropriate tools, obtain a sample of the white crystalline waste from a point nearest one of the sampling points depicted in figure 3 for basins #3 and #4. Place the sample in a wide mouth 1L amber glass bottle (sample should nearly fill the bottle) and seal the lid. Record the exact sampling location in the sample logbook.

2.0 Sludge material-sample method #1.

Insert a 12 inch diameter pipe of appropriate length into the black sludge material at the sampling point. Insert the pipe all of the way to the bottom of the sludge (the pipe will act as a cofferdam, preventing material/liquid from flowing into the sampling area as sample material is removed).

If a sample for persistence testing is required at that sampling point, insert a polycarbonate sludge sampler into the middle of the 12 inch pipe and as deep into the sludge as possible. Remove the sludge sampler and deposit the sample of black sludge into a 2L stainless steel beaker in such a manner that the number of air bubbles that pass through the sample is minimized. Transfer the sample from the stainless

steel beaker into 2-40 ml amber glass vials in such a manner that the number of air bubbles that pass through the sample is minimized. Fill the bottle as full as possible in an attempt to eliminate all entrapped air bubbles. Seal the vials. Note: Use caution when sealing the vials to insure that no solid material is between the seal and the glass vials.

Pour any sludge remaining in the 2L beaker into a 5 gallon polyethylene bucket.

Using shovels, scoops, etc., transfer all material trapped inside the 12 inch pipe into 5 gallon polyethylene buckets. Any large crystalline or other solid material should be transferred into the 2L stainless beaker and crushed with a steel rod and then returned to the 5 gallon buckets. It is easier to crush any large chunks of material at this time rather than attempt to do after the sample is transferred to the cement mixer. All solid chunks of material must be crushed so that the sample can be completely homogenized.

Transfer all material contained in the 5 gallon buckets to the cement mixer and mix. Any remaining large chunks of crystalline or other solid material should be crushed with a steel rod at this point during the mixing process.

After the sample is thoroughly mixed, transfer approximately 1L of the sample to a 1L wide mouth amber glass bottle and seal the lid on the bottle. Return the remaining sludge to the basin.

Rinse out the inside of the cement mixer with tap water. Dispose of the rinse water into an area of the basin that has already been sampled. (Note: Although it is necessary to thoroughly rinse the cement mixer between processing of samples, care should be taken to avoid using excessive amounts of water since such action generates additional basin waste for disposal.)

Rinse all sampling tools (pipe, scoops, shovels, etc.) with tap water.

3.0 Sludge material-sample method #2

As an alternate sludge sampling technique, the following method may be used in lieu of sample method #1.

Insert a 12 inch diameter pipe of appropriate length into the black sludge material at the sampling point. Insert the pipe as far into the sludge material as possible. Insert an 8-inch gas powered auger into the 12-inch pipe. Use the auger to break up any hard packed sludge that is preventing the 12 inch pipe from being inserted all of the way to the

bottom of the sludge. After the pipe has been fully inserted, continue to operate the auger until all of the hard packed/solid material has been completely broken up and thoroughly mixed into the rest of the sludge (the pipe will act as a cofferdam, preventing material/liquid from flowing into the sampling area as hard packed/solid material is broken up and the sample is being mixed). Remove the auger from the sludge.

If a sample for persistence testing is required at the sampling point, insert a polycarbonate sludge sampler into the middle of the 12 inch pipe to the bottom of the sludge. Remove the sludge sampler and deposit the sample of black sludge into a 2L stainless steel beaker in such a manner that the number of air bubbles that pass through the sample is minimized. Transfer the sample from the stainless steel beaker into 2-40 ml amber glass vials in such a manner that the number of air bubbles that pass through the sample is minimized. Fill the bottle as full as possible in an attempt to eliminate all entrapped air bubbles. Seal the vials. Note: Use caution when sealing the vials to insure that no solid material is between the seal and the glass vials.

Insert a polycarbonate sludge sampler into the middle of the 12 inch pipe to the bottom of the sludge. Remove the sludge sampler and deposit the sample of sludge into a 2L stainless steel beaker. Repeat the above until approximately 1L of sludge is collected in the 2L stainless steel beaker. Transfer the sample into a 1L wide mouth amber glass bottle and seal the lid on the bottle. Return any sludge remaining in the beaker to the basin.

Rinse all sampling tools (pipe,beaker,auger,etc.) with tap water.

4.0 Miscellaneous requirements

Place the appropriate chain of custody seals and labels (see attachment 1) on the bottles as the sample bottles are filled. Record the sample no., collector, date and time sampled and any appropriate field information (i.e. sample depth) on the sample labels and seals.

Record the above and any other pertinent information in the sample logbook.

Seal the sample bottles in plastic bags and place the 40 ml vials on ice in a cooler.

Repeat the sampling techniques specified in sections 1.0 through 4.0, as applicable, for all sample points in basins #3 and #4.

After sampling in both basins is completed, thoroughly rinse all sampling tools and other equipment with tap water. All the tap water used for rinsing should be discharged into either basin #3 or basin #4.

E. Chain of Custody/Sampling Analysis Request

When all samples have been collected and correctly labeled and sealed, complete the chain of custody record forms for each sample (see attachment 2). Package all samples into shipping containers as per the applicable DOT requirements (note: 40 ml vials must be kept on ice until received by the testing lab). Fill out the analysis request form for all samples (see attachment 3). Transport all samples to the testing laboratory.

4.0 Sample Analyses

4.1 Laboratory Qualification

All analyses shall be performed by a laboratory experienced in hazardous waste testing utilizing EPA document SW-846 methods.

4.2 QA/QC Requirements

The laboratory providing the analytical services shall comply with all QA/QC requirements specified in EPA document SW-846, including analysis of duplicate and spike samples. A copy of the laboratory QA/QC plan shall be submitted to UNC prior to beginning any hazardous waste analytical work. This plan will be incorporated into the hazardous waste report, which will be prepared by Hanford Decommissioning following receipt of the analytical results.

4.3 Laboratory Combining of Samples

The laboratory shall homogenize and prepare composite samples by combining 1 liter sample pairs in equal weight proportions (see Section 3.1) prior to performing the analyses specified in section 4.4. Analyses shall be performed on these composite samples. UNC will specify, on the sample analysis forms, which samples are to be combined.

4.4 Inorganic Analyses

The inorganic analyses to be provided for the waste samples provided in 1 liter glass containers shall be as specified below. These analyses shall be performed for each of the 25 waste samples. Prior to beginning any test, the laboratory shall provide UNC with anticipated detection limits for the test to be performed.

A. General chemical analyses:

1. Metals via Inductively Coupled Plasma Atomic Emission (ICP) per EPAA document SW-846 Method 6010 for the following constituents (minimum): Ag, Al, As, Ba, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Se, Sn, Zn, and Zr

2. Anions via Ion Chromatography (IC) for the following ions: F, Cl, PO_4, NO_2, NO_3, and SO_4

3. % H_2O

B. Corrosivity testing:

1. pH analysis of aqueous phase of samples in accordance with the Washington Department of Ecology document "Chemical Testing Methods for Complying with the State of Washington Dangerous Waste Regulation" (henceforth referred to as WDOE 83-13).

2. pH analysis of solid phase of sample in accordance with WDOE 83-13

C. Reactivity testing: Testing shall be provided to determine reaction of the wasts with water or dilute acid or alkali solutions.

D. EP toxicity analysis for 8 heavy metals: Extracts shall be prepared in accordance with the SW-846 method for EP toxicity, and the extracts analyzed for the following metals: Ag, As, Ba, Cd, Cr, Hg, Pb, Se. All extract analyses shall be per methods specified in the SW-846 document for EP toxicity evaluations. Detection limits for the methods used shall be 1/100th the RCRA designation limit for the 8 metals of concern, or better. Inasmuch as herbicides and pesticides were not discharged into the basins, analyses for the 6 organic materials listed in the EP toxicity test will not be pursued.

E. Radiological analyses:

1. Uranium

4.5 Organic Analyses

The analyses specified below shall be provided for each of the 15 waste samples provided in containers identified for organic analyses:

1. Total Organic Carbon (TOC) per SW-846 Method 9060.

2. Persistance testing: Persistance test extracts shall be prepared in accordance with the procedure specified in WDOE 83-13. Analyses of extracts shall be as follows:

a. Polycyclic Aromatic Hydrocarbon (PAH) testing in accordance with WDOE 83-13 if the extract indicates a PAH content greater than 1% of the crude sample. If < 1%, further PAH analysis will not be required.

b. Halogenated Hydrocarbon (HH) testing in accordance with WDOE 83-13.

4.6 Submittal of Results

Analytical result reports shall include the following, at a minimum:

A. A list of results with constituent or parameter of concern, sample number, reporting units, and detection limits clearly identified.

B. For each type of analysis (e.g., ICP, IC, EP toxicity, etc.) a signed statement certifying that the test was conducted in accordance with the procedure specified.

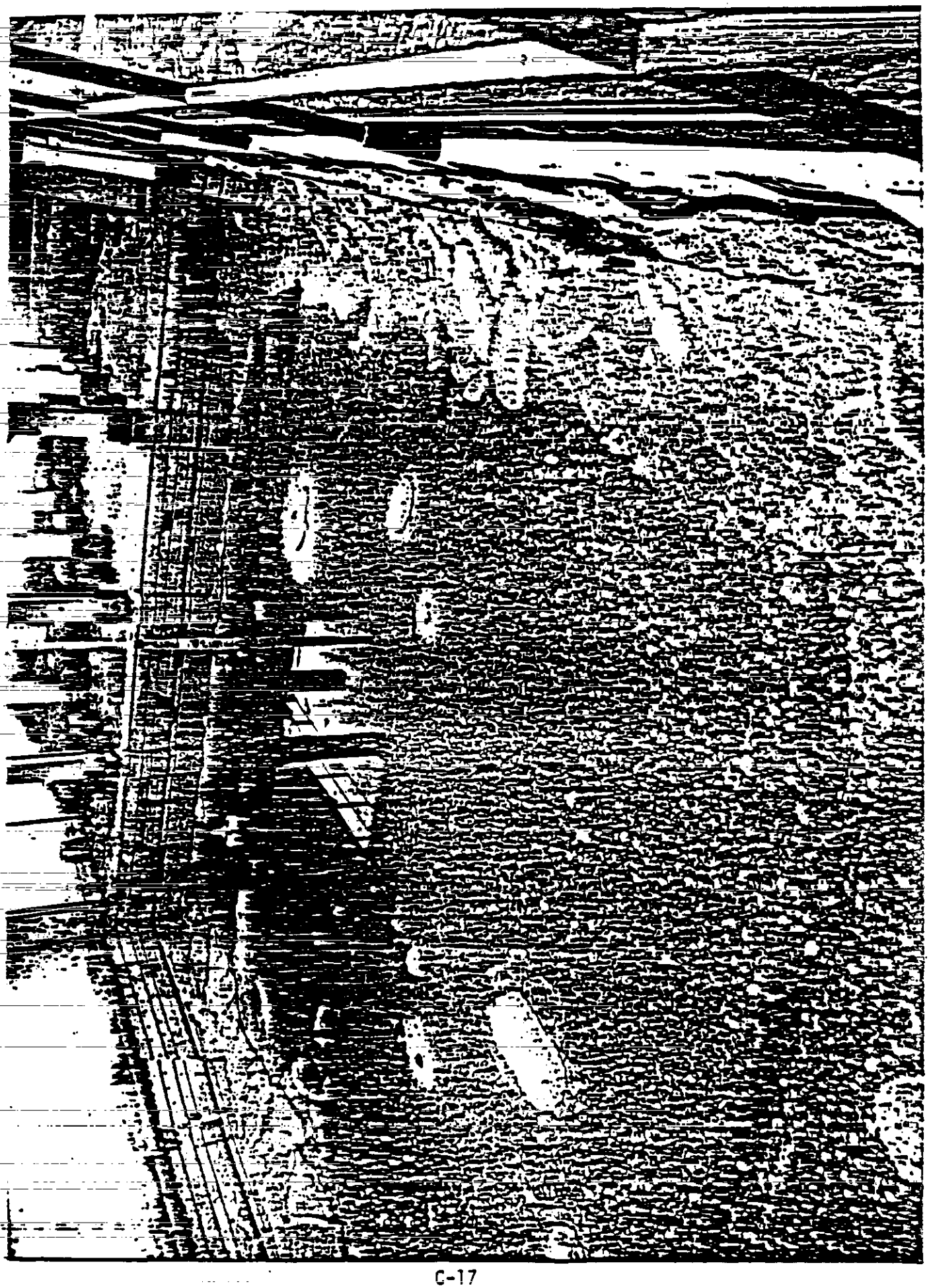
C. A description of unusual circumstances or situations, if any, which might make the analytical result of questionable validity.

5.0 Evaluation of Results

Upon completion of the sampling and analysis effort, Hanford Decommissioning shall prepare a waste characterization report. This report shall include results of all analytical testing specified by this Sampling and Analysis Plan, and shall provide a detailed discussion of the waste designation based upon these results.

6.0 Alterations to Sampling and Analysis Plan

Any alterations to this Sampling and Analysis Plan shall be fully documented. This documentation shall include a discussion of the need for the alteration, the sections of the plan affected, and the actual changes being made. All such alterations shall be incorporated into the final version of the plan. The revised plan shall be included in the waste report prepared at the conclusion of the waste sampling and analyses effort.



CUSTODY SEAL

DATE _____

SIGNATURE _____

Chain of Custody Seal

Collector _____	Sample No. _____
Place of Collection _____	
Date Sampled _____	Time Sampled _____
Field Information _____	
UNC Nuclear Industries, P.O. Box 490, Richland, Wa.	

Sample Label

ATTACHMENT 1

UNC Nuclear Industries
PO Box 490
Richland, Wa. 99352

CHAIN OF CUSTODY

Company Contact: _____ Telephone: _____

Samples Collected by: _____ Date: _____ Time: _____

Sample Location: _____

RSR # _____

Remarks: _____

Method of Shipment: _____

Sample Identification

CHAIN OF POSSESSION

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

ATTACHMENT 2

SAMPLE ANALYSIS REQUEST

NC Nuclear Industries
O Box 490
[illegible]d, Wa. 99352

ompany Contact _____
idress _____
hone No. _____
ite _____
ain of Custody No. _____

LABORATORY _____
ADDRESS _____
CITY/STATE _____ ZIP _____

Received by _____
Title _____
Date _____ Time _____

mple Number/Identification	Analysis Requested

MARKS: _____

Attachment 3

Sample Codes

All samples are identified by a two-part sample identification code. The first part of the code consists of a number and a letter. The number indicates the basin from which the sample was taken and the letter indicates the stratum from which the sample was taken. The following letters were utilized to specify the various sampling strata:

L = Liquid
C = White Crystalline Material
S = Sludge Matter

The second part of the code is the sample number. For example:

4S - 1

This code indicates the sample was taken from basin number 4 sludge material and was designated sample number one.

ATTACHMENT C

TMA
Thermo Analytical Inc.

TMA/Norcal
2030 Wright Avenue
Richmond, CA 94804-0040
(415) 235-2633

UNC Nuclear Industries
P.O. Box 490
Richland, WA 99352
Attention: Michael E. James
G87, L24 3000

June 19, 1987
Samples Received: 4/6/87
TMA/Norcal Lab No.: 4553-3

ANALYSIS REPORT
(Revised)

Sample Identification		Acid Mix Reactivity		Base Mix	Water Mix
TMA/Norcal	Customer	HCl	H_2SO_4	Reactivity	Reactivity
4553-2-1	4S-1 & 4S-2	Pos	Pos	Neg	Neg
4553-2-2	4S-3 & 4S-4	Pos	Pos	Neg	Neg
4553-2-3	4S-5 & 4S-6	Pos	Pos	Neg	Neg
4553-2-4	4S-7 & 4S-8	Pos	Pos	Neg	Neg
4553-2-5	4S-9 & 4S-10	Pos	Pos	Neg	Neg
4553-2-6	4C-1 & 4C-2	Pos	Neg	Neg	Neg
4553-2-7	4C-3 & 4C-4	Pos	Neg	Neg	Neg
4553-2-8	4C-5 & 4C-6	Pos	Pos	Neg	Neg
4553-2-9	4C-7 & 4C-8	Pos	Neg	Neg	Neg
4553-2-10	4C-9 & 4C-10	Pos	Neg	Neg	Neg
4553-2-11	3S-1 & 3S-2	Pos	Pos	Neg	Neg
4553-2-12	3S-3 & 3S-4	Pos	Pos	Neg	Neg
4553-2-13	3S-5 & 3S-6	Pos	Pos	Neg	Neg
4553-2-14	3S-7 & 3S-8	Pos	Pos	Neg	Neg
4553-2-15	3S-9 & 3S-10	Pos	Pos	Neg	Neg
4553-2-16	3C-1 & 3C-2	Pos	Neg	Neg	Neg
4553-2-17	3C-3 & 3C-4	Pos	Pos	Neg	Neg
4553-2-18	3C-5 & 3C-6	Pos	Pos	Neg	Neg
4553-2-19	3C-7 & 3C-8	Pos	Neg	Neg	Neg
4553-2-20	3C-9 & 3C-10	Pos	Pos	Neg	Neg
4553-2-21	2L-1	Pos	Pos	Neg	Neg
4553-2-22	2L-2	Pos	Pos	Neg	Neg
4553-2-23	2L-3	Pos	Pos	Neg	Neg
4553-2-24	2L-4	Pos	Pos	Neg	Neg
4553-2-25	2L-5	Pos	Pos	Neg	Neg

George E. Dunstan
Director of Program Management

GED/dss

TABLE 1 SLUDGE RESULTS

Sample Number	Total Uranium Results pCi/g dry wt. ± 2 σ
Composite of 4S-1, 4S-2	144 ± 7
Composite of 4S-3, 4S-4	820 ± 40
Composite of 4S-5, 4S-6	510 ± 20
Composite of 4S-7, 4S-8	650 ± 30
Composite of 4S-9, 4S-10	500 ± 20
Composite of 4C-1, 4C-2	16.6 ± 0.8
Composite of 4C-3, 4C-4	7.1 ± 0.4
Composite of 4C-5, 4C-6	20 ± 1
Composite of 4C-7, 4C-8	9.6 ± 0.5
Composite of 4C-9, 4C-10	9.0 ± 0.5
Composite of 3S-1, 3S-2	860 ± 40
Composite of 3S-3, 3S-4	320 ± 20
Composite of 3S-5, 3S-6	1560 ± 80
Composite of 3S-7, 3S-8	650 ± 30
Composite of 3S-9, 3S-10	970 ± 50
Composite of 3C-1, 3C-2	8.2 ± 0.4
Composite of 3C-3, 3C-4	62 ± 3
Composite of 3C-5, 3C-6	29 ± 1
Composite of 3C-7, 3C-8	11.2 ± 0.6
Composite of 3C-9, 3C-10	13.6 ± 0.7

TABLE 2 LIQUID RESULTS

Sample Number	Total Uranium Results pCi/L ± 2 σ
2L-1	74,000 ± 4,000
2L-2	74,000 ± 4,000
2L-3	92,000 ± 5,000
2L-4	78,000 ± 4,000
2L-5	94,000 ± 5,000

9413294.1585

TMA
Thermo Analytical Inc

TMA/Noreal
2030 Wright Avenue
Richmond, CA 94804-0040
(415) 235-2633

UNC Nuclear Industries
P.O. Box 490
Richland, WA 99352
Attention: Michael James
G-B7, L24, 3000

June 19, 1987
Samples Received: 3/30/87
TMA/Noreal Lab No.: 4553-3
P.O. No.: R-7M-SHH-87910

ANALYSIS REPORT
(Revised)

Sample Identification Analysis (mg/kg wet)	4553-3-1 4S-1 & 4S-2	4553-3-2 4S-3 & 4S-4	4553-3-3 4S-5 & 4S-6
Aluminum	490	390	400
Antimony	<30	<6	<6
Arsenic	<40	<7	<7
Barium	<1	27	20
Beryllium	1.8	<0.09	<0.09
Boron	32	26	29
Cadmium	4.2	2.9	3.2
Calcium	110	71	67
Chromium	210	220	270
Cobalt	<1	0.66	1.5
Copper	100,000	100,000	100,000
Iron	3,800	1,200	2,000
Lead	<30	14	<30
Lithium	<2,000	<300	<300
Magnesium	32	15	15
Manganese	680	720	760
Molybdenum	<3	<2	<2
Nickel	110	81	86
Potassium	370	78	400
Selenium	<50	<10	<10
Silver	220	140	140
Strontium	3.5	4.2	3.9
Thallium	<50	<10	<10
Tin	470	640	530
Vanadium	<10	<2	2.7
Zinc	310	370	350
Sodium	230,000	230,000	260,000
Zirconium	130,000	28,000	26,000
Moisture (%)	45	44	51

Note: All analyses were conducted in accordance with the procedures specified in the statement of work for Order No. RRM-SHH-87910.

George E. Dunstan
Director of Program Management

GED/dss

UNC Nuclear Industries
TMA/Norea Lab No.: 4553-3

Sample Identification Analysis (mg/kg wet)	4553-3-4 4S-7 & 4S-8	4553-3-5 4S-9 & 4S-10	4553-3-6 4C-1 & 4C-2
Aluminum	450	440	610
Antimony	<6	<6	<6
Arsenic	<7	<7	<7
Barium	39	33	0.96
Beryllium	<0.09	<0.09	0.60
Boron	31	38	2,700
Cadmium	4.5	4.1	<0.6
Calcium	77	97	43
Chromium	340	270	3.6
Cobalt	3.1	2.2	<6
Copper	120,000	97,000	1,700
Iron	2,000	1,700	42
Lead	<50	34	5.9
Lithium	<300	<300	<300
Magnesium	19	26	13
Manganese	890	740	9.8
Molybdenum	<1	<2	<2
Nickel	110	92	<2
Potassium	430	370	<20
Selenium	<10	<10	<10
Silver	170	160	1.6
Strontium	4.7	3.8	1.0
Thallium	<10	<10	<10
Tin	680	670	<5
Vanadium	3.1	<2	<2
Zinc	420	340	7.0
Sodium	230,000	230,000	370,000
Zirconium	3,800	3,400	290
Moisture (%)	43	46	1.1

UNC Nuclear Industries
TMA/Norcal Lab No.: 4553-3

Sample Identification Analysis (mg/kg wet)	4553-3-7 4C-3 & 4C-4	4553-3-8 4C-5 & 4C-6	4553-3-9 4C-7 & 4C-8
Aluminum	590	600	200
Antimony	<5	<30	<30
Arsenic	<7	<30	<40
Barium	2.0	3.4	2.3
Beryllium	<0.09	<0.4	<0.4
Boron	1,800	1,500	430
Cadmium	<0.6	<3	<3
Calcium	100	66	48
Chromium	3.4	11	6.4
Cobalt	0.82	<3	<3
Copper	1,800	4,500	2,400
Iron	150	84	52
Lead	<5	<20	<20
Lithium	<300	<300	<300
Magnesium	35	<20	<30
Manganese	12	34	<20
Molybdenum	<5	<7	<8
Nickel	2.3	<10	<10
Potassium	130	91	<20
Selenium	<10	<50	<50
Silver	2.3	32	<5
Strontium	1.7	<3	<3
Thallium	12	<50	<50
Tin	[illegible]	130	48
Vanadium	<5	<10	<10
Zinc	12	20	9.0
Sodium	500,000	330,000	420,000
Zirconium	490	3,300	840
Moisture (%)	1.1	3.9	1.9

UNC Nuclear Industries
TMA/Norcal Lab No.: 4553-3

Sample Identification Analysis (mg/kg wet)	4553-3-10 4C-9 & 4C-10	4553-3-11 3S-1 & 3S-2	4553-3-12 3S-3 & 3S-4
Aluminum	210	1,100	7,800
Antimony	<30	<80	<30
Arsenic	<40	<100	<40
Barium	3.0	<1	<1
Beryllium	<0.5	<1	3.4
Boron	300	<60	23
Cadmium	<3	<9	4.0
Calcium	49	650	220
Chromium	4.8	530	460
Cobalt	<3	8.9	<3
Copper	2,800	140,000	110,000
Iron	57	1,000	690
Lead	<30	<80	<30
Lithium	<300	<5,000	<2,000
Magnesium	<30	120	55
Manganese	22	1,100	1,000
Molybdenum	<8	<20	<8
Nickel	<10	180	120
Potassium	<20	<300	590
Selenium	<60	<200	<60
Silver	17	290	210
Strontium	<3	36	11
Thallium	<50	<200	<50
Tin	75	750	470
Vanadium	<10	<30	<10
Zinc	10	520	350
Sodium	300,000	200,000	220,000
Zirconium	1,600	220,000	5,800
Moisture (%)	25	51	35

9413294.1589

UNC Nuclear Industries
TMA/Norcal Lab No.: 4553-3

Sample Identification Analysis (mg/kg wet)	4553-3-13 3S-5 & 3S-6	4553-3-14 3S-7 & 3S-8	4553-3-15 3S-9 & 3S-10
Aluminum	17,000	10,000	8,500
Antimony	<90	<10	<10
Arsenic	<100	<40	<40
Barium	<1	22	<1
Beryllium	2.6	<0.5	3.8
Boron	<60	<20	<20
Cadmium	<9	5.0	3.6
Calcium	230	180	190
Chromium	290	320	360
Cobalt	<9	<1	<1
Copper	100,000	120,000	88,000
Iron	710	630	540
Lead	<30	<30	<30
Lithium	<1,000	<300	<2,000
Magnesium	<30	39	43
Manganese	980	990	800
Molybdenum	<20	<3	<3
Nickel	110	120	96
Potassium	1,600	490	440
Selenium	<200	<60	<60
Silver	140	120	190
Strontium	14	11	12
Thallium	<200	<50	<50
Tin	<20	<20	360
Vanadium	<10	<10	<10
Zinc	330	370	280
Sodium	230,000	270,000	210,000
Zirconium	22,000	23,000	110,000
Moisture (%)	39	43	42

UNC Nuclear Industries
TMA/Norcal Lab No.: 4553-3

Sample Identification Analysis (mg/kg wet)	4553-3-16 3C-1 & 3C-2	4553-3-17 3C-3 & 3C-4	4553-3-18 3C-5 & 3C-6
Aluminum	780	880	850
Antimony	<30	<30	<30
Arsenic	<30	<30	<40
Barium	2.5	<10	<10
Beryllium	<0.4	1.3	1.3
Boron	2,800	2,200	2,800
Cadmium	<3	<3	<3
Calcium	76	140	83
Chromium	12	40	19
Cobalt	<2	<2	<3
Copper	4,200	13,000	6,600
Iron	57	130	110
Lead	<20	<20	<30
Lithium	<300	<2,000	<2,000
Magnesium	<20	37	<30
Manganese	32	140	57
Molybdenum	<7	<7	<8
Nickel	<10	13	<10
Potassium	<20	<90	<100
Selenium	<50	<50	<60
Silver	9.6	17	9.4
Strontium	<3	4.8	<3
Thallium	<50	<50	<50
Tin	<20	72	36
Vanadium	<10	<10	<10
Zinc	17	52	24
Sodium	440,000	350,000	360,000
Zirconium	1,700	15,000	1,700
Moisture (%)	1.6	0.73	0.61

UNC Nuclear Industries
TMA/Norcal Lab No.: 4553-3

Sample Identification Analysis (mg/kg wet)	4553-3-19 3C-7 & 3C-8	4553-3-20 3C-9 & 3C-10	4553-3-21 2L-1
			(mg/L)
Aluminum	780	780	36
Antimony	<30	<30	<5
Arsenic	<40	<40	<7
Barium	5.3	<10	<0.2
Beryllium	1.2	0.89	<0.09
Boron	3,000	2,800	79
Cadmium	<3	<3	<0.6
Calcium	48	69	11
Chromium	6.6	27	19
Cobalt	<3	<3	0.77
Copper	11,000	9,800	410
Iron	48	88	5.8
Lead	<30	<30	<5
Lithium	<300	<2,000	<300
Magnesium	<30	<30	<5
Manganese	31	71	4.5
Molybdenum	<8	<8	<2
Nickel	<10	<10	8.7
Potassium	<20	<100	770
Selenium	<60	<60	<10
Silver	<5	13	1.1
Strontium	<3	3.3	<0.6
Thallium	<50	<50	<10
Tin	<20	46	11
Vanadium	<10	<10	<2
Zinc	39	35	2.1
Sodium	410,000	550,000	160,000
Zirconium	560	12,000	490
Moisture (%)	0.55	1.8	58

UNC Nuclear Industries
TMA/Nortal Lab No.: 4553-3

Sample Identification Analysis (mg/L)	4553-3-22 2L-2	4553-3-23 2L-3	4553-3-24 2L-4
Aluminum	44	36	34
Antimony	<4	<4	<4
Arsenic	<6	<6	<6
Barium	<0.2	<0.2	<0.2
Beryllium	<0.07	<0.07	<0.07
Boron	<30	37	73
Cadmium	<0.5	<0.5	<0.5
Calcium	13	6.5	9.6
Chromium	23	22	18
Cobalt	<0.4	<0.4	0.63
Copper	940	320	670
Iron	14	6.2	7.9
Lead	<4	<4	<4
Lithium	<300	<300	<300
Magnesium	<4	<4	<4
Manganese	13	5.4	7.2
Molybdenum	<1	<1	<1
Nickel	10	10	8.8
Potassium	670	670	670
Selenium	<9	<9	<9
Silver	2.8	1.8	1.9
Strontium	0.81	<0.5	0.51
Thallium	<8	<8	<8
Tin	25	15	16
Vanadium	<2	<2	<2
Zinc	5.4	2.4	3.1
Sodium	130,000	120,000	130,000
Zirconium	1,500	640	970
Moisture (%)	58	57	57

9413294.1593

UNC Nuclear Industries
TMA/Norcal Lab No.: 4553-3

Sample Identification	4553-3-25
Analysis (mg/L)	ZL-5
Aluminum	30
Antimony	<5
Arsenic	<7
Barium	<0.2
Beryllium	<0.09
Boron	97
Cadmium	<0.6
Calcium	<5
Chromium	16
Cobalt	0.74
Copper	120
Iron	2.8
Lead	<5
Lithium	<100
Magnesium	<5
Manganese	<4
Molybdenum	1.6
Nickel	8.3
Potassium	820
Selenium	<10
Silver	1.2
Strontium	<0.6
Thallium	<10
Tin	[illegible]
Vanadium	<2
Zinc	1.0
Sodium	140,000
Zirconium	320
Moisture (%)	57

UNC Nuclear Industries
TMA/Norcal Lab No.: 4553-3

EP TOXICITY RESULTS

Sample Identification Analysis (mg/L)	4553-3-26 4S-1 & 4S-2	4553-3-27 4S-3 & 4S-4	4553-3-28 4S-5 & 4S-6
Arsenic	<0.02	<0.02	<0.02
Barium	<0.003	<0.003	<0.003
Cadmium	0.065	0.056	0.057
Chromium	0.19	0.66	0.57
Lead	<0.08	<0.08	<0.08
Mercury	0.004	0.011	0.0097
Selenium	<0.05	0.02	<0.03
Silver	<0.08	<0.05	<0.05

Sample Identification Analysis (mg/L)	4553-3-29 4S-7 & 4S-8	4553-3-30 4S-9 & 4S-10	4553-3-31 4C-1 & 4C-2
Arsenic	<0.02	<0.02	0.2
Barium	<0.003	<0.003	<0.007
Cadmium	0.069	0.064	<0.009
Chromium	0.59	0.54	0.082
Lead	<0.08	<0.08	<0.2
Mercury	0.0090	0.011	0.006
Selenium	<0.03	<0.05	0.2
Silver	<0.05	<0.08	<0.4

Sample Identification Analysis (mg/L)	4553-3-32 4C-3 & 4C-4	4553-3-33 4C-5 & 4C-6	4553-3-34 4C-7 & 4C-8
Arsenic	0.08	0.08	<0.01
Barium	<0.003	<0.003	<0.003
Cadmium	<0.009	<0.009	<0.009
Chromium	0.13	0.27	0.19
Lead	<0.1	<0.08	<0.08
Mercury	0.002	<0.002	0.003
Selenium	0.1	0.2	0.1
Silver	<0.2	<0.06	<0.06

UNC Nuclear Industries
TMA/Norcal Lab No: 4553-3

Sample Identification Analysis (mg/L)	4553-3-35 4C-9 & 4C-10	4553-3-36 3S-1 & 3S-2	4553-3-37 3S-3 & 3S-4
Arsenic	<0.01	<0.04	<0.04
Barium	<0.003	<0.09	<0.003
Cadmium	<0.009	0.057	0.051
Chromium	0.074	0.30	0.33
Lead	<0.08	<0.08	<0.08
Mercury	<0.002	<0.002	<0.002
Selenium	0.2	<0.1	<0.1
Silver	<0.05	<0.09	<0.08

Sample Identification Analysis (mg/L)	4553-3-38 3S-5 & 3S-6	4553-3-39 3S-7 & 3S-8	4553-3-40 3S-9 & 3S-10
Arsenic	<0.04	<0.04	<0.04
Barium	<0.003	<0.003	<0.003
Cadmium	0.048	0.043	0.035
Chromium	0.32	0.25	0.12
Lead	<0.08	<0.08	<0.08
Mercury	<0.002	<0.002	0.005
Selenium	<0.1	0.04	<0.1
Silver	<0.08	<0.09	<0.08

Sample Identification Analysis (mg/L)	4553-3-41 3C-1 & 3C-2	4553-3-42 3C-3 & 3C-4	4553-3-43 3C-5 & 3C-6
Arsenic	<0.02	0.4	0.1
Barium	<0.003	<0.003	<0.003
Cadmium	<0.01	<0.02	<0.02
Chromium	0.15	0.53	0.34
Lead	<0.08	<0.08	<0.08
Mercury	<0.002	<0.002	<0.002
Selenium	<0.1	0.3	0.02
Silver	<0.2	<0.2	<0.2

Sample Identification Analysis (mg/L)	4553-3-44 3C-7 & 3C-8	4553-3-45 3C-9 & 3C-10	4553-3-46 2L-1
Arsenic	<0.7	0.02	0.06
Barium	0.43	<0.003	0.89
Cadmium	<0.01	<0.009	<0.009
Chromium	0.12	0.38	4.6
Lead	<0.08	<0.08	<0.08
Mercury	<0.002	<0.002	0.015
Selenium	0.2	<0.01	0.05
Silver	<0.4	<0.2	<0.1

Sample Identification Analysis (mg/L)	4553-3-47 2L-2	4553-3-48 2L-3	4553-3-49 2L-4
Arsenic	0.1	0.04	0.1
Barium	0.64	0.57	0.60
Cadmium	<0.009	<0.009	<0.009
Chromium	5.7	7.0	7.1
Lead	<0.08	<0.1	<0.08
Mercury	0.020	0.014	0.005
Selenium	0.07	0.02	<0.02
Silver	<0.09	<0.06	<0.05

Sample Identification Analysis (mg/L)	4553-3-50 2L-5
Arsenic	0.1
Barium	0.47
Cadmium	<0.02
Chromium	4.9
Lead	<0.2
Mercury	0.035
Selenium	<0.03
Silver	<0.2

UNC Nuclear Industries
TMA/Norcal Lab No.: 4553-1

June 19, 1987

Sample Identification TMA/Norcal	Customer	Chloride mg/kg	Fluoride mg/kg	Nitrogen Nitrate mgN/kg	Nitrogen Nitrite mgN/kg
		As Received			
4553-2-1	4S-1 & 4S-2	170	12,000	46,000	100
4553-2-2	4S-3 & 4S-4	220	11,000	54,000	110
4553-2-3	4S-5 & 4S-6	220	9,800	48,000	120
4553-2-4	4S-7 & 4S-8	230	11,000	48,000	140
4553-2-5	4S-9 & 4S-10	210	12,000	52,000	130
4553-2-6	4C-1 & 4C-2	330	58,000	16,000	<10
4553-2-7	4C-3 & 4C-4	<20	2,800	160,000	<50
4553-2-8	4C-5 & 4C-6	<130	30,000	50,000	<40
4553-2-9	4C-7 & 4C-8	<20	3,200	160,000	<50
4553-2-10	4C-9 & 4C-10	67	15,000	140,000	<70
4553-2-11	3S-1 & 3S-2	150	14,000	39,000	130
4553-2-12	3S-3 & 3S-4	410	15,000	58,000	240
4553-2-13	3S-5 & 3S-6	380	14,000	63,000	210
4553-2-14	3S-7 & 3S-8	310	11,000	65,000	210
4553-2-15	3S-9 & 3S-10	300	9,800	66,000	220
4553-2-16	3C-1 & 3C-2	130	40,000	<1,000	<40
4553-2-17	3C-3 & 3C-4	<20	49,000	<1,000	<10
4553-2-18	3C-5 & 3C-6	<10	32,000	<900	<5
4553-2-19	3C-7 & 3C-8	40	29,000	<700	<5
4553-2-20	3C-9 & 3C-10	<10	32,000	<900	<5

Sample Identification TMA/Norcal	Customer	Chloride mg/L	Fluoride mg/L	Nitrogen Nitrate mgN/L	Nitrogen Nitrite mgN/L
4553-2-21	2L-1	260	1,600	70,000	240
4553-2-22	2L-2	320	1,500	96,000	260
4553-2-23	2L-3	290	1,500	88,000	270
4553-2-24	2L-4	290	1,400	88,000	310
4553-2-25	2L-5	290	1,400	92,000	270

UNC Nuclear Industries
TMA/Noreal Lab No.: 4553-3

June 19, 1987

Sample Identification TMA/Noreal	Customer	Ortho Phosphate mgP/kg	Sulfate mg/kg	pH
		------as received ----		
4553-2-1	4S-1 & 4S-2	<20	39,000	9.9
4553-2-2	4S-3 & 4S-4	<10	15,000	9.7
4553-2-3	4S-5 & 4S-6	<20	13,000	9.7
4553-2-4	4S-7 & 4S-8	<20	13,000	9.8
4553-2-5	4S-9 & 4S-1	<10	17,000	9.7
4553-2-6	4C-1 & 4C-2	<20	310,000	9.7
4553-2-7	4C-3 & 4C-4	<140	54,000	9.3
4553-2-8	4C-5 & 4C-6	<110	160,000	9.6
4553-2-9	4C-7 & 4C-8	<120	15,000	9.3
4553-2-10	4C-9 & 4C-10	<170	84,000	9.2
4553-2-11	3S-1 & 3S-2	<20	38,000	10.2
4553-2-12	3S-3 & 3S-4	<140	51,000	11.9
4553-2-13	3S-5 & 3S-6	<100	53,000	12.0
4553-2-14	3S-7 & 3S-8	<20	26,000	12.1
4553-2-15	3S-9 & 3S-10	<20	19,000	11.8
4553-2-16	3C-1 & 3C-2	<10	210,000	10.0
4553-2-17	3C-3 & 3C-4	<20	260,000	9.9
4553-2-18	3C-5 & 3C-6	<10	170,000	10.0
4553-2-19	3C-7 & 3C-8	<10	160,000	10.0
4553-2-20	3C-9 & 3C-10	<10	180,000	10.0

Sample Identification TMA/Noreal	Customer	Ortho Phosphate mgP/L	Sulfate mg/L	pH
4553-2-21	2L-1	<100	8,000	10.5
4553-2-22	2L-2	<100	8,300	10.5
4553-2-23	2L-3	<100	8,000	10.6
4553-2-24	2L-4	<100	7,900	10.6
4553-2-25	2L-5	<100	7,800	10.7

9413294.1599

TMA
Thermo Analytical Inc.

TMA/Norcal
2030 Wright Avenue
Richmond, CA 94804-0040
(415) 235-2633

RECEIVED
JUN 10 1987
SUBCONTRACT

UNC Nuclear Industries
P.O. Box 490
Richland, WA 99352
Attention: Michael E. James
G-87, L24, 3000

June 8, 1987
Samples Received: 3/27/87
TMA/Norcal Lab No.: 4553-2
P.O. No.: R-RM-SHH-87910

9013291.1600

ANALYSIS REPORT
(Revised)

Sample Identification TMA/Norcal	Customer	WDOE Extraction Residue (%)	Total Organic Carbon mg/kg(wet)	mg/L
4553-2-1	4S-1	0.001	220	--
4553-2-2	4S-2	0.007	200	--
4553-2-3	4S-6	0.21	390	--
4553-2-4	4S-8	0.14	240	--
4553-2-5	4S-9	0.001	490	--
4553-2-6	3S-2	0.10	310	--
4553-2-7	3S-3	0.17	480	--
4553-2-8	3S-6	0.006	270	--
4553-2-9	3S-8	0.009	350	--
4553-2-10	3S-9	0.15	320	--
4553-2-11	2L-1	0.002	--	210
4553-2-12	2L-2	0.002	--	210
4553-2-13	2L-3	0.008	--	220
4553-2-14	2L-4	0.005	--	220
4553-2-15	2L-5	<0.001	--	220

Note: All analyses were conducted in accordance with the procedures specified in the statement of work for Order No. RRM-SHH-87910.

George E. Dunscan
Director of Program Management

GED/dss

TMA
Thermo Analytical Inc.

TMA/Norcal
2030 Wright Avenue
Richmond, CA 94804-0040
(415) 235-2633

RECEI
AUG 6
PURCHAS.

Westinghouse Hanford Co.
3200 George Washington Way
Richland, WA 99352
Attention: Michael E. James
GB7, L24 3000

August 3, 1987
Samples Received: 7/13/87
TMA/Norcal Lab No.: 4553-6
P.O. No.: RRM-SHH-87910, Mod. #1

9413294.1601

9011783163 0

ANALYSIS OF WDOE EXTRACT

Sample Identification TMA/Norcal	Customer	Total Halogenated Hydrocarbon mg/kg (wet wt. of original sample)
4553-6-1	4S-6	15
4553-6-2	4S-8	14
4553-6-3	3S-2	13
4553-6-4	3S-3	12
4553-6-5	3S-9	<10

Note: Samples were analyzed for Halogenated Hydrocarbons in accordance with Washington State Department of Ecology WAC 173-303.

for George E. Dunstan
Director of Program Management

GED/dss

UNC Nuclear Industries

Date: May 21, 1987

TMA/Norcal Lab No.: 4553-2-16

Client I.D.: 4S-1

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<50	1,2-dichloropropane	<25
bromomethane	<50	trans-1,3-dichloropropene	<25
vinyl chloride	<50	trichloroethene	<25
chloroethane	<50	dibromochloromethane	<25
methylene chloride	B 63	1,1,2-trichloroethane	<25
acetone	81	benzene	<25
carbon disulfide	<25	cis-1,3-dichloropropene	<25
1,1-dichloroethene	<25	2-chloroethylvinylether	<50
1,1-dichloroethane	<25	bromoform	<25
trans-1,2-dichloroethene	<25	2-hexanone	<50
chloroform	<25	4-methyl-2-pentanone	440
1,2-dichloroethane	<25	tetrachloroethene	<25
2-butanone	<50	1,1,2,2-tetrachloroethane	<25
1,1,1-trichloroethane	<25	toluene	J <25
carbon tetrachloride	<25	chlorobenzene	<25
vinyl acetate	<50	ethylbenzene	170
bromodichloromethane	<25	styrene	<25
		total xylenes	930

J = present, but below detection limits.

B = present in blank

UNC Nuclear Industries

Date: May 21, 1987
TMA/Norcal Lab No.: 4553-2-17
Client I.D.: 4S-6

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<25	1,2-dichloropropane	<13
bromomethane	<25	trans-1,3-dichloropropene	<13
vinyl chloride	<25	trichloroethene	<13
chloroethane	<25	dibromochloromethane	<13
methylene chloride	<13	1,1,2-trichloroethane	<13
acetone	58	benzene	<13
carbon disulfide	<13	cis-1,3-dichloropropene	<13
1,1-dichloroethene	<13	2-chloroethylvinylether	<25
1,1-dichloroethane	<13	bromoform	<13
trans-1,2-dichloroethene	<13	4-methyl-2-pentanone	121
chloroform	<13	2-hexanone	<25
1,2-dichloroethane	<13	tetrachloroethene	<13
2-butanone	<25	1,1,2,2-tetrachloroethane	<13
1,1,1-trichloroethane	<13	toluene	<13
carbon tetrachloride	<13	chlorobenzene	<13
vinyl acetate	<25	ethylbenzene	21
bromodichloromethane	<13	styrene	<13
		total xylenes	100

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UNC Nuclear Industries

Date: May 11, 1987

TMA/Norcal Lab No.: 4553-2-18

Client I.D.: 4S-8

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<25	1,2-dichloropropane	<13
bromomethane	<25	trans-1,3-dichloropropene	<13
vinyl chloride	<25	trichloroethene	<13
chloroethane	<25	dibromochloromethane	<13
methylene chloride	B 35	1,1,2-trichloroethane	<13
acetone	70	benzene	<13
carbon disulfide	<13	cis-1,3-dichloropropene	<13
1,1-dichloroethene	<13	2-chloroethylvinylether	<25
1,1-dichloroethane	<13	bromoform	<13
trans-1,2-dichloroethene	<13	4-methyl-2-pentanone	150
chloroform	<13	2-hexanone	<25
1,2-dichloroethane	<13	tetrachloroethene	<13
2-butanone	<25	1,1,2,2-tetrachloroethane	<13
1,1,1-trichloroethane	<13	toluene	<13
carbon tetrachloride	<13	chlorobenzene	<13
vinyl acetate	<25	ethylbenzene	27
bromodichloromethane	<13	styrene	<13
		total xylenes	153

B = present in blank

UNC Nuclear Industries

Date: May 21, 1987

TMA/Norcal Lab No.: 4553-2-19

Client I.D.: 4S-9

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<17	1,2-dichloropropane	<8
bromomethane	<17	trans-1,3-dichloropropene	<8
vinyl chloride	<17	trichloroethene	<8
chloroethane	<17	dibromochloromethane	<8
methylene chloride	B 28	1,1,2-trichloroethane	<8
acetone	90	benzene	<8
carbon disulfide	<8	cis-1,3-dichloropropene	<8
1,1-dichloroethene	<8	2-chloroethylvinylether	<17
1,1-dichloroethane	<8	bromoform	<8
trans-1,2-dichloroethene	<8	4-methyl-2-pentanone	270
chloroform	<8	2-hexanone	<17
1,2-dichloroethane	<8	tetrachloroethene	<8
2-butanone	<17	1,1,2,2-tetrachloroethane	<8
1,1,1-trichloroethane	<8	toluene	<8
carbon tetrachloride	<8	chlorobenzene	<8
vinyl acetate	<17	ethylbenzene	94
bromodichloromethane	<8	styrene	<8
		total xylenes	490

B = present in blank

UNC Nuclear Industries

Date: May 11, 1987
TMA/Norcal Lab No.: 4553-2-20
Client I.D.: 3S-2

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<100	1,2-dichloropropane	<50
bromomethane	<100	trans-1,3-dichloropropene	<50
vinyl chloride	<100	trichloroethene	<50
chloroethane	<100	dibromochloromethane	<50
methylene chloride	B 88	1,1,2-trichloroethane	<50
acetone	J <100	benzene	<50
carbon disulfide	<50	cis-1,3-dichloropropene	<50
1,1-dichloroethene	<50	2-chloroethylvinylether	<100
1,1-dichloroethane	<50	bromoform	<50
trans-1,2-dichloroethene	<50	4-methyl-2-pentanone	<100
chloroform	<50	2-hexanone	<100
1,2-dichloroethane	<50	tetrachloroethene	84
2-butanone	<100	1,1,2,2-tetrachloroethane	<50
1,1,1-trichloroethane	<50	toluene	J <50
carbon tetrachloride	<50	chlorobenzene	<50
vinyl acetate	<100	ethylbenzene	<50
bromodichloromethane	<50	styrene	<50
		total xylenes	<50

J = present, but below detection limits

B = present in blank

UNC Nuclear Industries

Date: May 21, 1987

TMA/Norcal Lab No.: 4553-2-21

Client I.D.: 3S-3

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<100	1,2-dichloropropane	<50
bromomethane	<100	trans-1,3-dichloropropene	<50
vinyl chloride	<100	trichloroethene	<50
chloroethane	<100	dibromochloromethane	<50
methylene chloride	<50	1,1,2-trichloroethane	<50
acetone	J <100	benzene	<50
carbon disulfide	<50	cis-1,3-dichloropropene	<50
1,1-dichloroethene	<50	2-chloroethylvinylether	<100
1,1-dichloroethane	<50	bromoform	<50
trans-1,2-dichloroethene	<50	4-methyl-2-pentanone	J <100
chloroform	<50	2-hexanone	160
1,2-dichloroethane	<50	tetrachloroethene	82
2-butanone	<100	1,1,2,2-tetrachloroethane	<50
1,1,1-trichloroethane	<50	toluene	100
carbon tetrachloride	<50	chlorobenzene	<50
vinyl acetate	<100	ethylbenzene	<50
bromodichloromethane	<50	styrene	<50
		total xylenes	240

J = present, but below detection limits

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UNC Nuclear Industries

Date: May 21, 1987

TMA/Norcal Lab No.: 4553-2-22

Client I.D.: 3S-6

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<100	1,2-dichloropropane	<50
bromomethane	<100	trans-1,3-dichloropropene	<50
vinyl chloride	<100	trichloroethane	<50
chloroethane	<100	dibromochloromethane	<50
methylene chloride	97	1,1,2-trichloroethane	<50
acetone	J <100	benzene	<50
carbon disulfide	<50	cis-1,3-dichloropropene	<50
1,1-dichloroethene	<50	2-chloroethylvinylether	<100
1,1-dichloroethane	<50	bromoform	<50
trans-1,2-dichloroethene	<50	4-methyl-2-pentanone	<100
chloroform	<50	2-hexanone	J <100
1,2-dichloroethane	<50	tetrachloroethene	90
2-butanone	<100	1,1,2,2-tetrachloroethane	<50
1,1,1-trichloroethane	<50	toluene	J <50
carbon tetrachloride	<50	chlorobenzene	<50
vinyl acetate	<100	ethylbenzene	<50
bromodichloromethane	<50	styrene	<50
		total xylenes	<50

J = present, but below detection limits

UNC Nuclear Industries

Date: May 21, 1987
TMA/Norcal Lab No.: 4553-2-23
Client I.D.: 3S-8

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<25	1,2-dichloropropane	<13
bromomethane	<25	trans-1,3-dichloropropene	<13
vinyl chloride	<25	trichloroethene	<13
chloroethane	<25	dibromochloromethane	<13
methylene chloride	34	1,1,2-trichloroethane	<13
acetone	55	benzene	<13
carbon disulfide	<13	cis-1,3-dichloropropene	<13
1,1-dichloroethene	<13	2-chloroethylvinylether	<25
1,1-dichloroethane	<13	bromoform	<13
trans-1,2-dichloroethene	<13	4-methyl-2-pentanone	J <25
chloroform	<13	2-hexanone	J <25
1,2-dichloroethane	<13	tetrachloroethene	40
2-butanone	<25	1,1,2,2-tetrachloroethane	<13
1,1,1-trichloroethane	<13	toluene	J <13
carbon tetrachloride	<13	chlorobenzene	<13
vinyl acetate	<25	ethylbenzene	<13
bromodichloromethane	<13	styrene	<13
		total xylenes	<13

J = present, but below detection limits

9413294.1609

UNC Nuclear Industries

Date: May 11, 1987
TMA/Norcal Lab No.: 4553-2-24
Client I.D.: 3S-9

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<50	1,2-dichloropropane	<25
bromomethane	<50	trans-1,3-dichloropropene	<25
vinyl chloride	<50	trichloroethene	<25
chloroethane	<50	dibromochloromethane	<25
methylene chloride	<25	1,1,2-trichloroethane	<25
acetone	53	benzene	<25
carbon disulfide	<25	cis-1,3-dichloropropene	<25
1,1-dichloroethene	<25	2-chloroethylvinylether	<50
1,1-dichloroethane	<25	bromoform	<25
trans-1,2-dichloroethene	<25	4-methyl-2-pentanone	81
chloroform	<25	2-hexanone	170
1,2-dichloroethane	<25	tetrachloroethene	73
2-butanone	<50	1,1,2,2-tetrachloroethane	<25
1,1,1-trichloroethane	<25	toluene	65
carbon tetrachloride	<25	chlorobenzene	<25
vinyl acetate	<50	ethylbenzene	<25
bromodichloromethane	<25	styrene	<25
		total xylenes	J <25

J = present, but below detection limits

UNC Nuclear Industries

Date: May 21, 1987
TMA/Norcal Lab No.: 4553-2-25
Client I.D.: ZL-1

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<10	1,2-dichloropropane	<5
bromomethane	<10	trans-1,3-dichloropropene	<5
vinyl chloride	<10	trichloroethene	<5
chloroethane	<10	dibromochloromethane	<5
methylene chloride	6	1,1,2-trichloroethane	<5
acetone	41	benzene	<5
carbon disulfide	<5	cis-1,3-dichloropropene	<5
1,1-dichloroethene	<5	2-chloroethylvinylether	<10
1,1-dichloroethane	<5	bromoform	<5
trans-1,2-dichloroethene	<5	4-methyl-2-pentanone	<10
chloroform	<5	2-hexanone	15
1,2-dichloroethane	<5	tetrachloroethene	<5
2-butanone	22	1,1,2,2-tetrachloroethane	<5
1,1,1-trichloroethane	6	toluene	J <5
carbon tetrachloride	<5	chlorobenzene	<5
vinyl acetate	<10	ethylbenzene	<5
bromodichloromethane	<5	styrene	<5
		total xylenes	<5

J = present, but below detection limits

UNC Nuclear Industries

Date: May 21, 1987

TMA/Norcal Lab No.: 4553-2-26

Client I.D.: ZL-2

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<10	1,2-dichloropropane	<5
bromomethane	<10	trans-1,3-dichloropropene	<5
vinyl chloride	<10	trichloroethene	<5
chloroethane	<10	dibromochloromethane	<5
methylene chloride	5	1,1,2-trichloroethane	<5
acetone	39	benzene	<5
carbon disulfide	<5	cis-1,3-dichloropropene	<5
1,1-dichloroethene	<5	2-chloroethylvinylether	<10
1,1-dichloroethane	<5	bromoform	<5
trans-1,2-dichloroethene	<5	4-methyl-2-pentanone	<10
chloroform	J <5	2-hexanone	12
1,2-dichloroethane	<5	tetrachloroethene	<5
2-butanone	20	1,1,2,2-tetrachloroethane	<5
1,1,1-trichloroethane	<5	toluene	<5
carbon tetrachloride	<5	chlorobenzene	<5
vinyl acetate	<10	ethylbenzene	<5
bromodichloromethane	<5	styrene	<5
		total xylenes	<5

J = present, but below detection limits

UNC Nuclear Industries

Date: May 21, 1987

TMA/Norcal Lab No.: 4553-2-27

Client I.D.: ZL-3

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<10	1,2-dichloropropane	<5
bromomethane	<10	trans-1,3-dichloropropene	<5
vinyl chloride	<10	trichloroethene	<5
chloroethane	<10	dibromochloromethane	<5
methylene chloride	7	1,1,2-trichloroethane	<5
acetone	63	benzene	<5
carbon disulfide	<5	cis-1,3-dichloropropene	<5
1,1-dichloroethene	<5	2-chloroethylvinylether	<10
1,1-dichloroethane	<5	bromoform	<5
trans-1,2-dichloroethene	<5	4-methyl-2-pentanone	<10
chloroform	<5	2-hexanone	<10
1,2-dichloroethane	<5	tetrachloroethene	<5
2-butanone	19	1,1,2,2-tetrachloroethane	<5
1,1,1-trichloroethane	<5	toluene	<5
carbon tetrachloride	<5	chlorobenzene	<5
vinyl acetate	<10	ethylbenzene	<5
bromodichloromethane	<5	styrene	<5
		total xylenes	<5

UNC Nuclear Industries

Date: May 11, 1987
TMA/Norcal Lab No.: 4553-2-28
Client I.D.: ZL-4

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<10	1,2-dichloropropane	<5
bromomethane	<10	trans-1,3-dichloropropene	<5
vinyl chloride	<10	trichloroethene	<5
chloroethane	<10	dibromochloromethane	<5
methylene chloride	6	1,1,2-trichloroethane	<5
acetone	49	benzene	<5
carbon disulfide	<5	cis-1,3-dichloropropene	<5
1,1-dichloroethene	<5	2-chloroethylvinylether	<10
1,1-dichloroethane	<5	bromoform	<5
trans-1,2-dichloroethene	<5	4-methyl-2-pentanone	<10
chloroform	<5	2-hexanone	22
1,2-dichloroethane	<5	tetrachloroethene	<5
2-butanone	28	1,1,2,2-tetrachloroethane	<5
1,1,1-trichloroethane	7	toluene	7
carbon tetrachloride	<5	chlorobenzene	<5
vinyl acetate	<10	ethylbenzene	<5
bromodichloromethane	<5	styrene	<5
		total xylenes	<5

UNC Nuclear Industries

Date: May 21, 1987

TMA/Norcal Lab No.: 4553-2-29

Client I.D.: 2L-5

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<10	1,2-dichloropropane	<5
bromomethane	<10	trans-1,3-dichloropropene	<5
vinyl chloride	<10	trichloroethene	<5
chloroethane	<10	dibromochloromethane	<5
methylene chloride	5	1,1,2-trichloroethane	<5
acetone	49	benzene	<5
carbon disulfide	<5	cis-1,3-dichloropropene	<5
1,1-dichloroethene	<5	2-chloroethylvinylether	<10
1,1-dichloroethane	<5	bromoform	<5
trans-1,2-dichloroethene	<5	4-methyl-2-pentanone	J <10
chloroform	<5	2-hexanone	28
1,2-dichloroethane	<5	tetrachloroethene	<5
2-butanone	30	1,1,2,2-tetrachloroethane	<5
1,1,1-trichloroethane	49	toluene	41
carbon tetrachloride	<5	chlorobenzene	<5
vinyl acetate	<10	ethylbenzene	<5
bromodichloromethane	<5	styrene	<5
		total xylenes	<5

J = present, but below detection limits

UNC Nuclear Industries

Date: May 21, 1987

TMA/Norcal Lab No.: 4553-2-30

Client I.D.: 4S-2

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<50	1,2-dichloropropane	<25
bromomethane	<50	trans-1,3-dichloropropene	<25
vinyl chloride	<50	trichloroethene	<25
chloroethane	<50	dibromochloromethane	<25
methylene chloride	110	1,1,2-trichloroethane	<25
acetone	190	benzene	<25
carbon disulfide	<25	cis-1,3-dichloropropene	<25
1,1-dichloroethene	<25	2-chloroethylvinylether	<50
1,1-dichloroethane	<25	bromoform	<25
trans-1,2-dichloroethene	<25	4-methyl-2-pentanone	J <50
chloroform	<25	2-hexanone	<50
1,2-dichloroethane	<25	tetrachloroethene	<25
2-butanone	<50	1,1,2,2-tetrachloroethane	<25
1,1,1-trichloroethane	<25	toluene	<25
carbon tetrachloride	<25	chlorobenzene	<25
vinyl acetate	<50	ethylbenzene	<25
bromodichloromethane	<25	styrene	<25
		total xylenes	27

J = present, but below detection limits

UNC Nuclear Industries

Date: May 21, 1987

Client I.D.:

TMA/Norcal Lab No.: Water Holding Blank (4/23/87)

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<10	1,2-dichloropropane	<5
bromomethane	<10	trans-1,3-dichloropropene	<5
vinyl chloride	<10	trichloroethene	<5
chloroethane	<10	dibromochloromethane	<5
methylene chloride	<5	1,1,2-trichloroethane	<5
acetone	<10	benzene	<5
carbon disulfide	<5	cis-1,3-dichloropropene	<5
1,1-dichloroethene	<5	2-chloroethylvinylether	<10
1,1-dichloroethane	<5	bromoform	<5
trans-1,2-dichloroethene	<5	4-methyl-2-pentanone	<10
chloroform	<5	2-hexanone	<10
1,2-dichloroethane	<5	tetrachloroethene	<5
2-butanone	<10	1,1,2,2-tetrachloroethane	<5
1,1,1-trichloroethane	<5	toluene	<5
carbon tetrachloride	<5	chlorobenzene	<5
vinyl acetate	<10	ethylbenzene	<5
bromodichloromethane	<5	styrene	<5
		total xylenes	<5

UNC Nuclear Industries

Date: May 11, 1987
Client I.D.:
TMA/Norcal Lab No.: Blank MB-1
(4/23/87)

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<10	1,2-dichloropropane	<5
bromomethane	<10	trans-1,3-dichloropropene	<5
vinyl chloride	<10	trichloroethene	<5
chloroethane	<10	dibromochloromethane	<5
methylene chloride	<5	1,1,2-trichloroethane	<5
acetone	<10	benzene	<5
carbon disulfide	<5	cis-1,3-dichloropropene	<5
1,1-dichloroethene	<5	2-chloroethylvinylether	<10
1,1-dichloroethane	<5	bromoform	<5
trans-1,2-dichloroethene	<5	4-methyl-2-pentanone	<10
chloroform	<5	2-hexanone	<10
1,2-dichloroethane	<5	tetrachloroethene	<5
2-butanone	<10	1,1,2,2-tetrachloroethane	<5
1,1,1-trichloroethane	<5	toluene	<5
carbon tetrachloride	<5	chlorobenzene	<5
vinyl acetate	<10	ethylbenzene	<5
bromodichloromethane	<5	styrene	<5
		total xylenes	<5

UNC Nuclear Industries

Date: May 11, 1987

Client I.D.:

TMA/Nortal Lab No.: Blank MB-1 (4/24/87)

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<10	1,2-dichloropropane	<5
bromomethane	<10	trans-1,3-dichloropropene	<5
vinyl chloride	<10	trichloroethene	<5
chloroethane	<10	dibromochloromethane	<5
methylene chloride	10	1,1,2-trichloroethane	<5
acetone	<10	benzene	<5
carbon disulfide	<5	cis-1,3-dichloropropene	<5
1,1-dichloroethene	<5	2-chloroethylvinylether	<10
1,1-dichloroethane	<5	bromoform	<5
trans-1,2-dichloroethene	<5	4-methyl-2-pentanone	<10
chloroform	<5	2-hexanone	<10
1,2-dichloroethane	<5	tetrachloroethene	<5
2-butanone	<10	1,1,2,2-tetrachloroethane	<5
1,1,1-trichloroethane	<5	toluene	<5
carbon tetrachloride	<5	chlorobenzene	<5
vinyl acetate	<10	ethylbenzene	<5
bromodichloromethane	<5	styrene	<5
		total xylenes	<5

UNC Nuclear Industries

Date: May 11, 1987

Client I.D.:

TMA/Norcal Lab No.: Blank MB-2 (4/24/87)

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<10	1,2-dichloropropane	<5
bromomethane	<10	trans-1,3-dichloropropene	<5
vinyl chloride	<10	trichloroethene	<5
chloroethane	<10	dibromochloromethane	<5
methylene chloride	6	1,1,2-trichloroethane	<5
acetone	<10	benzene	<5
carbon disulfide	<5	cis-1,3-dichloropropene	<5
1,1-dichloroethene	<5	2-chloroethylvinylether	<10
1,1-dichloroethane	<5	bromoform	<5
trans-1,2-dichloroethene	<5	4-methyl-2-pentanone	<10
chloroform	<5	2-hexanone	<10
1,2-dichloroethane	<5	tetrachloroethene	<5
2-butanone	<10	1,1,2,2-tetrachloroethane	<5
1,1,1-trichloroethane	<5	toluene	<5
carbon tetrachloride	<5	chlorobenzene	<5
vinyl acetate	<10	ethylbenzene	<5
bromodichloromethane	<5	styrene	<5
		total xylenes	<5

UNC Nuclear Industries

Date: May 21, 1987

Client I.D.:

TMA/Norcal Lab No.: Blank MB-3 (4/24/87)

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<10	1,2-dichloropropane	<5
bromomethane	<10	trans-1,3-dichloropropene	<5
vinyl chloride	<10	trichloroethene	<5
chloroethane	<10	dibromochloromethane	<5
methylene chloride	<5	1,1,2-trichloroethane	<5
acetone	<10	benzene	<5
carbon disulfide	<5	cis-1,3-dichloropropene	<5
1,1-dichloroethene	<5	2-chloroethylvinylether	<10
1,1-dichloroethane	<5	bromoform	<5
trans-1,2-dichloroethene	<5	4-methyl-2-pentanone	<10
chloroform	<5	2-hexanone	<10
1,2-dichloroethane	<5	tetrachloroethene	<5
2-butanone	<10	1,1,2,2-tetrachloroethane	<5
1,1,1-trichloroethane	<5	toluene	<5
carbon tetrachloride	<5	chlorobenzene	<5
vinyl acetate	<10	ethylbenzene	<5
bromodichloromethane	<5	styrene	<5
		total xylenes	<5

UNC Nuclear Industries

Date: May 21, 1987

Client I.D.:

TMA/Norcal Lab No.: Blank MB-4 (4/24/87)

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<10	1,2-dichloropropane	<5
bromomethane	<10	trans-1,3-dichloropropene	<5
vinyl chloride	<10	trichloroethene	<5
chloroethane	<10	dibromochloromethane	<5
methylene chloride	<5	1,1,2-trichloroethane	<5
acetone	<10	benzene	<5
carbon disulfide	<5	cis-1,3-dichloropropene	<5
1,1-dichloroethene	<5	2-chloroethylvinylether	<10
1,1-dichloroethane	<5	bromoform	<5
trans-1,2-dichloroethene	<5	4-methyl-2-pentanone	<10
chloroform	<5	2-hexanone	<10
1,2-dichloroethane	<5	tetrachloroethene	<5
2-butanone	<10	1,1,2,2-tetrachloroethane	<5
1,1,1-trichloroethane	<5	toluene	<5
carbon tetrachloride	<5	chlorobenzene	<5
vinyl acetate	<10	ethylbenzene	<5
bromodichloromethane	<5	styrene	<5
		total xylenes	<5

UNC Nuclear Industries

Date: May 21, 1987
Client I.D.:
TMA/Normal Lab No.: Blank MB-1 (4/27/87)

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<10	1,2-dichloropropane	<5
bromomethane	<10	trans-1,3-dichloropropene	<5
vinyl chloride	<10	trichloroethene	<5
chloroethane	<10	dibromochloromethane	<5
methylene chloride	<5	1,1,2-trichloroethane	<5
acetone	<10	benzene	<5
carbon disulfide	<5	cis-1,3-dichloropropene	<5
1,1-dichloroethene	<5	2-chloroethylvinylether	<10
1,1-dichloroethane	<5	bromoform	<5
trans-1,2-dichloroethene	<5	4-methyl-2-pentanone	<10
chloroform	<5	2-hexanone	<10
1,2-dichloroethane	<5	tetrachloroethene	<5
2-butanone	<10	1,1,2,2-tetrachloroethane	<5
1,1,1-trichloroethane	<5	toluene	<5
carbon tetrachloride	<5	chlorobenzene	<5
vinyl acetate	<10	ethylbenzene	<5
bromodichloromethane	<5	styrene	<5
		total xylenes	<5

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UNC Nuclear Industries

Date: May 21, 1987

Client I.D.:

TMA/Nortai Lab No.: Soil Holding Blank

Volatiles	ug/kg(ppb)	Volatiles	ug/kg(ppb)
chloromethane	<10	1,2-dichloropropane	<5
bromomethane	<10	trans-1,3-dichloropropene	<5
vinyl chloride	<10	trichloroethene	<5
chloroethane	<10	dibromochloromethane	<5
methylene chloride	<5	1,1,2-trichloroethane	<5
acetone	<10	benzene	<5
carbon disulfide	<5	cis-1,3-dichloropropene	<5
1,1-dichloroethene	<5	2-chloroethylvinylether	<10
1,1-dichloroethane	<5	bromoform	<5
trans-1,2-dichloroethene	<5	4-methyl-2-pentanone	<10
chloroform	<5	2-hexanone	<10
1,2-dichloroethane	<5	tetrachloroethene	<5
2-butanone	<10	1,1,2,2-tetrachloroethane	<5
1,1,1-trichloroethane	<5	toluene	<5
carbon tetrachloride	<5	chlorobenzene	<5
vinyl acetate	<10	ethylbenzene	<5
bromodichloromethane	<5	styrene	<5
		total xylenes	<5

ATTACHMENT C

EP TOXICITY STATISTICAL CALCULATION RESULTS

-BASIN #3, SLUDGE

CONCENTRATION (PPM)

Constituent	$\bar{x}$	Sx	$S\bar{x}$	UL
As				<0.04
Ba				<0.003
Cd	0.047	0.0083	0.0037	0.060
Cr	0.26	0.086	0.039	0.32
Pb				<0.08
Hg	<0.0026	<0.0013	<0.0006	<0.0035
Se				<0.1
Ag				<0.09

-BASIN #3, WHITE CRYSTALLINE MATERIAL

CONCENTRATION (PPM)

Constituent	$\bar{x}$	Sx	$S\bar{x}$	UL
As	<0.25	<0.30	<0.13	<0.45
Ba	<0.088	<0.191	<0.085	<0.22
Cd				<0.02
Cr	0.03	0.17	0.076	0.42
Pb				<0.08
Hg				<0.002
Se	<0.126	<0.124	<0.055	<0.21
Ag				<0.4

-BASIN #4, SLUDGE

CONCENTRATION (PPM)

Constituent	$\bar{x}$	Sx	$S\bar{x}$	UL
As	—	—	—	<0.02
Ba	—	—	—	<0.003
Cd	0.622	0.005	0.002	0.66
Cr	0.510	0.184	0.082	0.64
Pb	—	—	—	<0.08
Hg	0.0089	0.0029	0.0013	0.011
Se	<0.036	<0.013	<0.006	<0.045
Ag	—	—	—	<0.08

-BASIN #4, WHITE CRYSTALLINE MATERIAL

CONCENTRATION (PPM)

Constituent	$\bar{x}$	Sx	$S\bar{x}$	UL
As	0.076	0.078	0.035	<0.129
Ba	—	—	—	<0.007
Cd	—	—	—	<0.009
Cr	0.149	0.082	0.037	0.205
Pb	—	—	—	<0.2
Hg	<0.003	<0.0017	<0.0008	<0.0038
Se	0.16	0.055	0.024	0.198
Sg	—	—	—	<0.4

-BASIN #2, LIQUID

CONCENTRATION (PPM)

Constituent	$\bar{X}$	Sx	$S\bar{X}$	UL
As	0.080	0.028	0.013	0.099
Ba	0.634	0.156	0.070	0.74
Cd	———	———	———	<0.02
Cr	5.86	1.16	0.52	6.66
Pb	———	———	———	<0.02
Hg	0.0178	0.0110	0.0049	0.025
Se	<0.038	<0.022	<0.0097	<0.053
Ag	———	———	———	<0.2

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APPENDIX D

CLAY LINERS (ADMIXTURES) IN SEMIARID ENVIRONMENTS

NOTE: This appendix has been changed to incorporate Ecology's Notice of Deficiency comments and updated information.

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APPENDIX D

CLAY LINERS (ADMIXTURES) IN SEMIARID ENVIRONMENTS

The following paragraphs discuss the use of admixing clays to local soils to create low-permeability components for covers in semiarid environments such as that at the Hanford Site. Pure clay liners are not considered feasible for use in semiarid environments. However, with proper design, materials handling, construction, and quality control, a functional low-permeability liner consisting of local soils admixed with clay can be used in covers at the Hanford Site. A quick overview of clay liner failure mechanisms and documentation supporting clay liner use at the Hanford Site are discussed.

The following list of clay liner failure mechanisms has been thoroughly discussed (EPA 1986):

- Desiccation cracking
- Penetration
- Slope instability
- Settlement
- Erosion
- Freeze/thaw cycling
- Piping
- Design construction errors.

Of particular concern at the Hanford Site is desiccation cracking, a characteristic of clay-rich soils caused by volume changes in the clay structure. Volume changes occur because of stress imparted to the soil as a result of wet/dry cycling. This occurs when soils are exposed to the atmosphere. As soil pore water evaporates, a negative pore water pressure develops in the soil, causing a reduction in soil volume. The pore pressure acts in all directions causing soil shrinkage and cracking. When the soil is rewetted, the clay swells and the cracks are sealed. Failure occurs if foreign material, such as sand, is washed or blown into the cracks. The cracks can propagate deeper upon continuation of wet/dry, cycling providing preferential drainage paths for water.

Slope instability can occur when a liner is constructed on a sloped surface. Of particular concern in cover applications are clays placed over a synthetic membrane. The clay may slide over the smooth membrane surface. Failure can also occur in soils because of insufficient shear strength.

A small settlement, in general, is not a problem when it is uniform throughout the site. However, differential settlement can lead to cracks and cause pathways for water flow.

Piping failure is another important concern for clay liners. Piping is a form of soil erosion that occurs underground. Piping occurs when fine-grained soils (clays) contain particles that are bound together. When water percolates through the clay liner, it can detach some of these bound particles, thereby transporting them to coarser underlying soils. With time, progressively larger particles are removed causing an underground flow channel or pipe. The pipe would start at the underside of the clay liner and move progressively upward opposite the direction of flow. Clay liners underlain by soils containing less than 15 percent clay may be susceptible to piping. For piping to occur, the hydraulic gradient at the base of the clay liner must be greater than the interparticle bonding forces.

Penetration failure occurs when plant roots, animals, or humans are able to reach and disrupt the clay liner. Other potential penetrations are seal failures around manholes; and leak detection and collection system pipes.

Erosion failure occurs when raindrops detach soil particles that are then uniformly transported downslope (sheet erosion). Another type of failure (rill erosion) occurs when channels are developed by concentrated flow often caused by slumping of undercut slopes.

Freeze/thaw cycling can cause the formation of ice lenses at the frost line. Cold atmospheric temperatures cause soil moisture to migrate upward where freezing occurs at the frost line. For soils with only pore (interlayer) water present during the freezing cycle, this is not a major problem. Very little, if any, soil heaving is expected from this scenario. However, if water is added to the soil system prior to freezing, considerable ice lenses could form at the frost line, thus heaving the overlying soil and causing vertical cracks within the soil matrix.

The following construction errors have led to clay liner failures in past surface impoundment facilities (EPA 1986b).

- Desiccation of the clay liner between completion of construction and commencement of operations allows the clay to crack.

- A nonuniform moisture distribution in the soil results in clods with wet surfaces and dry, cracked interiors. This problem is caused by inadequate breakup of large clods prior to compaction, uneven water distribution by watertrucks, and inadequate time for water to penetrate the soil.

- High permeabilities result from inadequate control of moisture, density, and compactive effort.

- Improper screening of incoming liner material can result in small roots, rocks, lenses, and other heterogeneities in the clay liner that can increase permeability.

Of the above stated failure mechanisms, desiccation cracking seems to be of most concern. The following discussion indicates how all the clay liner failure mechanisms are addressed by proper design, materials handling, construction, and quality control, with special emphasis placed on desiccation cracking.

Failure due to cracking of clay liners in covers is controlled by implementation of the following factors:

- Optimizing the clay-to-native-soil ratio
- Constructing the clay liner to a depth such that the relative humidity of the soil remains greater than 54 percent
- Burying the clay liner below the frost line
- Preventing overlying materials from entering cracks.

Reduction of potential desiccation cracks in the 183-H Basins liner is provided by optimizing the clay-to-silty-sand ratio, thereby reducing shrinkage strains and preventing the clay liner from dehydrating by depth of burial. It is assumed that sodium bentonite, a montmorillonite clay will be admixed with existing excavation site soils (silty sand) at approximately 10 to 15 weight percent. The design of the 183-H Basins cover places the clay liner at a minimum depth of 4 feet below finished cover grade.

Optimizing the clay-to-silty-sand ratio is based on data that indicate that desiccation cracks result from clay shrinkage strains (Olson 1985). Therefore, a shrinkage-resistant clay liner system can be designed by providing a large percentage of sand in the liner matrix, forming a framework of rigid particles. Only enough clay is admixed such that upon wetting the clay effectively plugs up the void spaces between sand particles, providing a low-permeability mix.

A number of shrinkage, cracking, and permeability tests were performed on a range of clay and sand mixes including Wyoming bentonite and Los Alamos silty sand. The data indicate that compactive effort, compaction water content, and percent of silty sand influence soil matrix shrinkage potential (Olson 1985). Less than 1 percent shrinkage strain was found for the 12 percent bentonite/88 percent silty-sand mix which was compacted at less than 20 percent water content with complementary permeabilities less than 1 E-7 centimeters per second. In fact, Los Alamos silty sand mixed with 25 percent Wyoming bentonite produced a low-shrinkage strain of less than 3 percent. A few laboratory tests on Hanford soils and bentonite clay will determine the appropriate amount of bentonite to add to the 183-H Basins local site soils to provide a low-shrinkage, low-permeability clay liner composition.

The cover design for the 183-H Basins places the clay liner at least 4 feet below cover grade. The pore water mixed in the clay liner composition for compaction and permeability control may cause up to 1 percent shrinkage (inconsequential) upon evaporation. However, the montmorillonite will not

completely dehydrate and will remain capable of reswelling at 4 feet below grade. This is because the relative humidity of the soil at 4 feet below grade remains at approximately 99.9 percent all year. The basal spacing of montmorillonite at 0 percent relative humidity is 10 angstroms (1 ten-billionth of a meter: 10^{-10} meters). The basal spacing at greater than 54 percent relative humidity is 18 angstroms (Dixon 1977). Therefore, the montmorillonite remains partially expanded under this condition and will not dry out in the proposed barrier. Data providing field moisture contents of Hanford Site soils at approximately 4 feet below grade are listed in Table D-1.

Table D.1. Water Retention Data of Typical Hanford Site Soils.

Sample	Depth (m)	Moisture Content (Dry %)	Soil Water Potential (Bar)	Relative Humidity (%)
1.1	2.1	3.58	5.0	99.637
2.2	1.6	5.71	1.0	99.927
3.1	1.6	5.87	>0.1	99.993
4.1	1.6	5.63	>0.1	99.99
5.1	1.5	7.17	>0.1	99.99

The relative humidity of the soils listed in Table D.1 are taken from (Hillel 1977), based on the soil/water potential interpolated from the test data. Data exist that shows that the water content of Hanford Site soils at 6 feet below grade does not change more than approximately 2 percent over a period of 1 year as measured in field lysimeters (Jones 1978). The lysimeter measurements showed a change in water content from 4.5 percent to 6.5 percent, which indicates that the data in Table D.1 is applicable for an annual prediction of relative humidity being greater than 99.64 percent. This coupled with data in (Dixon 1977) indicates that the montmorillonite will stay expanded and, therefore, not dehydrate in the 183-H Basins cover.

When small cracks form due to approximately 1 percent anticipated shrinkage of the clay, failure would be dependant on the cracks filling with foreign materials prior to reswelling. The cover design calls for the use of geotextiles and properly graded filter materials to prevent the migration of overlain materials. This cover design will help reduce the availability of soils to fill cracks.

Slope stability analyses will be performed once the laboratory tests of soil strength and liner material properties are completed, and will provide for appropriate slope validation. The controlling factor for most liners using geomembranes is the relatively shallow friction angles between the geomembrane and the overlain clay soil.

Differential settlement is not anticipated to be a problem for the 183-H Basins cover due to a stable waste form. However, proper field compaction of

soil layers is important. Relatively uniform settlement is not a problem. Even minor differential settlement should be easily handled by the self healing properties of a 2-foot thick clay/native-soil layer.

Surface erosion of the clay liner may be a problem if much precipitation occurs during construction. However, subsurface erosion of a buried clay liner (piping) must be considered. The topsoil of the cover is designed to recycle water to the atmosphere, thus preventing most of the water from reaching the clay liner. A sand drainage layer is provided directly above the clay liner to remove any water that does permeate the topsoil. The computer model has indicated that only 0.0735 inch of precipitation (197 cubic feet per year) is expected to permeate through the cover annually, assuming a 10 percent geomembrane failure.

Penetration of the clay liner by plants, animals, and humans will, for the most part, be prevented by the depth of the liner. Plants, specifically, will not be likely to penetrate past the topsoil layer, because the sand drainage layer will be at a much lower water potential. The 40-mil high-density polyethylene geomembrane that is located 4 feet below the cover surface, directly on top of the clay liner, will also act as a deterrent to further growth of plant roots and animal intrusion. Data indicate that buried 40-mil polyethylene liners were not penetrated by rats, even when they were faced with starvation (Mitchell 1984). Most of the burrowing animals that occupy the Hanford Site, live in the top 4 feet of soil. Cobble on the cover embankment slopes will reduce the potential for animals to attempt to burrow dens laterally into the cover embankment. There is no topsoil on the sideslopes, only a one-foot thick sand drainage layer which is not stable for den construction. Also, without proper cobble protection, the mammals have much easier access to the geomembrane.

Perhaps of most importance, regarding successful clay liner performance, are the materials handling, construction methods, and construction quality control measures applied to the project. Continuous daily inspections of the liner installation project are mandatory to identify and document problems and successes, and to provide a mechanism to obtain corrective action to problem areas. Bad weather conditions should be avoided during construction. Precipitation events can flood or erode the construction site. Hot dry weather could desiccate the liner, if left unprotected. Frozen soils prevent adequate compaction. Depending on climatic conditions, the clays may need to be protected from moisture loss and erosion while stockpiled prior to construction. A plastic cover may need to be placed over the clay liner during inactive periods to prevent drying of the liner during construction.

Proper screening of materials used in liner construction to remove roots, rocks, and miscellaneous debris is imperative. Also, proper control of moisture content, density, and compactive effort during construction will help ensure a successful liner installation. These are standard construction practices. Reduction of clods in the clay/native-soil mixture is important to provide a homogeneous mixture of water in the liner materials.

The two design features, as discussed above, are the proper clay/native-soil composition and the depth of burial. These coupled design features

provide for a low-shrinkage, low-permeability, stable clay liner installation. When coupled with proper construction/installation techniques, the clay liner will function over the proposed lifetime of the cover.

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APPENDIX E

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE (HELP)

USING THE HELP MODEL

NOTE: This appendix is essentially unchanged from prior submittals (editorial corrections have been made to enhance readability).

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APPENDIX E

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE (HELP)

USING THE HELP MODEL

Hydrologic Evaluation of Landfill Performance (HELP) computer modeling results are included in this appendix. The HELP model was developed by the U.S. Environmental Protection Agency to aid hazardous waste landfill designers to estimate water budget and quantity of leachate from a landfill. Therefore, the model is used as a tool to estimate water drainage and percolation through covers and/or liner/leachate collection systems for landfills. The model uses a deterministic, sequential daily analysis to calculate runoff, evapotranspiration, percolation, and lateral drainage. The following discussion is based on the documentation of the HELP model (EPA 1984) and summary of model provided by Ebasco. The existing newest released version of the HELP model will be utilized during definitive design.

The HELP model requires the use of specific cover soil physical properties and local climatological data. The HELP model is provided with climatological data for many cities across the United States including Yakima, Washington. Local climatological data available from the Hanford Meteorological Station were input to the HELP model where available (Stone 1983). Some of the specific climate data inputs are daily precipitation, mean monthly temperatures, mean monthly solar radiation, leaf area indices, evaporative zone depth, and winter cover factors. The specific soil data input parameters include: porosity, hydraulic conductivity, water transmissivity, evaporation coefficient, and a Soil Conservation Service (SCS) run-off curve number. The topsoil water retention, porosity, and saturated hydraulic conductivity data used in the model were provided by Fayer 1987 (see Figure E.1). The soil properties displayed are derived from a composite of several sandy loam samples taken west of the 200 West Area. This soil is coarser with approximately one-half the water retention capacity of the silt loam available at the McGee Ranch site, thus providing a conservative estimate of water retention and percolation rates. Specific cover design data include layer thickness, lateral distance to a drainage medium, slope, and use and estimated failure of geomembranes.

The model is set up to run four different kinds of layers, three of which are used for the cover. The four types of layers are: (1) vertical drainage, (2) lateral drainage, (3) barrier or low-permeability components, and (4) waste layer. For the model, the waste layer was not used as a cover component for a vertical drainage layer.

The vertical layers ensure that there is no significant resistance to vertical flow. Water can move up or down to account for evapotranspiration as well as percolation. No lateral drainage is assumed for vertical drainage components. The topsoil and foundation layers are the vertical components modelled in the 183-H Basins cover.

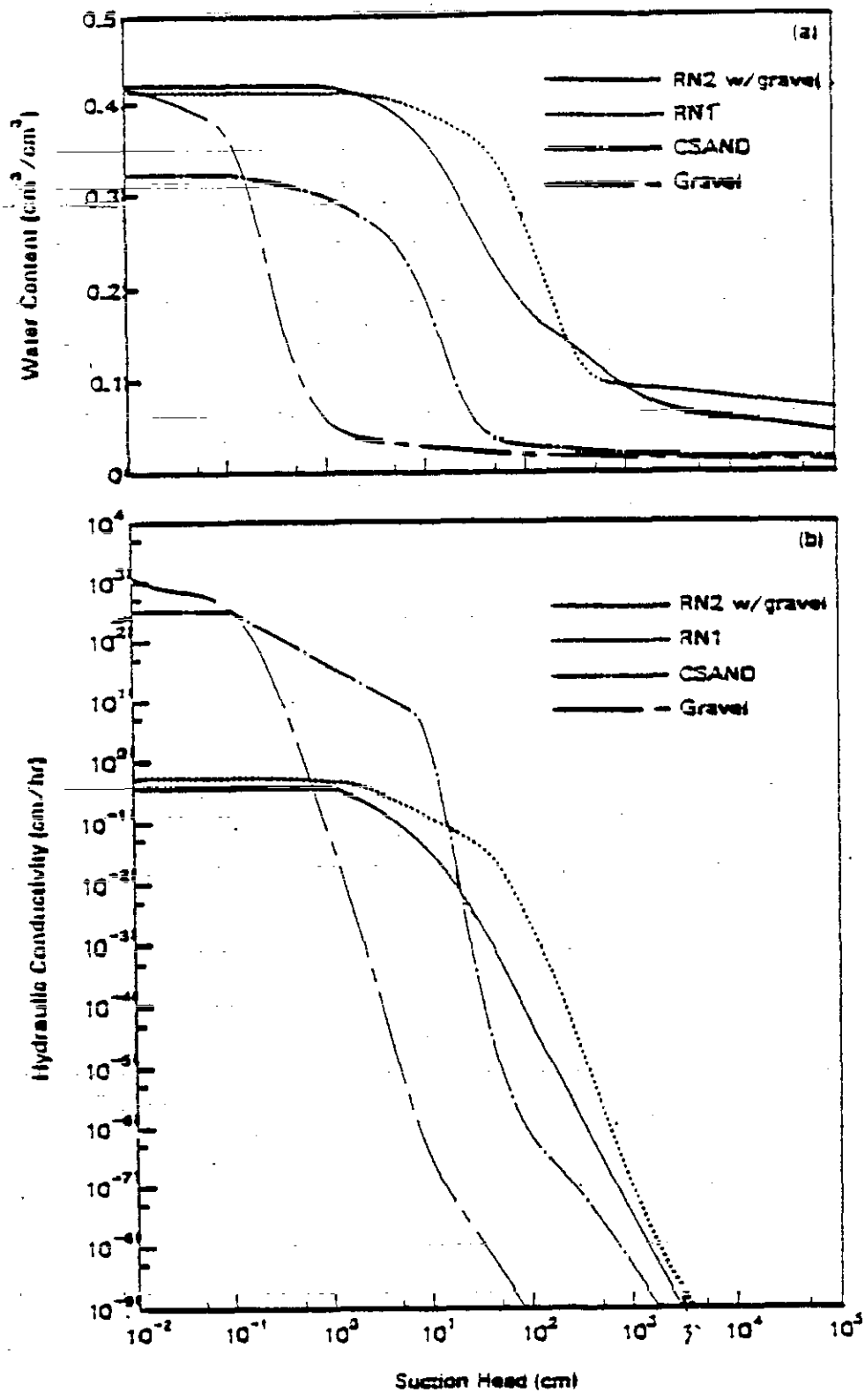


FIGURE E.1. Moist Characteristics (a) and Hydraulic Conductivity Functions (b) of Barrier Materials. (From PNL-6297, a Battelle Pacific Northwest Laboratories document for the U.S. DOE)

Both vertical and lateral flow conditions are assumed for the lateral drainage layers where lateral flow is controlled by the slope, lateral length of the drainage path that water must travel to exit the cover, and the depth of saturated soil above the low-permeability or barrier layer. The model assumes the lateral drainage layer has a permeability equal to or greater than the vertical drainage layers.

For a low-permeability or barrier layer, only vertical flow in the downward direction is assumed. This is based on the saturated soil height or head above the barrier layer. An impermeable geomembrane is placed directly on the barrier layer. Two scenarios assumed a 2 percent and 10 percent leakage rate through the geomembranes. A plan and cross-section of the areal extent and layered configuration that was modelled is presented in Figure E.2.

A general description of how the model functions is provided in the following paragraphs. The model calculates water movement off the cover surface and through the cover on a daily basis. The model handles precipitation as subdivided into components including run-off, evapotranspiration, percolation, and subsurface lateral drainage.

Surface run-off is that component of precipitation that does not infiltrate the soil. Once the infiltration requirements are fulfilled, water begins to be stored in natural surface depressions and flows through small channels in the cover surface. A Soil Conservation Service curve number is assigned to the soil and is coupled with a Darcian flow equation modified for unsaturated flow conditions.

Infiltration has been calculated based on the differences between daily precipitation and the sum of the change in surface storage of precipitation, the daily run-off, and surface evaporation. If the mean daily temperature is below 32 °F, the precipitation would be stored as snow.

Evapotranspiration has been modeled as a function of available energy, vegetation, soil, water transmissivity, and water content. For the evapotranspiration function, available surface water is first addressed and then subsurface water is used to separately calculate plant transpiration and evaporation on a daily basis.

The model assumes that the layers are homogeneous with respect to hydraulic conductivity, porosity, and field capacity. Free lateral flow is assume for the drainage layer above the low-permeability component.

The climatological and soil properties, and the cover design features used in the model runs are provided in Tables E.1 through E.3. The products of the model runs are summaries of annual totals, average annual total for five years, and peak daily totals for precipitation, run-off, evapotranspiration, percolation from top barrier, percolation from base of cover, drainage from top barrier layer, and drainage from base of cover. The worst-case scenario assuming a 10 percent geomembrane failure, indicated an annual percolation from the base of cover of 0.0735 inches (equivalent to 197 cubic feet). Table E.1 is based on the data from the hydrologic evaluation of landfill performance computer model runs.

EBASCO SERVICES INCORPORATED

BY MEH DATE 11/23/88 SHEET ____ OF ____

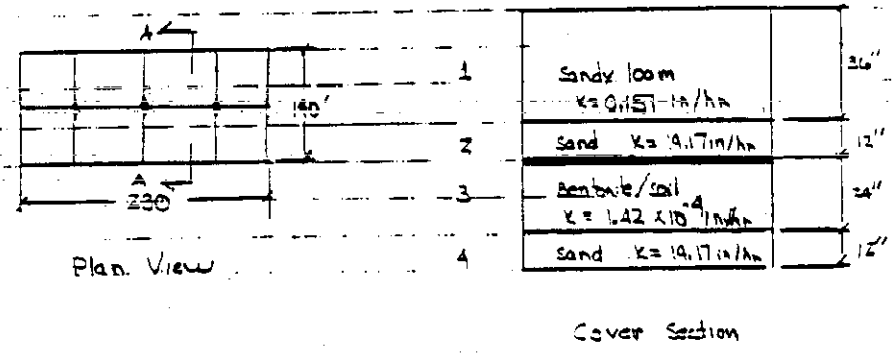
CHKD. BY ____ DATE ____ OFS NO. [illegible] DEPT. NO. [illegible]

CLIENT NLGC

PROJECT Closure of Evaporation Ponds

SUBJECT HELP MODEL ANALYSIS OF COVER SYSTEM

Design Criteria



Plan View

Cover Section

Model Parameters

LAYER	Thickness (in)	Model Code	Texture Code
1	36	1	8
2	12	2	3
3	24	5	20
4	12	1	3

drainage D = 70'
S = 3%

Surface Area = 32,200 ft.

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FIGURE E.2. Plan and Cross-Section of Modelled Cover System.

TABLE E.1. HELP Model Runs for the 183-H Solar Evaporation Basins Cover System, Hanford Site, Washington on January 26, 1988 with 2% and 10% Liner Leakage Factors (differing 10% factor value in parentheses)

	Vertical Percolation Layer 1	Lateral Drainage Layer 2	Barrier Soil Layer 3 with Liner	Vertical Percolation Layer 4	General Simulation
Thickness (in.)	36	12	24	12	--
Evaporation Coefficient (mm/day EO.5)	3.8	3.3	3.1	3.3	3.8
Porosity (vol/vol)	0.442	0.389	0.520	0.389	--
Field Capacity (vol/vol)	0.256	0.199	0.450	0.199	--
Wilting Point (vol/vol)	0.133	0.066	0.360	0.066	--
Effective Hydraulic Conductivity (in./n)	0.157	14.17	0.000142	14.17	--
Slope (%)	--	3	--	--	--
Drainage Length (ft)	--	70	--	--	--
SCS Runoff Curve No.	--	--	--	--	73
Total Area of Cover (ft^3)	--	--	--	--	32,200
Evaporative Zone Depth (in.)	--	--	--	--	4
Liner Leakage (%)	--	--	--	--	2 (10)
Vegetation Storage Upper Limit (in.)	--	--	--	--	1.768
Initial (in.)	--	--	--	--	0.778

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9 0 1 1 7 0 3 1 6 7 9

TABLE E.2. Annual Water Totals, Average Annual Totals, and Peak Daily Values for 1980-1984 for the 183-H Solar Evaporation Basins Cover System, Hanford Site, Washington with 2% and 10% Liner Leakage Factors (differing 10% factor values in parentheses)

	1980 Water Totals			1981 Water Totals			1982 Water Totals			1983 Water Totals			1984 Water Totals			1980-1984 Average Annual Totals			1980-1984 Peak Daily Values		
	(in.)	(ft^3)	(%)	(in.)	(ft^3)	(%)	(in.)	(ft^3)	(%)	(in.)	(ft^3)	(%)	(in.)	(ft^3)	(%)	(in.)	(ft^3)	(%)	(in.)	(ft^3)	(vol/vol)
Precipitation	9.26	24848	100	6.76	18139	100	7.54	20232	100	10.62	28497	100	6.96	18676	100	8.23	22078	100	0.92	2468.7	--
Runoff	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	--
Evapotranspiration	7.856	21093	84.84	5.962	15997 (15999)	88.19 (88.20)	5.815	15602 (15603)	77.12	7.614	20432 (20431)	71.70	6.440	17281 (17280)	92.53	6.737	18078 (18079)	81.88	--	--	--
Percolation*																					
From Top Barrier	0.0216 (0.0775)	58 (208)	0.23 (0.84)	0.0185 (0.0718)	50 (193)	0.27 (1.06)	0.0174 (0.0679)	47 (182)	0.23 (0.90)	0.0202 (0.0807)	54 (217)	0.19 (0.76)	0.0171 (0.0695)	46 (186)	0.25 (1.00)	0.0190 (0.0735)	51 (197)	0.23 (0.89)	0.0008 (0.0042)	2.2 (11.2)	-- --
From Base of Cover	0.0216 (0.0775)	58 (208)	0.23 (0.84)	0.0185 (0.0718)	50 (193)	0.27 (1.06)	0.0174 (0.0679)	47 (182)	0.23 (0.90)	0.0202 (0.0807)	54 (217)	0.19 (0.76)	0.0171 (0.0694)	46 (186)	0.25 (1.00)	0.0190 (0.0735)	51 (197)	0.23 (0.89)	0.0008 (0.0041)	2.2 (11.1)	-- --
Lateral Drainage through Sand Layer	0.878 (0.826)	2357 (2217)	9.48 (8.92)	1.152 (1.098)	3091 (2947)	17.04 (16.24)	1.422 (1.371)	3815 (3679)	18.86 (18.18)	2.545 (2.485)	6830 (6668)	23.97 (23.40)	0.983 (0.930)	2636 (2497)	14.12 (13.37)	1.396 (1.342)	3746 (3601)	16.97 (16.31)	0.078 (0.077)	208.2 (206.8)	-- --
From Base of Cover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	--
Soil Water at Start of Year	26.23	70333	--	26.71 (26.70)	71666 (71656)	--	26.33	70652 (70643)	--	26.64	71493 (71483)	--	26.60	71381 (71371)	--	--	--	--	--	--	--
at End of Year	26.71 (26.70)	71666 (71656)	--	26.33	70652 (70643)	--	26.64	71493 (71483)	--	26.60	71381 (71371)	--	26.55	71249 (71239)	--	--	--	--	--	--	--
Vegetation Soil Water																					
Maximum	--	--	--	--	--	--	--	--	--		--	--	--	--	--	--	--	--	--	--	0.2812
Minimum	--	--	--	--	--	--	--	--	--		--	--	--	--	--	--	--	--	--	--	0.1330
Head																					
on Top Barrier Layer	--	--	--	--	--	--	--	--	--		--	--	--	--	--	--	--	--	4.2	--	--
on Base of Cover	--	--	--	--	--	--	--	--	--		--	--	--	--	--	--	--	--	0	--	--
Snow Water																			0.91	2476	
at Start of Year	0	0	--	0.02	59	--	0.03	73	--	0	0	--	0.48	1293	--	--	--	--	--	--	--
at End of Year	0.02	59	--	0.03	73	--	0	0	--	0.48	1293	--	0.05	139	--	--	--	--	--	--	--
Annual Water Budget Balance	0	1	0	0	1	0	0	1 (0)	0	0	0	0	0	-1	-0.01	--	--	--	--	--	--

*Percolation from Top Barrier is defined as the percolation through the Low-Permeability Component.
Percolation from Base of Cover is defined as the percolation through the Foundation Component.

TABLE E.3. Monthly Mean and Average Values for the 183-H Solar Evaporation Basins Cover System, Hanford Site, Washington with 2% and 10% Liner Leakage Factors (differing 10% factor values in parentheses)

Month	Mean Temperature (°F)	Mean Solar Radiation (Langley/day)	1980 - 1984 Average Water Totals: Precipitation (in.)	Runoff (in.)	Evapotranspiration (in.)	Percolation (in.)** from Top of Barrier	Percolation (in.)** from Base of Cover	Drainage (in.)** from Top of Barrier	Drainage (in.)** from Base of Cover
January	30.74	105.13	0.74	0	0.615	0.0018 (0.0088)	0.0018 (0.0088)	0.166 (0.159)	0 0
February	33.75	190.35	0.91	0	1.202	0.0021 (0.0103)	0.0021 (0.0103)	0.115 (0.107)	0 0
March	41.85	322.64	0.64	0	0.636	0.0024 (0.0104)	0.0024 (0.0104)	0.091 (0.083)	0 0
April	52.87	466.55	0.46	0	0.486	0.0024 (0.0079)	0.0024 (0.0079)	0.021 (0.015)	0 0
May	63.86	583.52	0.80	0	0.701	0.0017 (0.0042)	0.0017 (0.0042)	0.011 (0.008)	0 0
June	71.88	642.20	0.69	0	0.761	0.0012 (0.0029)	0.0012 (0.0029)	0.006 (0.004)	0 0
July	74.76	626.87	0.13	0	0.186	0.0005 (0.0002)	0.0005 (0.0002)	0	0 0
August	71.75	541.65	0.05	0	0.048	0.0001	0.0001	0	0 0
September	63.65	409.36	0.59	0	0.486	0.0012 (0.0031)	0.0012 (0.0031)	0.011 (0.010)	0 0
October	52.63	265.45	0.47	0	0.333	0.0012 (0.0039)	0.0012 (0.0039)	0.037 (0.034)	0 0
November	41.64	148.48	1.35	0	0.638	0.0021 (0.0101)	0.0021 (0.0101)	0.039 (0.234)	0 0
December	33.62	89.80	1.39	0	0.647	0.0023 (0.0115)	0.0023 (0.0115)	0.698 (0.689)	0 0

*On Days 1, 119, 136, 153, 170, 187, 204, 220, 237, 254, 271, 288, and 366 of the year, the Leaf Area Index was 0. Assuming bare ground, the Winter Cover Factor was 0.

**Percolation and drainage from top of barrier and base of cover are defined in the footnote of Table E.2.

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APPENDIX F

COVER EROSION AND DRAINAGE CALCULATIONS

NOTE: This appendix has been changed from prior submittals to incorporate Ecology's Notice of Deficiency comments.

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APPENDIX F

COVER EROSION AND DRAINAGE CALCULATIONS

Water Erosion Potential--The erosion potential of the cover surface soil due to precipitation events is evaluated using the U.S. Department of Agriculture (USDA) Universal Soil Loss Equation (USLE). The Universal Soil Loss Equation consists of six quantifiable factors, as follows (EPA 1979):

$$A = RKLSCP$$

where:

A = Average soil loss (tons/acre/year)
R = Rainfall and run-off erosivity index
K = Soil erodibility factor
L = Slope length factor
S = Slope steepness factor
C = Cover/management factor
P = Practice factor.

The following topsoil properties and cover design details are used to evaluate A:

- Topsoil type: silty sand to silt
- Average percent organic matter: 0.23 percent (Routson 1973)
- Estimated percent clay: 6 percent (Routson 1973)
- Estimated percent silt: 85 percent (Last 1987)
- Estimated percent sand: 9 percent (Last 1987)
- Uniform percent cover slope: 3 percent
- Cover length (Maximum drainage length): 70 feet
- Cover revegetation: Thickspike and Siberian wheatgrasses to 0 percent cover with no canopy.

Therefore:

R = 20, from Figure F.1 (EPA 1979)
K = 0.64, from Figure F.2 (EPA 1979)
LS = 0.26, from Table F.1 (EPA 1979)
C = 0.20 (Nyhan 1986)
P = 1.0 (Nyhan 1986)
A = (20)(0.64)(0.26)(0.20)(1.0) = 0.67 tons per acre per year.

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9 0 1 1 7 0 3 1 6 7 7

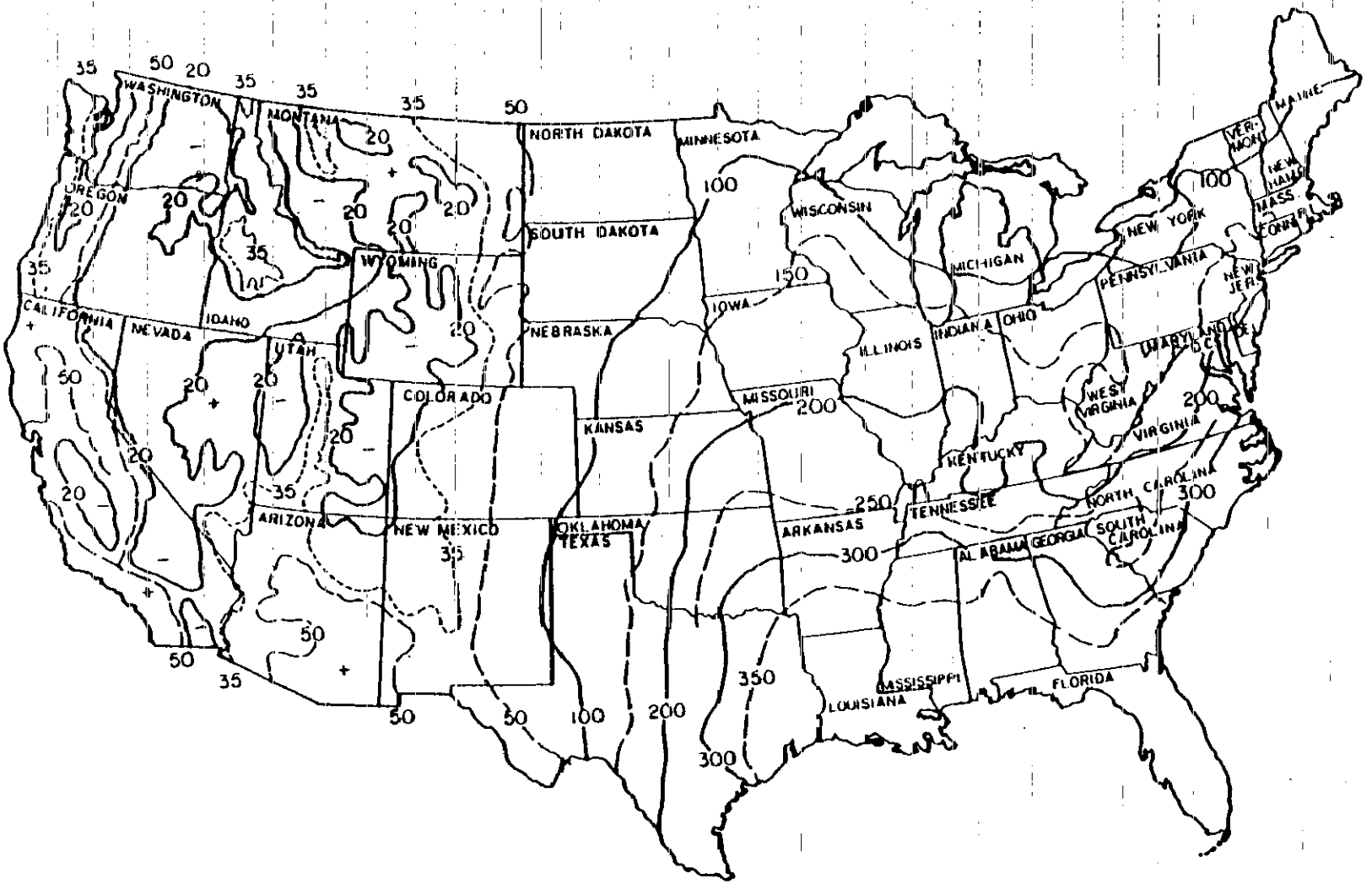

FIGURE F.1. Average Annual Values of Rainfall-Erosivity Factor R. (EPA 1979)

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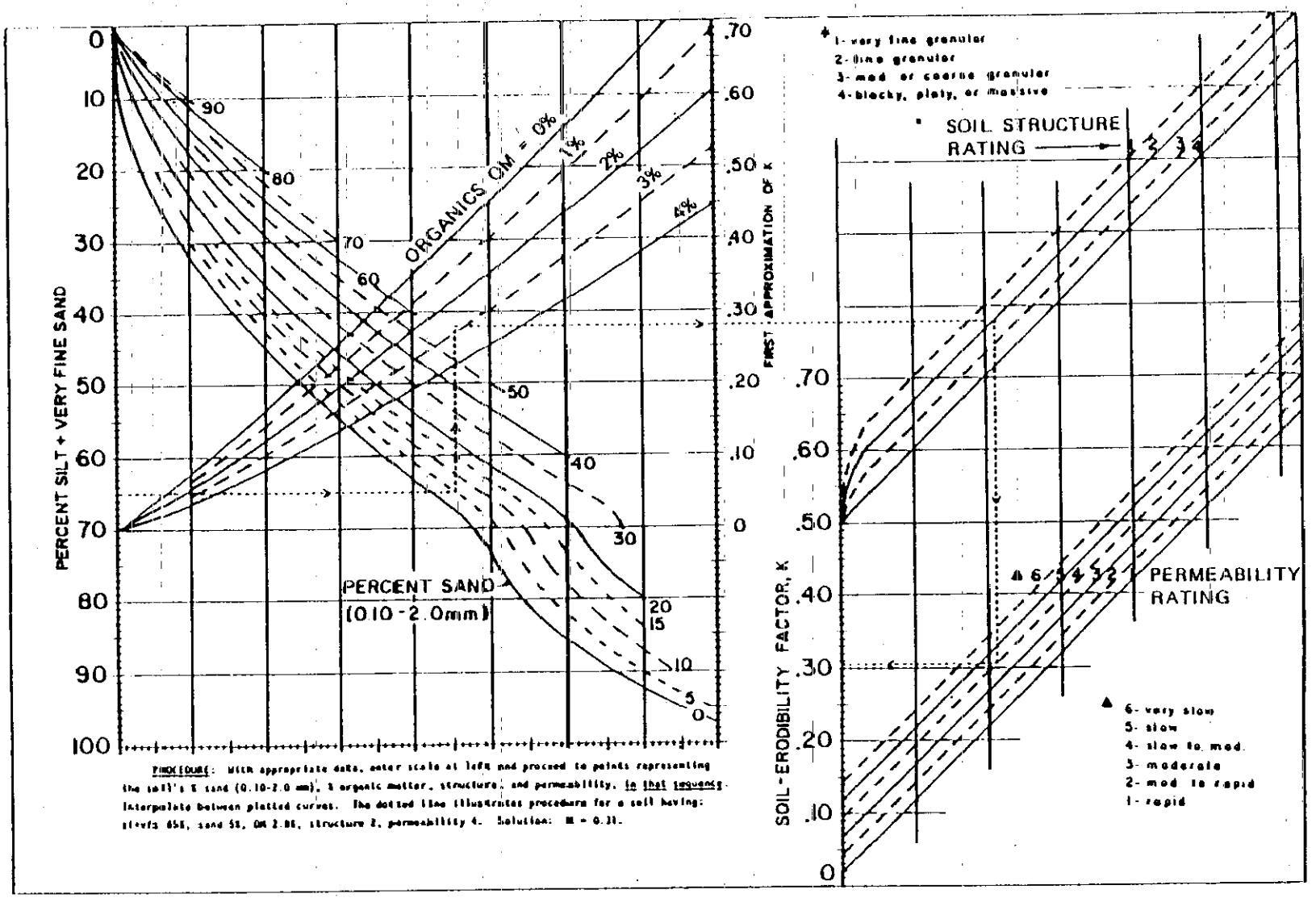


FIGURE F.2. Nomograph for Determining Soil-Erodibility Factor K for U.S. Mainland. (EPA 1979)

TABLE F.1. Values of the Factor LS for Specific Combinations of Slope Length and Steepness

% Slope	Slope length (feet)											
	25	50	75	100	150	200	300	400	500	600	800	1000
0.5	0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.15	0.16	0.17	0.19	0.20
1	0.09	0.10	0.12	0.13	0.15	0.16	0.18	0.20	0.21	0.22	0.24	0.26
2	0.13	0.16	0.19	0.20	0.23	0.25	0.28	0.31	0.33	0.34	0.38	0.40
3	0.19	0.23	0.26	0.29	0.33	0.35	0.40	0.44	0.47	0.49	0.54	0.57
4	0.23	0.30	0.36	0.40	0.47	0.53	0.62	0.70	0.76	0.82	0.92	1.0
5	0.27	0.38	0.46	0.54	0.66	0.76	0.93	1.1	1.2	1.3	1.5	1.7
6	0.34	0.48	0.58	0.67	0.82	0.95	1.2	1.4	1.5	1.7	1.9	2.1
8	0.50	0.70	0.86	0.99	1.2	1.4	1.7	2.0	2.2	2.4	2.8	3.1
10	0.69	0.97	1.2	1.4	1.7	1.9	2.4	2.7	3.1	3.4	3.9	4.3
12	0.90	1.3	1.6	1.8	2.2	2.6	3.1	3.6	4.0	4.4	5.1	5.7
14	1.2	1.6	2.0	2.3	2.8	3.3	4.0	4.6	5.1	5.6	6.5	7.3
16	1.4	2.0	2.5	2.8	3.5	4.0	4.9	5.7	6.4	7.0	8.0	9.0
18	1.7	2.4	3.0	3.4	4.2	4.9	6.0	6.9	7.7	8.4	9.7	11.0
20	2.0	2.9	3.5	4.1	5.0	5.8	7.1	8.2	9.1	10.0	12.0	13.0
25	3.0	4.2	5.1	5.9	7.2	8.3	10.0	12.0	13.0	14.0	17.0	19.0
30	4.0	5.6	6.9	8.0	9.7	11.0	14.0	16.0	18.0	20.0	23.0	25.0
40	6.3	9.0	11.0	13.0	16.0	18.0	22.0	25.0	28.0	31.0	--	--
50	8.9	13.0	15.0	18.0	22.0	25.0	31.0	--	--	--	--	--
60	12.0	16.0	20.0	23.0	28.0	--	--	--	--	--	--	--

Values given for slopes longer than 300 feet or steeper than 18% are extrapolations beyond the range of the research data and, therefore, less certain than the others.

(EPA 1979)

This is an acceptable erosion rate as the overall site erosion is recommended to be limited to 2 tons per acre, which is a rate that does not significantly increase cover maintenance (EPA 1982).

Wind Erosion Potential--The wind erosion potential of the topsoil is evaluated using the Wind Erosion Equation (WEE) (EPA 1979) as follows:

$$A' = f(K', C', L', T', V')$$

where:

A' = Annual soil loss (tons per acre per year)
K' = Soil erodibility index
T' = Soil ridge roughness factor
C' = Climate factor
L' = Length of field along prevailing wind direction
V' = Equivalent quantity of vegetative cover

The erodibility index factor $(A_1') = (K')$ is a product of the soil erodibility factor and knoll adjustment (Figure F.3), respectively. The range of particle sizes greater than 0.84 millimeters is less than 7 percent in the best case; and therefore, an average of 1 percent is assumed for the sandy silt to silt of the McGee Ranch soils. Figure F.3 yields an erodibility factor of 250 tons per acre. The knoll adjustment, based on a 3 percent slope, is 147 percent soil loss. Therefore:

$$(A_1') = 1.47(250) = 367.5 \text{ tons per acre.}$$

The estimated soil ridge factor (T') is 0.6, based on a 1-inch assumed ridge roughness (see Figure F.4). The erodibility increment is:

$$A_2' = A_1'(T') = 367.5 \text{ tons/acre}(0.6) = 220.5 \text{ tons per acre.}$$

The climate factor (C') is provided for two months, March and October (see Figure F.5). Both months were selected to represent one-half year, thus being more realistic for the range of seasons. C' is interpolated from Figure F.5 to be 9 percent for October and 25 percent in March. The erodibility increment $A_3' = A_2'(C')$.

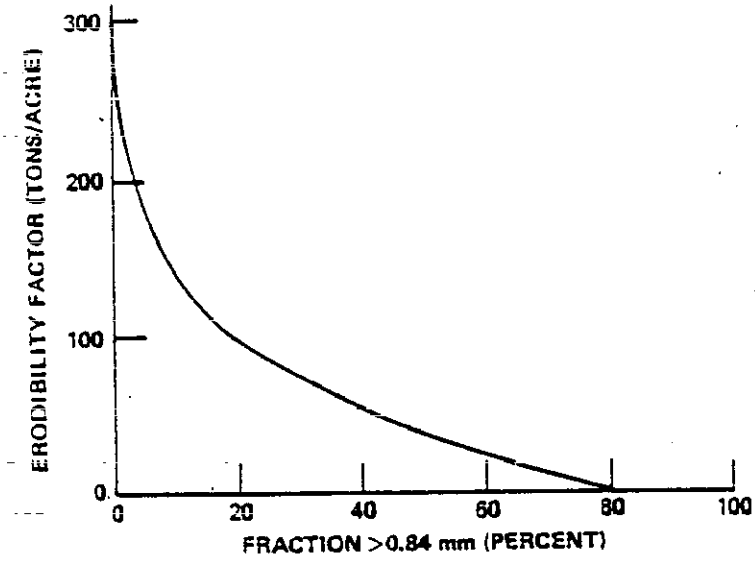
For one-half year, $A_3' = 220.5$ tons per acre(0.09) = 20 tons per acre.

For one-half year, $A_3' = 220.5$ tons per acre(0.25) = 55 tons per acre.

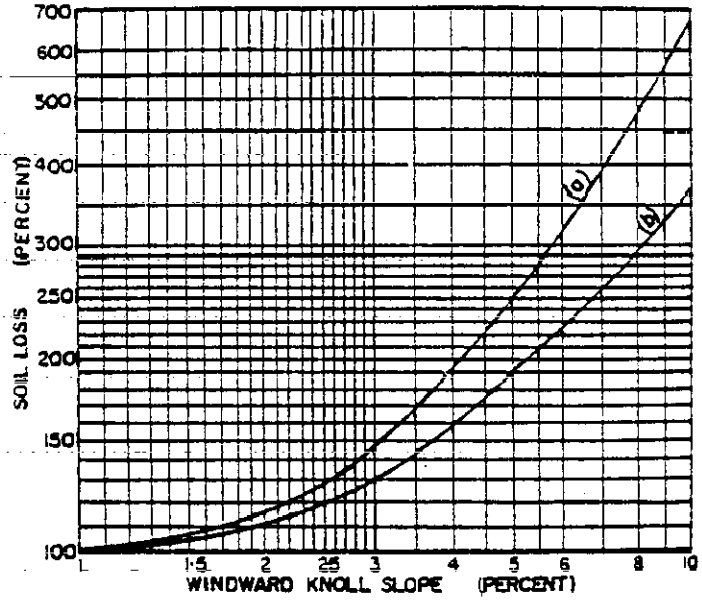
A graphical solution to $A_4' = (A_3')\ f(L')$ is derived through the use of Figure F.6. The prevailing wind direction is from the WNW to NW (Stone 1983); therefore, the field length is assumed as worst case or 230 feet.

For one-half year, $A_4' = 49$ tons per acre.

For one-half year, $A_4' = 17$ tons per acre.



Wind erosion versus percent coarse fraction.[93]



Knoll adjustment (a) from top of knoll and (b) from upper third of slope.

FIGURE F.3. Erodibility Factor and Knoll Adjustment. (EPA 1979)

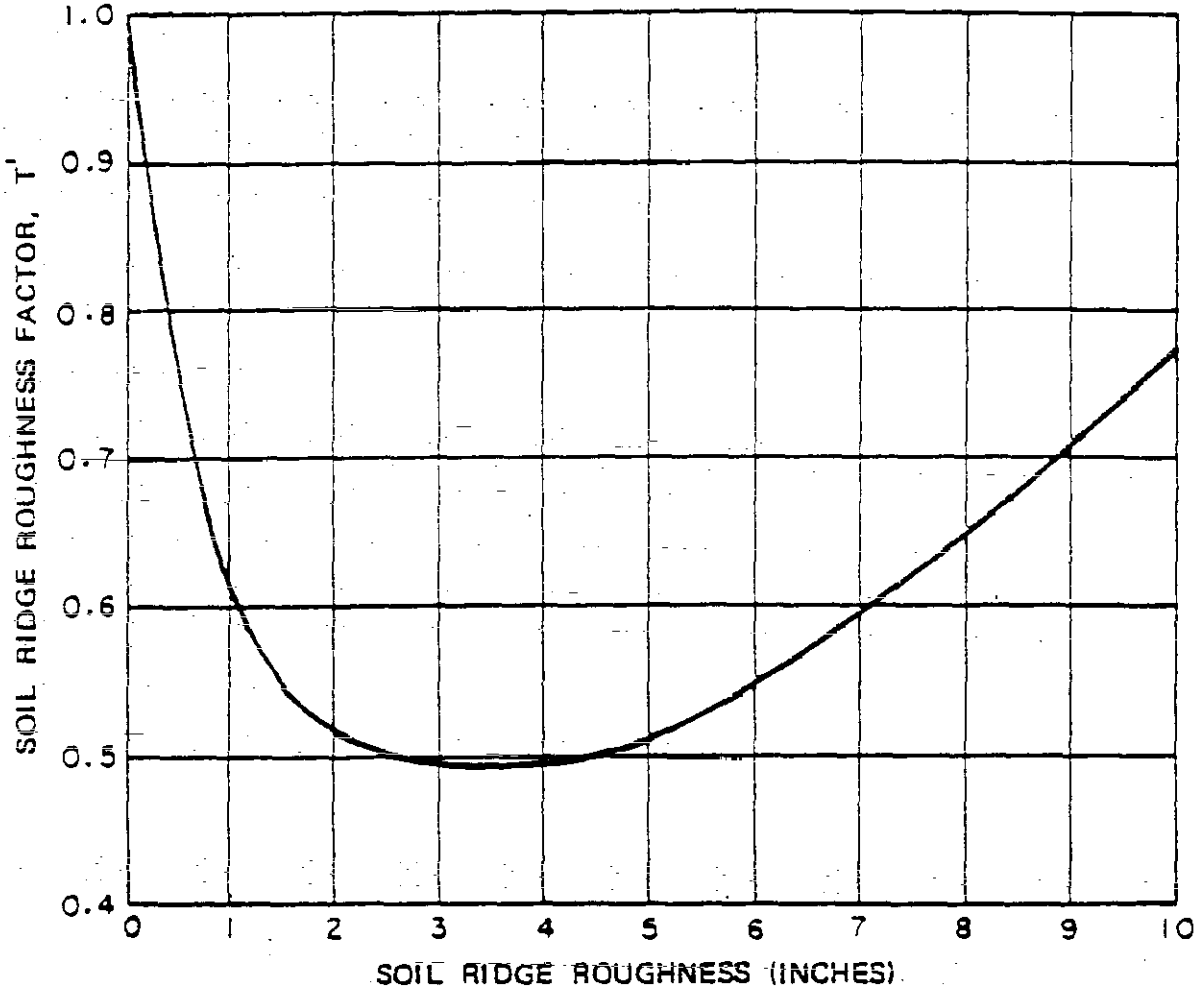
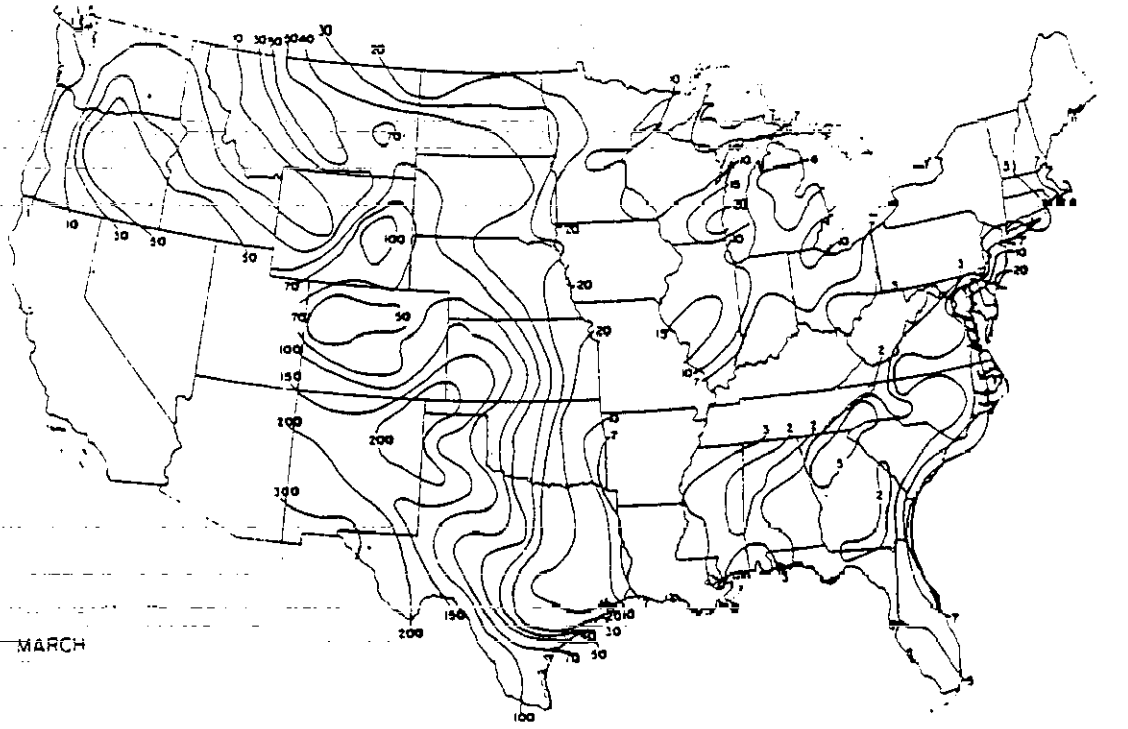


FIGURE F.4. Soil Ridge Roughness Factor T' from Actual Soil Ridge Roughness. (EPA 1979)



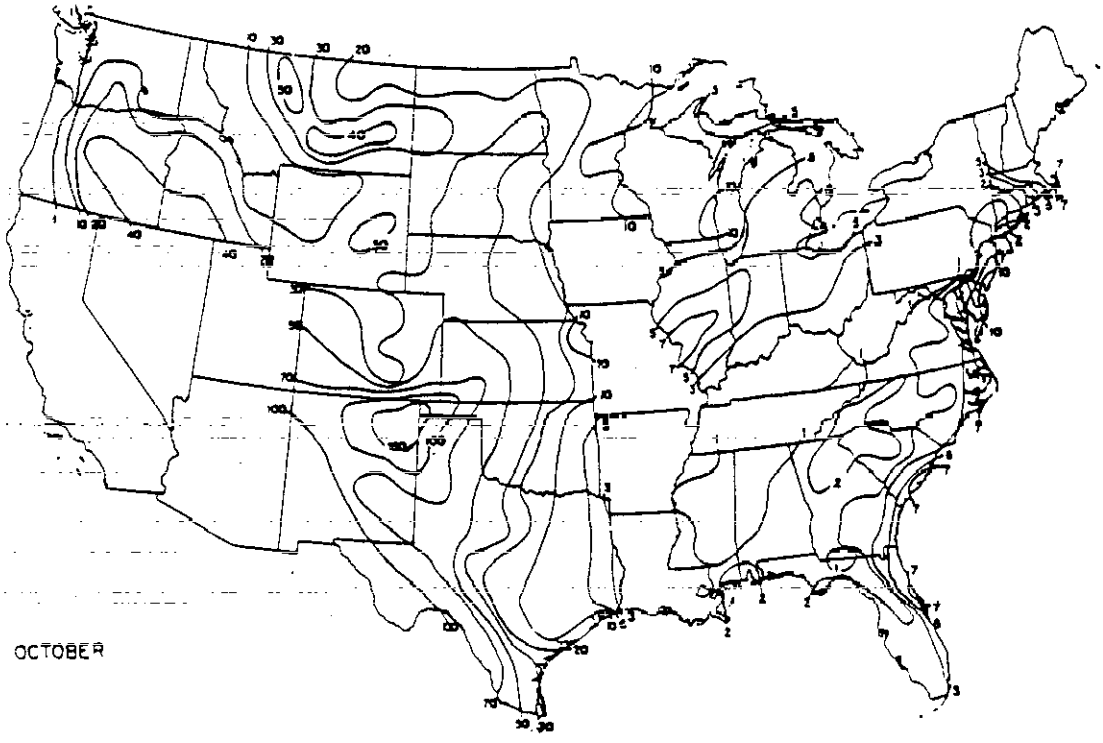
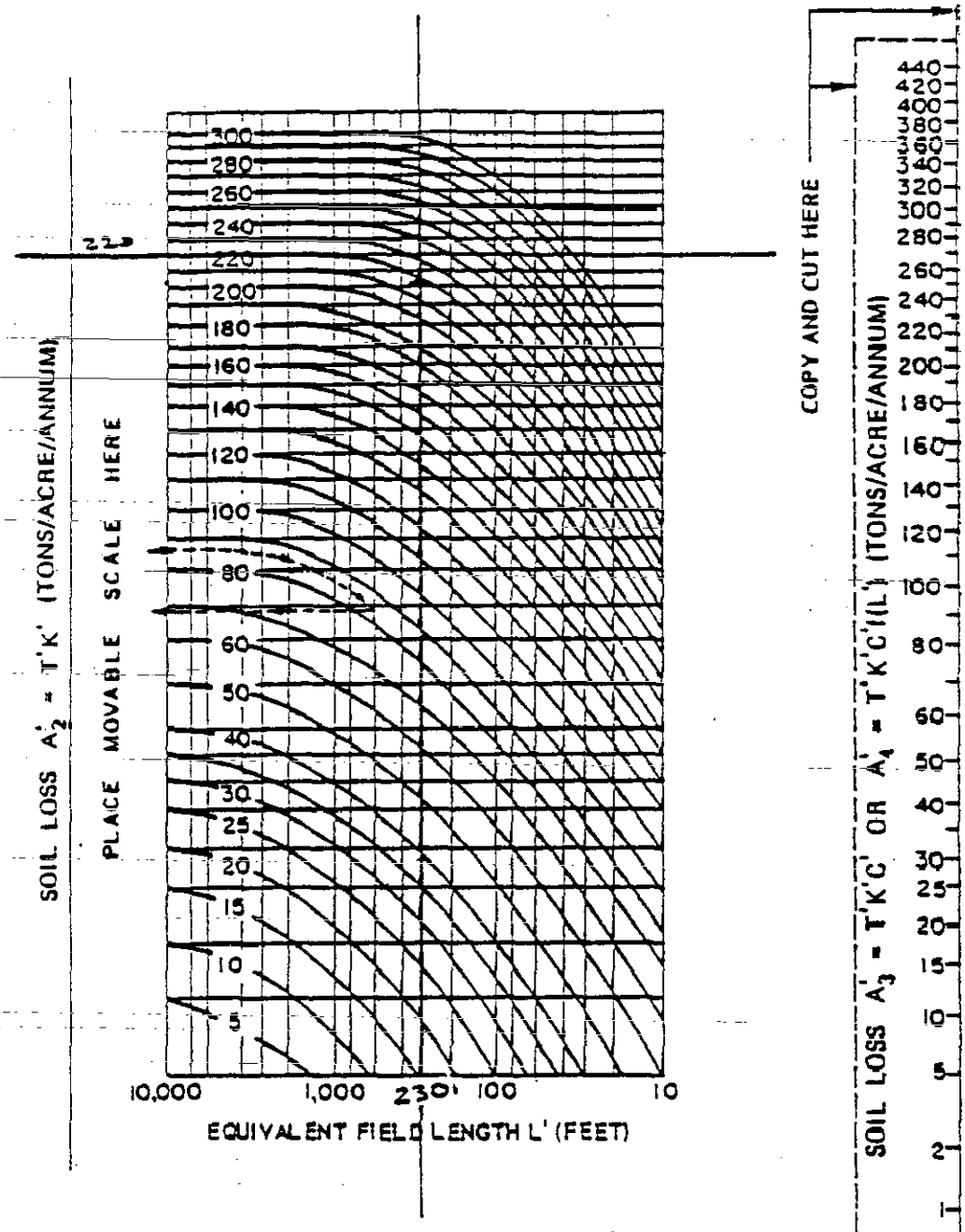


FIGURE F.5. Wind Erosion Climatic Factor C′ (in Percent) for March and October. (EPA 1979)



PROCEDURE:

FOR UNSHELTERED AREA OF APPROXIMATELY EQUAL LENGTH AND WIDTH. FOLLOW THIS EXAMPLE WHERE $A_2' = 86$ TONS/ACRE/YEAR. $A_3' = 55$ TONS/ACRE/YEAR. AND $L' = 600$ FT. COPY MOVABLE A_3', A_4' SCALE AND PLACE THE COPY ALONG LEFT SIDE OF CHART.. MOVE UP TO MATCH 55 (A_3') ON MOVABLE SCALE TO 86 (A_2') ON CHART.. FOLLOW CURVE FOR 86 TO RIGHT TO INTERSECTION WITH 600 (L'). RETURN HORIZONTALLY LEFT TO MOVABLE SCALE AND READ $A_4' = 42$ TONS/ACRE/YEAR. FOR SOLVING THE MORE COMPLICATED CASE WHERE AREA LENGTH GREATLY EXCEEDS WIDTH. CONSULT THE ORIGINAL REFERENCE.

FIGURE F.6. Chart for Determining Soil Loss A_4' from A_2', A_3', and L'. (EPA 1979)

where:

$A_3' = 55$ tons per acre

$A_3' = 20$ tons per acre

An actual cover of 750 pounds per acre is assumed (USDA 1972). The equivalent $V' = 6{,}000$ pounds per acre for standing stubble (see Figure F.7). The graphical solution yields the following:

For one-half year, 0.5 tons per acre per year .

For one-half year, 3.7 tons per acre per year

where:

$A_3' = 20$ tons per acre

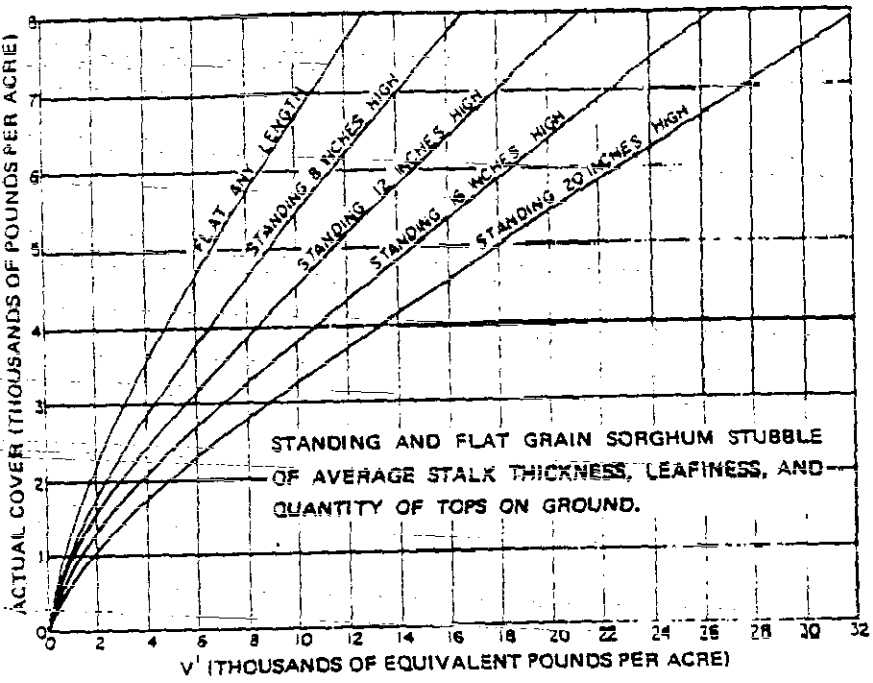
$A_3' = 55$ tons per acre.

A graphical solution to $A_5' = A' = (A_4')\ f(V')$ also is used (Figure F.8). Therefore, yearly soil loss due to wind = 0.5(0.5 + 3.7) = 2.1 tons per acre per year. The sum of wind and water erosion potential is 2.1 + 0.7 = 2.8 tons per acre per year. This is equivalent to an approximate soil loss of 0.014 inches per year based on the assumed topsoil density of 100 pounds per cubic foot. The EPA recommends a maximum erosion rate of approximately 2 tons per acre per year to control potential for gully erosion and to minimize maintenance. The design yields a slightly higher erosion rate for the 183-H Basins cover and is considered adequate to control erosion because only 1/64 inch per year of soil loss is expected.

$$2.8\ \text{tons/acre}(2000\ \text{lb/ton})(\text{acre}/43{,}560\ \text{ft}^2)(\text{ft}^3/100\ \text{lb})(12\ \text{in./ft})$$
$$= 0.015\ \text{inches per year, or approximately 1/64 inch per year}$$

Sheet Erosion Potential of Cover--The cover design is also evaluated to determine if the 3 percent topsoil can withstand overland or sheet flow with a minimum of erosion. The 50-year, 20-minute storm rainfall intensity of 1.6 inches per hour (Table F.2) is assumed for the design storm (Stone 1983). The 50-year storm was selected because it exceeds the minimum design life of the cover. The 20-minute rainfall intensity of 1.6 inches per hour was assumed because that intensity did occur once in a 20-minute thunderstorm over the 37 years that data were recorded at the Hanford Meteorology Station (Stone 1983). The Rational Method is used for determining design discharge for tributary areas of 1 square meter or less (about 1.196 square yards) (Nelson 1986). Unit width analysis is used where area is expressed as slope length by unit width, where unit width = 1 foot.

$$Q = CiA$$



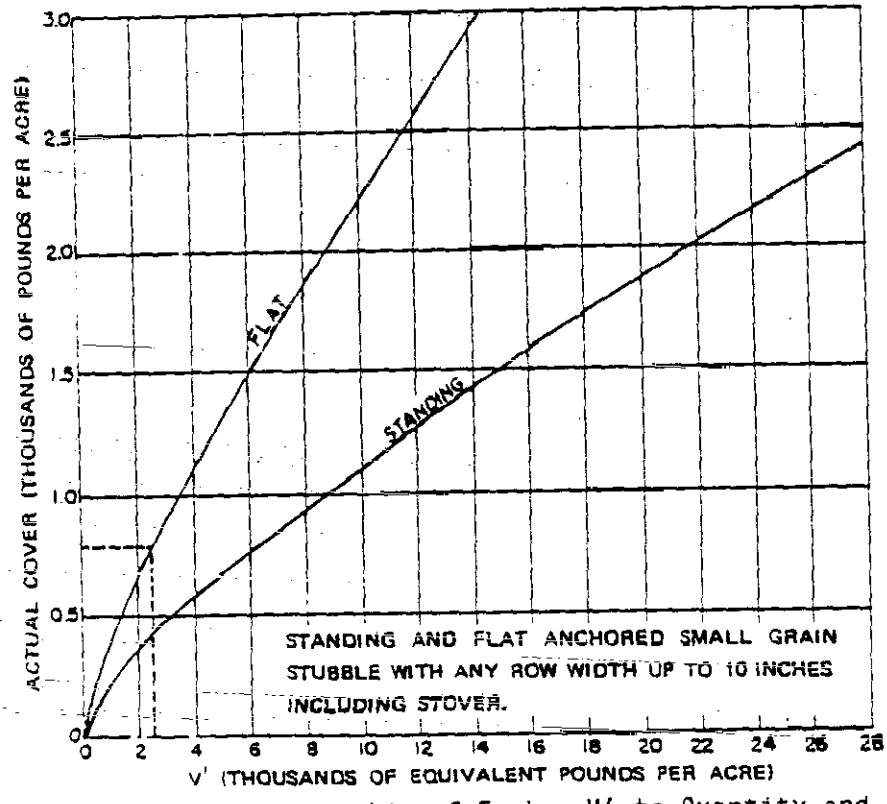


FIGURE F.7. Relationship of Factor V' to Quantity and Type of Vegetative Cover. (EPA 1979)

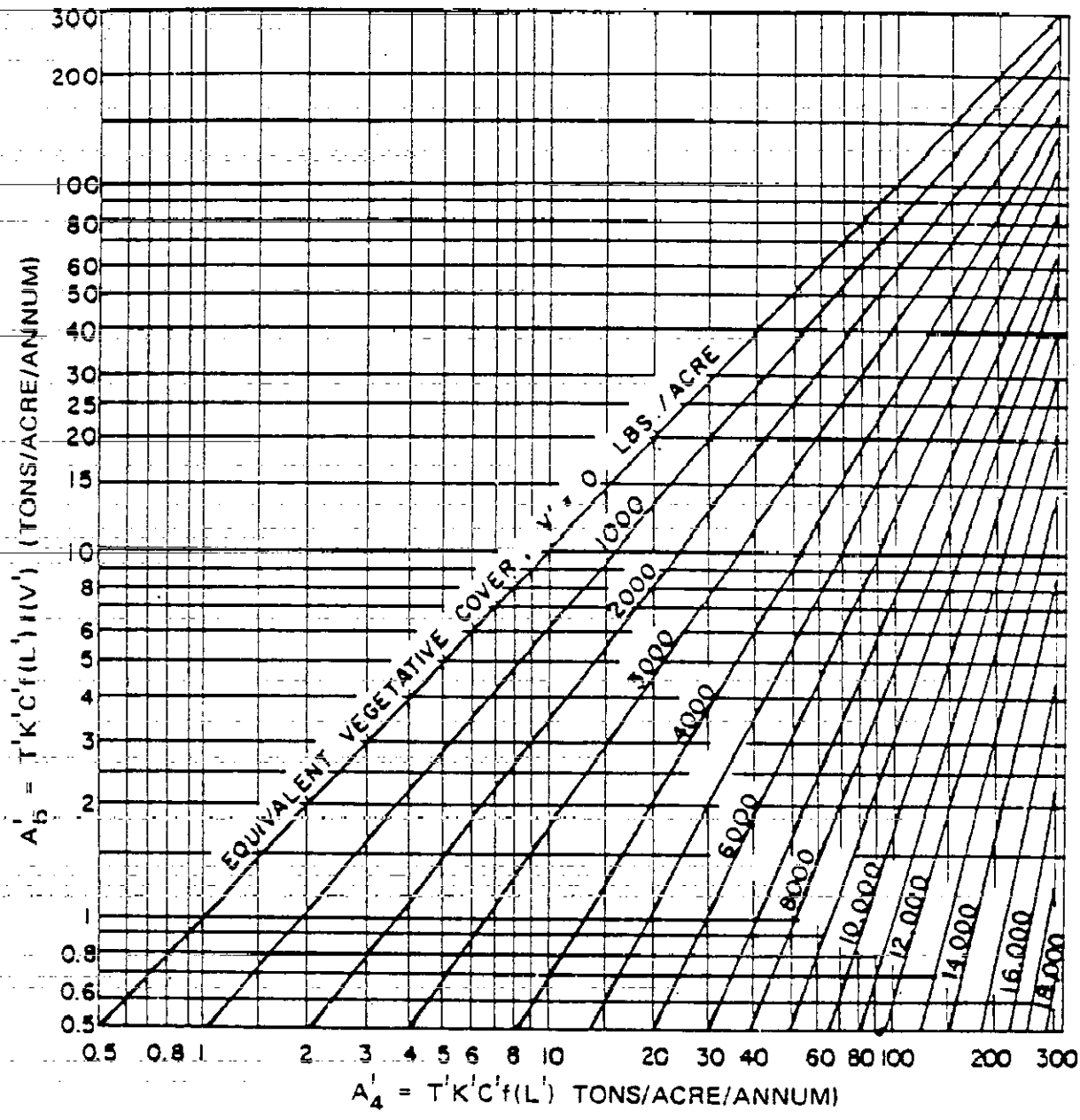


FIGURE F.8. Chart for Determining Soil Loss A'_5. (EPA 1979)

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TABLE F.2. Average Return Period (R) and Existing Record (ER) for Various Precipitation Amounts and Intensity During Specified Time Periods at Hanford (Based on Extreme Value Analysis of 1947 Through 1969 Records)*

	AMOUNT (INCHES)							INTENSITY (INCHES PER HOUR)						
	TIME PERIOD							TIME PERIOD						
R (YEARS)	20 MIN	60 MIN	2 HRS	3 HRS	6 HRS	12 HRS	24 HRS	20 MIN	60 MIN	2 HRS	3 HRS	6 HRS	12 HRS	24 HRS
2	0.16	0.26	0.30	0.36	0.48	0.62	0.72	0.49	0.26	0.15	0.12	0.08	0.052	0.030
5	0.24	0.40	0.48	0.55	0.77	0.95	1.06	0.72	0.40	0.24	0.18	0.13	0.079	0.044
10	0.37	0.50	0.59	0.67	0.96	1.17	1.28	1.1	0.50	0.30	0.22	0.16	0.098	0.053
25	0.47	0.62	0.74	0.83	1.21	1.45	1.56	1.4	0.62	0.37	0.28	0.20	0.121	0.065
50	0.53	0.72	0.85	0.96	1.40	1.66	1.77	1.6	0.72	0.42	0.32	0.23	0.138	0.074
100	0.60	0.81	0.96	1.07	1.59	1.87	1.99	1.8	0.81	0.48	0.36	0.27	0.156	0.083
250	0.68	0.93	1.11	1.22	1.82	2.13	2.26	2.0	0.93	0.55	0.41	0.30	0.177	0.094
500	0.73	1.02	1.22	1.33	2.00	2.34	2.47	2.2	1.02	0.61	0.44	0.33	0.195	0.103
1000	0.80	1.11	1.33	1.45	2.20	2.55	2.68	2.4	1.11	0.67	0.48	0.37	0.212	0.112
ER	**	0.59	0.88	1.08	1.68	1.88	1.91	**	0.59	0.44	0.36	0.28	0.157	0.080
		6/12	10/1	10/1	10/1-2	10/1-2	10/1-2		6/12	10/1	10/1	10/1-2	10/1-2	10/1-2
DATE	--	1969	1957	1957	1957	1957	1957	--	1969	1957	1957	1957	1957	1957

*From PNL-4622, a Battelle Pacific Northwest Laboratories document for the U.S. DOE.

**No records have been kept for time periods of less than 60 minutes. However, the rain gage chart for 6-12-69 shows that 0.55 in. occurred during a 20-minute period from 1835 to 1855 pst. An additional 0.04 inch occurred between 1855 and 1910 to account for the record 60-minute amount of 0.59 in.

where:

Q = Maximum design discharge (cubic feet per second)
C = Run-off coefficient (assuming C = 1.00 indicates no infiltration or worst-case scenario)
i = Intensity of rainfall (inches per hour)
A = Area of tributary (acre).

$$y = [Qn/(1.486)(S^{0.5})]^{0.6}$$

where:

y = Depth of flow (feet)
Q = Maximum design discharge (cubic feet per second)
N = Manning roughness coefficient (where n = 0.02 for silt loam (Nelson 1986)
S = Cover slope (percent).

$$V = Q/A$$

where:

V = Design flow velocity (feet per second)
Q = Maximum design discharge (cubic feet per second)
A = Area of flow (square feet).

The cover design is a 3 percent slope with a length of 70 feet.

$Q = (1.00)(1.6\ in./h)(70\ ft)(1\ ft)(ft/12\ in.)(h/3600\ s) = 0.0026$ cubic feet per second

$y = [(0.0026\ cfs)(0.020)/(1.486)(0.03)^{0.5}]^{0.6} = 0.006$ feet

$V = (0.0026\ ft^3/s)/(1\ ft)(0.006\ ft) = 0.4$ feet per second.

Allowable V for silt loam is 3 feet per second (Nelson 1986). Therefore, sheet erosion potential of the cover materials is not a problem.

Sheet Erosion Potential of Embankment--The same assumptions are used for the embankment calculations as for the cover calculation of sheet erosion potential except that the embankment slope is approximately 18.4 degrees or 3H:1V with a slope length of 22.1 feet. However, the embankment slope must also handle the water from the cover run-off. Therefore, a length of 70 feet + 21.1 feet = 91.1 feet is used for the analysis. The purpose of performing the sheet erosion potential and gully erosion potential for the embankment is to determine if cobble slope protection is required.

$Q = (1.00)(1.6\ in./h)(91.1\ ft)(1\ ft)(ft/12\ in.)(h/3600\ s) = 0.0033$ cubic feet per second

$y = [(0.0033\ ft^3/s)(0.020)/(1.486)(0.333)^{0.5}]^{0.6} = 0.0034$ feet

$V = (0.0033\ ft^3/s)/(1\ ft)(0.0034\ ft) = 1.0$ feet per second.

Allowable V for silt = 3.0 feet per second (Nelson 1986). Therefore, sheet erosion is not a problem on the embankment.

Gully Erosion Potential of Embankment--The purpose of performing the gully erosion prediction calculations is to determine if cobble slope protection is required. The following assumptions were made:

- 3H:1V slope: slope length = 22.1 feet, horizontal length = 21 feet, and height = 7 feet
- Silt loam soil characteristics: D_{10} = 0.003 millimeters, D_{50} = 0.01 millimeters, and D_{60} = 0.015 millimeters (see Figure F.9)
- Precipitation events of magnitude greater than 0.5 inches: Average annual number = 2 (ERDA 1975)
- Gully erosion procedure based on limited database from sites in arid, western states (Nelson 1986)
- Erosion time = 100 years.

$$D_j = 0.909 + 22.418(Si)$$

where:

D_j = Drainage density (square feet per foot)
S_i = Initial slope.

$$D_a = D_j(L_j) + D_{j+1}(L_{j+1}) + \ldots$$

where:

D_a = Drainage area (square feet)
L_j = Length of drainage path (feet).

$$S = (41.2)(1 + D_{50})/(D_a)(P)$$

where:

S = Stable slope gradient (percent)
D_{50} = Median particle diameter of topsoil (millimeters)
P = Average number of annual precipitation events > 0.5 inches.

$$S_t = (S_i)e^{(GSt)}$$

where:

S_t = Transition slope
S_i = Initial slope
G = Coefficient
t = Estimated time (year)
S = Stable slope gradient.

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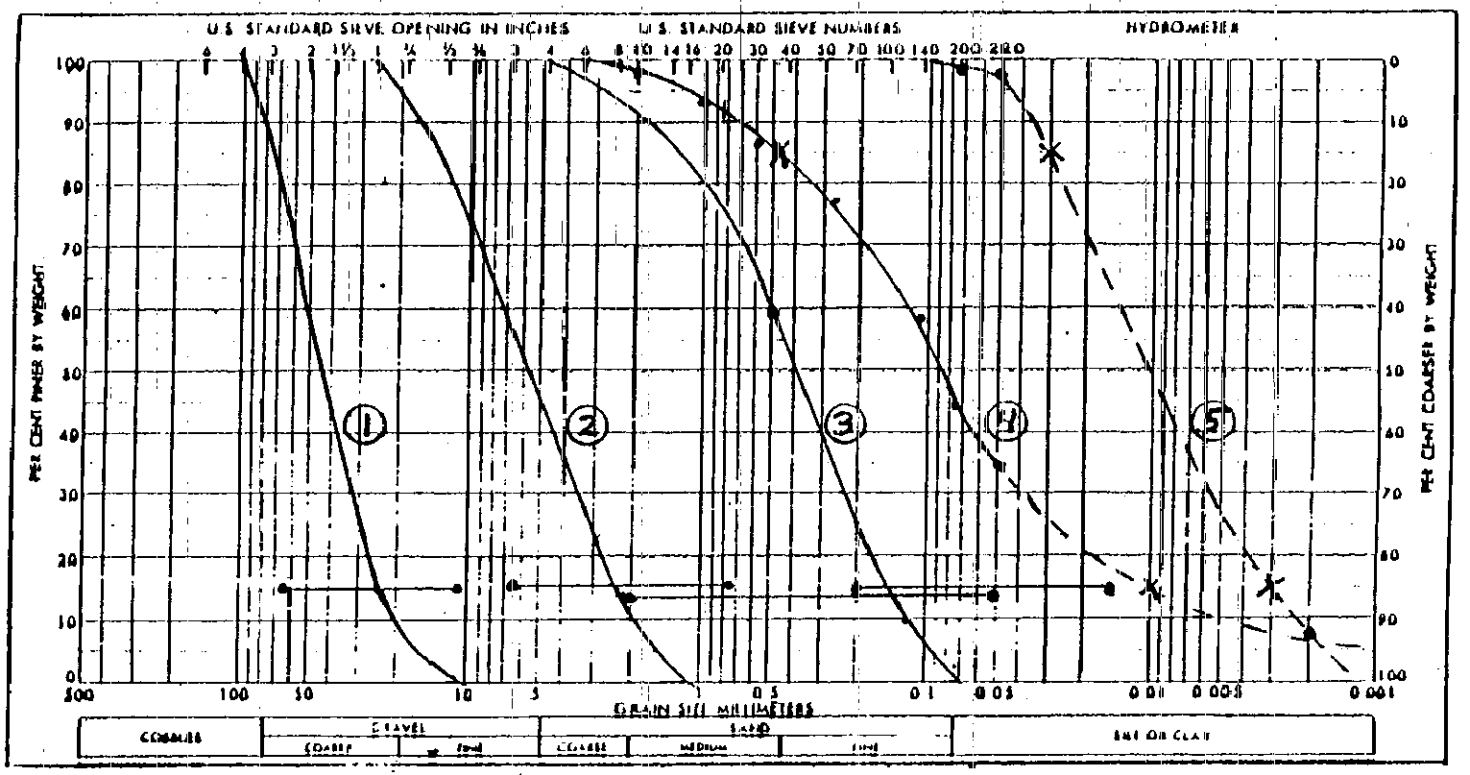

1 Embankment Cobble

2 Cobble Bedding

3 SP Sand Drainage Layer

4 to 5 Range of Top Soil: Silty Sand to Silt

FIGURE F.9. Particle Size Distribution Curves for Cover Materials.

$$D_{max} = (L_d/L)[H - (x)(S_t - S)]$$

where:

D_{max} = Maximum depth of gully incision (feet)
L_d = Distance from toe of slope to point of maximum gully incision (feet)
L = Length of slope (feet)
x = Horizontal component of slope length (feet)
S_t = Transition slope
S = Stable slope
H = Height (feet)

$$W_t = 4.936 + 2.923 \log (D_{max}/C_u)$$

where:

W_t = Approximate gully top width (feet)
D_{max} = Maximum depth of gully incision (feet)
C_u = Uniformity coefficient = D_{60}/D_{10}.

Calculations:

$D = 0.909 + 22.418(0.184) = 5.03\ ft^2/ft$, embankment
$D = 0.909 + 22.418(0.03) = 1.58\ ft^2/ft$, cover

$D_a = 5.03\ ft^2/ft(22.1\ ft) + 1.58\ ft^2/ft(70\ ft) = 111.1\ ft^2 + 110.7\ ft^2 = 221.8$ square feet

$S = 41.2(1 + 0.01)/(221.8\ ft^2)(2) = 0.0938 = 9.4$ percent

$S_t = (0.184)e^{-(0.02)(0.13)(100\ yr)} = 0.141 = 14.1$ percent

$Cu = (0.015)/(0.003) = 5$

$D_{max} = (0.62)[7\ ft - 21\ ft(0.142 - 0.94)] = 3.7$ feet

$L_d = (0.62)(22.1\ feet) = 13.7$ feet from the toe of the slope

$W_t = 4.936 + 2.923 \log (3.7/5) = 4.7$ feet.

Therefore, without protective measures taken to prevent the start of gully erosion, it is likely that gullies will be formed on the embankment to depths of greater than 3 feet and widths up to 4.7 feet. Cobble slope protection is recommended.

Size of Cobble to Protect Embankment (Sideslopes)--The U.S. Bureau of Reclamation (USBR) method is used to design the cobble protection for the cover embankment (Abt 1987). The USBR method is based on the velocity of water flow at the bottom of the sloped surface. The USBR method is used to determine the largest stone diameter required for the cover. Recommended minimum cobble thickness and gradation requirements are provided.

Given: Average velocity of flow = 0.8 feet per second, provided in the sheet erosion calculation documented above. Maximum allowable velocity of coarse sand filter bed = 2.5 feet per second (Nelson 1986). Therefore, using Figure F.10 and a bottom velocity of 2 feet per second to be conservative, a maximum cobble size of 2 inches is required. However, to help control animal intrusion into the sideslopes of the cover, the median (D_{50}) cobble size shall be 4 inches (Cline 1980).

A check on the estimated average velocity of water in the cobble voids is calculated using the Leps equation, as follows:

$$V_v = W_m^{0.5}(i^{0.54})$$

where:

V_v = Average velocity of water in the voids of the cobbles
W = Empirical constant
m = Hydraulic mean radius
i = Hydraulic gradient.

Assuming a 2-inch D_{50} rock size, W_m = 16 inches per second (Nelson 1986)

$$i = dh/dl = 7\ ft/22\ ft = 0.3\ ft/ft$$
$$V_v = 16\ in./s(0.3)^{0.54} = 8.3\ in./s = 0.7\ ft/s.$$

Therefore, the cobble will be effective in minimizing erosion on the sideslopes. The cobble layer should be well-graded and consist mostly of the largest size particles recommended according to the USBR. The cobble specification is as follows:

100 percent passing the 4-inch sieve
80 - 90 percent passing the 3-inch sieve
50 - 60 percent passing the 2-inch sieve
10 - 20 percent passing the 0.75-inch sieve.

Prevention of Clogging in the Drainage Layers--Two filter design equations are used to design the cover components so that no clogging of drainage layers occurs:

$$D_{15}(filter) < (5)D_{85}(soil) \quad \text{(Sowers 1970)}$$

$$D_{15}(filter) > (5)D_{15}(soil) \quad \text{(Sowers 1970).}$$

Refer to Figure F.9, which depicts optimum particle size distribution curves for the cover components.

At the McGee Ranch site, soil conditions range from sandy silts to silts. Therefore, an effective filter design must consider the ranges of particle sizes that follow from the two sets of McGee Ranch bounding equations.

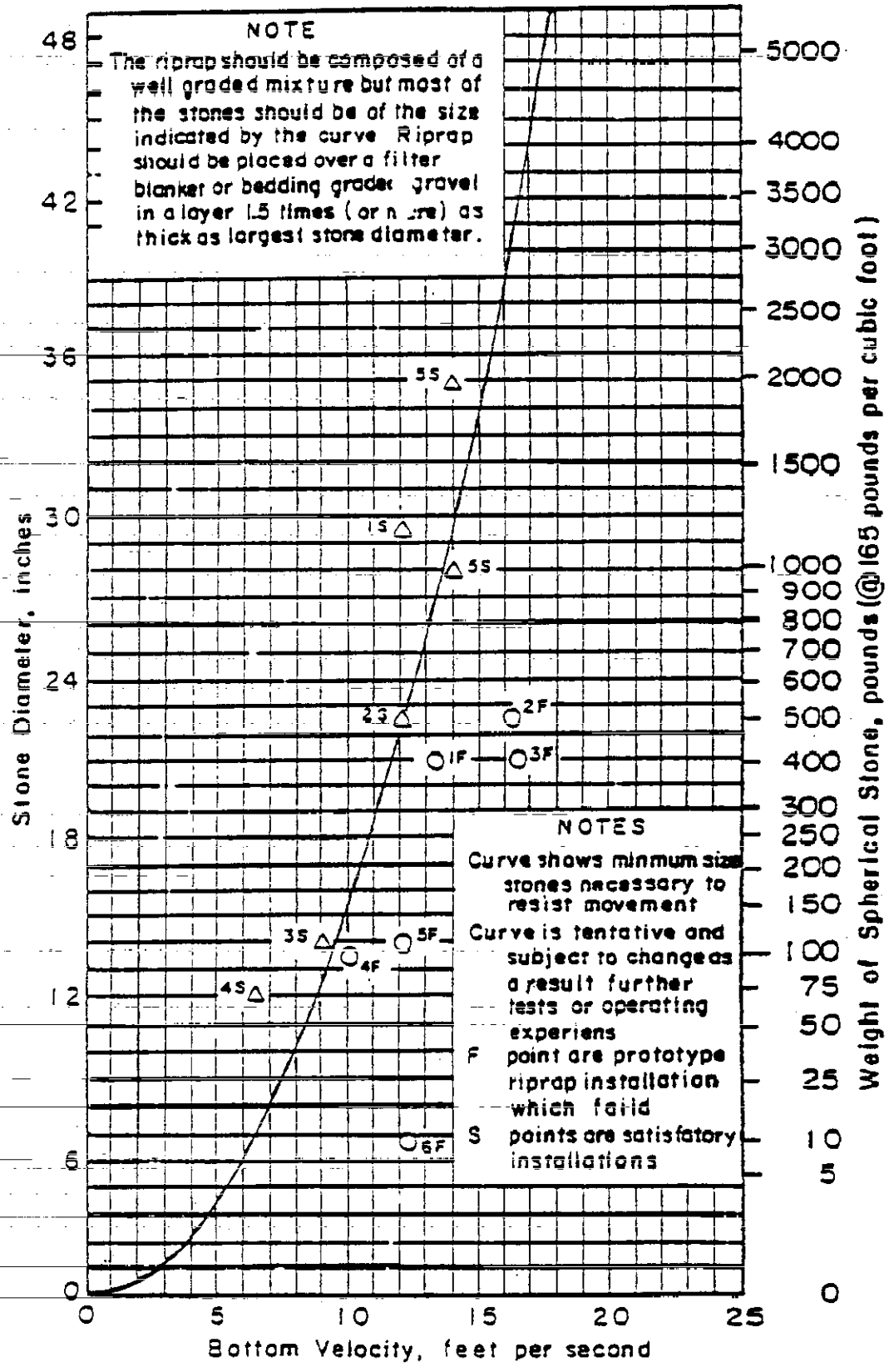

FIGURE F.10. Parametric Curve Used to Determine Maximum Stone Size in Cobble Mixture as a Function of Channel Flow Velocity.

Best McGee Ranch silt:

D_{85} = 0.04 millimeters
D_{15} = 0.003 millimeters.

Therefore, the filter limits for the McGee Ranch silt are:

D_{85}(filter) < 5(0.04) = 0.2 millimeters, where filter = drainage layer
D_{15}(filter) > 5(0.003) = 0.015 millimeters.

Worst McGee Ranch Sandy silt:

D_{85} = 0.46 millimeters
D_{15} = 0.01 millimeters.

Therefore, the filter limits for the McGee Ranch silt are:

D_{85}(filter) < 5(0.46) = 2.3 millimeters, where filter = drainage layer
D_{15}(filter) > 5(0.01) = 0.05 millimeters.

The clogging criteria for the cobble filter bed and cobble layers are also evaluated in the following calculations.

D_{85}(drainage layer) = 1.3 millimeters
D_{15}(drainage layer) = 0.15 millimeters.

Therefore, the filter limits for the cobble bedding material are:

D_{85}(drainage layer) < 5(1.3) = 6.5 millimeters
D_{15}(drainage layer) > 5(0.15) = 0.75 millimeters.

Verify cobble gradation works with bedding:

D_{85}(bedding) = 13 millimeters
D_{15}(bedding) = 2.3 millimeters.

Therefore, the filter limits for the cobble are:

D_{85}(cobble) < 5(13) = 65 millimeters
D_{15}(cobble) > 5(2.3) = 11.5 millimeters.

A review of the cobble specifications indicates that the design is adequate regarding clogging of the filter bed.

No filter criteria calculations are deemed necessary for the drainage layer/low-permeability layer interface because SP sands will be used as the major constituent in the low-permeability soil. The low-permeability soil will have the addition of bentonite clay; however, that layer is below the SP sand drainage layer.

Geotextile Design for the Topsoil/Drainage Layer Interface--The following design assumptions were used.

- The geotextile must protect and maintain a distinct interface at the sandy-silt-to-silt topsoil/SP-sand drainage layer interface.

- The geotextile must provide drainage without clogging.

- The geotextile must act as a filter media.

The following criteria are used in the planning of geotextile design (Allen 1987).

- Soil Retention Criteria.

  More than 50 percent of the sandy-silt-to-silt soil passes through the #200 sieve. Under steady-state flow, woven geotextiles, AOS < D_{85}. Under steady-state flow, non-woven geotextiles, AOS < 1.8 D_{85}

where:

AOS = Largest opening in geotextile
D_{85} = Size of soil particle when 85 percent passes through a sieve.

- Permeability Criteria.

  K geotextile > 10 K soil
  K sandy-silt-to-silt < 1 E-4 centimeters per second.

  Therefore, K geotextile > 1 E-3 centimeters per second.

- Clogging Criteria.

  For severe applications, a gradient ratio (GR) test is recommended with a suggested maximum GR < 3. This is a filtration performance test with soils and the geotextile. Clogging can be a problem with silty-type soils. However, in lieu of test data available at this time, the geotextile is specified with a maximum possible opening size approaching that of the soil retention criteria.

- Durability Criteria.

  Geotextile with >30 percent strength loss in 500 hours exposed to sunlight should not be exposed to sunlight for more than five days. (ASTM D-4355)

  Geotextiles with higher resistance to ultraviolet degradation should not be exposed to sunlight for more than 30 days.

- Minimum Physical Properties for Construction/Survivability in the Field.

  The installation application is considered Class B or less severe at the sandy-silt-to-silt/SP-sand interface. Therefore:

  Grab Strength > 100 pounds (ASTM D1682)(ASTM 1986c)
  Puncture Strength > 40 pounds (ASTM 751-modified)(ASTM 1986b)
  Burst Strength > 150 pounds per square inch (ASTM D3786, mullen burst)(ASTM 1986e)
  Trapezoidal Tear > 30 pounds (ASTM D1117)(ASTM 1986a).

Geotextile Selection--A number of manufacturers produce and market geotextile products for use in construction applications and could bid on the specified geotextile.

Control of Run-On and Run-Off--Run-on is not deemed to be a problem at the 183-H Basins site because the general site topography is very mild, with slopes of less than 2 percent for several hundred feet (see Figure F.11). The soil at the site are highly permeable sands and gravels contributing to very low potential for run-on problems.

Run-off from the cover, not including embankment area, was calculated using the HELP model. The peak daily run-off from the cover from a 0.92-inch precipitation event is 0 inches. Drainage from the top of the low-permeability layer is 208.2 cubic feet. The average annual values for surface run-off are 0 cubic feet and 51 cubic feet from the top of the low-permeability layer. These data are based on daily precipitation events at the Hanford Site from 1980 through 1984.

The design for a run-off control system must handle both the run-off and lateral drainage from the cover, as provided above, plus the run-off from the embankment area, which is calculated below. Figure F.11 shows how the lateral drainage layer and embankment drainage layers, which handle surface run-off, are interfaced. The following was assumed for the embankment peak run-off calculation.

- All precipitation runs off immediately; i.e., no delay in the bedding layer.

- The 50-year, 24-hour rainfall event is 1.77 inches.

The surface area of the embankment is the difference of areas of the outside perimeter of the entire cover (182 feet x 242 feet) and the cover (230 feet x 140 feet).

$$44{,}044\ ft^2 - 32{,}200\ ft^2 = 11{,}844 \text{ square feet}$$

$$1.77 \text{ inches } (ft/12\text{-in.})(11{,}844\ ft^2) = 1{,}747 \text{ cubic feet.}$$

Therefore, the run-off control system must accommodate 1,747 cubic feet + 208 cubic feet = 1,955 cubic feet for a worst-case daily rainstorm. The drainage ditch and pipe will slope at approximately 1.5 percent around the

perimeter of the cover (see Figures F.11 and F.12) and drain downstream from the cover.

Specific design calculations regarding pipe sizing, drainage ditch slope, and length and direction of drainage ditch are not calculated at this time and will be completed upon actual sizing of the cover and determination of the extent and direction of contaminated subsurface soils.

NOTE: The final design must be approved by Ecology before construction begins.

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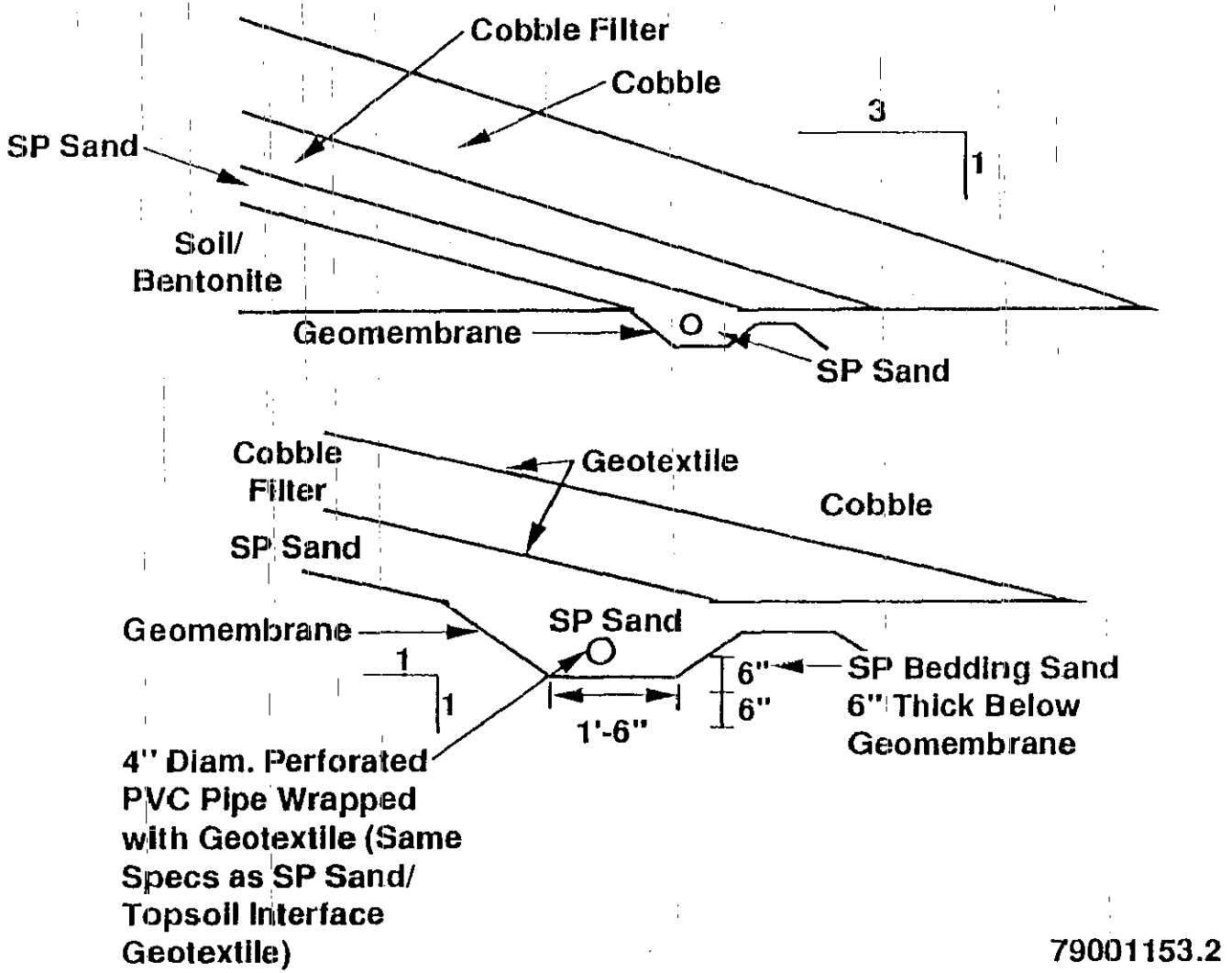

Figure F.11. Cover Embankment Cross-Section.

9413294.1671

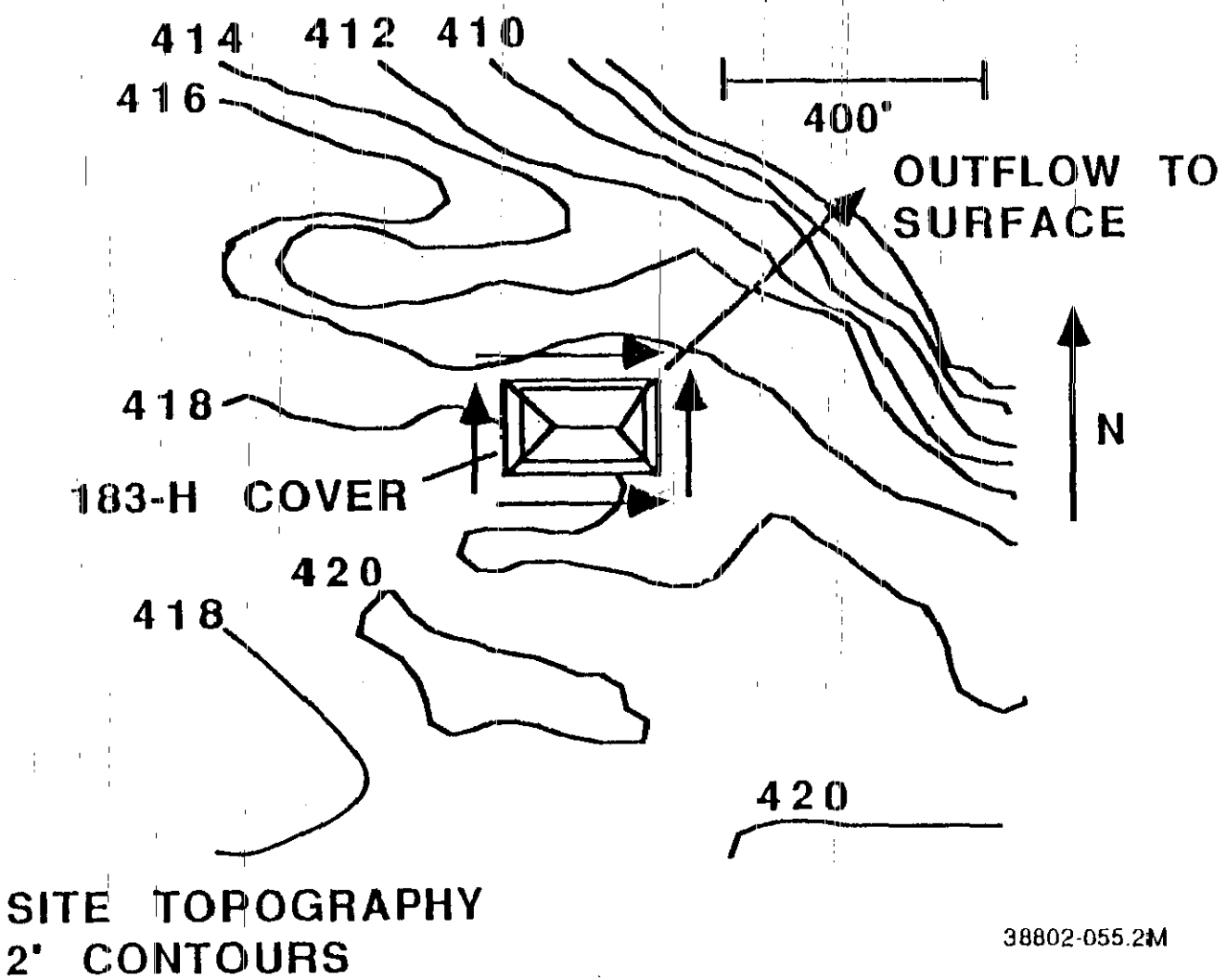

FIGURE F.12. Conceptual Cross Section of Runoff (Lateral Drainage) Diversion System.

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APPENDIX G

COVER MATERIAL VOLUME ESTIMATES

NOTE: The prior content of Appendix G, entitled "Detailed Cover Construction Procedures", are hereby withdrawn. Until the cover design has been finalized, establishment of construction procedures is inappropriate. In compliance with WAC 173-303-665, construction procedures will be submitted for Ecology's review/concurrence.

In prior submittals the following data were labeled as Appendix H. It has been modified to incorporate Ecology's Notice of Deficiency comments.

9413291.1672

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9011170317 9413294.1673

APPENDIX G

COVER MATERIAL VOLUME ESTIMATES

The required volume of each of the cover components is estimated in Table H.1. The exact surface area requirements for the cover have yet to be determined until the site is decommissioned and decontaminated and the subsurface soil contamination extent is determined. However, a preliminary amount of materials required for each cover component is estimated based on the following assumptions:

- Cover area not including embankment slopes is 230 feet by 140 feet
- Cover area including embankment slopes is 272 feet by 182 feet
- Cover is 7 feet high at the cover/embankment interface
- The individual component thicknesses are as depicted in Figures II.B-4 and II.B-5.

Table G.1. Cover Material Volume/Area Estimates

Cover Component	Cubic Yards	Square Yards
Foundation Soil	1,235	
Low-Permeability Native Soil	2,456	
Low-Permeability Bentonite Clay Admix	435	
SP Sand (Drainage)	1,545	
Topsoil	3,415	
Cobble Filter	505	
Cobble	1,405	
Geomembrane		4,450
Geotextile		4,630

NOTE: Ecology must approve the final cover deisgn prior to construction.

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APPENDIX H

CHEMICAL WASTE DISPOSAL PERMITS (CWDPs) AND ASSOCIATED LABORATORY REPORTS FOR CHEMICALS DISCHARGED TO BASIN NUMBERS 2, 3, AND 4

NOTE: This is 61 pages of new data. It is compiled from historic records and is presented herein to document the known extent of discharges to these basins.

9413294.1675

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9013284.1679

Completed on 6-29-78

CHEMICAL WASTE DISPOSAL PERMIT

Date 5-8-78 Permit No. 6-78

Quantity 10 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Used absorbing solution for air sampling. Neutral salt solution of $HgCl_2$, KCl and EDTA.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
$HgCl_2$ 10.9 gr/l = 0.9 pounds total.
EDTA 0.07 gr/l.
KCl 6 gr/l.

Disposal Procedures (By QC & E)
Mix with water or filter press effluent in Tank 9 or 10 in the 313 Bldg and tranfer into the outside storage tank in the 311-Tank Farm. Rinse out plastic containers and return to HEHF.

Submitted By LJ Maas, HEHF (2-7040)

Approved By [signature] Manager, Fuels Engineering 5-8-78

Approved By EMG [signature] Manager, Environmental & Radiological Control 5/11/78

APP H-3

Accepted By N.A.

Accepted By AEB W R Koch 5/12/78

9413294.1677

Completed 9-25-78

CHEMICAL WASTE DISPOSAL PERMIT

Date 9-7-78 Permit No. 8-78

Quantity 200 gallons (4 55-gallon drums)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)
Copper strip solution from depleted U extrusions in 306 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)
Depleted U (0.20% U-235) = 0.18 lb/gal = 36 lbs.
Cu = 1.22 lb/gal = 244 lbs.
HNO_3 = 0.66 lb/gal = 132 lbs.

Disposal Procedures (By QC & E)
Use a barrel pump to transfer acid solution into Tank 10 (Cu Strip) when Tank 10 is being drained to the Chemical Waste System. Rinse out barrels with water and pump wash solution into Tank 10. Return barrels to 306 Bldg. for reuse.

Submitted By KV Clark, PNL (2-5688)

Approved By [signature] 9/7/78
Manager, Fuels Engineering

Approved By [signature] 9/13/78
Manager, Environmental & Radiological Control

APP H-4

Accepted By [signature]
Manager, Fuels Fabrication

Accepted By [signature]
Manager, Materials

9413294.1678

9011703170

BATTELLE-NORTHWEST

ANALYTICAL LABORATORY - BUILDING 3720

REPORT OF ANALYSIS CWDP 8-78

SERIAL NO. 02839

SAMPLE OF Cu Strip

SOURCE

FOR AREA

SAMPLING DATE 8-18-78 TIME AM PM

SUBMITTED BY K Clark

REMARKS

DATE REPORTED TIME AM PM

ANALYST

CONSTITUENT	ANALYSIS
Cu	146 g/l = 1.22 lb/gal
U	22 g/l = 0.18 lb/gal
HNO_3	79 g/l = 0.66 lb/gal

REPORT APPROVED

80-4361-032 (7-66)

Completed 1-30

CHEMICAL WASTE DISPOSAL PERMIT

Date 1-16-79 Permit No. 1-79

Quantity 800 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Clean waste from shake-down tests of acid digestion system in 234-5 Bldg.

pH > 10

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

$NaNO_3$, $NaSO_4$, NaCl, $NaCO_3$

Disposal Procedures (By Fuels Engineering)

The empty 3000-gallon tank trailer will be sent to the 234-5 Bldg. and the waste solution will be pumped by HEDL personnel into the tank trailer using a hose inserted through one of the top openings.

The loaded waste solution will be transferred and dumped into the 183-H Evaporation Basin. Six other loads have been disposed of already as covered by Permit Nos. 1-78, 2-78 & 3-78.

Submitted By RG Cowan, HEDL (2-2149)

Approved By 1/16/79
Manager, Fuels Engineering

Approved By EMG
Manager, Environmental & Occupational Safety

Accepted By
Manager, Fuels Operations

9413294.1680

Completed 3-1-79

CHEMICAL WASTE DISPOSAL PERMIT

Date 1-26-79 Permit No. 2-79

Quantity 526 gallons of waste acid and 200 gallons of virgin acid.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Depleted U (0.21% U-235) solution from 306 Bldg. Virgin 56.5% HNO_3 solution from 306 Bldg. The uranyl nitrate solution is material left over from work for Exxon Nuclear and permission has been obtained from DOE to dispose of the waste through UNI's disposal facility. (See attached letter.)

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Depleted U = 111 pounds in waste acid.

HNO_3 = 810 pounds in waste acid.

Disposal Procedures (By Fuels Engineering)

UNI will supply SS barrels for transferring the acid solutions.

Use a barrel pump to transfer uranyl nitrate solutions into Tank 10 (Cu Strip) when Tank 10 is being drained to the Chemical Waste System. Rinse out barrels with water and pump wash solution into Tank 10. Return barrels to storage pad.

The virgin HNO_3 should be used in Tank 10 or in the cleaning tanks in 313 Bldg. Use a barrel pump to transfer the virgin acid into the process tanks. Rinse out barrels with water and return barrels to storage pad.

Submitted By GA Jensen, PNL (86-2779)

Approved By [signature] 1/26/79
Manager, Fuels Engineering

Approved By [signature]
Manager, Environmental Control

Accepted By [signature] 1/26/79
Manager, Fuels Operations

BATTELLE-NORTHWEST
ANALYTICAL LABORATORY - BUILDING 3720
REPORT OF ANALYSIS

CWDP 2-7

SERIAL NO. 02882	CONSTITUENT / ANALYSIS
SAMPLE OF Sa # 1	H^+ = 12.1 N
SOURCE	56.5%
FOR ____ AREA / SAMPLING DATE 8-31 / TIME ____ AM PM	U < 10 µg/ml
SUBMITTED BY G. Jensen	
REMARKS 86-2779	
ROB/Rm 1241	150-200 gallons
DATE REPORTED / TIME ____ AM PM	
ANALYST	REPORT APPROVED

BD-4361-032 (7-66)

9413294.1682

9011781171

BATTELLE-NORTHWEST
ANALYTICAL LABORATORY - BUILDING 3720
REPORT OF ANALYSIS

SERIAL NO. 02883	CONSTITUENT / ANALYSIS
SAMPLE OF Sample # 3	H^+ = 2.61 N = 1.4 lb/gal
SOURCE	
FOR ____ AREA / SAMPLING DATE / TIME ____ AM PM	U = .294 g/l = .0024 lb/gal = 1.18
SUBMITTED BY	
REMARKS	480 gallons
	0.21 U235
DATE REPORTED / TIME ____ AM PM	
ANALYST	REPORT APPROVED

BD-4361-032 (7-66)

CWDP 2-79

BATTELLE-NORTHWEST
ANALYTICAL LABORATORY - BUILDING 3720

REPORT OF ANALYSIS

SERIAL NO. 04006

SAMPLE OF U from G. Jensen

SOURCE

FOR ____ AREA | SAMPLING DATE 12-12-78 | TIME AM PM

SUBMITTED BY

REMARKS 86-2779

DATE REPORTED | TIME AM PM

ANALYST

CONSTITUENT	ANALYSIS
U = 287 g/l	2.4 lb/gal = 110 lb
NO_3^- = 360 g/l	= 3.0 lb/gal = 138 lb
H^+ = 2.8 N	
46 gallons	
0.	

REPORT APPROVED

RO-4361-032 (7-68)

Completed 1 load 3-
Completed 2nd load:

CHEMICAL WASTE DISPOSAL PERMIT

Date 3-1-79 Permit No. 3-79

Quantity 1,800 gallons in 2 loads.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Clean waste from shake-down tests of acid digestion system in 234-5 Bldg.

pH > 10.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

$NaNO_3$, $NaSO_4$, NaCl, $NaCO_3$

Disposal Procedures (By Fuels Engineering)

The empty 3000-gallon tank trailer will be sent to the 234-5 Bldg. and the waste solution will be pumped by HEDL personnel into the tank trailer using a hose inserted through one of the top openings.

The loaded waste solution will be transferred and dumped into the 183-H Evaporation Basin. Seven other loads have been disposed of already as covered by Permit Nos. 1-78, 2-78, 3-78 & 1-79.

Submitted By RG Cowan, HEDL (2-2149)

Approved By [signature]
Manager, Fuels Engineering

Approved By [signature]
Manager, Environmental Control

Accepted By [signature]
Manager, Fuels Operations

APP H-10

165 gallons
completed in Sept

CHEMICAL WASTE DISPOSAL PERMIT

Date July 5, 1979 Permit No. 4-79

Quantity Up to 500 gallons.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Neutralized steel shoe derusting solution from 313 Bldg. Before addition of NaOH, derust solution consisted of 2.5 wt % oxalic acid, 3.9 vol % H_2O_2 and 0.01 vol % of conc. H_2SO_4.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

sodium oxalate

Fe

Disposal Procedures (By Fuels Engineering)

Mix with water or filter press effluent in Tank 9 or 10 in the 313 Bldg. and transfer into the outside storage tank in the 311-Tank Farm. Rinse out 55-gallon drum and reuse for collecting more neutralized derust solution.

Submitted By EA Weakley, UNC (2-3378)

Approved By [signature]
Manager, Fuels Engineering

Approved By EMG [signature] FOR JJ DORIHA
Manager, Environmental Control

Accepted By J. E. LYTTLE / [signature]
Manager, Fuels Operations

APP H-11

9413294.1605

11-30-79

CHEMICAL WASTE DISPOSAL PERMIT

Date 10-30-79 Permit No. 5-79

Quantity 30 gallons of liquid

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Unused chromic acid plating solution from PNL in 5-gallon carboys (from 314 Bldg).

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

40 oz/gal chromic acid = 75 lbs total

1% H_2SO_4

Disposal Procedures (By Fuels Engineering)

Pour chromic acid solution slowly into Tank 12, 13, 14, 15 or 16 in the 313 Bldg. cleaning line and pump into the chemical waste storage tanks in 334-A Bldg or directly into the Tank 2 neutralizer in 313 Bldg. Rinse out carboys and dispose of rinse water into the same tank. Dispose of carboys in appropriate dumpster. Wear approved protective clothing while handling acid.

Submitted By DH Getchell, PNL (2-3756)

Approved By Manager, Fuels Engineering

Approved By Manager, Environmental Control

Accepted By Manager, Fuels Operations

APP H-12

9413294.1686

1 drum on 1-24-80 10 ppm BeSO
3 " " 3-28-80 "

CHEMICAL WASTE DISPOSAL PERMIT

Date 10-30-79 Permit No. 6-79

Quantity Up to 450 gallons of liquid in 9 55-gallon drums.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Dilute $BeSO_4$ solution from 331 Bldg that was used to test the effect of $BeSO_4$ on trout fry and eggs.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

0.01 to 100 ppm $BeSO_4$ with an average of about 10 ppm.

(UNCs waste acid from Tanks 19 & 26 contain about 12 ppm Be in solution.)

Disposal Procedures (By Fuels Engineering)

Pump into Tank 9 or 10 in the 313 Bldg and transfer to the waste storage tank. Rinse out tanks and dispose of in Tank 9 or 10. Return empty drums to PNL.

6-1815

Submitted By DC Klopfer, PNL (2-3251 ex. 325)

Approved By [signature] Manager, Fuels Engineering

Approved By EMG [signature] Manager, Environmental Control

Accepted By [signature] Manager, Fuels Operations

APP H-13

9413294.1687

12-17-7

CHEMICAL WASTE DISPOSAL PERMIT

Date 12-04-79 Permit No. 7-79

Quantity 1,000 gallons.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Clean waste from shake-down tests of acid digestion system in 234-5 Bldg.

pH > 10.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

$NaNO_3$, $NaSO_4$, $NaCl$, $NaCO_3$

Disposal Procedures (By Fuels Engineering)

The empty 3000-gallon tank trailer will be sent to the 234-5 Bldg. and the waste solution will be pumped by HEDL personnel into the tank trailer using a hose inserted through one of the top openings.

The loaded waste solution will be transferred and dumped into the 183-H Evaporation Basin. Nine other loads have been disposed of already as covered by Permit Nos. 1-78, 2-78, 3-78, 1-79 and 3-79.

Submitted By RG Cowan, HEDL (2-2149)

Approved By 12/4/79
Manager, Fuels Engineering

Approved By 12-10-
Manager, Environmental Control

Accepted By
Manager, Public Operations

APP H-14

9413294.1688

300 gallons on 1-21-80

CHEMICAL WASTE DISPOSAL PERMIT

Date 12-13-79 Permit No. 8-79

Quantity 250 gallons (5 55-gallon drums)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Copper strip solution from depleted U extrusions in 306 Building.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Depleted U (0.20% U-235) = 0.12 lb/gal = 31 lbs.

Cu = 1.54 lb/gal = 386 lbs.

HNO_3 = 2.5 lb/gal = 626 lbs.

Disposal Procedures (By Fuels Engineering)

Use a barrel pump to transfer acid solution into Tank 10 (Cu Strip) when Tank 10 is being drained to the Chemical Waste System. Rinse out barrels with water and pump wash solution into Tank 10. Return barrels to 306 Building to reuse.

The disposal of this depleted uranium solution is a routine procedure. The last disposal permit number was 8-79.

Submitted By KV Clark, PNL (2-5688)

Approved By [signature] Manager, Fuels Engineering 12/13/79

Approved By EMG [signature] Manager, Environmental Control

Accepted By [signature] Manager, Fuels Operations

APP H-15

9413294.1689

CWDP 8-79

ANALYSES REPORT

BATTELLE-NORTHWEST

RICHLAND, WASHINGTON

CC: [illegible]

TO: [illegible] Clark

DATE: [illegible]-79

Lab. No. 04064 [illegible]

	g/liter	g/gal
Nitric Acid	[illegible]	[illegible]
Copper	185	[illegible]
Uranium	14.7	[illegible]

A-4360-018 (6-64)

9413294.1690

9011783171 3

Completed 4-1-80

3 drums on 3-12
4 " 3-13
1 " 3-14
3 " 3-21
4 " on 3-31
2 " " 4-1
935 gallons

CHEMICAL WASTE DISPOSAL PERMIT

Date 2-1-80 Permit No. 1-80

Quantity 500 gallons of liquid

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Waste H_2SO_4 from start-up tests of the acid digestion system in 234-5 Bldg. Waste acid is stored in 55-gallon drums at 324 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

20% H_2SO_4 solution containing 500 ppm Al; 300 ppm Ca, Cu, Fe & Zn; 60 ppm Ni; 30 ppm Ba, Cr, Mg, Mn & Ti.

Disposal Procedures (By Fuels Engineering)

Pump waste acid into Tank 15 or 16 in the 313 Bldg cleaning line. Pump directly to the neutralizer -- DO NOT PUMP TO 334-A Bldg. Rinse out drums and transfer rinse water to chemical waste system. Dispose of drums in noncompactable waste luggers or save for UNC's use.

Submitted By WO Greenhalgh, HEDL (2-3309)

Approved By [signature]
Manager, Fuels Engineering

Approved By [signature]
Manager, Environmental Control

Accepted By [signature]
Manager, Fuels Operations

Lab # 00267

SPECTROCHEMICAL ANALYSIS REPORT

DOUGLAS-UNITED NUCLEAR, INC.
SPECTROCHEMICAL LABORATORY
BUILDING 3720

CC: SPEC. LAB.

CWDP 1-80

MATERIAL Composite RADTU Acid Waste

SUBMITTER'S NO.

SUBMITTED BY Weakley

ANALYZED BY G. W. Gay

DATE REPORTED 1-25-80

ELEMENT		ELEMENT		ELEMENT	
Ag		In		Sr	
Al	500	K		Ta	
As		La		Te	
Au		Li		Th	
B		Mg	30	Ti	30
Ba	30	Mn	30	Tl	
Be		Mo	5	U	
Bi		Na	3000	V	1
Ca	300	Nb		W	
Cd		Ni	60	Zn	500
Co		P		Zr	1
Cr	30	Pb			
Cu	300	Pd			
Fe	300	Pt			
Ga		Sb			
Hf		Si	3		
Hg		Sn			

TYPE OF ANALYSIS

☑ QUALITATIVE

SYMBOL	MEANING	APP'X. CONC.
VS	MAJOR DETECTABLE CONSTITUENT	
S	STRONG	
M	MODERATE	
T	TRACE	
—	NOT DETECTED	
F	INTERFERENCE	
?	DETECTION UNCERTAIN. INTERFERENCE	

☐ ~~SEMIQUANTITATIVE~~ QUALITATIVE

SYMBOL	MEANING
G	CONCENTRATION GREATER THAN
L	DETECTABLE CONCENTRATION LESS THAN
—	NOT DETECTED

NUMERICAL VALUES ☑ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± FACTOR 10

☐ QUANTITATIVE

SYMBOL	MEANING
GX (LX)	CONC. GREATER THAN (LESS THAN) CALIBRATED WORKING CURVE

NUMERICAL VALUES ☐ PARTS PER MILLION ☐ PERCENT ☐ _____

APPR'X. PRECISION ± _____

REMARKS:

H^+ as H_2SO_4 = 230 g/l = 1.92 g/l

REPORT APPROVED F. Hara

LABORATORY INFORMATION

SPECTROGRAPH AND SOURCE	SIZE OF SAMPLE	METHOD OF ANALYSIS	PLATE NO
Ebert & Varisource	10 mg	dc-arc	0072

APP H-18

A—5300—079 (12-65)

9413294.1692

9011731721

Tank rinsed for 5 days starting on 10-16-80
Sludge pumped out on 11-21-

CHEMICAL WASTE DISPOSAL PERMIT

Date 5-1-80 Permit No. 3-80

Quantity About 625 gallons.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

The heel in the West NaOH storage tank in the 311 Tank Farm containing NaOH and sludge.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

50% NaOH containing Na_2CO_3 soluble sludge and insoluble sludge (mostly iron oxides with about ½ % Hg). The Na_2CO_3 sludge forms from the reaction of CO_2 in the air with concentrated NaOH and the insoluble sludge is from impurities in the NaOH that settled out in the tank over the many years.

Disposal Procedures (By Fuels Engineering)

It is necessary to completely drain and flush the storage tank so the integrity of the walls and bottom can be examined and to remove unneeded sparge line supports that would damage the new Teflon coated heating coil. The drain valve will be closed and the tank filled to overflowing with water to dissolve the Na_2CO_3 sludge. Open the heel drain valve slightly and allow the rinse water to discharge while adding water through the fill line for at least 5 days. (Will also be overflowing.) Attach the drain line to the Rupp pump and transfer as much of the insoluble sludge as possible into the trailer for disposal at 100-H Basin. Shovel the large pieces of sludge into a plastic lined drum for later disposition.

Submitted By Ean EA Weakley, UNC (2-3378)

Approved By T. E. Auth for J. E. Lyttle
Manager, Fuels Engineering

Approved By EMG [signature]
Manager, Environmental Control

Accepted By [signature]
Manager, Fuels Operations

APP H-19

9413294.1693

Completed 10-

CHEMICAL WASTE DISPOSAL PERMIT

Date 10-2-80 Permit No. 4-80

Quantity 100 gallons in two 55-gallon drums.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Used Fremont silk screen cleaner from the Sign Shop in 3713 Bldg. having a pH of 12.1-12.2 and which contains particles of silk screen paint. New Fremont cleaners contain glycols and Na metasilicate.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Induction coupled plasma spectrometer analysis showed the following harmful impurities: 500-1100 ppm K; 90-100 ppm Ba; 40-60 ppm Pb; 40 ppm Zn; 30 ppm Cu; and 5-10 ppm B.

Disposal Procedures (By Fuels Engineering)

The used cleaner from the silk screen cleaning tank was pumped into two used drums. One of these drums was an empty oil drum, so the solution will have some oil floating on the surface. The solution from this used oil drum will be transferred into an open top drum and sheets of 3M Type 156 Oil Sorbent will be floated on top to absorb the oil.

After the oil has been absorbed, the solution from this drum and the second drum will be transferred into Tank 9 or 10 in the 313 Bldg. and pumped into the outside waste storage tank.

Submitted By EA Weakley (6-3378)

Approved By _____ Manager, Fuels Engineering

Approved By _____ Manager, Environmental Control

Accepted By _____ Manager, Fuels Operations

APP H-20

9413294.1694

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

CWBP 4.80

Serial No. 02655

Sample Of Fremont Chemicals

Source Turbine Oil Barrel

For Area | Sampling Date 9-10-80 | Time AM PM

Submitted By E. A. Weakley

Remarks

Date Reported | Time AM PM

Analyst

CONSTITUENT	ANALYSIS
PH	12.18
Spec	

Report Approved

A-1700-165 (7-79)

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

Serial No. 02656

Sample Of Fremont Chemicals

Source

For Area | Sampling Date 9-10-80 | Time AM PM

Submitted By E. A. Weakley

Remarks

Date Reported | Time AM PM

Analyst

CONSTITUENT	ANALYSIS
PH	12.08
Spec	

Report Approved

A-1700-165 (7-79)

CWDP 4-80

	Detection Limit ppm	2655	2656	
Al	.03			
As	.08			
B	.01	<.005 g/l	.01	5-70 ppm
Ba	.002	.09 g/l	.1	90-100 ppm
Ca	.01	.07 g/l	.1	
Cd	.004	.01 g/l	.01	10 ppm
Ce	.04			
Co	.01			
Cr	.02			
Cu	.004	.03	.03	30 "
Dy	.004			
Eu	.002			
Fe	.005	.03	.02	20 "
Gd	.01			
K	.3	.5	1.1	500-1100
La	.008			
Li	.004			
Mg	.06			
Mn	.002			
Mo	.01		.01	
Na	.01	21 g/l	16	
Nd	.02			
Ni	.02			
P	.1			40 - 60
Pb	.06	.04 g/l	.06	
Ru	.05			
Sb	.05			
Si	.02	3.9	2.6	
Sr	.002			
Te	.06			
Ti	.002			40
Zn	.02	.04	.04	
Zr	.008	.006	.02	
Cs				

9413294.1696

9011783172

complete [redacted]
11-25-80

CHEMICAL WASTE DISPOSAL PERMIT

Date 11-7-80 Permit No. 5-80

Quantity 800 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Clean waste from shake-down tests of acid digestion system in 234-5 Bldg.

pH > 10.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

$NaNO_3$ and $NaSO_4$

Disposal Procedures (By Fuels Engineering)

The empty 3000-gallon tank trailer will be sent to the 234-5 Bldg and the waste solution will be pumped by HEDL personnel into the tank trailer using a hose inserted through one of the top openings.

The loaded waste solution will be transferred and dumped into the 183-H Evaporation Basin. Ten other loads have been disposed of already as covered by Permit Nos. 1-78, 2-78, 3-78, 1-79, 3-79 and 7-79.

Submitted By RG Cowan, HEDL (6-5215)

Approved By [signature]
Manager, Fuels Engineering

Approved By [signature]
Manager, Environmental Control

Accepted By [signature]
Manager, Fuels Operations

Complete 2-3-81
+ 1-28-81

CHEMICAL WASTE DISPOSAL PERMIT

Date November 26, 1980 Permit No. 6-80

Quantity 1000 to 1200 gallons
900 actual

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Boiler cleaning solutions, about 600 gallons originating with a pH of 10, 200 gallons at a pH of 5, and the remaining rinse water at a pH between 6 and 7

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Fe, Cu, Ni, EDTA (max. 300 lbs), Ammonium persulfate (max. 450 lbs), aqua ammonia (max 200 gal), ethylene diamine (max. 55 gal), hydrazine (47 gal), Thiourea (50 lb ma

Disposal Procedures (By Fuels Engineering) Fluid will be used in the 1717 Building at 100K. Pumping to a tank truck should begin on December 17, 1980, and be completed by December 22, 1980.

The loaded waste solution will be transferred and dumped into the 183-H Evaporation Basin.

Submitted By E. M. Woodruff, Corrosion Research & Engineering, PNL, 3720/114/300 (6-50

Approved By 12/2/80
Manager, Fuels Engineering

Approved By EMB
Manager, Environmental Control

Accepted By 12/2/80
Manager, Fuels Operations

APP H-24

9413294.1698

Completed 3-19-81

CHEMICAL WASTE DISPOSAL PERMIT

Date 2-12-81 Permit No. 1-81

Quantity 300 gallons (6 55-gallon drums)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Copper strip solution from U depleted U extrusion in 306 Building.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Depleted U (0.20% U-235) = 0.022 lb/gal = 6.6 lbs.

Cu = 1.46 lb/gal = 438 lbs.

HNO_3 = 2.63 lb/gal = 789 lbs.

Disposal Procedures (By Fuels Engineering)

Use barrel pump to transfer acid solution into Tank 10 (Cu Strip) when Tank 10 is being drained to the Chemical Waste System. Rinse out barrels with water and pump wash solution into Tank 10. Return barrels to 306 Building for reuse.

The disposal of this depleted uranium solution is a routine procedure. The last disposal permit number was 8-79.

Submitted By KV Clark, PNL (6-5688)

Approved By Manager, Fuels Engineering

Approved By FMG Manager, Environmental Control

Accepted By Manager, Fuels Operations

APP H-25

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

CWDP 1-81

Serial No. 00447	CONSTITUENT / ANALYSIS
Sample Of: Waste Cu Strip Sol	HNO_3 2.63 #/gal
Source: 306 Bldg	
For / Area / Sampling Date: 2-6-81 / Time: AM PM	
Submitted By: Keith Clark / Beckley	Cu 1.46 #/gal
Remarks: A-88604	
Report to both	U. 2.623 g/l = .022 #/gal
Date Reported: 2-12-81 / Time: AM PM	
Analyst	Report Approved

A-1700-165 (7-79)

9413294.1700

9011173317 29

CHEMICAL WASTE DISPOSAL PERMIT

Date 9-23-81 Permit No. 2-81

Quantity 500 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Clean waste from shake-down tests of acid digestion system in 234-5 Bldg.

pH > 10

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

$NaNO_3$ and $NaSO_4$

Disposal Procedures (By Fuels Engineering)

The empty 3000-gallon tank trailer will be sent to the 234-5 Bldg. and the waste solution will be pumped by HEDL personnel into the tank trailer using a hose inserted through one of the top openings.

The loaded waste solution will be transferred and dumped into the 183-H Evaporation Basin. Eleven other loads have been disposed of already as covered by Permit Nos. 1-78, 2-78, 3-78, 1-79, 3-79, 7-79 and 5-80.

Submitted By RG Cowan, HEDL (6-3316)

Approved By [signature] 9-23-81
Manager, Fuels Engineering

Approved By EMG [signature]
Manager, Environmental Control

Accepted By [signature] 9/24/81
Manager, Fuels Operations

APP H-27

Completed 2-1-82

CHEMICAL WASTE DISPOSAL PERMIT

Date 12-3-81 Permit No. 3-81

Quantity 5 gallons of 6 different mixtures (see list below)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Unneeded solutions for dyeing and sealing anodized Al surfaces. Found in the Sign Shop, 3713 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

See listing below.

Disposal Procedures (By Fuels Engineering) All the mixtures are compatible with our neutralized waste. Add these mixtures into Tank 9 or 10 in the 313 Bldg and transfer into the outside waste storage tank. Wash out containers and dispose of empty containers in waste lugger.

Identification	Gallons	pH	Metal Content, ppm											
			Al	As	Ca	Co	Cr	Cu	Fe	Mg	Ni	P	Sb	Zn
Ni Acetate	1/4	3.24	20	13	12				2	1	1			1
Cu ND-120	1 1/2	7.79			32		90			7			1	
C 2140 Green	3/4	7.45			9				3			3		
Ni Sulfate	1	5.34		1	1	1	1				1530	5		1
MT-110	3/4	8.43			1	25						4		
Red ZR-130	3/4	8.92			23		80	4	2	5		1	1	

Submitted By EA Weakley (6-3378)

Approved By [signature] 12-3-81
Manager, Fuels Engineering

Approved By EMG [signature]
Manager, Environmental Control

Accepted By EMG [signature] 12/3/81
Manager, Fuels Operations

APP H-28

9413294.1702

CWDP 3-81

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

Serial No. 03765	
Sample Of Na Acetate	
Source	
For / Area	Sampling Date 11-9-81 / Time AM PM
Submitted By Wakley	
Remarks	
Date Reported 11-11-81	Time AM PM
Analyst	Report Approved

CONSTITUENT	ANALYSIS
pH 3.24	
ICP	
Al = 20 ppm	Ni < .8 ppm
Ca < 12 ppm	Si = 48 ppm
Fe = 25 ppm	Zn = 1 ppm
Mg = 1 ppm	
Na = 20 ppm	

A-1700-165 (7-79)

CWDP 3-81

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

Serial No. 03768	CONSTITUENT / ANALYSIS
Sample Of Cu ND-120	PH 7.79
Source	ICP
For Area / Sampling Date 11-9-81 / Time AM PM	Metal ions
Submitted By Weakley	Ca = 32 ppm
Remarks	Cr = 90 ppm
	Mg = 7 ppm
	Na = 570 ppm
Date Reported 11-11-81 / Time AM PM	Si = 4 ppm
Analyst	Report Approved

A-1700-165

9413294.1704

CWDP 3-81

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

Serial No. 03767	
Sample Of C 1140 Green	
Source	
For / Area	Sampling Date 11-9-81 / Time AM PM
Submitted By Weakley	
Remarks	
Date Reported 11-11-81	Time AM PM
Analyst	Report Approved

CONSTITUENT	ANALYSIS
pH	7.45
ICP	
Metal ion	
Ca	9 ppm
Na	350 ppm

A-1700-165 (7-79)

CWDP 3-81

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

Serial No. 03769	CONSTITUENT ANALYSIS
Sample Of MT-110	PH 8.43
Source	ICP
For Area / Sampling Date 11-9-81 / Time AM PM	
Submitted By Weakley	
Remarks	Metal ions
	Co = 25 ppm
	Na = 150 ppm
Date Reported 11-11-81 / Time AM PM	
Analyst	Report Approved

A-1700-16

9413294.1706

9011703173

CWDP 3-81

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

Serial No. 03766	CONSTITUENT / ANALYSIS
Sample Of Well ZR - 130	PH 8.92
Source	ICP
For / Area / Sampling Date 11-9-81 / Time AM PM	
Submitted By Weakley	
Remarks	
Date Reported 11-11-81 / Time AM PM	
Analyst	Report Approved

A-1700-165 (7-79)

completed 1-:

CHEMICAL WASTE DISPOSAL PERMIT

Date 1-5-82 Permit No. 1-82

Quantity 300 gallons (6 55-gallon drums)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Copper strip solution from depleted U extrusions in 306 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Depleted U (0.20% U-235) = 0.152 lb/gal = 45.6 lbs.

Cu = 1.31 lb/gal = 393 lbs.

HNO_3 = < 0.1 lb/gal = < 30 lbs.

(Other impurities see below.)

Disposal Procedures (By Fuels Engineering)

Use barrel pump to transfer acid solution into Tank 10 (Cu Strip) when Tank 10 is being drained to the Chemical Waste System. Rinse out barrels with water and pump wash solution into Tank 10. Return barrels to 306 Bldg for reuse.

The disposal of this depleted U solution is a routine procedure.

The last disposal permit was 1-81, dated 2-12-81.

Impurities: 100 ppm Zn, 42 ppm Fe, 28 ppm Ni, 20 ppm Ti, 16 ppm Ca

Submitted By KV Clark, PNL (6-5688)

Approved By [signature] 1-5-82
Manager, Fuels Engineering

Approved By EMG [signature]
Manager, Environmental Control

Accepted By [signature] 1/6/82
Manager, Fuels Operations

APP H-34

9413294.1708

9 0 1 1 7 0 1 1 7 3 7

1-82

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

CWDP 1-82

Serial No. 04157	CONSTITUENT / ANALYSIS
Sample Of Copper etch	HNO_3 < .1 #/gal
Source	Cu 157 g/l = 1.31 #/gal
For Area / Sampling Date 12-15-81 / Time AM PM	U .152 #/gal
Submitted By Keith Clark	
Remarks 6-5688	
Date Reported 12-16-81 / Time AM PM	
Analyst	Report Approved

A-1700-165 (7-79)

6 drums x 50 gal = 300

2- NLA albany billets with surface contaminants.

9413294.1709

Completed 2-11-8

CHEMICAL WASTE DISPOSAL PERMIT

Date 1-5-82 Permit No. 2-82

Quantity 50 gallons in 2 30-gallon drums.

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Used Fremont silk screen cleaner from the Sign Shop, 3713 Bldg., having a pH of 11.78 and which contains particles of silk screen paint. New Fremont cleaners contain glycols and Na metasilicate.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Induction coupled plasma spectrometer analysis showed the following harmful impurities: 28 ppm Ba; 26 ppm Ca; 140 ppm Cu; 12 ppm P; 26 ppm Pb; 3 ppm Zn and 5 ppm Ti.

Disposal Procedures (By Fuels Engineering)

Add solution to Tank 9 or 10 in the 313 Bldg. and transfer into the outside waste storage tank. Wash out drums and save for reuse.

Used Fremont solution previously disposed on permit 4-80, 10-2-80.

Submitted By EA Weakley (6-3378)

Approved By TA Galuto 1-5-82
Manager, Fuels Engineering

Approved By EMB
Manager, Environmental Control

Accepted By 1/6/82
Manager, Fuels Operations

APP H-36

9013294.1710

2-82

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

CWDP 2-82

Serial No. 04158	CONSTITUENT / ANALYSIS
Sample Of Simple From Sign Shop	ph 11.78
Source Dip Tank	ICP
For Area / Sampling Date 12-15-81 / Time AM PM	
Submitted By [illegible]	
Remarks 6-3336	
~50 gal	
Date Reported 12-21-81 / Time AM PM	
Analyst	Report Approved

A-1700-165 (7-79)

9413294.1711

9 0 1 1 7 8 3 1 7 4 0

CWDP 2-82

O/ LAB NO 04158 SA SIGN SHOP DIP TANK 100X DIL2%HCL PH
EHGGGVCAIHAC WEAKLEY

BURN # 1 WEST 11:23 21DEC81

BURN # 2 WEST 11:23 21DEC81

BURN # 3 WEST 11:23 21DEC81

BURN # 1 WEST 11:23 21DEC81

2634									
< 0	.013	.010	.285	.265	< 0	< -.01	< -.00	.009	1.75
< .000	< 0	.098	< -.00	< 0	< -.00	.001	.007	.001	.004
41.7	< .000	< -.01	.110	.260	< -.00	< 0	17.6	.006	< -.00
.051	.031	< -.00	50.4						

BURN # 2 WEST 11:24 21DEC81

2634									
< 0	.010	.008	.280	.265	< 0	< -.00	.000	.003	1.35
< .000	< 0	.094	< -.00	< 0	< -.00	.001	.015	.001	.002
39.8	< .000	-.00	.059	.257	< -.00	.006	17.3	.006	< -.00
.056	.028	< -.00	49.1						

BURN # 3 WEST 11:24 21DEC81

2634									
.001	< -.00	.007	.282	.264	< 0	< -.01	< -.00	.008	1.13
< .000	< 0	.090	< -.00	< 0	< -.00	< 0	.004	.001	.001
42.7	< .000	-.00	.191	.255	< -.00	< 0	17.6	.006	< -.00
.056	.029	< -.00	51.1						

AVERAGE WEST 11:24 21DEC81

2634									
4192	1174	987	2473	3192	95	4279	929	242	8178
1615	235	1166	922	7323	422	72	3343	191	512
57799	1919	303	283	11176	2739	3975	118429	146	6509
810	340	686	16052	1727	10009	7608	12596		

AVERAGE WEST 11:24 21DEC81

IS									
2634									
AL	AS	B	BA	CA	CD	CE	CO	CR	CU
< 0	.004	.008	.282	.265	< 0	< -.01	< -.00	.007	1.41
DY	EU	FE	GD	K	LA	LI	MG	MN	MO
< .000	< 0	.094	< -.00	< 0	< -.00	< 0	.009	.001	.003
NA	ND	NI	P	PB	RU	SB	SI	SR	TE
41.4	< .000	-.00	.120	.257	< -.00	< 0	17.5	.006	< -.00
TI	ZN	ZR	NA						
.054	.029	< -.00	50.2						

* Ba = 28 ppm Na = 4,100 ppm [illegible]
Ca = 26 ppm P = 12 ppm
Cu = 140 ppm Pb = 26 ppm
Fe = 9 ppm Sn = 1750

9413294.1712

completed 7-19-82

CHEMICAL WASTE DISPOSAL PERMIT

Date 7-9-82 Permit No. 3-82

Quantity 60 gallons liquid & 35 pounds of solid

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Excess and unmarked materials found during container survey by Shop Operations: 35 pounds of oxalic acid in 313 Bldg., 55 gallons Oakite LSD in 303-K yard, and about 5 gallons unmarked liquid east of 333 Bldg.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Unmarked liquid: pH 13.3; Cu 6 ppm.

Oakite LSD: pH 13.7; Al 10 ppm, Ca 23 ppm, Cu 18 ppm, Si 3800 ppm & Zn 13 ppm.

Disposal Procedures (By Fuels Engineering)

Add unmarked liquid and Oakite LSD to Tank 9 or 10 in the 313 Bldg, rinse out drums, add rinse water to Tank 9 or 10, and transfer empty drums to empty drum disposal location by 3710-A Bldg. Add the oxalic acid to Tank 9 or 10 and dissolve in hot water. Dispose of glass containers in load lugger.

Submitted By EA Weakley (6-3378)

Approved By TA Coalion 7-9-82
Manager, Fuels Engineering

Approved By EMG
Manager, Environmental Control

Accepted By
Manager, Fuels Operations

APP H-39

9413294.1713

completed 12-

CHEMICAL WASTE DISPOSAL PERMIT

Date 11-5-82 Permit No. 4-82

Quantity 13 gallons liquid

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Nitric acid solution found in abandoned pipe from old slug pickle machine.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

HNO_3 = 0.32 lb/gal = 4.2 lbs

U = 607 ppm = 0.07 lb

Disposal Procedures (By Fuels Engineering)

Use barrel pump to transfer acid solution into Tank 10 (Cu Strip) when Tank 10 is being drained to the Chemical Waste System. Rinse out barrel with water and pump wash solution into Tank 10. Return barrel to 303-K yard.

Submitted By EA Weakley (6-3378)

Approved By [signature] 11-5-82
Manager, Fuels Engineering

Approved By EMG [signature]
Manager, Environmental Control

Accepted By [signature] 11/5/82
Manager, Fuels Operations

APP H-40

9413294.1714

9 0 1 1 7 3 3 1 7 4 3

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY - 3720 BLDG.

REPORT OF ANALYSIS

CWDP 4-82

Serial No. 03737

Sample Of acid from [illegible]

Source

For Area

Sampling Date 11-2-82

Time 3:35 AM PM

Submitted By

Remarks

Date Reported

Time AM PM

Analyst

CONSTITUENT	ANALYSIS
Pb	0.15
HNO_3	.32 #/gal or .6 M
U	607 g/gm

Report Approved

A-1700-165 (7-79)

Completed Feb., 1983

CHEMICAL WASTE DISPOSAL PERMIT

Date 1-17-83 Permit No. 1-83

Quantity 12 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Used absorbing solution for air sampling. Neutral salt solution of $HgCl_2$.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

$HgCl_2$ 100 gr/l = 9.8 lbs.

Disposal Procedures (By Fuels Engineering)

Mix with water or filter press effluent in Tank 9 or 10 in the 313 Bldg and transfer into the outside storage tank in the 311 Tank Farm. Rinse out plastic containers and return to HEHF.

$HgCl_2$ solution previously disposed on permit 6-78, 5-8-78.

Submitted By J. Bunch HEHF (6-5238)

Approved By T. E. Ault 1/19/83
Manager, Engineering Support

Approved By EMG A. J. Orion 1/24/83
Manager, Environmental Control

Accepted By [illegible] 1/27/83
Manager, Production Control

Accepted By N.A.
Manager, Fuels Production

9413294.1716

Completed in May

CHEMICAL WASTE DISPOSAL PERMIT

Date 4/22/83 Permit No. 2-83

Quantity 2 30-gallon drums

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Used Fremont silk screen cleaner from the Sign Shop, 3713 Building, having pH's of 10.7 and 12.8 and which contain particles of silk screen paint. New Fremont cleaners contain glycols and Na metasilicate.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Induction coupled plasma spectrometer analysis showed the following impurities: Drum 1-2ppm Ba, 17ppm Ca, 630ppm Na, 150ppm Si; Drum 2-20ppm Ba, 30ppm Ca, 2ppm Mo, 1400ppm Na, 260ppm Pb, 300ppm Si, 2ppm Sr, 3ppm Zr.

Disposal Procedures (By Fuels Engineering)

Add solution to Tank 9 or 10 in the 313 Building and transfer into the outside waste storage tank. Wash out drums and save for reuse.

Used Fremont solution previously disposed on permit 2-82, 1-5-82.

Submitted By B. L. Vedder (6-8903)

Approved By [signature] 4/25/83
Manager, Engineering Support

Approved By EMG [signature]
Manager, Environmental Control

Accepted By [signature]
Manager, Production Control

Accepted By N/A
Manager, Fuels Production

200(3-72)

Chemical Form from Step (

CWDP 2.83

	Detection Limit µg/ml	B1		B2
Dilution Factor		100X		100X
Al	.03			
As	.08			~~[illegible]~~
B	.01			
Ba	.002	2 ppm		20
Ca	.01	17		30
Cd	.004			
Ce	.04			
Co	.01			
Cr	.02			
Cu	.004			
Dy	.004			
Eu	.002			
Fe	.005			
Gd	.01			
K	.3			
La	.008			
Li	.004			
Mg	.06			
Mn	.002			
Mo	.01			2
Na	.01	630		1400
Nd	.02			
Ni	.02			
P	.1			
Pb	.06			260
Ru	.05			
Sb	.05			
Si	.02	150		300
Sr	.002			2
Te	.06			
Ti	.002			
Zn	.02			3
Zr	.008			
Cs				
		10.7		12.9

9413294.1718

CHEMICAL WASTE DISPOSAL PERMIT

Date 4/25/83 Permit No. 3-83

Quantity 400 gallons (8 55-gallon drums)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Copper strip solution from depleted U extrusions in 306 Building.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Depleted U (00.2% U-235) = 0.816 #/gallon = 326 lbs.

Cu = 1.52 #/gallon = 608 lbs.

HNO_3 = 1.07 #/gallon = 428 lbs.

(other impurities see below)

Disposal Procedures (By Fuels Engineering)

Use barrel pump to transfer acid solution into Tank 10 (Cu strip) when Tank 10 is being drained to the Chemical Waste System. Rinse out barrels with water and pump wash solution into Tank 10. Return barrels to 306 Building for reuse.

The disposal of this depleted U solution is a routine procedure. The last disposal permit was 1-82, dated 1-5-82.

Impurities: 280ppm Zn; 790ppm Ti; 30ppm Ni; 170ppm Fe; 470ppm Ca

Submitted By K. V. Clark, PNL (6-5688)

Approved By T. E. Ault 3/26/83
Manager, Engineering Support

Approved By EMG
Manager, Environmental Control

Accepted By 5/10/83
Manager, Production Control

Accepted By
Manager, Fuels Production

8 drums - ≈ 400 gallons

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

CWDP 3-83

Serial No. 01917	CONSTITUENT / ANALYSIS
Sample Of Special Cu Solution	Cu 1.52
Source 306 Bldg	U 0.816 #/gal
For Area / Sampling Date 4-12-83 / Time AM PM	HNO3 - 1.07 #/gal
Submitted By Keith Clark 6-5688	ICP
Remarks 306 W/126 PNL/Mtls	
Date Reported / Time AM PM	
Analyst	Report Approved

A-1700-165 (7

9413294.1720

9011703174 9

Barry

CWDP 3-83

O/ LAB NO 01917 SA [redacted]SPECIAL .5?/100 50X DIL
EHGGGVCAIHAC

BURN # 1 WEST 14:09 21APR83

BURN # 2 WEST 14:09 21APR83

BURN # 3 WEST 14:09 21APR83

BURN # 1 WEST 14:09 21APR83
2615

.183	.052	.008 <	0	.048	.002	.072	.006	.004	17.5
.008	.003	.019	.759 <	0	.021	.001	.359	.003 <	-.00
.027	.038	.004	.056	.030	.033	.010	.120	.001	.037
.079	.028	.007	3.27	29.4					

BURN # 2 WEST 14:09 21APR83
2615

.188	.044	.006 <	0	.047	.002	.065	.004	.001	17.7
.008	.003	.013	.792 <	0	.021	.001	.360	.003	.011
.032	.031	.001	.074	.027	.033	.003	.123	.001	.038
.078	.026	.008	2.96	29.4					

BURN # 3 WEST 14:09 21APR83
2615

.192	.050	.007 <	0	.047	.002	.064	.006	.005	17.6
.009	.003	.019	.779	.006	.024	.001	.362	.003	.012
.027	.039	.005	.012	.030	.040	.005	.126	.001	.042
.079	.031	.008	3.30	30.3					

AVERAGE WEST 14:09 21APR83
2615

4176	892	761	177	1777	83	3155	791	180	77426
1284	182	655	1009	6645	313	69	3793	180	404
310	1484	264	210	7826	2534	3273	9185	77	5756
727	272	552	7145	329	9457	6783	13826		

AVERAGE WEST 14:10 21APR83
IS
2615

AL	AS	B	BA	CA	CD	CE	CO	CR	CU
.188	.049	.007 <	0	.047	.002	.067	.005	.003	17.6
DY	EU	FE	GD	K	LA	LI	MG	MN	MO
.008	.003	.017	.777 <	0	.022	.001	.361	.003	.008
NA	ND	NI	P	PB	RU	SB	SI	SR	TE
.029	.036	.003	.047	.029	.035	.006	.123	.001	.039
TI	ZN	ZR	NA	NI					
.079	.028	.008	3.17	29.7					

17.6 ug/ml × 50 × 100/0.5 ml = 1.469 #/gal

*

Completed Aug. 83

CHEMICAL WASTE DISPOSAL PERMIT

Date 7-11-83 Permit No. 4-83

Quantity 550 gallons (10 55-gallon drums)

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Copper strip solution from depleted U extrusions in the 306 building.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Depleted U (0.2% U-235) = 0.302 #/gallon = 166.1 lbs.

Cu = 1.51 #/gallon = 830.5 lbs.

HNO_3 = 3.00 #/gallon = 1650.0 lbs.

(other impurities see below)

Disposal Procedures (By Fuels Engineering) Use barrel pump to transfer acid solution into Tank 10 (Cu strip) when Tank 10 is being drained to the Chemical Waste System. Rinse out barrels with water and pump wash solution into Tank 10. Return barrels to 306 building for reuse.

The disposal of this depleted U solution is a routine procedure. The last disposal permit was 1-82, dated 1-5-82.

Impurities: 324 ppm Zn, 64 ppm Fe, 30 ppm Ni, 270 ppm Ti, 230 ppm Ca, 1178 ppm Mg, 98 ppm Pb, 364 ppm Si

Submitted By K. V. Clark, PNL (6-5688)

Approved By R H Thomas
Manager, Engineering Support

Approved By EMG
Manager, Environmental Control

Accepted By
Manager, Production Control

Accepted By
Manager, Fuels Production

9413294.1722

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

CWDP 4-83

Serial No. 03383	CONSTITUENT / ANALYSIS
Sample Of Special Cu Etch Solution	Cu 1.51 #/gal ~1.75
Source	.85
For / Area / Sampling Date / Time AM PM	HNO_3 0.116 #/gal at 5.24 ph
Submitted By Keith Clark	3.00 #/gal at 7.79 ph
Remarks Kyrtle Keith Clark 6-5688	U. 0.302 #/gal
306 w/126 PNL/matls & Barry Vedder – Unc	ICP.
Date Reported 7-8-83 / Time AM PM	
Analyst	Report Approved

A-1700-165 (7-79)

10 barrels

9413294.1723

9011781

H
G

03383
Specific Cu Et
.5/100
10X Dil
7-7-83

BURN # 1 WEST 16:37 13JUL83
J
G

BURN # 2 WEST 16:37 13JUL83
G

BURN # 3 WEST 16:37 13JUL83
V

CWBP 4-83

BURN # 1 WEST 16:37 13JUL83
C

2602								
.294	< -.01	.012	.001	.115	.004	.142	.012	.011
.017	.006	.032	1.41	.007	.041	.001	.590	.007
.010	.070	.015	.036	.058	.071	.039	.182	.002
.135	.159	.016	5.29	12.3				

BURN # 2 WEST 16:37 13JUL83
C

2602								
.311	.046	.010	.001	.113	.004	.131	.012	.015
.016	.005	.032	1.36	< 0	.039	.001	.581	.006
.013	.059	.013	.066	.039	.067	.030	.179	.002
.134	.162	.014	4.94	4.83				

BURN # 3 WEST 16:37 13JUL83
C

2602									
.301	.046	.011	.001	.117	.003	.139	.013	.018	8
.017	.006	.032	1.39	< 0	.043	< 0	.596	.006	.
.015	.067	.017	.104	.051	.065	.049	.184	.002	.
.135	.164	.015	5.15	4.83					

I

2602									
4420	895	710	160	1915	74	2940	715	191	410
1211	169	639	1117	5940	303	61	4169	177	
263	1361	245	290	7510	2341	3023	4943	69	5
811	888	529	6955	57	9451	6433	15739		

H
A

AVERAGE WEST 16:37 13JUL83
C

IS									
2602									
AL	AS	B	BA	CA	CD	CE	CO	CR	
.302	.027	.011	.001	.115	.004	.137	.012	.014	9
DY	EU	FE	GD	K	LA	LI	MG	MN	
.017	.006	.032	1.39	< 0	.041	.000	.589	.006	.
NA	ND	NI	P	PB	RU	SB	SI	SR	
.013	.065	.015	.069	.049	.068	.039	.182	.002	.
TI	ZN	ZR	NA	N1					
.135	.162	.015	5.13	7.33					

Factor = 0.01669

Cu = 1.510 #/gal

D
F

Completed 4/27/84 into basin # 3.

CHEMICAL WASTE DISPOSAL PERMIT

Date April 18, 1984 Permit No. 1-84

Quantity 3 - 30 gallon drums

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Used Fremont silk screen cleaner from the Sign Shop, 3713 Building, having pH's of 12.9, 11.9, and 12.2. New Fremont cleaners contain glycols and sodium metasilicate.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.) Induction coupled plasma spectrometer showed the following impurities:

Drum 1: 45 ppm Ba, 42 ppm Ca, 12 ppm Cr, 10,900 ppm Na, 110 ppm Pb, 2200 ppm Si; Drum 2: 13 ppm Ca, 1.1 ppm Cr, 670 ppm Na, 370 ppm Pb, 340 ppm Si; Drum 3: 42 ppm Ba, 28 ppm Ca, 6 ppm Cr, 10,500 ppm Na, 50 ppm Pb, 2480 ppm Si.

Disposal Procedures (By Fuels Engineering)

Add solution to Tank 9 or 10 in the 313 Building and transfer into the outside waste storage tank. From waste storage tank, transfer into tanker and transport to 183-H. The tanker load containing the silk screen cleaner solution and the next two loads taken from the waste storage tank are to be discharged into either Basin #2 or #3 at 183-H; not into Basin #4.

The drums holding the solution are to be washed out (into Tank 9 or 10) and saved for reuse.

Used Fremont solution was previously disposed on permit 2-83, dated 4/22/83.

Submitted By B. L. Vedder (6-8903) BLV. 4/18/84

Approved By [signature] Manager, Fuels Design & Projects

Approved By EMG [signature] Manager, Environmental Control

Accepted By [signature] 4/24/84 Manager, Production Control

Accepted By N. A. Manager, Fuels Production

9413294.1725

CWDP 1-84

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

Serial No. 00192

Sample Of Sign Shop Chemical Tank

Source Barrel #1

For Area

Sampling Date 1-11-84

Time AM PM

Submitted By

Remarks

Date Reported 3-8-84

Time AM PM

Analyst

Report Approved

CONSTITUENT	ANALYSIS
pH	12.92
Fcp	

Old Fremont → Crud in one

A-1700-165

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

Serial No. 00193

Sample Of Sign Shop Chemical Tank

Source Barrel #2

For Area

Sampling Date 1-11-84

Time AM PM

Submitted By

Remarks

Date Reported 3-8-84

Time AM PM

Analyst

Report Approved

CONSTITUENT	ANALYSIS
pH	11.94
Fcp	

A-1700-165

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY — 3720 BLDG.

REPORT OF ANALYSIS

CWDP 1-84

Serial No. 00194	CONSTITUENT / ANALYSIS
Sample Of Sign Shop Chemical Tank	ph 12.21
Source Barrel #3	
For Area / Sampling Date 1-11-84 / Time AM PM	Icp.
Submitted By	
Remarks	
Date Reported 3-8-84 / Time AM PM	
Analyst	Report Approved

A-1700-165 (7-79)

9413294.1727

CWDP 1-

Dilution factor	Detection limit µg/ml	Bbl #1 100X	Bbl #1 1000X			Bbl #2 10X	Bbl #2 100X		Bbl #3 100X	Bbl #3 1000X			
Al	.03												
As	.08												
B	.01												
Ba	.002	45	~~30~~						.42				
Ca	.01	42	~~28~~			13	~~6~~		28				
Cd	.004												
Ce	.04												
Co	.01												
Cr	.02	12				1.1			6				
Cu	.004					.4			1.2				
Dy	.004												
Eu	.002												
Fe	.005	3				.3			1.2				
Gd	.1												
K	.3					~~1400~~	1160						
La	.008												
Li	.004												
Mg	.06					2.3							
Mn	.002												
Mo	.01												
Na	.01	10900	10,200			670	~~530~~		10500	10700			
Nd	.02												
Ni	.02												
P	.1					370	~~280~~		20				
Pb	.06	110	~~190~~			~~280~~	~~280~~		50				
Ru	.05												
Sb	.05												
Si	.02	2200				340	~~260~~		2480				
Sr	.002	2.7				.5			1.4				
Te	.06												
Ti	.002	.5											
Zn	.02					.54			2				
Zr	.008												
Cs													

9413294.1728

Completed June, 1984

CHEMICAL WASTE DISPOSAL PERMIT

Date May 3, 1984 Permit No. 2-84

Quantity Approximately 225 gallons in 5-55 gallon drums

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Copper strip solution from depleted U extrusions in the 306 Building. The pH of the solution is 0.65.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Depleted U (0.20% U-235) = 0.44 #/gallon = 99 lbs.

Cu= 1.80 #/gallon = 405 lbs.

HNO_3 = 0.19 #/gallon = 43 lbs.

(other impurities see below)

Disposal Procedures (By Fuels Engineering) Use barrel pump to transfer acid solution into Tank 10 (Cu strip) when Tank 10 is being drained to the Chemical Waste System. Rinse out barrels with water and pump wash solution into Tank 10. Return barrels to 306 building for reuse.

This disposal of this depleted U solution is a routine procedure. The last disposal permit was 4-83, dated 7-11-83.

Impurities: Al-1482ppm; Ca-406ppm; Ce-374ppm; Gd-3820ppm; Mg-2220ppm; P-1192ppm; Si-814ppm; Pb-336ppm; Zn-588ppm; Ti-212ppm.

Submitted By K. V. Clark, PNL (6-5688)

Approved By [signature] B.L.V. 5/4/84
Manager, Fuels Design & Projects

Approved By EMG [signature]
Manager, Environmental Control

Accepted By [signature] 5/24/84
Manager, Production Control

Accepted By [signature] 5-8-84
Manager, Fuels Production

APP H-55

9413294.1729

CHEMICAL WASTE DISPOSAL PERMIT

Date April 12, 1985 Permit No. 1-85

Quantity Approximately 200 gallons in four 55-gallon drums

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Copper strip solution from depleted U extrusions in the 306 Building. The pH of the solution is 0.22

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Depleted U (0.20% U-235 = 0.394#/gallon = 78.8 lbs.

Cu-1.60#/gallon = 320 lbs.

HNO3 = 0.07# gallon = 14 lbs.

(other impurities see below)

Disposal Procedures (By Fuels Engineering) Use barrel pump to transfer acid solution into Tank 10 (Cu strip) when Tank 10 is being drained to the Chemical Waste System. Rinse out barrels with water and pump wash solution into Tank 10. Return barrels to 306 Building for reuse.

This disposal of this depleted U solution is a routine procedure. The last disposal permit was 2-84, dated 5-3-84.

Imputrities: Al-1400ppm; Ca-300ppm; Fe-150ppm; Co-60ppm; Mg-2000ppm; Na-1600ppm; P-600ppm; Si-700ppm; Zn-300ppm; Ti-150ppm.

Submitted By K. V. Clark, PNL (6-5688)

Approved By [signature] 4-12-85 4/12/85
Manager, Fuels Design and Projects

Approved By EMG [signature]
Manager, Environmental Control

Accepted By [signature] 4/23/85
Manager, Production Control

Accepted By John A Remaize 4/26/85
Manager, Fuels Production

APP H-56

9413294.1730

9 0 1 1 7 3 1 7 5 9

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY — 3720 BLDG.

REPORT OF ANALYSIS

CWDP 1-85

Serial No. 1655	CONSTITUENT / ANALYSIS
Sample Of: Copper Strip Waste Sol	HNO_3 .07 #/gal
Source	Cu 1.60 #/gal
For / Area / Sampling Date 3-27-85 / Time AM PM	U 0.394 #/gal
Submitted By: K Clark	pH 0.22
Remarks: B64561 376-5688	
Keith Clark	
306W/126 BNW - 300 area	
3 Reported phone to Keith Clark.	
Date Reported / Time AM PM	
Analyst	Report Approved

A-1700-165 (7-79)

Disposal Permit
1-85

Quantity ≐ 200 gallons in 4 barrels
depleted U

REPORTED VALUES ug/ml Copper Stripper LAB NO. 01651

CWDP 1-85

Dilution factor	Detection limit ug/ml	5000
Al	.03	1400
As	.08	
B	.01	
Ba	.002	
Ca	.01	300
Cd	.004	
Ce	.04	
Co	.01	(60)
Cr	.02	
Cu	.004	194,000
Dy	.004	
Eu	.002	
Fe	.005	150
Gd	.1	
K	.3	
La	.008	
Li	.004	
Mg	.06	2000
Mn	.002	
Mo	.01	
Na	.01	1600
Nd	.02	
Ni	.02	
P	.1	(600)
Pb	.06	
Ru	.05	
Sb	.05	
Si	.02	900
Sr	.002	
Te	.06	
Ti	.002	150
Zn	.02	(300)
Zr	.008	
Cs		

Note: Due to the high copper in solution, a 5000X dilution is required for ICP analysis. Values in parenthesis are at or near detector limit of the instrument

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APP H 50

CHEMICAL WASTE DISPOSAL PERMIT

Date May 10, 1985 Permit No. 2-85

Quantity 80 gallons

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Used Turco Decon 4512 A solution from Tank 13 in the 313 Building Slug Recovery area, containing phosphoric and citric acid, with a pH of 1.0.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

H_3PO_4 - 0.38 # gallon; Ca - 18 ppm, Citrate - 1400 ppm, Fe-4ppm; Na - 30ppm; Si - 7 ppm

Disposal Procedures (By Fuels Engineering)

Pump solution from Tank 13 into Tank 2 (waste acid neutralizer tank) after 50% caustic solution has been added to the tank in preparation for neutralizing a batch of waste acid. After Tank 13 has been emptied, rinse with water and pump again into Tank 2. Finish the neutralizer with normal waste acid from the 334-A storage tanks.

Submitted By JK Marshall (6-1859) 5-14-85

Approved By 5/23/85
Manager, Engineering Support

Approved By 5-24-85
Manager, Environmental Control

Accepted By 5/21/85
Manager, Production Control

Accepted By 5-24-85
Manager, Fuels Production

CHEMICAL WASTE DISPOSAL PERMIT

Date 5/21/85 Permit No. 3-85

Quantity Approximately 20 empty 55-gallon drums

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Drums contained 36% sulfuric acid for use with the new deionized water system; residual acid remaining in the drums needs to be washed out.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

H_2SO_4 - 3.81 #/gallon

Disposal Procedures (By Fuels Engineering) Rinse the drums with water and place the rinse solution into Tank 17 in Slug Recovery. Rinse each drum twice. Pump the rinse solution into the waste acid neutralizer tank (Tank 2) and neutralize in the same manner as the waste acid.

Submitted By JK Marshall JK Marshall 5-22-85

Approved By R H Thomas
Manager, Fuels Design & Projects

Approved By [signature] 5/23/85
Manager, Environmental Control

Accepted By [signature] 5/23/85
Manager, Production Control

Accepted By [signature] 5/23/85
Manager, Fuels Production

APP H-60

9413294.1734

CHEMICAL WASTE DISPOSAL PERMIT

Date October 16, 1985 Permit No. 4-85

Quantity Approximately 200 gallons in four 55-gallon drums

Nature and Source of Material (acid, basic, neutral, pH, organic, solid)

Copper strip solution from depleted U extrusions in the 306 Building.

Major Pollutants (Heavy metals, Be, U, Cations, Anions, etc.)

Depleted U-0.249#/gallon = 49.8 lbs.

Cu - 1.19#/gallon = 238 lbs.

HNO_3 - 0.032#/gallon = 6.4 lbs.

Disposal Procedures (By Fuels Engineering) Use barrel pump to transfer acid solution into Tank 10 (Cu strip) when Tank 10 is being drained to the Chemical Waste System. Rinse out barrels with water and pump wash solution into Tank 10. Return barrels to 306 Building for reuse.

Disposal of this depleted U solution is a routine procedure. The last disposal permit was 1-85, dated 4-12-85.

Impurities: Al-790 ppm; Ca-250 ppm; Fe-50 ppm; Mg-1200 ppm; Si-430 ppm; Ti-90 ppm.

Submitted By J. K. Marshall JK Marshall 11-25-85

Approved By R. A. Cox
Manager, Fuels Manufacturing Engrng.

Approved By Eric M. Greager
Manager, Environmental Protection

Accepted By 12/26/85
Manager, Production Control

Accepted By John O Reynolds 12-11-85
Manager, Fuels Production

Battelle
Pacific Northwest Laboratories

BNW ANALYTICAL LABORATORY – 3720 BLDG.

REPORT OF ANALYSIS

CWDP 4-85

Serial No. 04764	CONSTITUENT / ANALYSIS
Sample Of Cu Strip Solution	HNO_3 – 0.032 #/gal
Source	
For Area / Sampling Date 10-8-85 / Time AM PM	
Submitted By Keith Clark 6-5688	Cu 1.19 #/gal
Remarks	
C.W.D. Permit 4-85	U. 0.249 #/gal
Date Reported 10-11-85 / Time AM PM	
Analyst	Report Approved

A-1700-165 (7-79

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9011178317 65

REPORTED VALUES µg/ml CWD Permit 4-85 LAB NO. 4764

Cu solution from K. Clark

CWDP 4-85

Dilution factor	Detection limit µg/ml	1000X
Al	.03	790
As	.08	
B	.01	
Ba	.002	
Ca	.01	250
Cd	.004	
Ce	.04	
Co	.01	
Cr	.02	
Cu	.004	225,000
Dy	.004	
Eu	.002	
Fe	.005	50
Gd	.1	
K	.3	
La	.008	
Li	.004	
Mg	.06	1200
Mn	.002	
Mo	.01	
Na	.01	
Nd	.02	
Ni	.02	
P	.1	
Pb	.06	
Ru	.05	
Sb	.05	
Si	.02	430
Sr	.002	
Te	.06	
Ti	.002	90
Zn	.02	
Zr	.008	
Cs		

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APPENDIX I

STATEMENT OF WORK: WELL DRILLING SPECIFICATIONS

NOTE: This Appendix remains unchanged. It is an historic record (PNL-SOW-183-H).

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9011178376

PNL-SOW.183-H

STATEMENT OF WORK

WELL DRILLING SPECIFICATIONS
183-H SOLAR EVAPORATION BASINS

July 15, 1986

APPENDIX I

STATEMENT OF WORK: WELL DRILLING SPECIFICATIONS, 183-H SOLAR EVAPORATION BASINS

The Statement of Work presented in this appendix contains drilling specifications for wells installed near the 183-H Basins during 1986 under the RCRA Compliance Ground-Water Monitoring Project. The Statement of Work covers general requirements, quality assurance, preparations, construction materials, hydrologic testing, and a description of work.

9413294.1741

STATEMENT OF WORK

WELL DRILLING SPECIFICATIONS
183-H SOLAR EVAPORATION BASINS

July 15, 1986

1.0 GENERAL

1.1 Scope of Work

The purpose of this contract is to furnish all labor, equipment, and materials necessary to drill, install, develop, and test at least 16 and possibly up to 25 ground-water monitoring wells. Currently, 23 wells are planned (three clusters of three wells each and 14 single shallow wells). However, the number of single shallow wells may change as drilling progresses.

These wells are being drilled as part of the Revised Ground-Water Monitoring Plan for the 183-H Solar Evaporation Basins. Drilling and testing of these wells will provide additional hydrogeologic data, help determine the extent of low-level ground-water contamination, and help determine the rate of movement of trace levels of hazardous chemical wastes within the ground water.

1.2 Work Location

All drilling sites are located in the 100-H Area of the Hanford Site in the State of Washington, approximately 37 road miles north of Richland. Each well site is clearly marked and labeled in the field with a painted stake. Figure 1 is a map of the 100-H Area showing existing wells and proposed new well locations.

1.3 Drilling Schedule

Drilling for this contract shall be conducted in two phases. The first phase will consist of drilling 16 wells; seven single shallow wells (W1 through W7, Figure 1), and three well clusters (C1 through C3, Figure 1). Each cluster will consist of one shallow, one intermediate, and one deep well, approximately 25 feet apart from one another. Construction of the wells in this phase will commence August 1, 1986 and be completed on or before December 1, 1986.

Currently, seven single shallow wells (W8 through W14, Figure 1) are planned for the second phase of drilling. However, this number may change as drilling progresses. Construction of the wells in this phase will commence March 30, 1987 and be completed on or before May 29, 1987.

1.4 Working Hours

Work will be performed on a five-day work week schedule, Monday-Friday, between the hours of 8:00 a.m. and 4:30 p.m. The work will be done on consecutive working days over the period of the contract. Days not included

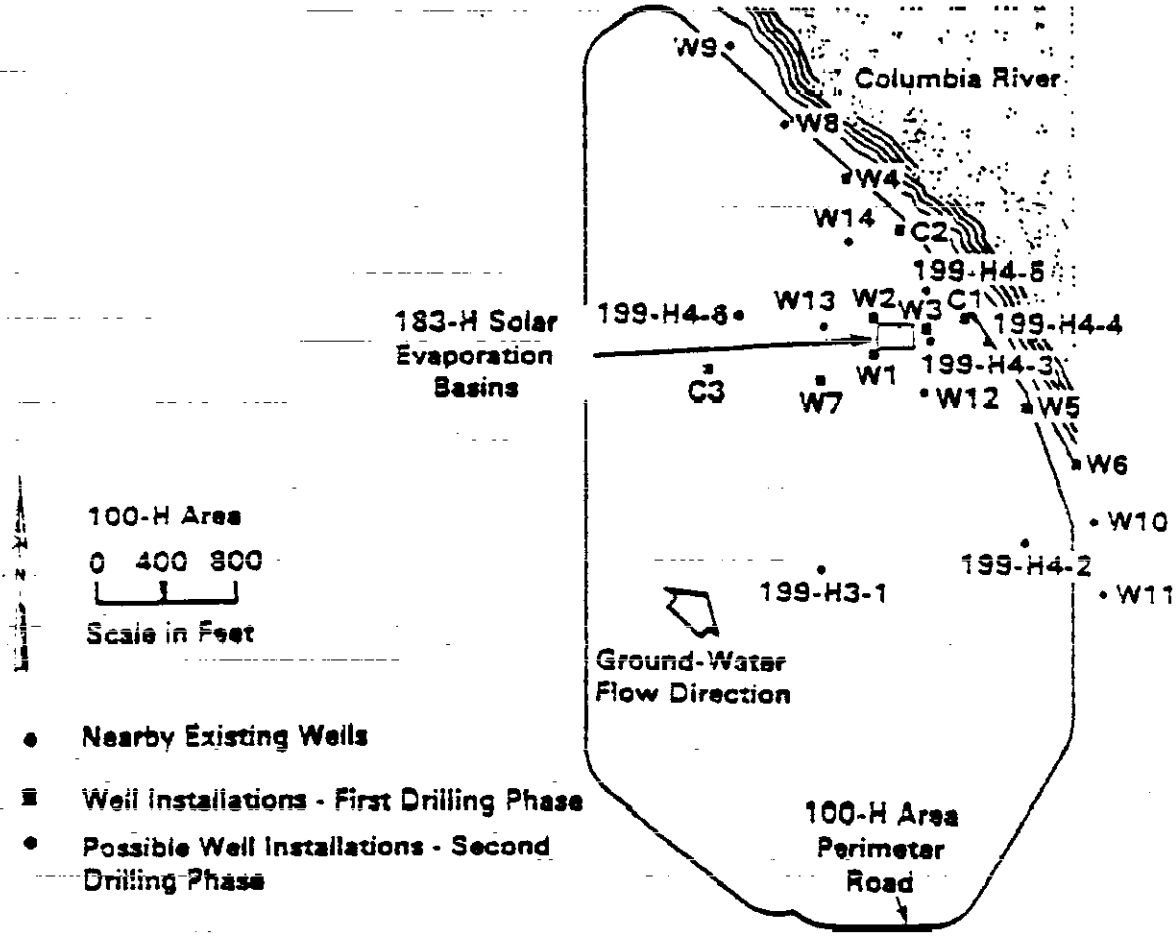

FIGURE 1. Well Location Map of the 100-H Area

in this schedule are those holidays observed by PNL staff. Scheduled holidays for the contract period are: September 1, November 27-28, 1986 and May 25, 1987. Exceptions may be made in the work schedule if mutually agreed upon by the contractor and PNL.

In the event that special tests (i.e., geophysical logging) must be performed during drilling operations, standby time will be paid. Standby time will be held to a minimum and is estimated to be 40 hours during the period of this contract. The PNL geologist and driller will both sign and date the drilling log for approved standby time.

Downtime not specifically ordered by PNL will not be considered as standby time and no compensation will be made.

1.5 Equipment Required

The contractor is required to furnish all labor and equipment necessary to drill, install, develop, and test these wells as specified in sections 4, 5, and 6 of this contract, and as shown in the contract figures. These wells shall be drilled by the cable tool method using drive barrel and/or hard tools.

1.6 Materials Required

The contractor is required to furnish all well construction materials necessary to drill, install, develop, and test these wells as specified in sections 4, 5, and 6 of this contract, and as shown in the contract figures. Water used during the drilling operations shall be obtained from the 100 or 300 Area Fire Stations.

1.7 Contract Figures

The contract figures are not to scale and do not attempt to show exact details of well construction. Exact measurements such as completion depths, amount of materials used, joints, spacing, etc. shall be determined in the field by PNL.

1.8 As-Built Diagrams

As-built diagrams for each well will be maintained by the PNL geologist as the well is being drilled. Each diagram will be an accurate record showing well construction and completion. The contractor shall readily provide all information necessary to complete these diagrams.

1.9 Drilling Logs

The contractor shall keep a daily log of operations performed on each well. The log will be accurate and legible, with entries made in continuous, chronological order. The log shall contain the following: geologist, date, rig number, well number, depth at beginning of shift, depth at completion of shift, JAJ contract number, total casing (temporary and permanent), depth, drill method, wet/dry sample,

lithologic description, time, drilling comments, and all other pertinent information for the completion of these wells. The log shall be complete, signed and dated by the driller and PNL geologist at the end of each day. The log shall be available to the PNL geologist upon request and after completion of each well. Drilling logs will be furnished by PNL. Figure 2 is an example drilling log.

1.10 Site Geology

The contractor should anticipate drilling in unconsolidated to consolidated materials, consisting of clay, silt, sand, gravel, cobbles, and boulders. These materials were deposited in former river channels and may be cemented, forming hardened layers of variable thickness. Low levels of radiological and chemical contamination may be encountered during drilling. PNL will provide routine monitoring of the drill cuttings and fluids penetrated in each borehole.

2.0 QUALITY ASSURANCE

2.1 Qualifications of Drillers

All drillers shall be licensed in the State of Washington and have a minimum of five years cable tool drilling experience using both drive barrel and hard tools. In addition, each driller shall have experience in radiological and/or hazardous waste drilling and monitoring well construction. The contractor shall provide a complete list of drillers and helpers involved and enter those present in the drilling log.

2.2 Compliance with Specifications

All wells shall be constructed and completed in accordance with Chapter 173-160 WAC, "Minimum Standards for Construction and Maintenance of Water Wells," and the specifications contained herein. Any changes or modifications made to these specifications must be approved by the PNL geologist.

As required during and after construction of each well, the contractor shall furnish proof acceptable to PNL (i.e., copies of receipts) that the quality of materials used for construction and installation of the monitoring wells equals or exceeds all requirements specified for this work.

In the event such proof is not acceptable to PNL, the contractor may be required to remove or replace those unacceptable items with material meeting the specified requirements. In such case, the contractor shall repair all damage caused in the removal and replacement at no additional cost to PNL.

2.3 Well Site Inspections

The PNL geologist shall be present at all times and will perform the Title III inspection and any other duties necessary to ensure the proper installation of

9413294.1746

9 0 1 1 7 8 3 1 7 7 3

DRILL LOG	By	Rig	Well Number	Computer Number	Project or Work Order No
	Date		Depth To		Subcontract No

Total Casing	Depth	Drill Method	Wet/Dry Sample	LITHOLOGIC DESCRIPTION % Each Grain Size, Color, Roundness, Caliche, Etc.	Time	Drilling Comments

REMARKS

D Drive Barrel H Hard Tool L Large M Medium S Small VC Very Coarse C Coarse F Fine VF Very Fine ____ Standing Water

A 6000 021 (6-86)

FIGURE 2. Example Drilling Log

the monitoring wells in strict accordance with all specifications contained in this contract.

2.4 Well Abandonment

If, in the judgement of the PNL geologist, the well should be abandoned for whatever reason, the contractor will be instructed in writing, to abandon and backfill the hole. If well abandonment is deemed necessary as a result of contractor negligence, the contractor shall be held responsible for all replacement costs.

3.0 PREPARATIONS

3.1 General

The reliability of ground-water samples analyzed for hazardous chemical wastes are known to be affected by drilling methods and equipment used. Therefore, the following precautions must be taken before and during drilling operations:

A. Drilling Method

Drilling shall be done by the cable tool method. Drive barrel will be used where possible above the water table. Hard tools shall be used thereafter.

B. Steam Cleaning

Drill rig and peripheral equipment (i.e., drill tools, cables, etc.) shall be steam cleaned before coming on site. No detergents shall be used with the steam. In addition, the contractor shall steam clean the drill rig and all equipment, including the backpulled 10-in. and 12-in. casings, between wells (onsite). The contractor shall provide and maintain the steam cleaning equipment.

C. Storage of Construction Materials

The contractor shall use all means necessary to protect well construction materials before, during, and after installation. All materials shall be kept off the ground on stands, racks, or sawhorses. During vehicle transport, all materials shall be enclosed in the containers in which they were shipped.

D. Tool Lubricants

The contractor shall use only inorganic lubricants approved by PNL for assembling tool strings.

E. Drilling Additives

With the exception of water, no drilling additives will be allowed. Any water used during drilling operations shall be obtained from the 100 or 300 Area Fire Stations.

F. Drill Cutting and Water Disposal

Drill cuttings from the saturated and unsaturated zones shall be disposed of by spreading and leveling in the vicinity of the well bore. Water pumped from the wells during development shall be disposed of in the vicinity of the well bore. Water pumped from the wells during aquifer testing shall be discharged a minimum of 1000 ft away from the well bore, other wells in the vicinity, and the Columbia River. In the event contaminated materials and/or water are encountered, disposal shall be performed in accordance with PNL Industrial Health and Safety requirements.

4.0 CONSTRUCTION MATERIALS

4.1 Carbon Steel Casing and Drive Shoe (12-in.)

Initially, carbon steel casing and drive shoe shall be new, 12-in. nominal diameter material, free from pits or breaks. The pipe shall be Schedule 40, meeting ASTM A53 Specification. The individual segments of 12-in. carbon steel casing shall have straight beveled cuts and will be welded together.

4.2 Carbon Steel Casing and Drive Shoe (10-in.)

Initially, carbon steel casing and drive shoe shall be new, 10-in. nominal diameter material, free from pits or breaks. The pipe shall be Schedule 40, meeting ASTM A53 Specification. The individual segments of 10-in. carbon steel casing shall have straight beveled cuts and will be welded together. The contractor shall machine the 10-in. drive shoe down, if necessary, to allow the shoe to pass through the 12-in. casing.

4.3 Stainless Steel Screen (10-in. telescope size)

Stainless steel screen shall be new, 10-in. telescope size, Type 304 stainless steel. The screens shall be of the continuous slot, wire-wound design with flat stainless steel plates welded to the bottom. The contractor is to determine slot size by a sieve analysis, with final slot size to be based on a 50 percent pass through. Determination of slot size must be reviewed and approved by PNL. The screens shall be factory cleaned and separately wrapped in protective polyethylene for shipment.

4.4 Stainless Steel Screen (6-in. pipe size)

Stainless steel screen shall be new, 6-in. pipe size, Type 304 stainless steel. The screens shall be of the continuous slot, wire-wound design with

flat stainless steel plates welded to the bottom. Slot size shall be 20 slot (.020-in.) screen for the shallow and intermediate wells, and 10 slot (.010-in.) for the deep wells. End fittings shall be double entry Stub ACME flush screw threads. The screens shall be factory cleaned and separately wrapped in protective polyethylene for shipment.

4.5 Stainless Steel Casing (6-in.)

Stainless steel casing shall be new, 6-in. nominal diameter, Type 304 stainless steel. The casing shall consist of Schedule 10 pipe with Schedule 40 couplings, meeting ASTM A312 or A778 Specification. End fittings shall be double entry Stub ACME flush screw threads. The casing shall be factory cleaned and separately wrapped in protective polyethylene for shipment.

4.6 Artificial Sand Pack

Artificial sand packs shall consist of kiln dried quartz (silica) sand, 10-20 U.S. sieve size for shallow and intermediate wells, and 20-40 U.S. sieve size for deep wells. The grains shall be rounded and spherical with a uniformity coefficient of less than 1.5.

4.7 Bentonite Pellet Seal

Bentonite pellet seals shall be composed of commercially available pellets that have a dry bulk density of 80 lb/ft^3 and are 0.25 in. in diameter.

4.8 Bentonite Slurry Seal

Bentonite slurry seals shall be a mixture of bentonite and water, with a Marsh Funnel viscosity of 120 seconds.

4.9 Granular Bentonite Seal

Granular bentonite seals shall be composed of coarse granular bentonite crumbles, 8-20 mesh.

4.10 Concrete Seal and Pad

Each well shall be sealed from land surface to a depth of 5 ft with concrete. In addition, a 4-ft by 4-ft, 4-in. thick concrete pad shall be placed at the surface around the permanent well casing. Using 3/4-in. maximum size aggregate, the concrete shall have a minimum compressive strength of 3000 psi at 28 days, and 6-in. maximum slump. The contractor shall supply a brass survey marker to be visibly placed in the concrete pad. The surface of the survey marker shall be of sufficient size to be stamped with the well number and horizontal and vertical controls.

4.11 Well Cap

Each well shall have a locking, removable, stainless steel cap of nominal diameter 2 in. greater than the permanent casing diameter to provide for pump hardware.

4.12 Protective Steel Posts

Four protective steel posts shall be concreted in the ground around each well. The posts shall be 4-in. nominal diameter and 6 ft in length, with 4 ft extending above ground.

4.13 Safety Paint

Each well casing, cap, and adjacent protective posts shall be painted safety yellow upon completion of the well.

5.0 HYDROLOGIC TESTING

5.1 Water Level Measurements

Once the water table has been reached, water level measurements will be made in each well at the start of each shift by the PNL geologist. PNL will supply all equipment for measuring water levels.

5.2 Ground-Water Samples

Once the water table has been reached, ground-water samples may be collected from various wells by PNL. PNL will supply all necessary ground-water sampling equipment.

5.3 Well Development

Each well will be developed by bailing, jetting, or other acceptable techniques as approved by PNL. At a minimum, each well shall be developed until it is cleared of sand and other fine grained material, as determined by the PNL geologist.

5.4 Aquifer Testing

Aquifer testing will be performed on some or all of the wells. These tests may include, but are not limited to: bailer, slug, step drawdown, 8-hr pumping, and 8-hr recovery tests. The contractor shall supply, install, and operate all aquifer testing equipment, which may include some or all of the following: pump, power source, flowmeter, and discharge line. The pump shall be capable of producing a yield of up to 750 gpm. A minimum of 1000 ft of discharge line will be required. PNL will supply equipment and personnel necessary for data collection.

6.0 DESCRIPTION OF WORK

6.1 Single Shallow Wells

All single shallow wells shall be completed in the Hanford gravels. Initially, each of these wells will be drilled to the top of the uppermost silt and clay

layer of the Ringold Formation with 10-in. diameter carbon steel casing and drive shoe. As the wells are being drilled, samples of the materials penetrated will be collected at 5-ft intervals and at changes in lithology by the PNL geologist. Sample jars will be provided by PNL.

A straightness test will then be performed on each well. Each well must pass a 20-ft section of 8-in. diameter pipe over the entire depth. The 10-in. casing will then be pulled back and the hole backfilled to the completion depth, which will be determined by the PNL geologist as each well is being drilled.

A 10-ft section of 10-in. (telescope size) stainless steel screen shall then be installed at the bottom of each well. The 10-in. casing shall then be pulled back, forming a natural pack around the exposed 10-ft section of screen.

Each well will then be developed. A test pump will be installed and an aquifer test performed. Upon completion of the aquifer test and removal of the test pump, each well will be completed by installing a 15-ft section of 6-in. (pipe size) stainless steel screen inside the 10-in. screen.

The top of each 6-in. well screen shall be threaded to 6-in. diameter stainless steel casing. The stainless steel casing shall extend from the top of each well screen to 2 ft above the land surface.

An artificial sand pack will then be placed between the 6-in. and 10-in. screens, extending upward to 5 ft above the top of each 6-in. screen. A bentonite pellet seal shall be placed on top of the artificial sand pack, extending upward 5 ft. A granular bentonite seal shall extend from the top of the bentonite pellet seal to 5 ft below land surface. Placement of sand pack and seals shall be accomplished as the 10-in. casing is being removed. The method of placement for sand pack and seals shall be approved by the PNL geologist.

The remaining annular space between the 6-in. and 10-in. casings shall be sealed with concrete as the 10-in. casing is removed completely from the borehole. The surface of each well will then be sealed with a concrete pad.

A locking, removable stainless steel cap will then be placed on each well. Four protective steel posts will be concreted in the ground around each well and the casings, caps, and posts will be painted safety yellow.

Each well will then be redeveloped as needed. Upon completion, the borehole will be inspected by PNL with the Downhole Television System to ensure that the wells have been constructed according to specification. Figure 3 is a diagram showing the construction and completion of the single shallow wells.

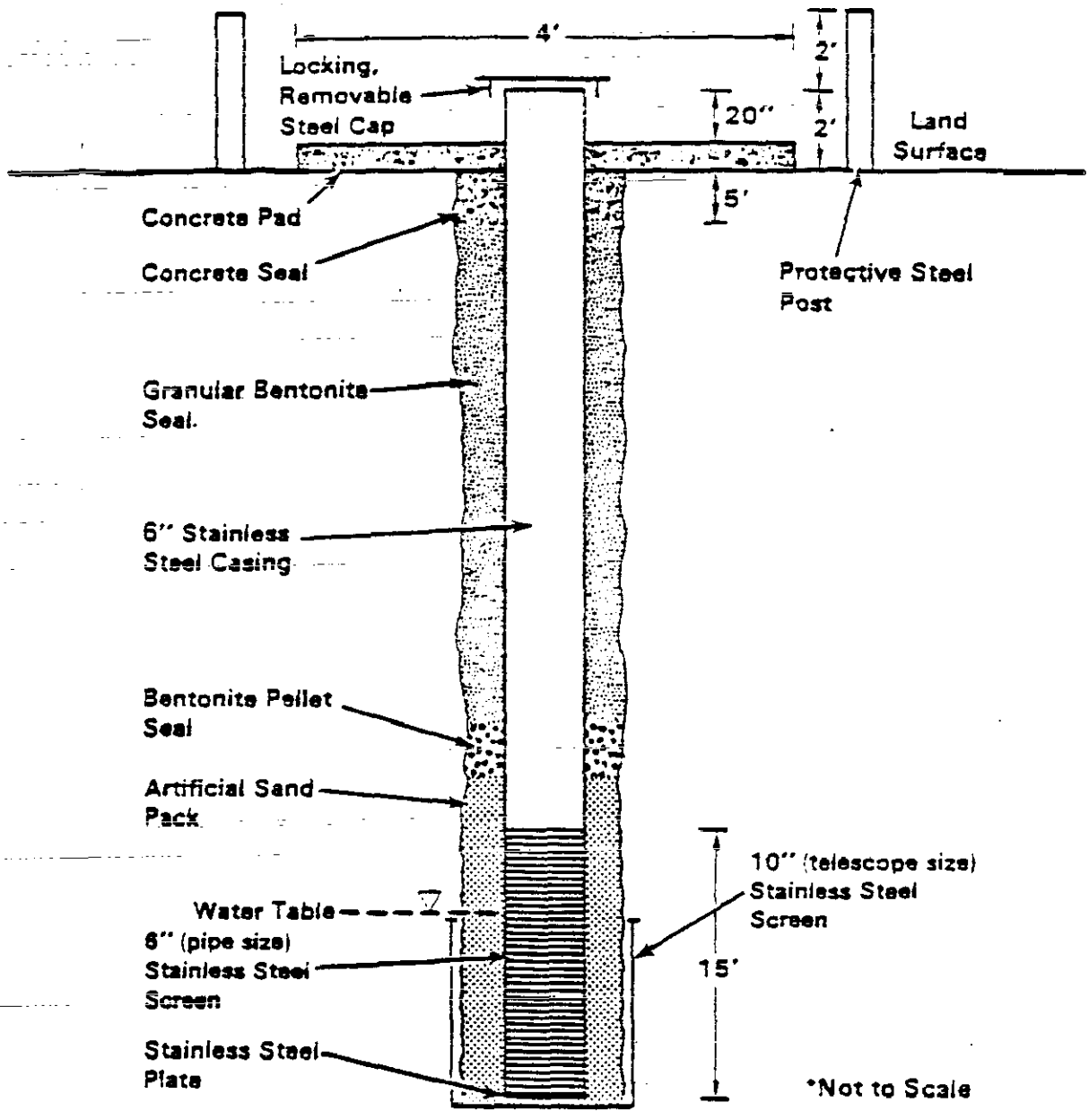

FIGURE 3. Single Shallow Wells Completed in Hanford Gravels

6.2 Cluster Wells

A. General

Each cluster will consist of three wells, one shallow, one intermediate, and one deep well. The wells will be constructed 25 ft apart from one another as shown in Figure 4. The shallow cluster wells will be completed in the Hanford gravels, identical to each of the single shallow wells. The intermediate cluster wells will be completed at the top of the uppermost silt and clay layer of the Ringold Formation. The deep cluster wells will be completed within the Ringold clays.

B. Intermediate Cluster Wells

Figure 5 is a diagram showing the construction and completion of the intermediate cluster wells. These wells will be drilled to the top of the uppermost silt and clay layer of the Ringold Formation with 10-in. diameter carbon steel casing and drive shoe. As the wells are being drilled, samples of the materials penetrated will be collected at 5-ft intervals and at changes in lithology by the PNL geologist. Sample jars will be provided by PNL.

A straightness test will then be performed on each well. Each well must pass a 20-ft section of 8-in. diameter pipe over the entire depth. A 5-ft section of 10-in. (telescope size) stainless steel screen shall then be installed at the bottom of each well. The 10-in. casing shall then be pulled back, forming a natural pack around the exposed 5-ft section of screen.

Each well will then be developed. A test pump will be installed and an aquifer test performed. Upon completion of the aquifer test and removal of the test pump, each well will be completed by installing a 5-ft section of 6-in. (pipe size) stainless steel screen inside the 10-in. screen.

The top of each 6-in. well screen shall be threaded to 6-in. diameter stainless steel casing. The stainless steel casing shall extend from the top of each well screen to 2 ft above the land surface.

An artificial sand pack will then be placed between the 6-in. and 10-in. screens, extending upward to 5 ft above the top of each 6-in. screen. A bentonite pellet seal shall be placed on top of the artificial sand pack, extending upward to 5 ft above the water table. A granular bentonite seal shall extend from the top of the bentonite pellet seal to 5 ft below land surface. Placement of sand pack and seals shall be accomplished as the 10-in. casing is being removed. The method of placement for sand pack and seals shall be approved by the PNL geologist.

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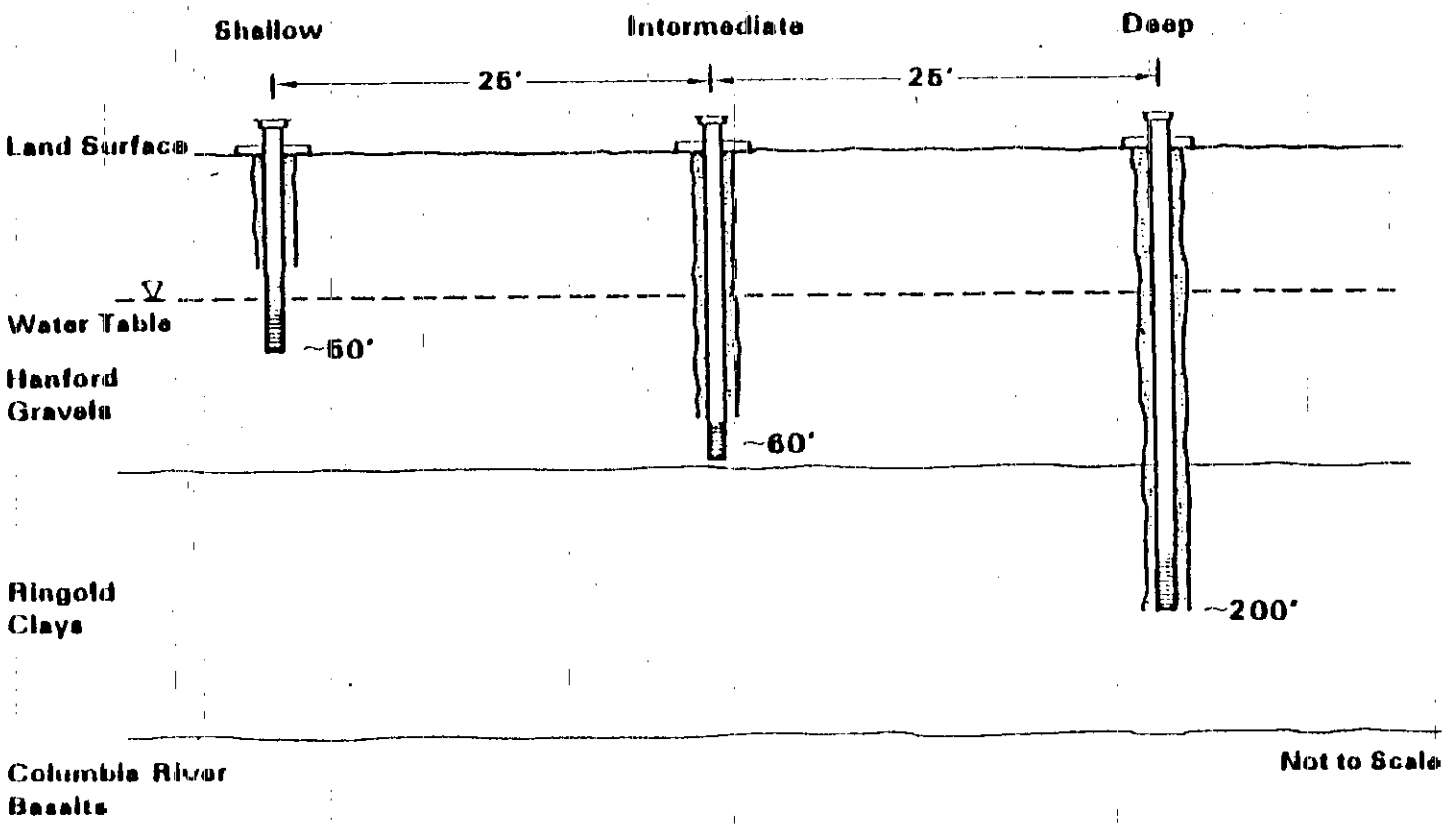

FIGURE 4. Cross Sectional View of Well Cluster Completion

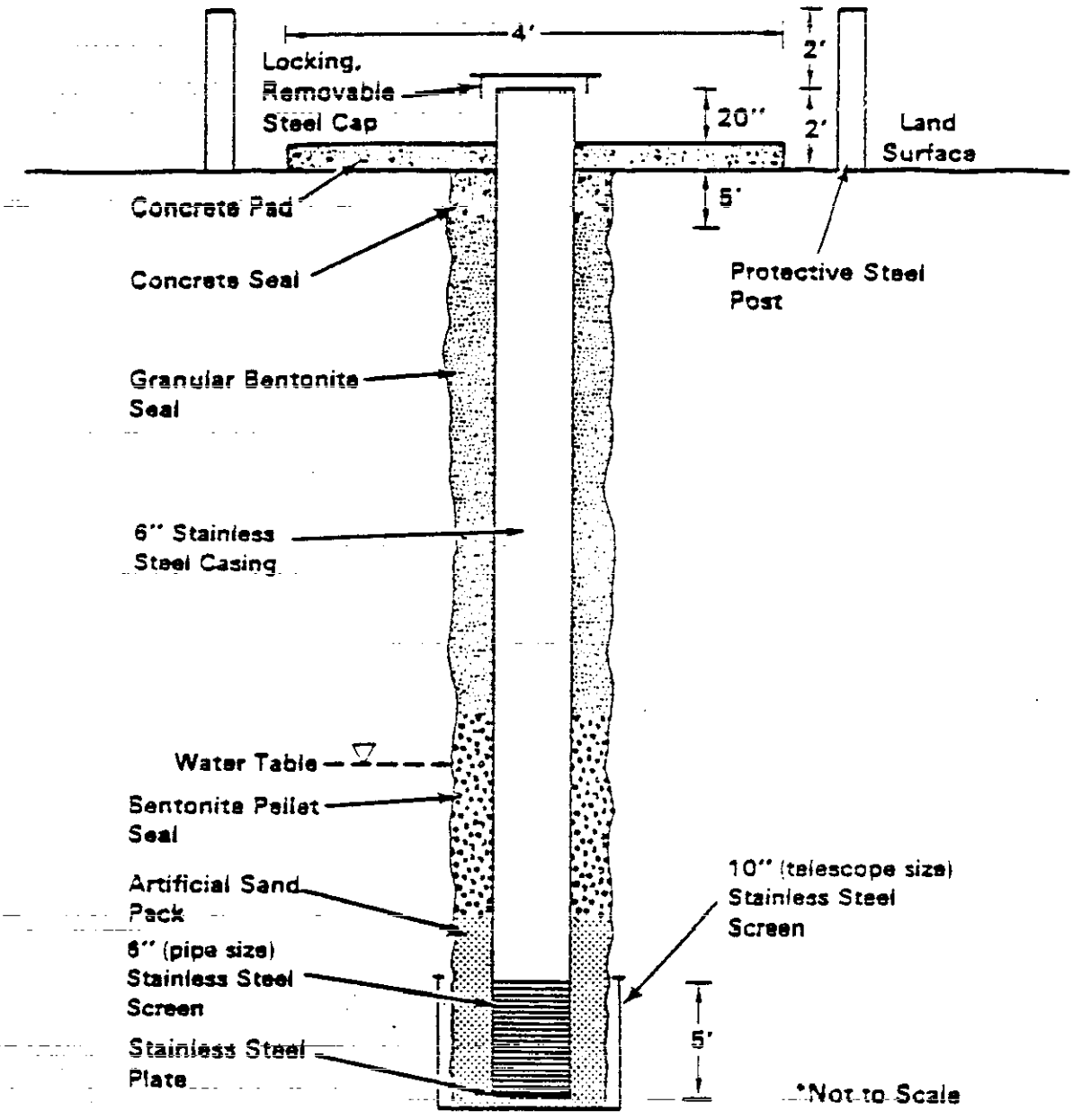

FIGURE 5. Intermediate Wells Completed at Top of Ringold Clays

The remaining annular space between the 6-in. and 10-in. casings shall be sealed with concrete as the 10-in. casing is removed completely from the borehole. The surface of each well will then be sealed with a concrete pad.

A locking, removable stainless steel cap will then be placed on each well. Four protective steel posts will be concreted in the ground around each well and the casings, caps, and posts will be painted safety yellow.

Each well will then be redeveloped as needed. Upon completion, the borehole will be inspected by PNL with the Downhole Television System to ensure that the wells have been constructed according to specification.

C. Deep Cluster Wells

Figure 6 is a diagram showing the construction and completion of the deep cluster wells. These wells will be completed within the Ringold clays. Each well will be drilled to the top of the uppermost silt and clay layer of the Ringold Formation with 12-in. diameter carbon steel casing and drive shoe. As the wells are being drilled, samples of the materials penetrated will be collected at 5-ft intervals and at changes in lithology by the PNL geologist. Sample jars will be provided by PNL.

The well will then be continued into the Ringold clays to the total depth with 10-in. diameter carbon steel casing and drive shoe. The total depth will be determined by the PNL geologist as each well is being drilled. Split spoon or shelby tube sediment samples will be collected in any low permeability unit thought to be significantly retarding vertical ground-water movement.

A straightness test will then be performed on each well. Each well must pass a 20-ft section of 8-in. diameter pipe over the entire depth. A 10-ft section of 6-in. (pipe size) stainless steel screen shall then be installed at the bottom of each well.

The top of each well screen shall be threaded to 6-in. diameter stainless steel casing. The stainless steel casing shall extend from the top of each well screen to 2 ft above the land surface.

An artificial sand pack shall then be placed between the 6-in. screen and 10-in. casing as the casing is being pulled back. The sand pack shall extend from the bottom of the screen upward to 10 ft above the top of the screen. A bentonite slurry seal shall be placed on top of the artificial sand pack, extending upward to 5 ft above the water table. A granular bentonite seal shall extend from the top of the bentonite slurry seal to 5 ft below land surface. Placement of sand pack and seals shall be accomplished as the 10-in. and 12-in. casings are being removed. The method of placement for sand pack and seals shall be approved by the PNL geologist.

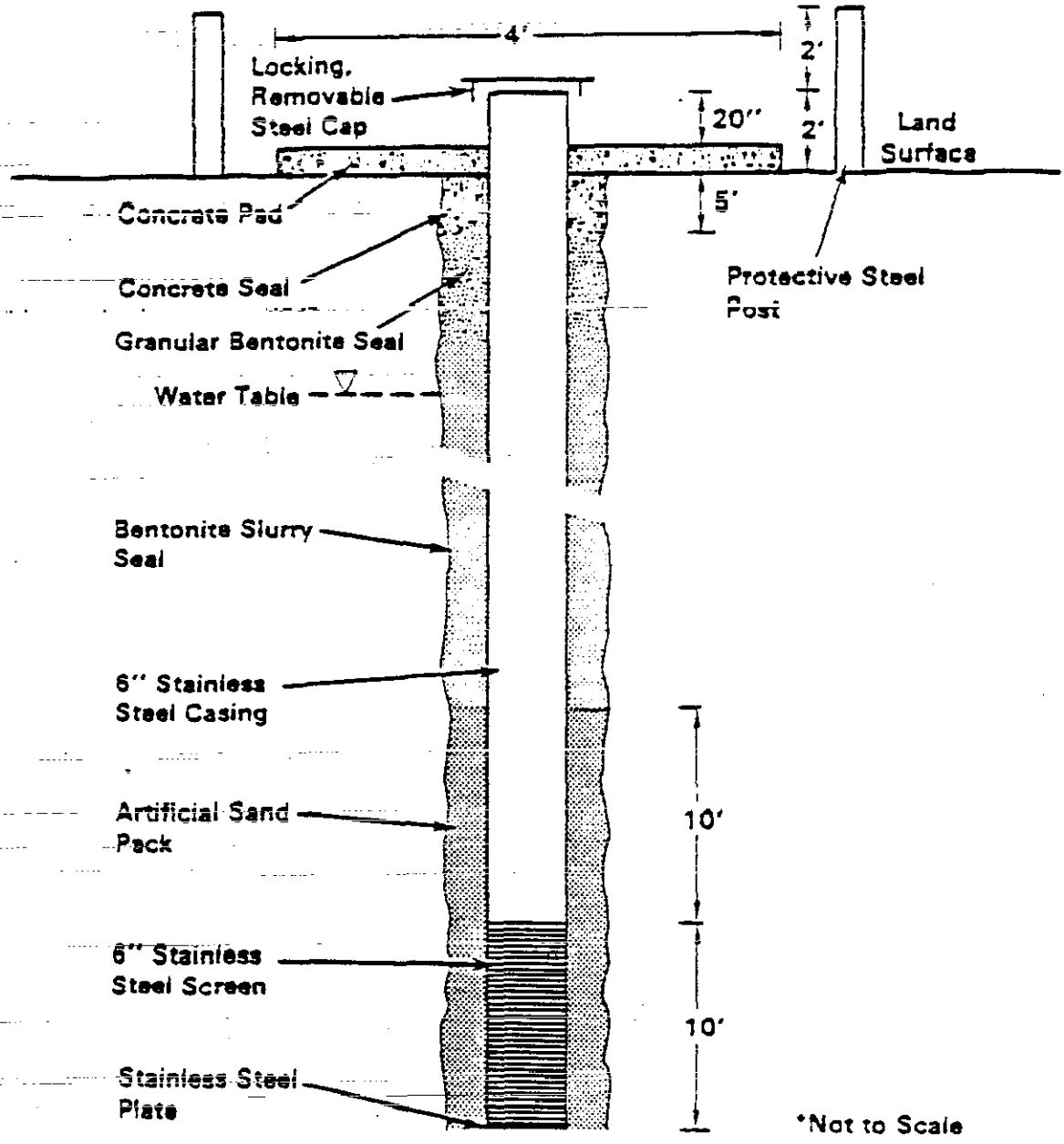

FIGURE 6. Deep Wells Completed Within Ringold Clays

The remaining annular space between the 6-in. and 12-in. casings shall be sealed with concrete as the 12-in. casing is removed completely from the borehole. The surface of each well will then be sealed with a concrete pad.

A locking, removable stainless steel cap will then be placed on each well. Four protective steel posts will be concreted in the ground around each well and the casings, caps, and posts will be painted safety yellow.

Each well will then be developed. Upon completion, the borehole will be inspected by PNL with the Downhole Television System to ensure that the wells have been constructed according to specification.

Aquifer tests may then be performed on some or all of the deep cluster wells, as determined by the PNL geologist.

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APPENDIX J

PROCEDURES FOR COLLECTION AND DOCUMENTATION OF DRILLING DATA

NOTE: This Appendix contains the written procedures used for collection and documentation of drilling data during the 1987 well installation effort for the 100-H Area.

Current procedures for drilling and field sampling are contained in the Westinghouse Hanford Company's *Environmental Investigations and Site Characterization Manual* (WHC-CM-7-7). This is a controlled manual and Ecology maintains a copy and is provided with updates.

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Procedure for Collection and Documentation of Drilling Data,
P-6 for RCRA Compliance/Hazardous Materials Monitoring

1.0 OBJECTIVE

This procedure provides standardized methods for the collection and documentation of sediment samples and well construction data, for wells drilled by the cable tool method.

2.0 APPLICABILITY

This procedure applies to work performed by well site geologists during well construction.

3.0 RESPONSIBILITIES

3.1 Well Site Geologist

- Collect and document drilling data

3.2 Senior Technical Reviewer

- Review and sign/date As-Built Diagram (Log of Borehole and Monitor Well Construction)
- Review and sign/date Title III Inspection List
- Review Drill Logs

4.0 PROCEDURE

4.1 Collection of Sediment Samples

Sediment samples shall be collected at 5-foot intervals and changes in formation by the well site geologist. All drill cuttings to be sampled shall be collected from the driller in a 5-gallon bucket.

Two pint jars shall then be filled from the bucket. One jar shall be submitted for laboratory analysis and the other retained for archiving.

A label indicating well number, depth, date and drilling method shall be placed on each sample jar.

If the well is being drilled with a drive barrel above the water table, a moisture sample shall also be collected from the bucket. Moisture tins shall be numbered consecutively as the well is being drilled. Each moisture sample shall be sealed with white identification tape and doubly wrapped in a plastic bag, and taped shut. The moisture sample number shall be recorded in the drill log.

The remainder of the sample in the bucket shall be used for sediment sample description.

4.2 Documentation of Sediment Samples and Well Construction Data

Sediment sample descriptions and well construction data for each well shall be recorded on an As-Built Diagram (Attachment 1), Title III Inspection List (Attachment 2) and Drill Log (Attachment 3). These data shall be recorded daily by the well site geologist.

The As-Built Diagram is a graphical representation of the well construction, geologic and hydrologic data. Data recorded on the As-Built Diagram shall include: general project and well information, well construction data, geologic and hydrologic data. After completion of the well, an overall review of the As-Built Diagram shall be performed by the Senior Technical Reviewer.

The Title III Inspection List provides a complete summary of well construction and completion data. Data recorded on the Title III Inspection List shall include: well number, item, approved by, date and remarks. All items listed shall be approved by the well site geologist. After completion of the well, an overall review of the Title III Inspection List shall be performed by the Senior Technical Reviewer.

The Drill Log contains detailed descriptions of the sediment samples and well construction data. Data recorded on the Drill Log shall include: geologist, date, rig, well number, depth at start, depth at finish, computer number, project number, subcontract number, total casing, depth, drill method, wet/dry sample, lithologic description, moisture sample number, time, drilling comments and remarks. A new Drill Log shall be used each day. After completion of the well, an overall review of the Drill Logs shall be performed by the Senior Technical Reviewer.

4.3 Description of Sediment Samples and Well Construction Data

Detailed descriptions of the sediment samples and well construction data shall be recorded on the Drill Log by the well site geologist.

Sediment sample descriptions shall include the following information as a minimum: lithologic name, texture, consolidation, mineralogy, color, roundness, reaction in hydrochloric acid (HCl), moisture content, and changes in lithology.

Well construction data shall include the following information as applicable: drill method, drill depth, completion depth, casing (type, size and lengths), perforations (type, depth and schedule), screen (type, length, slot size and depth), annular seal (type, interval and volume), packer (type, size and depth), well development and depth to water.

4.4 Data Management

After completion of the project, the original As-Built Diagram, Title III Inspection List and Drill Logs for each well shall be retained by V. L. McGhan of the PNL Geosciences Department. A copy of each completed form shall be retained by the PNL Records Retention Center.

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LOG OF BOREHOLE AND MONITOR WELL CONSTRUCTION

BOREHOLE OR WELL NO. _____

PROJECT _____ GEOLOGIST _____ PAGE ____ OF ____

LOCATION DESCRIPTION OR COOR. _____ DATE: STARTED _____ COMPLETED _____

DRILLING COMPANY _____ DRILLERS' NAMES _____ AND _____

DRILLING METHOD(S) _____ DRILL RIG _____

DRILLING FLUID _____ TEMPORARY CASING OR AUGER: TYPE _____ INSIDE DIA. _____

DRILL BITS: TYPE _____ OUTSIDE DIA. _____ SURVEYED GROUND ELEVATION _____

CIRCULATION		CONSTRUCTION DATA			DEPTH	GEOLOGIC AND HYDROLOGIC		
RETURN IN GPM	LOSS GPM	DESCRIPTION	DIAGRAM ANNULUS	DIAGRAM WELL	IN FT	DIAGRAM LITHOL.	DESCRIPTION AND COMMENTS	% Core & Box No.

TITLE III INSPECTION LIST

Number: _____

Item	Approved By	Date	Remarks
Qualifications of Drillers			
Drilling Method			
Steam Cleaning			
Storage of Construction Materials			
Tool Lubricants			
Drilling Additives			
Construction Materials			
Carbon Steel Casing			
Drive Shoes			
Stainless Steel Screen			
Stainless Steel Casing			
Artificial Sand Pack			
Bentonite Pellet Seal			
Bentonite Slurry Seal			
Granular Bentonite Seal			
Concrete Seal and Pad			
Well Cap			
Protective Steel Posts			
Safety Paint			
Well Depth			
Straightness Test			
Screen Slot Size and Placement			
Well Development			
Aquifer Testing			
Sand Pack Placement			
Bentonite Pellet Placement			
Bentonite Slurry Placement			
Granular Bentonite Placement			
Concrete Placement			
Downhole TV Inspection			
Completed Driller's and Geologist's Logs			
As-Built Diagram			
Well Abandonment			
Other			

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9 0 1 1 7 3 3 1 7 9 5

DRILL LOG	By	Rig	Well Number	Computer Number	Project or Work Order No.
	Date		Depth To		Subcontract No.

Total Casing	Depth	Drill Method	Wet/Dry Sample	LITHOLOGIC DESCRIPTION % Each Grain Size, Color, Roundness, Caliche, Etc.	Time	Drilling Comments

REMARKS:

APPENDIX K

SAMPLE ANALYSIS TABLE FOR OCTOBER 1989 THROUGH DECEMBER 1989

NOTE: This is new data which supercedes the prior submittal information. These data have been derived from PNL's second quarter 1989 Quarterly Monitoring Report Draft (PNL 7134, August 1989).

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Table K.1 Constituent List and Summary of Sampling Results for the 183-H Basins, September to November 1989. Table is directly from PNL's 'draft' Groundwater Monitoring Report).

Table K.2 Constituents with at Least One Detection Value for the 183-H Basins, September to November 1989. Table is directly from PNL's 'draft' Groundwater Monitoring Report).

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9 0 1 1 7 3 3 1 7 9 7

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9 0 1 1 7 8 3 1 7 9

Table K-1. Constituent List and Summary of Sampling Results for the 183-H Basins, September to November 1989. (Table is directly from PNL's 'draft' Groundwater Monitoring Report.) (sheet 1 of 3)

Constituent List= Contamination Indicator Parameters

Constituent Code	Name	Units	Detection Limit	Samples	Below Detection	Drinking Water Standards Standard	Agency	Exceeded	Full Name
191	CONDFLD	UMHO	1	14	0	700	WDOE	xxx	Specific conductance
199	PHFIELD		.100	14	0	6.5-8.5	EPAS		pH, Field Measurement
207	PH-LAB		.0100	10	0	6.5-8.5	EPAS		pH, Laboratory Measurement
H42	TOXLDL	PPB	10	11	2				Total Organic Halogen, Low Det. Level

Constituent List= Interim Primary Drinking Water Parameters

Constituent Code	Name	Units	Detection Limit	Samples	Below Detection	Drinking Water Standards Standard	Agency	Exceeded	Full Name
111	BETA	PCI/L	8	14	0	50	EPA	xxx	Gross beta
112	ALPHAHI	PCI/L	4	14	0	15	EPA	xxx	Alpha, High Detection Level
A08	BARIUM	PPB	8	15	0	1000	EPA		Barium
A07	CADMIUM	PPB	2	15	13	10	EPA	xxx	Cadmium
A08	CHROMUM	PPB	10	15	0	50	EPA	xxx	Chromium
A10	SILVER	PPB	10	15	15 ***	50	EPA		Silver
C72	NITRATE	PPB	500	15	0	45000	EPA	xxx	Nitrate
C74	FLUORID	PPB	500	15	11	4000	EPA		Fluoride
H20	FBARIUM	PPB	8	15	0	1000	EPA		Barium, filtered
H21	FCADMIU	PPB	2	15	14	10	EPA		Cadmium, filtered
H22	FCHROMI	PPB	10	15	0	50	EPA	xxx	Chromium, filtered
H23	FSILVER	PPB	10	15	15 ***	50	EPA		Silver, filtered
H80	TURBID	NTU	.100	10	0	1	EPA	xxx	Turbidity

Constituent List= Water Quality Parameters

Constituent Code	Name	Units	Detection Limit	Samples	Below Detection	Drinking Water Standards Standard	Agency	Exceeded	Full Name
A11	SODIUM	PPB	200	15	0	.			Sodium
A17	MANGESE	PPB	5	15	9	50	EPAS	xxx	Manganese
A19	IRON	PPB	30	15	3	300	EPAS	xxx	Iron
C73	SULFATE	PPB	500	15	0	250000	EPAS		Sulfate
C75	CHLORID	PPB	500	15	0	250000	EPAS		Chloride
H24	FSODIUM	PPB	200	15	0	.			Sodium, filtered
H29	FMANGAN	PPB	5	15	10	50	EPAS	xxx	Manganese, filtered
H31	FIRON	PPB	30	15	12	300	EPAS	xxx	Iron, filtered

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Table K-1. Constituent List and Summary of Sampling Results for the 183-H Basins, September to November 1989. (Table is directly from PNL's 'draft' Groundwater Monitoring Report.) (sheet 2 of 3)

---------- Constituent List= Site Specific and Other Constituents ----------

Constituent Code	Name	Units	Detection Limit	Samples	Below Detection		Drinking Water Standards Standard	Agency	Exceeded	Full Name
104	U	PCI/L	.600	10	0		600	DOE		Uranium
197	TC-99	PCI/L	15	10	5		900	EPAR	xxx	Technetium-99
A01	BERYLUM	PPB	5	15	15	***	.			Beryllium
A03	STRONUM	PPB	10	15	0		.			Strontium
A04	ZINC	PPB	5	15	9		6000	EPAS		Zinc
A05	CALCIUM	PPB	50	15	0		.			Calcium
A12	NICKEL	PPB	10	15	11		.			Nickel
A13	COPPER	PPB	10	15	14		1300	EPAP		Copper
A14	VANADUM	PPB	5	15	0		.			Vanadium
A15	ANTIONY	PPB	100	15	15	***	.			Antimony
A16	ALUMNUM	PPB	150	15	12		.			Aluminum
A18	POTASUM	PPB	100	15	0		.			Potassium
A50	MAGNES	PPB	50	15	0		.			Magnesium
C70	PHOSPHA	PPB	1000	15	15	***	.			Phosphate
H18	FZINC	PPB	5	15	7		6000	EPAS		Zinc, filtered
H19	FCALCIU	PPB	50	15	0		.			Calcium, filtered
H25	FNICKEL	PPB	10	15	12		.			Nickel, filtered
H26	FCOPPER	PPB	10	15	15	***	1300	EPAP		Copper, filtered
H27	FVANADI	PPB	5	15	4		.			Vanadium, filtered
H28	FALUMIN	PPB	150	15	14		.			Aluminum, filtered
H30	FPOTASS	PPB	100	15	0		.			Potassium, filtered
H32	FMAGNES	PPB	50	15	0		.			Magnesium, filtered
H33	FBERYLL	PPB	5	15	14		.			Beryllium, filtered
H35	FSTRONT	PPB	10	15	0		.			Strontium, filtered
H36	FANTIMO	PPB	100	15	15	***	.			Antimony, filtered
H58	ALKALIN		20000	11	0		.			Alkalinity
H66	BROMIDE	PPB	1000	15	15	***	.			Bromide
H67	NITRITE	PPB	1000	15	15	***	.			Nitrite
H86	FBORON	PPB	10	15	1		.			Boron, filtered
H87	FCOBALT	PPB	20	15	15	***	.			Cobalt, filtered
H88	FLITHIU	PPB	10	15	15	***	.			Lithium, filtered
H89	FMOLY	PPB	40	15	15	***	.			Molybdenum, filtered
H90	FSILICO	PPB	50	15	0		.			Silicon, filtered
H91	FTIN	PPB	30	15	15	***	.			Tin, filtered
H92	FTITAN	PPB	60	15	14		.			Titanium, filtered
H93	FZIRCON	PPB	50	15	15	***	.			Zirconium, filtered
P01	BORON	PPB	10	15	0		.			Boron
P02	COBALT	PPB	20	15	15	***	.			Cobalt
P03	LITHIUM	PPB	10	15	15	***	.			Lithium
P04	MOLY	PPB	40	15	15	***	.			Molybdenum

Table K-1. Constituent List and Summary of Sampling Results for the 183-H Basins, September to November 1989. (Table is directly from PNL's 'draft' Groundwater Monitoring Report.) (sheet 3 of 3)

---------- Constituent List= Site Specific and Other Constituents ----------

Constituent Code	Name	Units	Detection Limit	Samples	Below Detection	Drinking Water Standards Standard	Agency Exceeded	Full Name
P06	SILICON	PPB	50	15	0		.	Silicon
P08	TIN	PPB	30	15	15 ***		.	Tin
P07	TITAN	PPB	60	15	14		.	Titanium
P08	ZIRCON	PPB	50	15	15 ***		.	Zirconium

---------- Constituent List= WAC 173-303-9906 Constituents ----------

Constituent Code	Name	Units	Detection Limit	Samples	Below Detection	Drinking Water Standards Standard	Agency Exceeded	Full Name

*** - Indicates all samples were reported as below contractual detection limits
xxx - Indicates that Drinking Water Standards were exceeded
EPA - based on Maximum Contaminant Levels given in 40 CFR Part 141 (July, 1987) National Primary Drinking Water Regulations as amended by 52 FR 26890
EPAR - based on National Interim Primary Drinking Water Regulations, Appendix IV, EPA-570/9-76-003
EPAP - based on proposed Maximum Contaminant Level Goals in 50 FR 46936
EPAS - based on Secondary Maximum Contaminant Levels given in 40 CFR Part 143 National Secondary Drinking Water Regulations
DOE - based on Derived Concentration Guides, Draft DOE Order 5400.xx
WDOE - based on additional Secondary Maximum Contaminant Levels given in WAC 248-54, Public Water Supplies

79002117.3

Table K-2. Constituent with at Least One Detection Value for the 183-H Basins, September to November 1989. (Table is directly from PNL's 'draft' Groundwater Monitoring Report.) (sheet 1 of 5)

Well name	Collection date	Duplicate sample number	CONDFLD UMHO 1/700w	PH-LAB .01/6.5-8.5s	PHFIELD .10/6.5-8.5s	TOXLDL PPB 10/.
1-H3-2A	11OCT89		360	8	8.03	18
1-H4-3	29SEP89		883	.	7.82	.
	11OCT89		833	8	7.99	18
	11OCT89	1	.	.	.	25
	28NOV89		868	.	8	.
1-H4-4	11OCT89		1085	7.90	8.10	16
	28NOV89		887	.	7.61	.
1-H4-5	11OCT89		541	7.80	7.43	13
1-H4-6	11OCT89		569	8.10	7.87	19
1-H4-7	18OCT89		515	7.90	7.22	12
	30NOV89		513	.	7.75	.
1-H4-12A	11OCT89		536	7.90	7.86	14
1-H4-12C	11OCT89		288	8	8.02	18
1-H4-14	17OCT89		358	7.80	7.40	28
1-H4-18	11OCT89		381	7.80	7.68	35

79002117.4

Table K-2. Constituent with at Least One Detection Value for the 183-H Basins, September to November 1989. (Table is directly from PNL's 'draft' Groundwater Monitoring Report.) (sheet 2 of 5)

Well name	Collection date	Duplicate sample number	FLUORID PPB 500/4000	FCHROMI PPB 10/50	FMANGAN PPB 5/50s	FALUMIN PPB 150/.	FPOTASS PPB 100/.	FBERYLL PPB 5/.	FSTRONT PPB 10/.	ALKALIN 20000/.
1-H3-2A	11OCT89		<500	39	5	<150	4490	<5	243	112000
1-H4-3	29SEP89		800	208	51	1390	4900	<5	141	.
	11OCT89		800	117	<5	<150	3830	<5	94	158000
	11OCT89	1	800	123	<5	<150	3670	<5	96	158000
	28NOV89		<500	129	7	<150	4730	<5	118	.
1-H4-4	11OCT89		600	184	<5	<150	6140	<5	291	140000
	28NOV89		<500	137	<5	<150	6050	<5	245	.
1-H4-5	11OCT89		<500	81	<5	<150	5330	<5	374	147000
1-H4-6	11OCT89		<500	83	88	<150	6370	<5	388	145000
1-H4-7	18OCT89		<500	109	8	<150	5360	<5	313	140000
	30NOV89		<500	114	<5	<150	5880	<5	317	.
1-H4-12A	11OCT89		<500	83	<5	<150	4850	7	307	150000
1-H4-12C	11OCT89		<500	295	<5	<150	4080	<5	204	102000
1-H4-14	17OCT89		<500	420	<5	<150	4450	<5	253	104000
1-H4-18	11OCT89		<500	179	<5	<150	3880	<5	238	121000

Well name	Collection date	Duplicate sample number	ALPHAHI PCI/L 4/15	ALUMNUM PPB 150/.	BARIUM PPB 8/1000	FBARIUM PPB 8/1000	BETA PCI/L 8/50	BORON PPB 10/.	FBORON PPB 10/.	CADMIUM PPB 2/10
1-H3-2A	11OCT89		1.98	<150	24	24	5.57	30	14	<2
1-H4-3	29SEP89		87.1	2040	119	42	133	49	65	11
	11OCT89		82.3	478	24	19	83	66	47	<2
	11OCT89	1	84.8	285	25	19	85	66	53	<2
	28NOV89		42.3	<150	22	22	82.2	54	64	<2
1-H4-4	11OCT89		73.5	<150	78	71	202	45	30	<2
	28NOV89		41.1	<150	59	59	134	40	35	<2
1-H4-5	11OCT89		.	<150	69	77	.	88	55	<2
1-H4-6	11OCT89		5	<150	45	49	9.18	58	51	<2
1-H4-7	18OCT89		3.02	<150	43	48	4.45	34	30	<2
	30NOV89		3.74	<150	45	44	8.37	51	40	<2
1-H4-12A	11OCT89		11.1	<150	87	80	16.1	39	39	2
1-H4-12C	11OCT89		1.09	<150	9	7	4.72	12	<10	<2
1-H4-14	17OCT89		3.18	<150	23	30	5.93	19	13	<2
1-H4-18	11OCT89		3.42	<150	32	32	9.05	27	20	<2

79002117.5

Table K-2. Constituent with at Least One Detection Value for the 183-H Basins, September to November 1989. (Table is directly from PNL's 'draft' Groundwater Monitoring Report.) (sheet 3 of 5)

Well name	Collection date	Duplicate sample number	FSILICO PPB 50/.	SODIUM PPB 200/.	FSODIUM PPB 200/.	STRONUM PPB 10/.	SULFATE PPB 500/250000a	TC-99 PCI/L 15/900r	TITAN PPB 60/.	FTITAN PPB 60/.
1-H3-2A	11OCT89		15400	13100	13700	221	38000	*3.54	<60	<60
1-H4-3	29SEP89		18300	176000	165000	233	92000	.	92	68
	11OCT89		13400	133000	132000	104	80000	844	<60	<60
	11OCT89	1	13800	146000	133000	110	89000	830	<60	<60
	28NOV89		15400	138000	140000	112	80900	.	<60	<60
1-H4-4	11OCT89		14300	153000	158000	296	78000	2440	<60	<60
	28NOV89		14200	134000	133000	242	70700	.	<60	<60
1-H4-5	11OCT89		15200	12600	13500	343	74000	.	<60	<60
1-H4-6	11OCT89		14800	24800	25800	352	97000	*3.36	<60	<60
1-H4-7	18OCT89		14600	14300	15500	287	78000	*1.49	<60	<60
	30NOV89		13700	15700	15100	318	73700	.	<60	<60
1-H4-12A	11OCT89		12700	17100	15200	346	61000	164	<60	<60
1-H4-12C	11OCT89		29200	3910	3820	204	23900	*1.73	<60	<60
1-H4-14	17OCT89		14900	7940	8790	221	44000	*.804	<60	<60
1-H4-18	11OCT89		13400	9810	9510	235	43000	20.1	<60	<60

Well name	Collection date	Duplicate sample number	TURBID NTU .10/1	U PCI/L .50/800d	VANADUM PPB 5/.	FVANADI PPB 5/.	ZINC PPB 5/5000a	FZINC PPB 5/5000a
1-H3-2A	11OCT89		.200	2.08	13	<5	<5	9
1-H4-3	29SEP89		.	.	20	10	25	9
	11OCT89		10	40.4	7	<5	9	<5
	11OCT89	1	.	52.3	9	6	<5	<5
	28NOV89		.	.	10	9	<5	<5
1-H4-4	11OCT89		2	64.1	7	<5	60	41
	28NOV89		.	.	8	8	39	32
1-H4-5	11OCT89		.500	.	8	8	48	53
1-H4-6	11OCT89		1.50	4.24	11	6	43	56
1-H4-7	18OCT89		5.10	3.26	12	11	<5	8
	30NOV89		.	.	9	8	<5	<5
1-H4-12A	11OCT89		.200	7.07	6	<5	<5	<5
1-H4-12C	11OCT89		.200	.891	36	33	<5	<5
1-H4-14	17OCT89		.700	1.72	12	11	<5	<5
1-H4-18	11OCT89		.500	2.11	14	6	<5	6

79002117.6

Table K-2. Constituent with at Least One Detection Value for the 183-H Basins, September to November 1989. (Table is directly from PNL's 'draft' Groundwater Monitoring Report.) (sheet 4 of 5)

Well name	Collection date	Duplicate sample number	FCADMIU PPB 2/10	CALCIUM PPB 50/.	FCALCIU PPB 50/.	CHLORID PPB 500/250000s	CHROMUM PPB 10/50	COPPER PPB 10/1300p	IRON PPB 30/300s	FIRON PPB 30/300
1-H3-2A	110CT89		<2	41800	44300	6900	48	<10	59	<30
1-H4-3	29SEP89		3	41100	23800	10000	789	34	37400	7210
	110CT89		<2	19300	17400	10000	149	<10	984	<30
	110CT89	1	<2	20200	17900	11000	147	<10	708	<30
	28NOV89		<2	20300	21400	9700	137	<10	118	<30
1-H4-4	110CT89		<2	53800	54200	8000	177	<10	201	<30
	28NOV89		<2	43200	44300	7800	142	<10	112	<30
1-H4-5	110CT89		<2	75500	78000	8000	90	<10	120	<30
1-H4-6	110CT89		<2	84000	85700	13000	109	<10	178	41
1-H4-7	180CT89		<2	80800	81900	11000	113	<10	202	93
	30NOV89		<2	83800	87200	13100	122	<10	129	<30
1-H4-12A	110CT89		<2	72700	85500	8800	72	<10	<30	<30
1-H4-12C	110CT89		<2	29200	29400	2700	299	<10	33	<30
1-H4-14	170CT89		<2	44800	49800	5800	375	<10	<30	<30
1-H4-18	110CT89		<2	50000	48800	8200	191	<10	<30	<30

Well name	Collection date	Duplicate sample number	MAGNES PPB 50/.	FMAGNES PPB 50/.	MANGESE PPB 5/50s	NICKEL PPB 10/.	FNICKEL PPB 10/.	NITRATE PPB 500/45000	POTASUM PPB 100/.	SILICON PPB 50/.
1-H3-2A	110CT89		9340	9780	<5	<10	<10	18100	4450	14000
1-H4-3	29SEP89		7270	4600	480	21	12	242000	5750	23800
	110CT89		3520	3090	11	<10	<10	172000	3980	15900
	110CT89	1	3620	3120	10	10	<10	178000	4040	16100
	28NOV89		3680	3890	6	<10	<10	127000	4820	15400
1-H4-4	110CT89		8140	8230	<5	17	10	368000	6080	14300
	28NOV89		8730	8880	<5	<10	<10	253000	8040	13900
1-H4-5	110CT89		12700	13400	<5	<10	<10	39000	5120	14400
1-H4-6	110CT89		14600	14800	83	<10	<10	38000	6320	14500
1-H4-7	180CT89		11900	12500	8	<10	<10	38000	5080	14100
	30NOV89		12400	12600	<5	<10	<10	36300	5710	14300
1-H4-12A	110CT89		11500	10400	<5	<10	<10	59000	5160	13800
1-H4-12C	110CT89		10300	10300	<5	18	16	6300	4320	29000
1-H4-14	170CT89		8650	9550	<5	<10	<10	21700	4130	13400
1-H4-18	110CT89		8810	8500	<5	<10	<10	23600	4130	13800

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Table K-2. Constituent with at Least One Detection Value for the 183-H Basins, September to November 1989. (Table is directly from PNL's 'draft' Groundwater Monitoring Report.) (sheet 5 of 5)

The column headers consist of : Constituent Name
Analysis Units
Contractual Detection Limit/Drinking Water Standard(suffix)

Suffix
none - based on Maximum Contaminant Levels given in 40 CFR Part 141 (July, 1987) National Primary Drinking Water Regulations as amended by 52 FR 25690
r - based on National Interim Primary Drinking Water Regulations, Appendix IV, EPA-570/9-76-003
p - based on proposed Maximum Contaminant Level Goals in 50 FR 46938
s - based on Secondary Maximum Contaminant Levels given in 40 CFR Part 143 National Secondary Drinking Water Regulations
d - based on Derived Concentration Guides, Draft DOE Order 5400.xx
w - based on additional Secondary Maximum Contaminant Levels given in WAC 248-54, Public Water Supplies

Data Flags
< - Less than Contractual Detection Limit, reported as Limit
- Less than Contractual Detection Limit, measured value reported
* - For radioactive constituents, reported value is less than 2-sigma error

79002117.8

APPENDIX L

PROCEDURES FOR SAMPLE COLLECTION, CHAIN OF CUSTODY, AND FIELD MEASUREMENTS

NOTE: The prior submittal appendix is being withdrawn. It has been superceded by the Westinghouse Hanford Company's *Environmental Investigations and Site Characterization Manual* (WHC-CM-7-7). A copy of this manual has been given to Ecology and updates are mailed to Ecology as issued.

Procedure EII 10.2, "Measurement of Groundwater Levels", Rev. 1, Page 2 of 9, stipulates tape reading consistency within ± 0.02 feet (6 mm) when taken with a weighted measuring tape, and within ± 0.04 feet (12 mm) for an electrical water level measuring device.

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APPENDIX M

ANALYTICAL METHODS AND QUALITY CONTROL PROCEDURES

NOTE: The prior submittal appendix is being withdrawn. It has been superceded by the Westinghouse Hanford's Company *Environmental Investigations and Site Characterization Manual* (WHC-CM-7-7) for field control of samples. A copy of this manual has been given to Ecology and updates are mailed to Ecology as issued.

The analytical laboratory procedures will conform to SW-846 (EPA 1986a) requirements and the laboratory personnel will perform their duties in accordance with the EPA guidelines (SW-846 protocols).

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APPENDIX N

PERSONNEL TRAINING

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APPENDIX N

PERSONNEL TRAINING

Personnel Training. All personnel involved with the closure activities of the 183-H Basins will receive a minimum level of dangerous waste training.

- Managers and supervisors are responsible for supervising, coordinating, and directing the closure activities and personnel.
- Nuclear Process Operators and Decommissioning and Decontamination workers are responsible for sampling, packaging, and handling of dangerous waste, nonradioactive, and radioactive material.
- Health Physics Technicians are responsible for surveying for radiological and dangerous waste contamination.
- Crafts personnel are responsible for specialized work. The various crafts include carpenters, electricians, ironworkers/riggers, heavy equipment operators, crane operators, millwrights, pipefitters, and painters.

In addition to the personnel mentioned, any person entering a TSD unit during closure must have the 40 hour hazardous workers training.

Table N-1 contains a matrix that relates job categories to the individual training course. Appendix N contains brief descriptions of the training courses, including descriptions of the target audience, instructional technique, evaluation method, length of course, and frequency of retraining.

Table N-1. Company-General Training Matrix.

Course title	Type	Target/Audience			
		MS	NPO	HPT	CR
Generator Hazards Safety Training	I	X	X	X	X
Hazardous Waste Worker Safety Training	I	X	X	X	X
Hazardous Waste Worker Safety Training, Refresher	C	X	X	X	X
Hazardous Materials/Waste Job Specific Training	I	X	X	X	X
Scott SKAPAK* MSA PAPR	C	X	X	X	X
Self-Contained Breathing Apparatus (SCBA) Training (optional)	C	X	X	X	X
Radiation Safety Training	C	X	X	X	X
On-the-Job Training	C	X	X	X	X
Cardiopulmonary Resuscitation	C	X	X	X	X
Noise Control (optional)	C	X	X	X	X

C = continuing course.
I = introductory course.
NPO = nuclear process operators and decommissioning and decontamination workers.
MS = manager and supervisors.
X = required course.
HPT = health physics technicians.
CR = crafts.

* Scott SKAPAK is a trademark of Figgie International, Incorporated.

Title:	Generator Hazards Safety Training
Description:	Provides the dangerous material/waste worker with the fundamentals for safe use and disposal of dangerous materials.
Target Audience:	Dangerous material and waste workers
Technique:	Classroom
Evaluation:	Written test
Length:	4 hours
Frequency:	24 months

Title:	Hazardous Waste Worker Safety Training
Description:	Provides the dangerous waste worker with the fundamentals of safety when working with dangerous waste.
	Note: This course fulfills training requirements of 29 CFR 1910.120 requiring dangerous waste training of workers at all treatment, storage, and/or disposal facilities regulated under RCRA.
Target Audience:	Dangerous material and waste workers
Technique:	Classroom and on-the-job training
Evaluation:	Written test
Length:	24 hours
Frequency:	Not applicable

Title:	Hazardous Waste Worker Safety Training Refresher
Description:	Provides the dangerous waste worker with a refresher in the fundamentals of safety when working with dangerous waste.
	Note: This course fulfills training requirements of 29 CFR 1910.120 requiring dangerous waste training of workers at all treatment, storage, and/or disposal facilities regulated under RCRA.
Target Audience:	Dangerous material and waste workers
Technique:	Classroom
Evaluation:	Written test
Length:	8 hours
Frequency:	12 months

Title:	Hazardous Material/Waste Job-Specific Training
Description:	Provides job-specific dangerous material/waste information. Two checklists may be obtained from safety training to help the supervisor/manager through this session with each employee.
	Note: Not a classroom presentation--supervisor conducts this exercise with each employee using the checklists.
Target Audience:	Employees who complete generator hazards safety training
Technique:	On-the-job training
Evaluation:	On-the-job training checklist
Length:	Average - 2 hours
Frequency:	12 months

Title:	Scott SKAPAK MSA PAPR
Description:	This class is designed to instruct employees in the proper use of the Scott "SKAPAK" for entry, exit or work in conditions immediately dangerous to life and health and to instruct employees to recognize and handle emergencies. This class also includes instructions in the use of MSA PAPR.
Target Audience:	General, Safety, QA, OPS/OPRS, Management, Maintenance Engineering
Technique:	Classroom
Evaluation:	Practical exam
Length:	Approximately 2 hours
Frequency:	12 months

Title:	Self-Contained Breathing Apparatus (SCBA) Annual Qualification
Description:	Provides instructions in the proper use of a pressure-demand respirator in which breathing air is supplied from a cylinder carried on the user's back. The SCBA are typically used for emergency response situations in an atmosphere that is immediately dangerous to life or health.
Target Audience:	General, Safety, OPS/OPRS, Maintenance
Technique:	Taught in a classroom using a slide projector and overhead
Evaluation:	Written and practical test
Length:	Approximately 4 hours
Frequency:	12 months

1	Title:	Radiation Safety Training
2	Description:	A practical dress/undress demonstration is also required. Instructs radiation workers in the fundamentals of radiation protection and the proper procedures for monitoring exposures (ALARA). Training includes knowledge of the acute and chronic effects of exposure to radiation risks associated with occupational radiation exposure, mode of exposure, protective measures, instrumentation, monitoring programs, contamination control, personnel decontamination, warning signs and alarms, and responsibilities of employees and managers.
3	Target Audience:	Radiation workers as defined in WHC-CM-4-10
4	Technique:	Taught in a classroom using a white board, appropriate audio/visual equipment
5	Evaluation:	Written exam and practical dress/undress
6	Length:	Approximately 7 hours
7	Frequency:	24 months (Retraining under Course Number 020003)
8		
9		
10	Title:	On-The-Job Training
11	Description:	On-the-job training session under the supervision of an experienced person before full responsibilities may be assumed. In addition, all personnel on the hazardous waste site are required to have reviewed this Waste Sampling and Analysis Plan.
12	Target Audience:	Dangerous Material and Waste Workers
13	Technique:	Classroom and on-the-job training
14	Evaluation:	Practical exercise and on-the-job training checklist
15	Length:	40 hours
16	Frequency:	12 months

Title:	Cardiopulmonary Resuscitation (CPR)
Description:	Provide cardiopulmonary Resuscitation training to the American Heart Association standards.
Target Audience:	All employees
Technique:	Classroom and active participation.
Evaluation:	Practical exam and written test.
Length:	4 hours
Frequency:	24 months (recertification)

Title:	Noise Control (Noise-Hearing Conservation)
Description:	Provide employees with information conducive to hearing conservation. Supervisors and employees responsibility, exposure limits, hearing conservation requirements, protection devices, diagnosis of noise, induced hearing loss.
Target Audience:	All employees exposed to an 8 hour time weighted average sound level of 85 dBA or greater.
Technique:	Classroom
Evaluation:	None
Length:	Approximately 1 hour
Frequency:	12 months

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