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Revised Ground-Water Monitoring Compliance Plan for the 183-H Solar Evaporation Basins

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September 1986

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
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Revised Ground-Water Monitoring Compliance Plan for the 183-H Solar Evaporation Basins

September 1986

Prepared by the
Pacific Northwest Laboratory
for the
U.S. Department of Energy
Richland Operations Office

REVISED GROUND-WATER MONITORING COMPLIANCE PLAN FOR THE 183-H SOLAR EVAPORATION BASINS

September 1986

Prepared by
Pacific Northwest Laboratory
for the U.S. Department of Energy
Richland Operations Office
Richland, Washington 99352

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INTRODUCTION

This document contains ground-water monitoring plans for a mixed waste storage facility located on the Hanford Site in southeastern Washington State (Figure 1). This facility, operated by UNC Nuclear Industries (UNC), has been designated the 183-H Solar Evaporation Basins (183-H Basins). This facility has been used since 1973 for storage of mixed wastes, which contain both chemicals and radionuclides.

The ground-water monitoring plans presented here represent revision and expansion of an effort initiated in June 1985. At that time, a facility-specific monitoring program was implemented at the 183-H Basins as part of the regulatory compliance effort being conducted on the Hanford Site. This monitoring program was based on the ground-water monitoring requirements for interim-status facilities, which are those facilities that do not yet have final permits, but are authorized to continue interim operations while engaged in the permitting process. The applicable monitoring requirements are described in the Resource Conservation and Recovery Act (RCRA), 40 CFR 265.90 [U.S. Environmental Protection Agency (USEPA) 1984], and in WAC 173-303-400 of Washington State's regulations (Washington State Department of Ecology 1986).

The program initially implemented for the 183-H Basins was designed to be an alternate program, which is required instead of the standard detection program when a facility is known or suspected to have contaminated the ground water in the uppermost aquifer. The plans for the program, contained in a document prepared by the U.S. Department of Energy (USDOE) in 1985, called for monthly sampling of the five existing shallow wells at the 100-H Area. This effort, named the RCRA Compliance Ground-Water Monitoring Project for the 183-H Basins, was implemented in June 1985 by the USDOE's Pacific Northwest Laboratory (PNL). A supporting project involving ground-water flow modeling for the area surrounding the 183-H Basins was also initiated during 1985. Those efforts and the results obtained are described in subsequent chapters of this document.

Results of the recent monitoring and modeling work have been used to produce the revised ground-water monitoring plans requested by the USEPA and the

Washington State Department of Ecology. These revised plans are based on two primary objectives: 1) to collect the additional site-specific hydrogeological information needed to more fully characterize the area and support decisions concerning the monitoring well network for the 183-H Basins, and 2) to conduct an expanded sampling and analysis effort designed to determine the extent of contamination originating from the basins and the rate of movement of contaminants. A crucial element in achieving both of these objectives is the installation of new wells. Therefore, a number of new wells are planned.

The current five-well sampling and analysis effort will be expanded as new wells are completed and added to the network. The basics of this effort, including procedures and quality control, were established and documented in the original program plans (USDOE 1985), but they have been updated for inclusion in the text and appendices of this document.

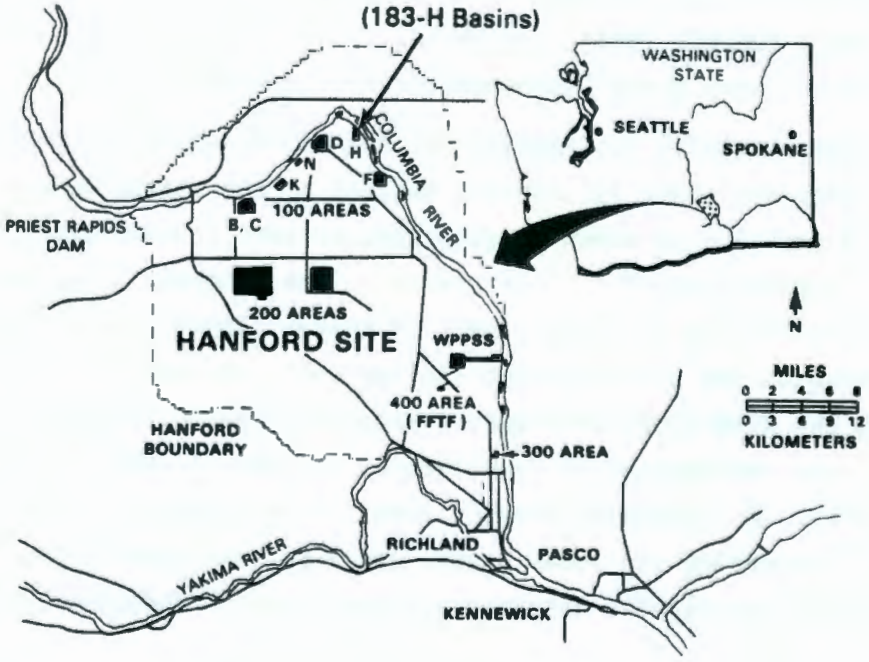


FIGURE 1. The Hanford Site

BACKGROUND INFORMATION

Pertinent background information concerning the 183-H Basins and the surrounding area is given in the following sections. These sections contain information on the facility itself, the geology and hydrology of the 100-H Area, and the results of past ground-water monitoring efforts.

FACILITY DESCRIPTION

The 183-H Basins are located in the northern part of the Hanford Site in the 100-H Area (Figure 1). This oval-shaped area encompasses approximately 320 acres and is bordered on the northeastern side by the Columbia River. The 100-H Area is the site of a retired plutonium-production reactor, which is located near the center of the area. Figure 2 is a map of the area showing the main facilities and the existing monitoring wells. The 183-H Basins are in the northeastern part of the area, between the reactor and the river.

The 100-H reactor began operating in October 1949, and was deactivated in April 1965 [U.S. Energy Research and Development Administration (USERDA) 1975]. Since shutdown of the reactor, activities in the 100-H Area have been limited, consisting primarily of mixed-waste storage at the 183-H Basins. The retired facilities in the 100-H Area, including the reactor building and ancillary facilities, are slated for decommissioning. This effort is currently in progress.

Physical Structure of the 183-H Basins

The 183-H facility consists of four separate concrete basins surrounded by an earthen berm. Figure 3 is a schematic cross section showing the facility's dimensions and relationship to the water table. Each basin has a shallow section and a deep section, as shown on the plan view of the facility in Figure 4. The concrete floor is 6 in. thick in the deep section and 10 in. thick in the shallow section. The walls of the shallow section are 1 ft thick, while those of the deep section (and also between basins) are 2 ft thick at the bottom and 1 ft thick at the maximum fill level.

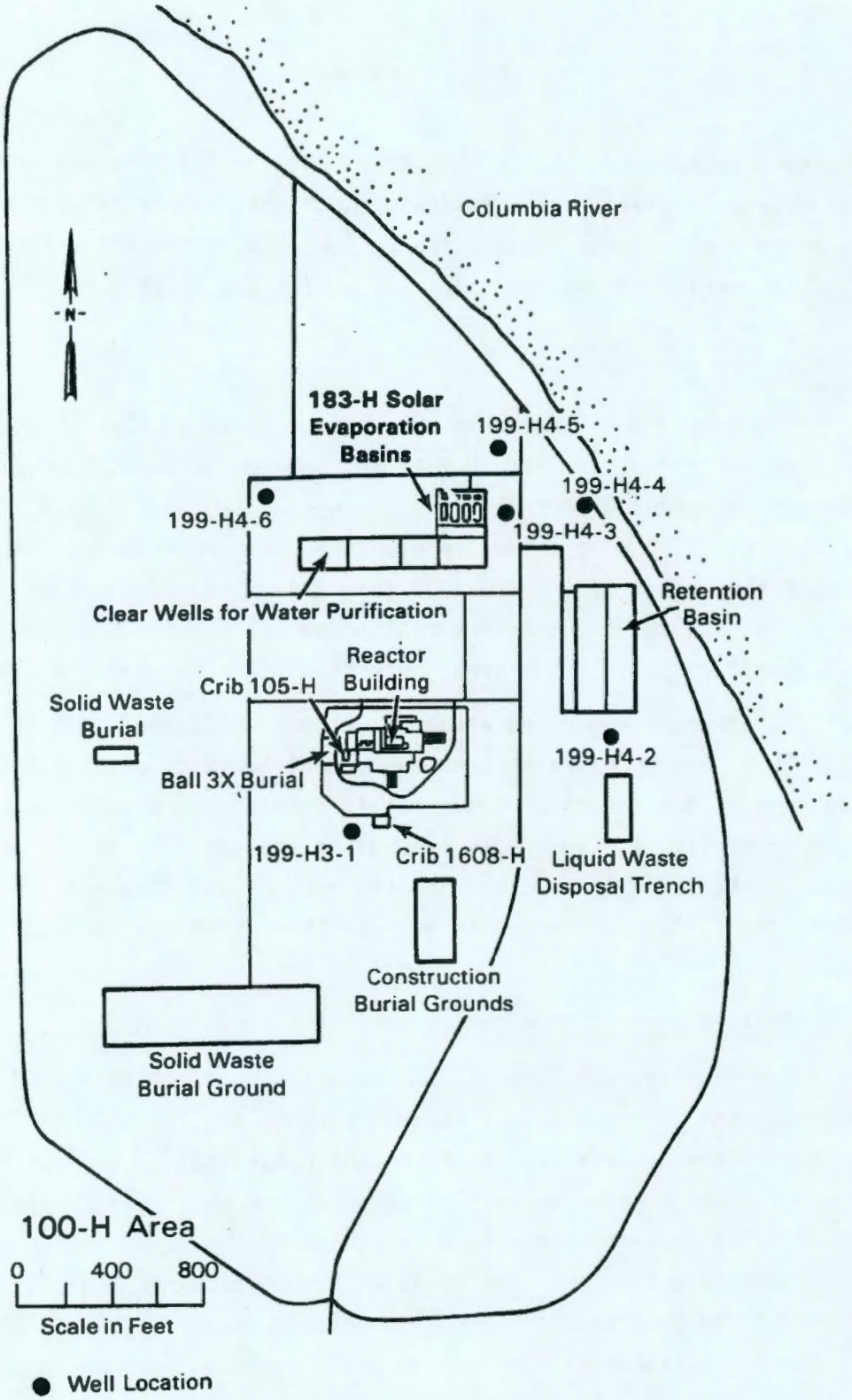
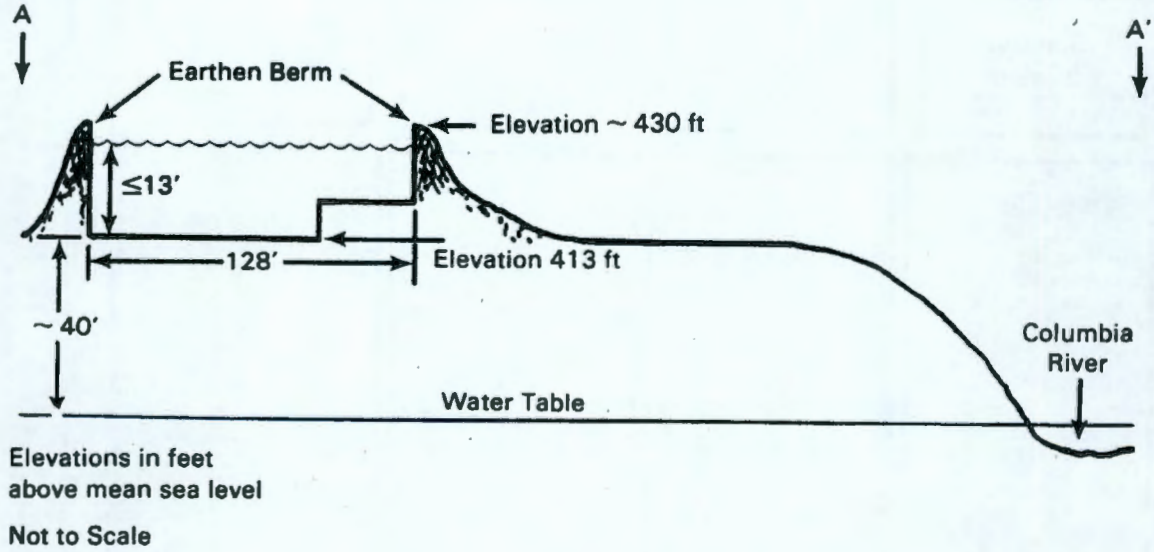


FIGURE 2. 100-H Area Map



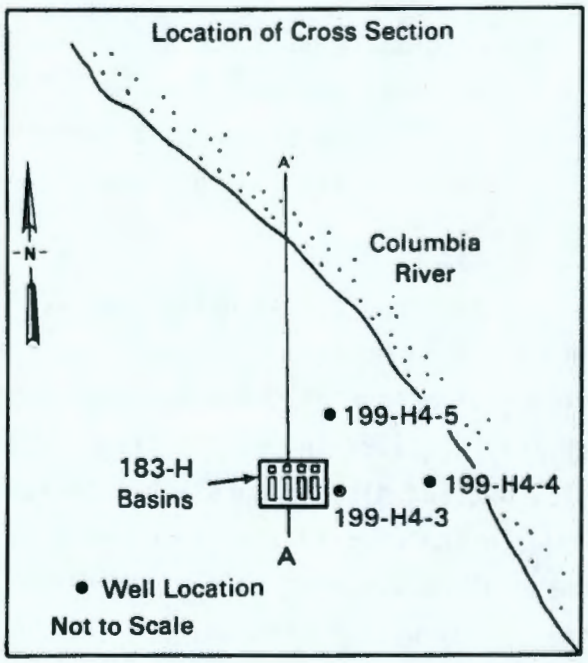


FIGURE 3. Schematic Cross Section of the 183-H Basins

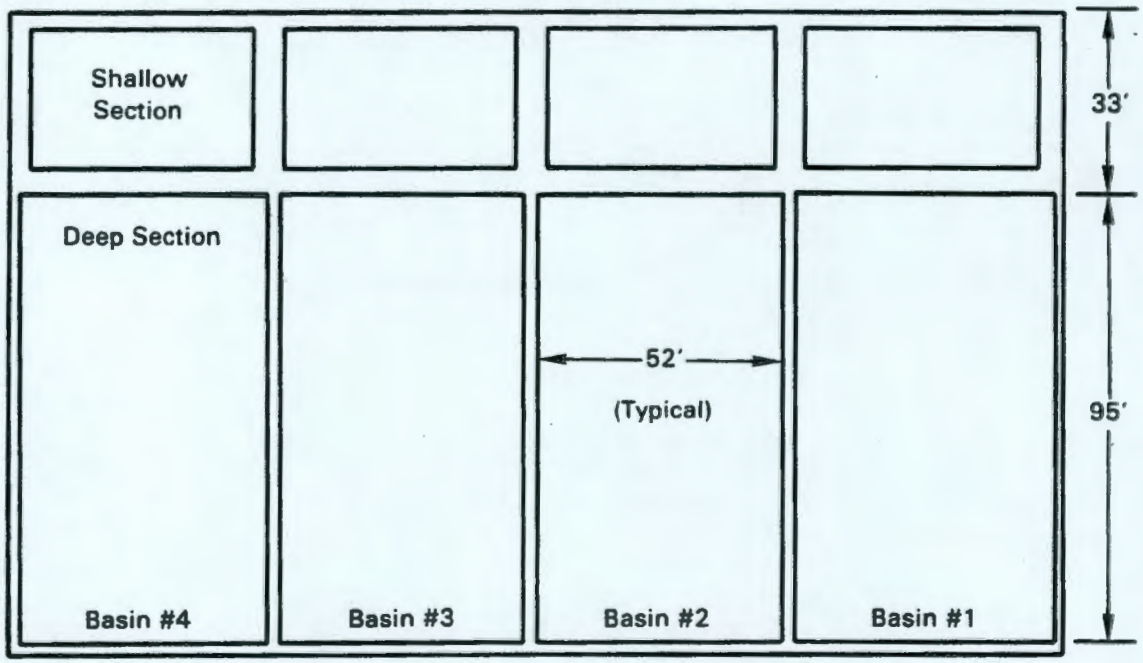


FIGURE 4. Plan View of the 183-H Basins

The 183-H Basins were originally used for water treatment, but in the 1970s they were designated for use as evaporation basins for mixed wastes. At that time, the basins were modified by permanently plugging the drains and installing a pipeline to be used in filling the basins (Greager 1982).

Operational History of the 183-H Basins

Mixed wastes from the 300 Area fuel fabrication facility were first discharged to the 183-H Basins in June 1973. At that time, only basin #1 was in use. After 2 months in service, use of the basin was postponed for over a year because of operational problems in the 300 Area. Use of basin #1 was resumed in January 1975, but was discontinued again in August 1978, after nitrate contamination was discovered in the ground water at well 199-H4-3 and was attributed to seepage of wastes from this unlined basin. At that time, basin #1 was permanently removed from service, and the pumpable wastes were removed from it, leaving a sludge. Use of basins #2 and #3, which had been prepared by coating the walls and floors with urethane, was initiated at that

time. Filling of those two basins to capacity led to use of basin #4, which had been lined with butyl and hypalon, starting in late 1982 (Greager 1982).

The 183-H facility is no longer receiving wastes and is now in the process of being deactivated by UNC. This activity is being conducted in accordance with the closure requirements of RCRA. The sludge remaining in basin #1 was removed in July 1985, and the walls and floor of the basin were decontaminated with a high-pressure water spray. Discharge of wastes to basins #2, #3 and #4 was discontinued in November 1985, and removal of the wastes in these basins began in July 1986. Depth of wastes in each of these three basins prior to initiating waste removal was 7 to 8 ft, for an approximate total of 620,000 gal of liquid and 36,000 ft^3 of solid material.

The waste-removal process being implemented involves: 1) pumping the liquid waste from basin #2 into basins #3 and #4, 2) removing the sludge from basin #2 and packaging this material in barrels for disposal by Rockwell at the Low-Level Solid Waste Burial Grounds, 3) installing a 36 mil hypalon liner in basin #2, 4) pumping all liquid wastes from basins #3 and #4 into basin #2, and 5) removing the sludge from basins #3 and #4 for packaging and disposal. The liquid in basin #2 will later be removed, although the procedure to be used is still under consideration. Following removal of any remaining sludge in basin #2, the facility will be ready for final cleanup and demolition.

Nature of the Stored Wastes

The primary wastes discharged to the 183-H Basins were the neutralized mixed wastes routinely produced at the 300 Area during the fuel fabrication process. Nitrate, sulfate, and copper were present in the wastes in high concentrations; other materials, such as fluoride, hexavalent chromium, and enriched uranium, were present in smaller amounts. Table 1 gives the quantities of various materials discharged to the basins in CY 1985 (through November 8, at which time disposal to the basins was discontinued). The materials in Table 1 are representative of those discharged in the past.

The total volume of routine wastes from the fuel fabrication process discharged to the 183-H Basins since 1973 is 2,529,000 gal. The amount discharged annually rose fairly steadily over time until discharge was halted, with the

Table 1. Quantities of Materials Discharged to the 183-H Basins in 1985 (from Rokkan 1986)

Material	Pounds
Ammonium ion	520
Fluoride ion	27,000
Nitrate ion	550,000
Chromium	90
Copper	49,000
Manganese	200
Sulfate ion	97,000
Uranium	440

most recent annual figure (for January 1 through November 8, 1985) being 370,000 gal (Rokkan 1986).

Relatively small quantities of other chemical wastes besides those generated during fuel fabrication were discharged to the basins on a nonroutine basis. These wastes were checked for compatibility with the fuel fabrication wastes before disposal, and they were required to be water-soluble, nonflammable, and nonexplosive. Constituents in these wastes include the following:

- cadmium and compounds
- copper and compounds
- oxalic acid
- cyanide and compounds
- mercury and compounds
- barium perchlorate
- hydrazine
- chromium and compounds
- vanadium pentoxide
- lead and compounds
- nickel and compounds.

GEOLOGY AND HYDROLOGY OF THE 100-H AREA

Knowledge of the local geology and hydrology of the 100-H Area has been

gained mainly through installation of ground-water monitoring wells for the routine Hanford Ground-Water Monitoring Project conducted by PNL. Most of the wells in the 100-H Area penetrate only the uppermost geologic formations, but one well has been drilled into the top layers of the basalt bedrock. The drilling log for this deep well (199-H4-2) forms the primary basis for the following interpretation of the local geology. Appendix A contains the drilling logs for the six existing wells in the 100-H Area.

Geology

A generalized geologic column for the 100-H Area is presented in Figure 5, and cross sections are shown in Figure 6. (Figure 7 gives the location map for the cross sections.) As shown in the geologic column and cross sections, three geologic formations have been identified during drilling operations conducted in this area. They are, in ascending order, the Columbia River Basalts, the Ringold Formation, and the glaciofluvial sediments, which are informally known as the Hanford formation. A description of the general nature of these formations, including some additional detail concerning their characteristics at the 100-H Area, follows.

The Columbia River Basalts are of Miocene age and form the bedrock beneath the Hanford Site (including the 100-H Area). These flood basalts were extruded from fissure systems in the eastern and southern portions of the Columbia Plateau (Swanson et al. 1975). The individual flows comprising the formation range in thickness from about 10 to 150 ft, and they are generally separated by sedimentary interbeds. The basalts were originally flat lying but have been locally warped and folded, producing anticlines that rise above the water table and crop out at the land surface (Newcomb, Strand, and Frank 1972). At the 100-H Area, the top of the basalts is at a depth of about 350 ft below land surface, as indicated by the log of well 199-H4-2 (Appendix A).

The Ringold Formation overlies the basalts. This formation is of Pliocene age (Gustafson 1978) and, with the exception of a weakly consolidated conglomerate member, it consists mainly of layered silts, clays, and fine sands deposited in a lacustrine environment. Distinctive lithologic zones within this formation include: 1) blue and green silts and clays of the lower Ringold, and 2) a conglomerate consisting of well-rounded pebbles and cobbles, with

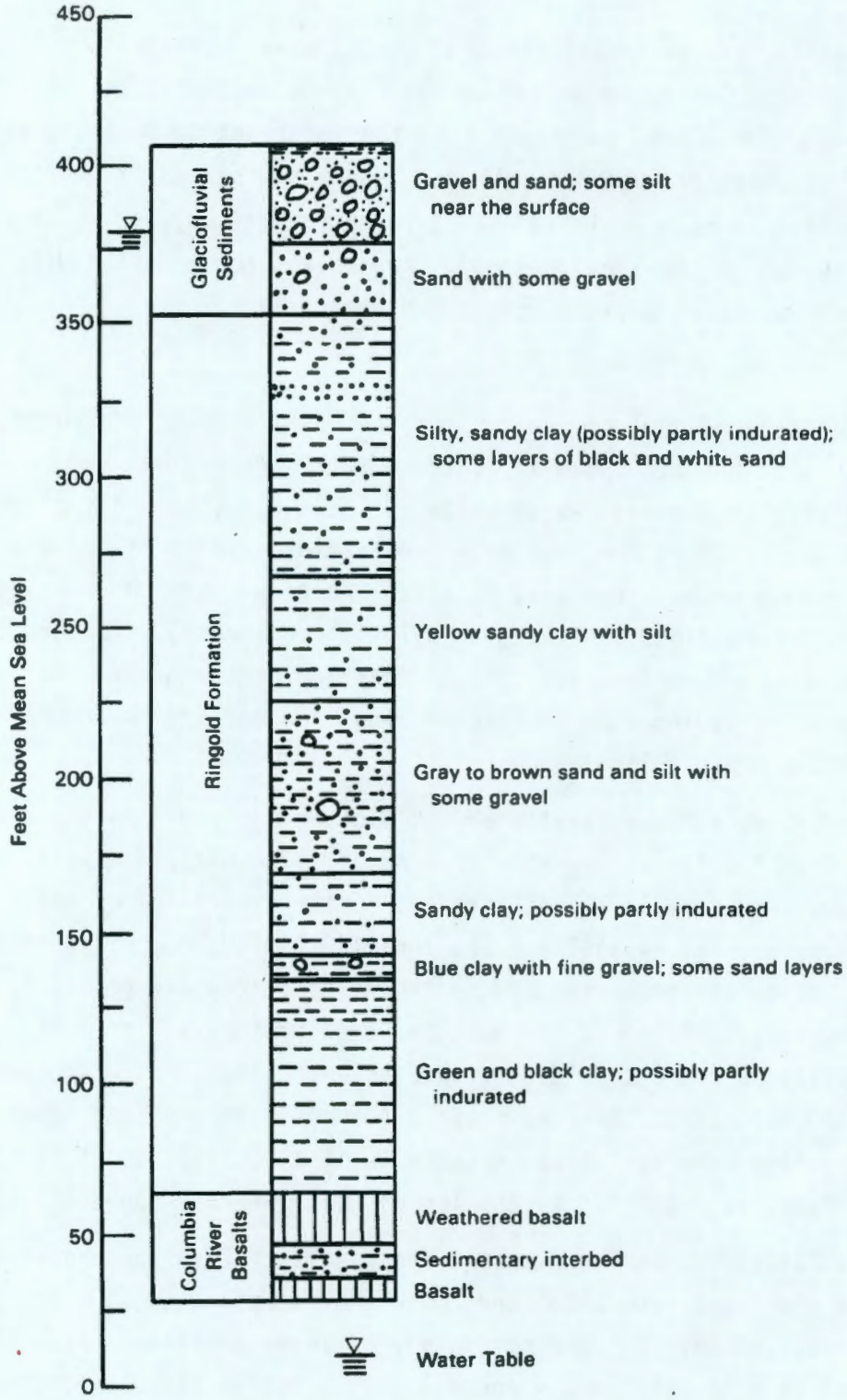
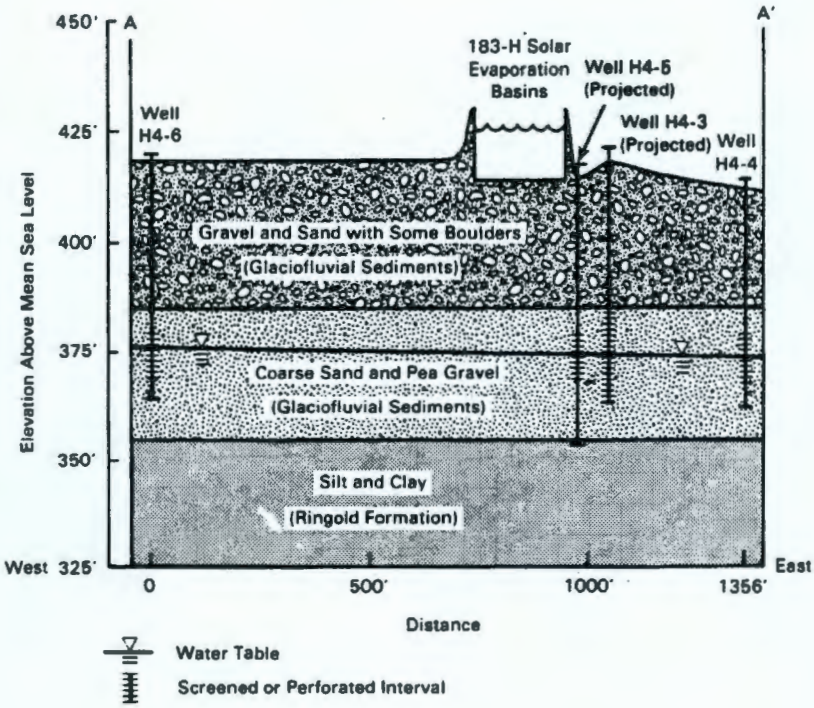


FIGURE 5. Generalized Geologic Column for the 100-H Area



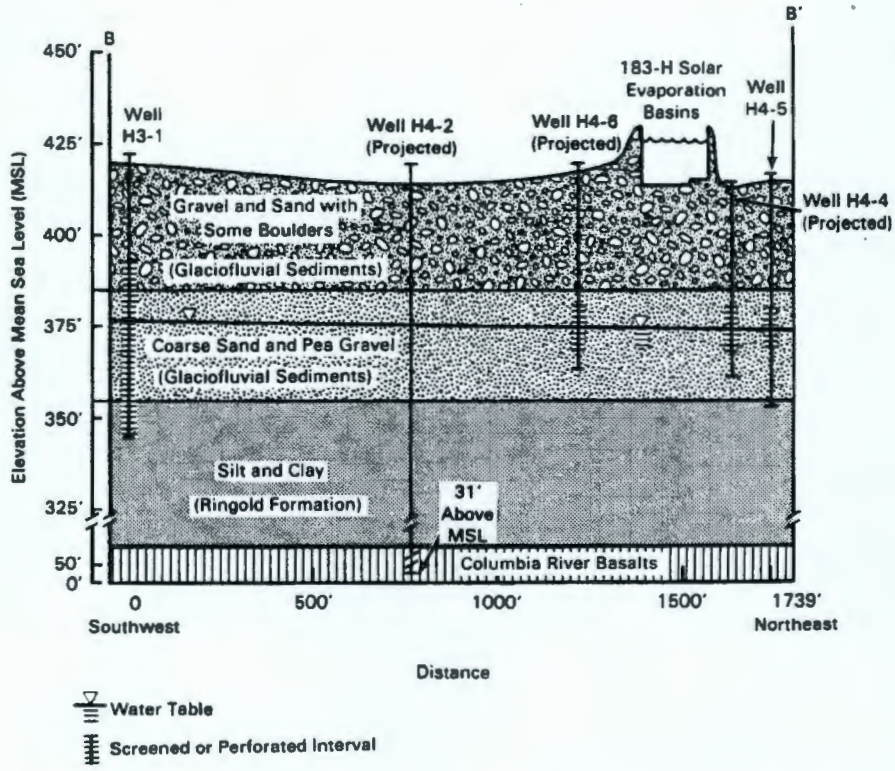


FIGURE 6. Geologic Cross Sections of the 100-H Area

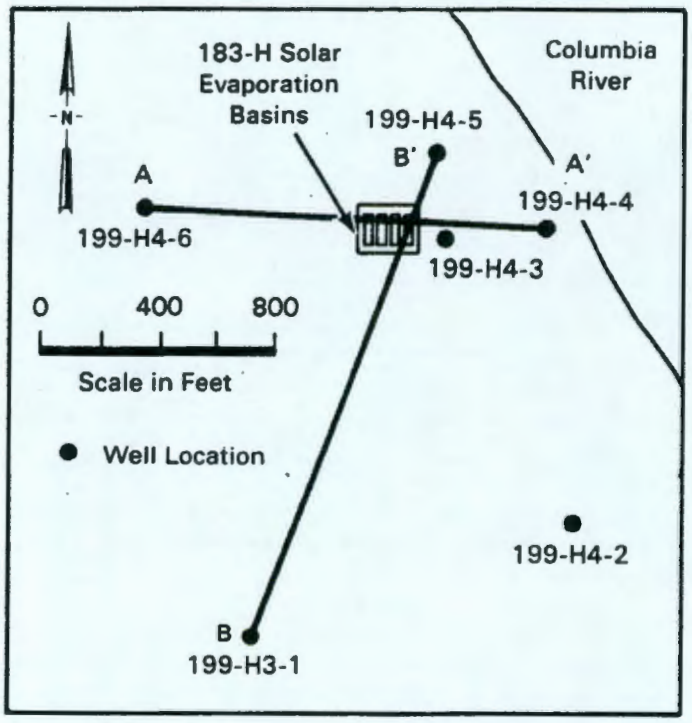


FIGURE 7. Location Map for Geologic Cross Sections

medium to fine sand filling the interstitial spaces (Newcomb, Strand, and Frank 1972). According to the 100-H Area drilling logs (Appendix A), the Ringold Formation is composed almost entirely of a series of tight silt and clay layers in this area and lacks the more permeable conglomerate unit present in other areas of the Hanford Site. Some of the clay layers are apparently partly indurated. The thickness of the Ringold silts and clays is about 300 ft in the 100-H Area.

Above the Ringold Formation lie the glaciofluvial sediments, which are coarse clastic deposits laid down by the ancestral Columbia River when it was swollen by glacial meltwater (Newcomb, Strand, and Frank 1972). At the 100-H Area, this formation consists of unconsolidated gravels and sands, with some boulders and cobbles. A few of the drilling logs also indicate the presence of a small amount of intermixed silt in this formation. The contact between the Ringold Formation and the glaciofluvial sediments in the 100-H Area is at a depth of about 50 to 60 ft below land surface and is distinguished by a change from sandy materials to clays.

Hydrology

Both unconfined and confined aquifers are present beneath the 100-H Area. The uppermost aquifer, which is unconfined, is the most likely to be affected by the 183-H Basins. Underlying aquifers, contained in the basalts, are confined. The potential for these confined aquifers to be contaminated by the 183-H facility is low because of two factors: 1) a 300-ft thick layer of low-permeability clays separates the basalts from the unconfined aquifer, and these clays should serve as an aquitard; and 2) the piezometric surface for the basalt aquifer, tapped by well 199-H4-2, is above the land surface (although the casing has been extended so that the well does not flow). Because of the low potential for contamination of the confined aquifers, the discussion of hydrology that follows is primarily concerned with the unconfined aquifer.

The upper portion of the unconfined aquifer in the 100-H Area is in the glaciofluvial sediments, and the lower part of the aquifer (probably partially confined) is in the Ringold clays. The water table is at a depth of about 40 ft below land surface, and the clays begin at a depth of 50 to 60 ft.

The hydraulic conductivity of the glaciofluvial sediments is about 1,000 times that of the Ringold clays (Bierschenk 1959). Therefore, the upper 10 to 20 ft of the aquifer is thought to be most active in transmitting water in the 100-H Area, and the top of the Ringold clays is considered as the effective base of the aquifer. Based on the few quantitative hydrologic tests made in and adjacent to the 100-H Area, aquifer transmissivity for the Hanford formation is on the order of 3,000 ft^2 per day with a resultant hydraulic conductivity of about 200 ft per day.

The hydrology of the 100-H Area is complex and difficult to fully characterize because of the proximity and hydraulic influence of the Columbia River. Studies conducted at the Hanford Site have shown that the diurnal and seasonal fluctuations of the river stage, caused by changes in the discharge rate of the dams upstream, have a marked effect on the unconfined aquifer near the river (Raymond and Brown 1963; Prater et al. 1984; Mitchell and Williams 1985). These studies have shown that water levels within wells near the river fluctuate in response to changes in the river stage. The water level in wells

near the river rises when the river stage is high and river water enters the bank. This trend later reverses, and the bank-stored water reenters the river. As a result of this phenomenon, concentrations of contaminants in the wells near the river also vary with the river stage on a seasonal basis. The concentrations have been observed to decline in the spring months when the river rises and river water enters the bank; this trend reverses in the fall when the river stage drops (Prater et al. 1984). The character of the changes in the unconfined aquifer due to the river's fluctuations depends greatly on the local geology and must therefore be studied on a site-specific basis. Knowledge concerning the local hydrologic system in the 100-H Area has been fairly limited until recently, when new monitoring and modeling efforts (described in a later chapter) provided a considerable amount of new information.

Water-level measurements collected on a biweekly basis from a network of wells located in and around the 100-H Area have been used to produce a series of recent water-table maps. Four maps, one for each quarter of the past year, are presented in Figures 8 through 11. These maps show that the general direction of ground-water flow in the vicinity of the basins is toward the northeast. The contour lines shown on the figures are inferred from a limited number of data points, and work is continuing to define the water table and dynamic interactions with the river.

HISTORICAL DATA OBTAINED BY THE HANFORD GROUND-WATER MONITORING PROJECT

The ground water in the 100-H Area has for many years been monitored on a routine basis by the Hanford Ground-Water Monitoring Project conducted by PNL. Although not specifically designed as a compliance-type monitoring project, this effort has provided valuable historical information on the effects of the 183-H Basins on the ground water. The monitoring well network and the analytical data obtained for this effort before implementation of the RCRA Compliance Ground-Water Monitoring Project in 1985 are summarized below.

Five monitoring wells in the 100-H Area have been used by the Hanford Ground-Water Monitoring Project for sampling the unconfined aquifer. These five wells are designated as 199-H3-1, 199-H4-3, 199-H4-4, 199-H4-5, and

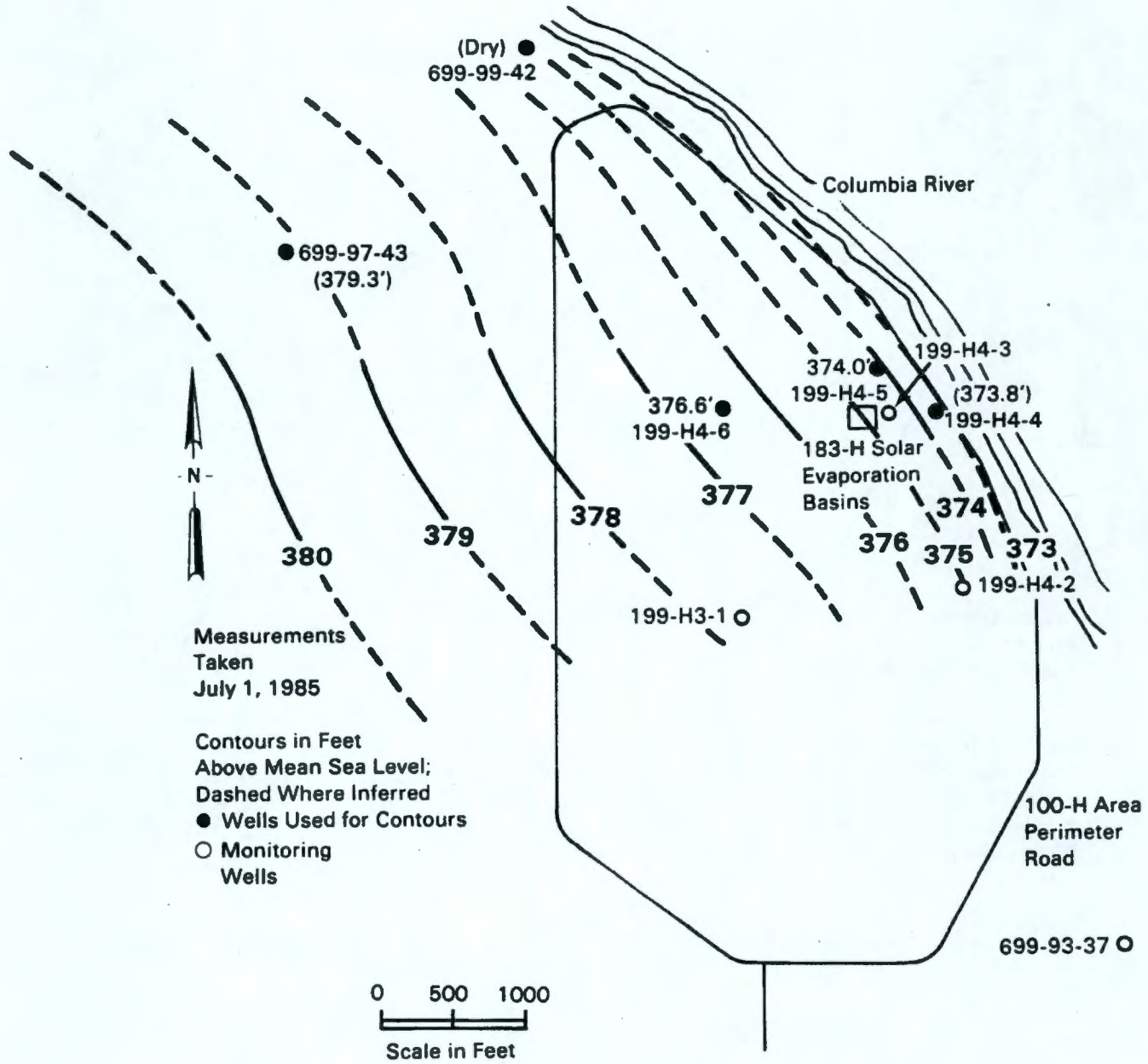


FIGURE 8. 100-H Area Water-Table Map (July 1, 1985)

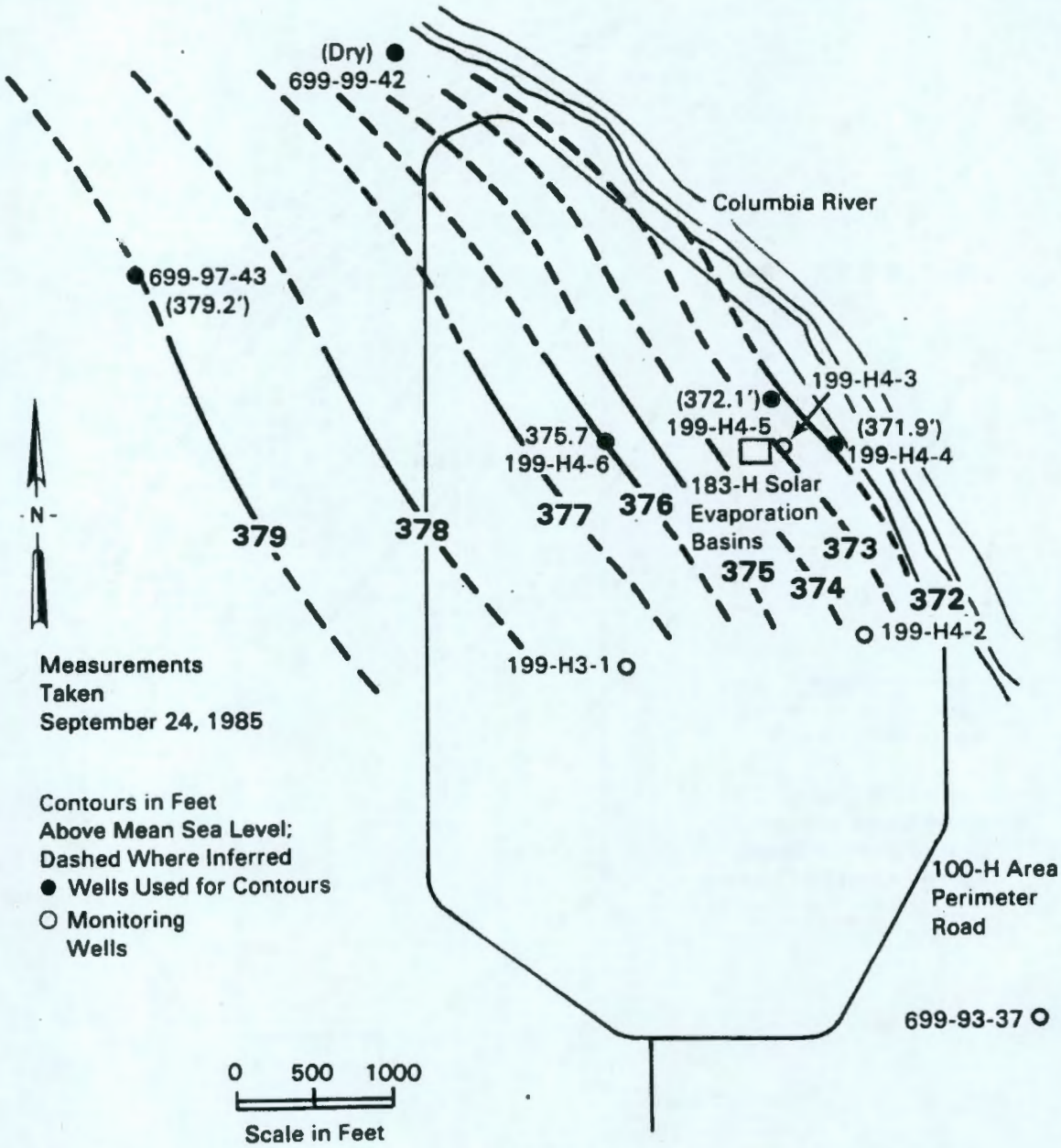


FIGURE 9. 100-H Area Water-Table Map (September 24, 1985)

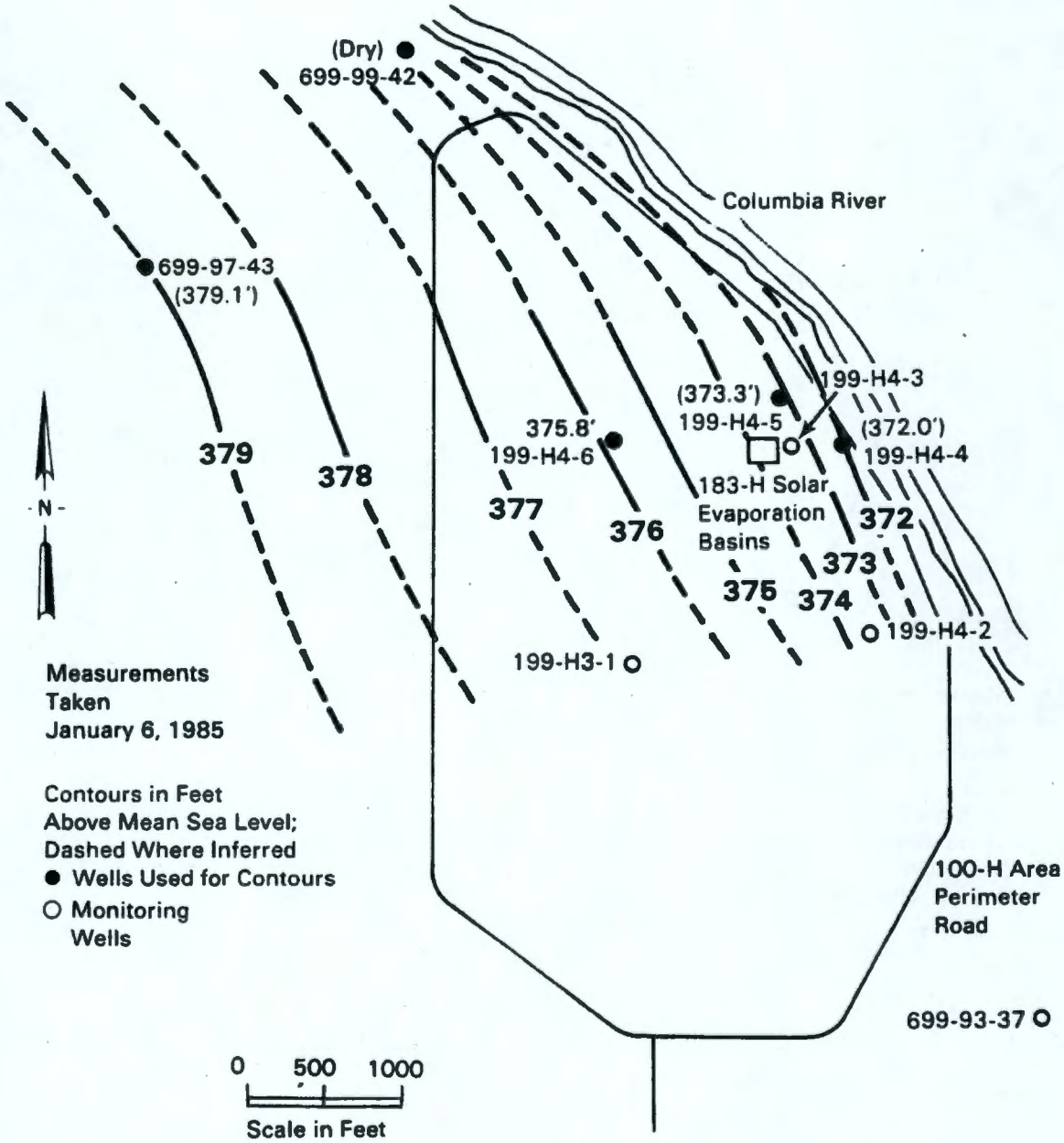


FIGURE 10. 100-H Area Water-Table Map (January 6, 1986)

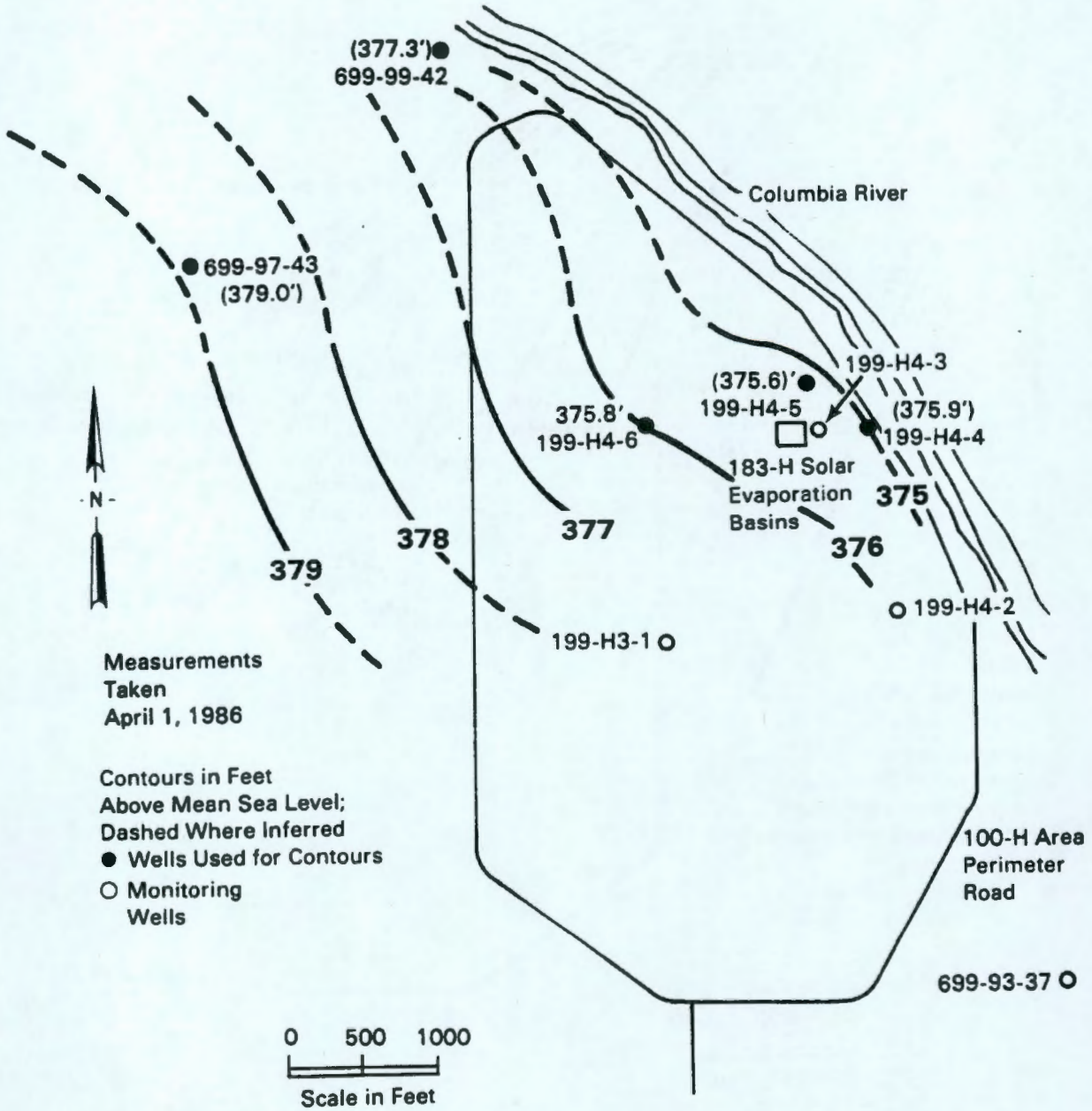


FIGURE 11. 100-H Area Water-Table Map (April 1, 1986)

199-H4-6. Locations of these wells relative to the 183-H Basins and the general direction of ground-water flow are shown in Figure 12. A few other wells have been installed in this area over the years but have been abandoned and filled for various reasons. Another existing well in the 100-H Area, 199-H4-2, was drilled into the basalts and is currently being used in a study of the confined aquifer's piezometric surface.

Of the five wells used to monitor the unconfined aquifer in the 100-H Area, only 199-H4-3 and 199-H3-1 have been sampled long enough to provide a significant amount of historical monitoring data. Data obtained from 199-H4-3, which is the closest well to the 183-H Basins, have provided the best information on the facility's impacts.

Sampling of well 199-H4-3 began in 1974, shortly after its completion. Routine review of the analytical data obtained led to the discovery in June 1977 that nitrate and hexavalent chromium levels in well 199-H4-3 were increasing. Subsequent investigation indicated that basin #1, which was the only basin in use at the time, was apparently leaking. As described previously in the section entitled "Operational History of the 183-H Basins," corrective actions were initiated to remove the source of contamination, and ground-water sampling was conducted simultaneously and afterward to provide an indication of the success of these actions. As shown in Figures 13 and 14, the concentrations of nitrate and hexavalent chromium peaked in this well in 1978 and declined sharply thereafter as the corrective actions took effect. The concentrations of these contaminants in this well then stabilized at a level higher than preoperational concentrations. Stabilization at this higher level may indicate that the source of contamination was not completely removed by the corrective actions taken.

Nitrate data collected for well 199-H3-1 have shown a general upward trend, with a marked increase beginning in 1976 (Figure 15), shortly after continuous use of the basins was initiated. Although this well is some distance from the 183-H Basins, this pattern had been thought to indicate a possible effect from the facility. When the RCRA Compliance Ground-Water Monitoring Project was implemented in 1985, well 199-H3-1 was included in the sampling network so

that the additional data needed to determine the situation regarding this well could be obtained.

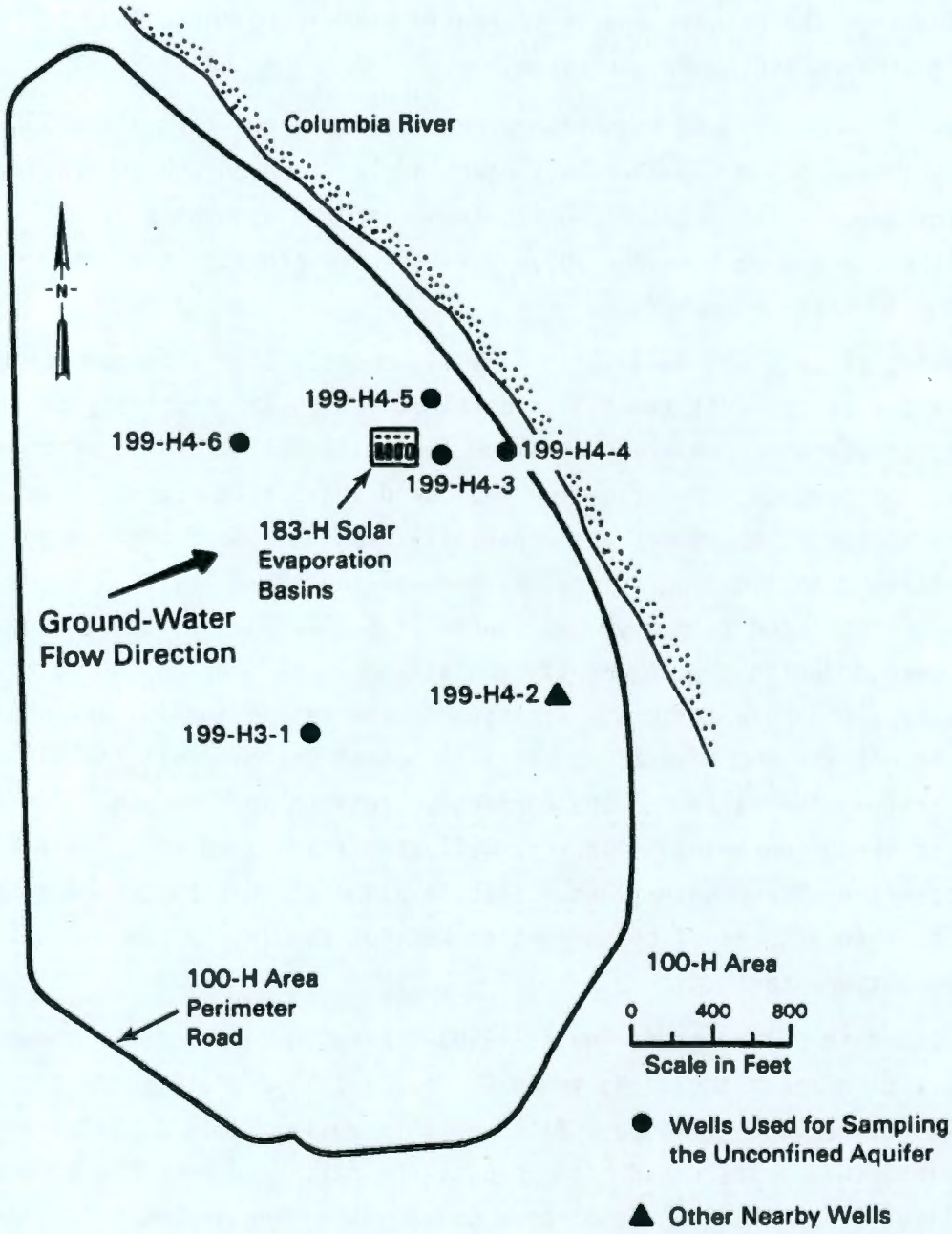


FIGURE 12. 100-H Area Well-Location Map

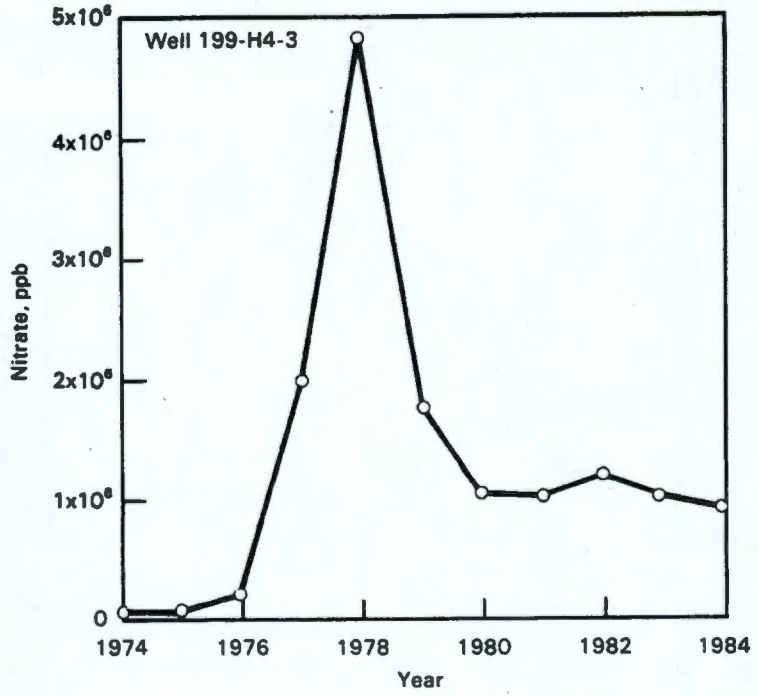


FIGURE 13. Annual Average Concentrations of Nitrate in Well 199-H4-3

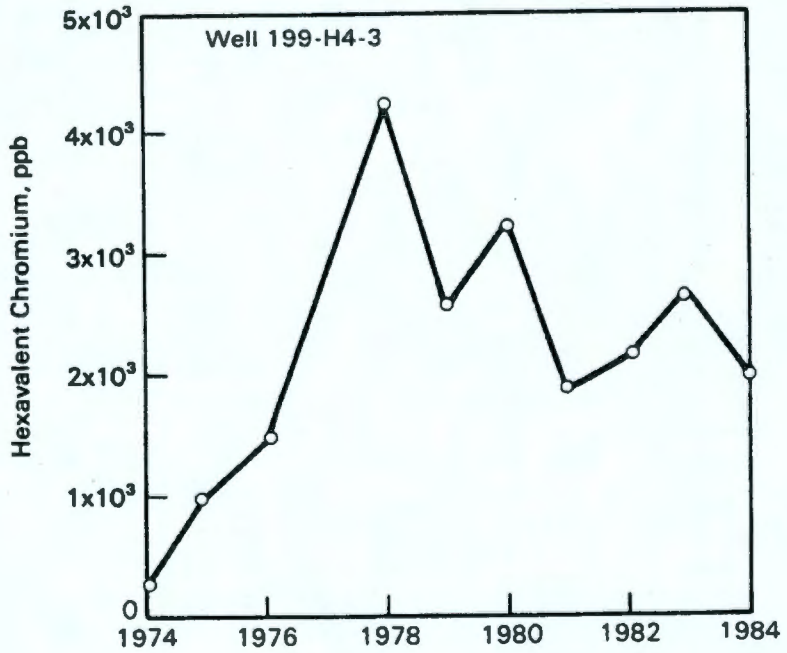


FIGURE 14. Annual Average Concentrations of Chromium in Well 199-H4-3

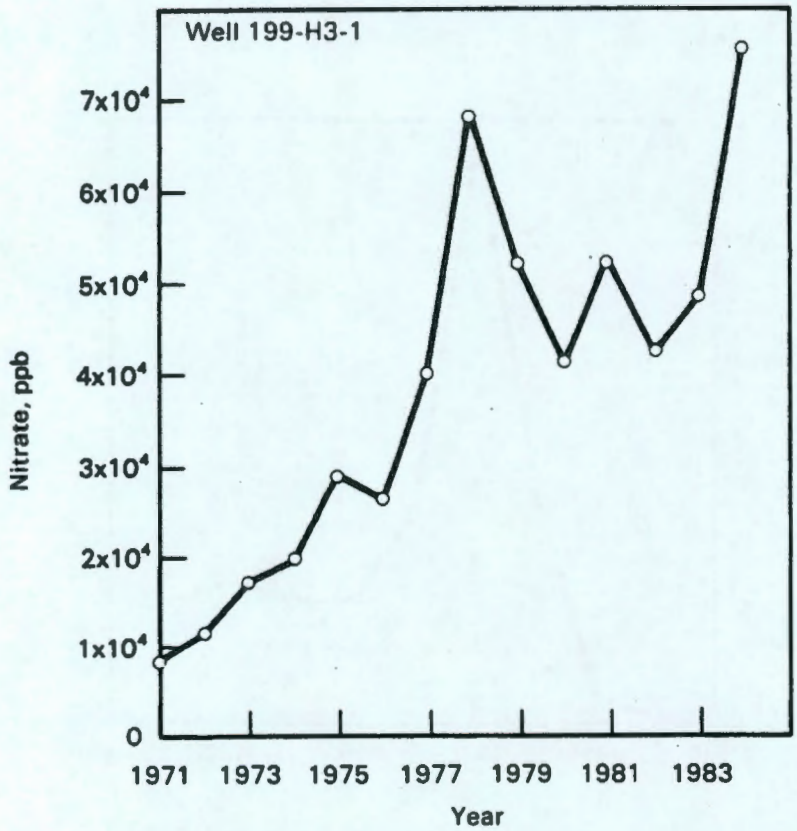


FIGURE 15. Annual Average Concentrations of Nitrate in Well 199-H3-1

INTERIM STATUS WORK CONDUCTED TO DATE

In February 1985, the USDOE prepared plans for an interim-status ground-water monitoring program for the 183-H Basins. This new facility-specific effort was based on: 1) the ground-water monitoring requirements in 40 CFR 265.90 of the federal regulations (USEPA 1984) and in WAC 173-303-400 of Washington State's regulations (Washington State Department of Ecology 1986), and 2) the results of past monitoring conducted at the 100-H Area. The program was designed to be an alternate ground-water monitoring program, which is required instead of the standard detection program when the facility being monitored is known or suspected to have contaminated the uppermost aquifer. This effort, named the RCRA Compliance Ground-Water Monitoring Project for the 183-H Basins, began in June 1985 and has continued to the present. A supporting project involving ground-water flow modeling for the area surrounding the 183-H Basins was also implemented in 1985. The scope of these projects and the results obtained are described in this chapter.

SCOPE AND DESCRIPTION

Initial plans for the RCRA Compliance Ground-Water Monitoring Project were presented by the USDOE in a document entitled the Hazardous Waste Ground-Water Monitoring Plan (USDOE 1985). Implementation of these plans occurred in June 1985, when monthly sampling of a five-well network was initiated.

Well Network

The five-well network used for this project consists of the existing shallow wells in the 100-H Area. Figure 12 shows the locations of these wells relative to the 183-H Basins and also the general direction of ground-water flow. Two of the wells in the network, 199-H3-1 and 199-H4-6, are considered to be upgradient of the facility, although fluctuations of the river stage apparently cause localized, short-term gradient reversals (as discussed in a later section concerning results of recent modeling).

Three of the wells (199-H4-4, 199-H4-5, and 199-H4-6) were constructed in 1983 for the specific purpose of monitoring the 183-H Basins. These wells have carbon steel casings and stainless steel screens, as shown in Figures 16 through 18. The other two wells, 199-H3-1 and 199-H4-3, are older and have perforated casings instead of screens (Figures 19 and 20, respectively). To help determine the suitability of the existing wells for this monitoring effort, a special field investigation was recently conducted on the Hanford Site at the 300 Area. The results have shown that, at least within the limitations of this study (i.e., selected volatile organic chemicals and one field location), the different construction materials used in the past for construction of Hanford Site wells did not, under field conditions, significantly affect the analytical results obtained for ground-water samples collected from them (Liikala et al. 1986). Continued use of the existing wells for sampling is therefore deemed to be justified and should not have a detrimental effect on the results obtained.

All five of the wells in the network have comparable completion intervals, although the water column in well 199-H3-1 is slightly longer than the water column in the others. All five wells are open at the upper portion of the aquifer and are designed to accommodate some water-table fluctuations, which are known to occur in this area.

These wells, along with all regularly sampled wells at the Hanford Site, are kept on a regular maintenance schedule so that they will continue to be useful sampling structures. Under this effort, the wells are periodically swabbed, cleaned out, and redeveloped. The wells may also be checked for problems with a downhole television camera.

Sample Collection

Sampling of the wells has been conducted on a monthly basis during the last year because of their proximity to the river. This frequency, although greater than the quarterly frequency specified by the regulations, was deemed to be necessary for defining the seasonal variability expected to be present in the analytical data.

Special pumps and new procedures have been employed to help ensure that the samples collected are representative of the ground water. Each well has two dedicated pumps: 1) a submersible pump for purging the well and for collecting samples to be analyzed for nonvolatile constituents such as anions and metals, and 2) a Teflon[a] bladder pump for collecting samples to be analyzed for volatile, semi-volatile, and other organic chemicals. Additional information on the pump types, materials, and position in the wells is given in Figures 16 through 20.

The samples are collected by trained Environmental Radiation Protection Technologists (RPTs) using documented PNL procedures (Earth Sciences Department 1986). As required by the federal and state regulations, a water-level measurement is taken at each well prior to sampling. The well is then purged for a calculated period of time, based on removal of three borehole volumes. For added assurance that the stagnant water has been removed from the well, the pH, specific conductivity, and temperature are checked for stabilization via periodic measurements taken as the well is purged. All of these measurements are recorded in the field logbook, but only the final set of measurements taken just prior to sample collection are entered into the data base. Procedures for well purging, field measurements, and sample collection are contained in Appendix B.

Sample preservation techniques are used as appropriate to help ensure that the analytical results obtained by the laboratory have not been affected by alteration of the sample after collection. The preservation techniques currently used include pH control, chemical addition, and temperature control. The specific techniques applied for each of the analyses are discussed in another section of this chapter, entitled "Sample Analysis." Regarding the question of whether or not to filter the metals samples prior to acidification, a recommendation issued by EPA in 1983 (USEPA 1983), indicating that the samples should not be filtered (thereby yielding "total recoverable" metals), has been followed on this effort to date. To provide data needed for geochemical modeling and to comply with more recent EPA guidance, plans are now being made

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(a) Teflon is a trademark of E. I. DuPont de Nemours, Co., Wilmington, Delaware.

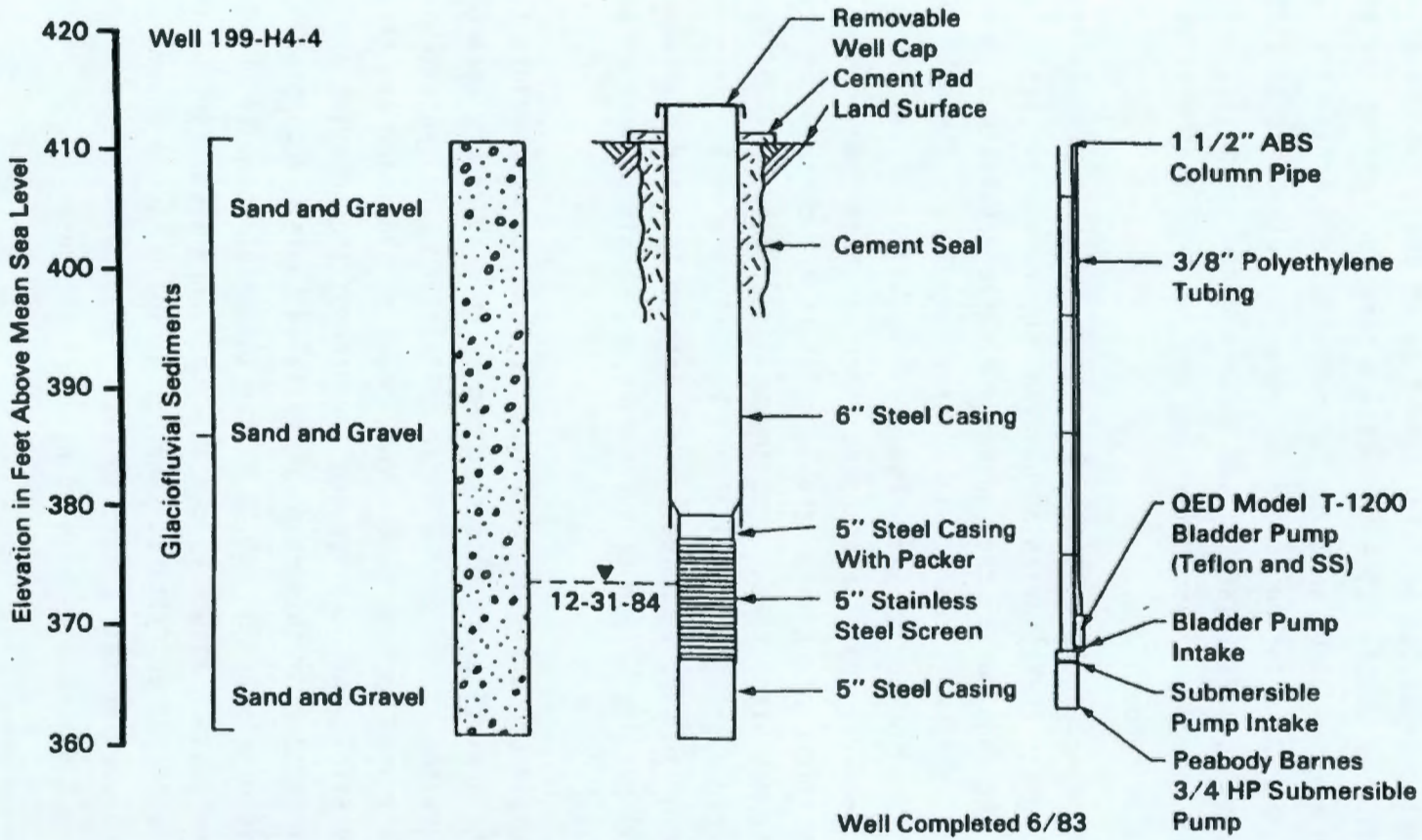

FIGURE 16. Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H4-4

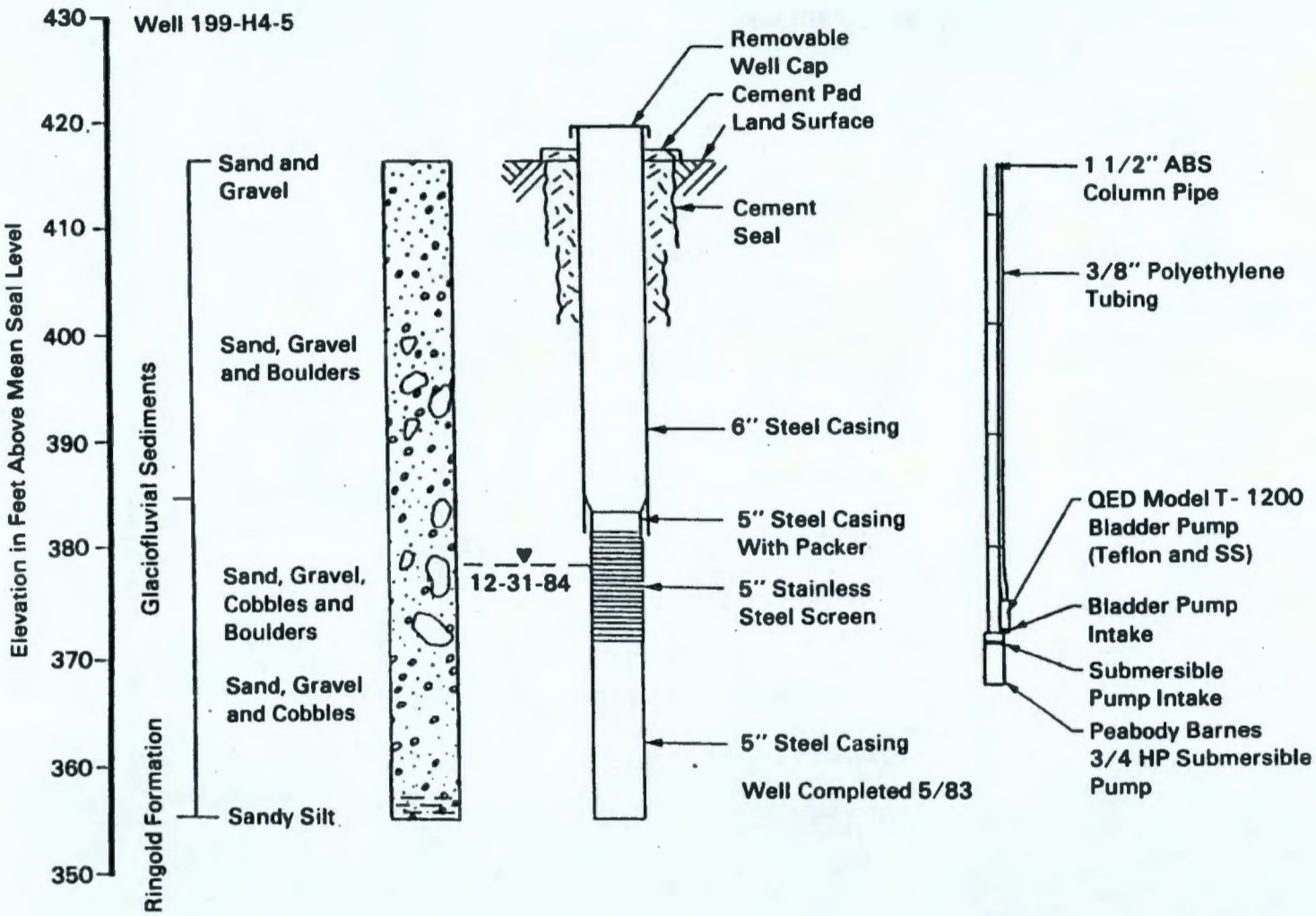

FIGURE 17. Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H4-5

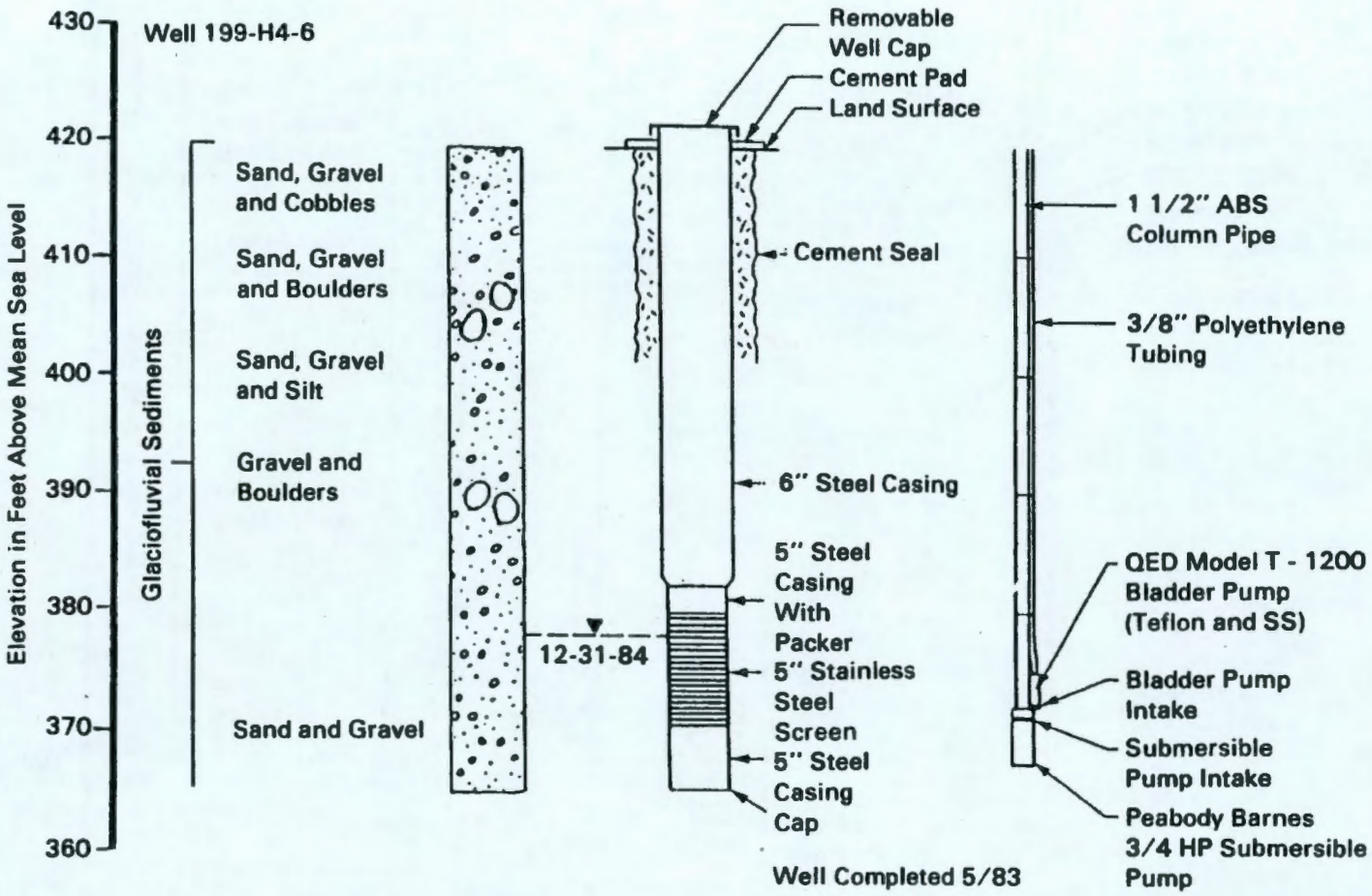

FIGURE 18. Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H4-6

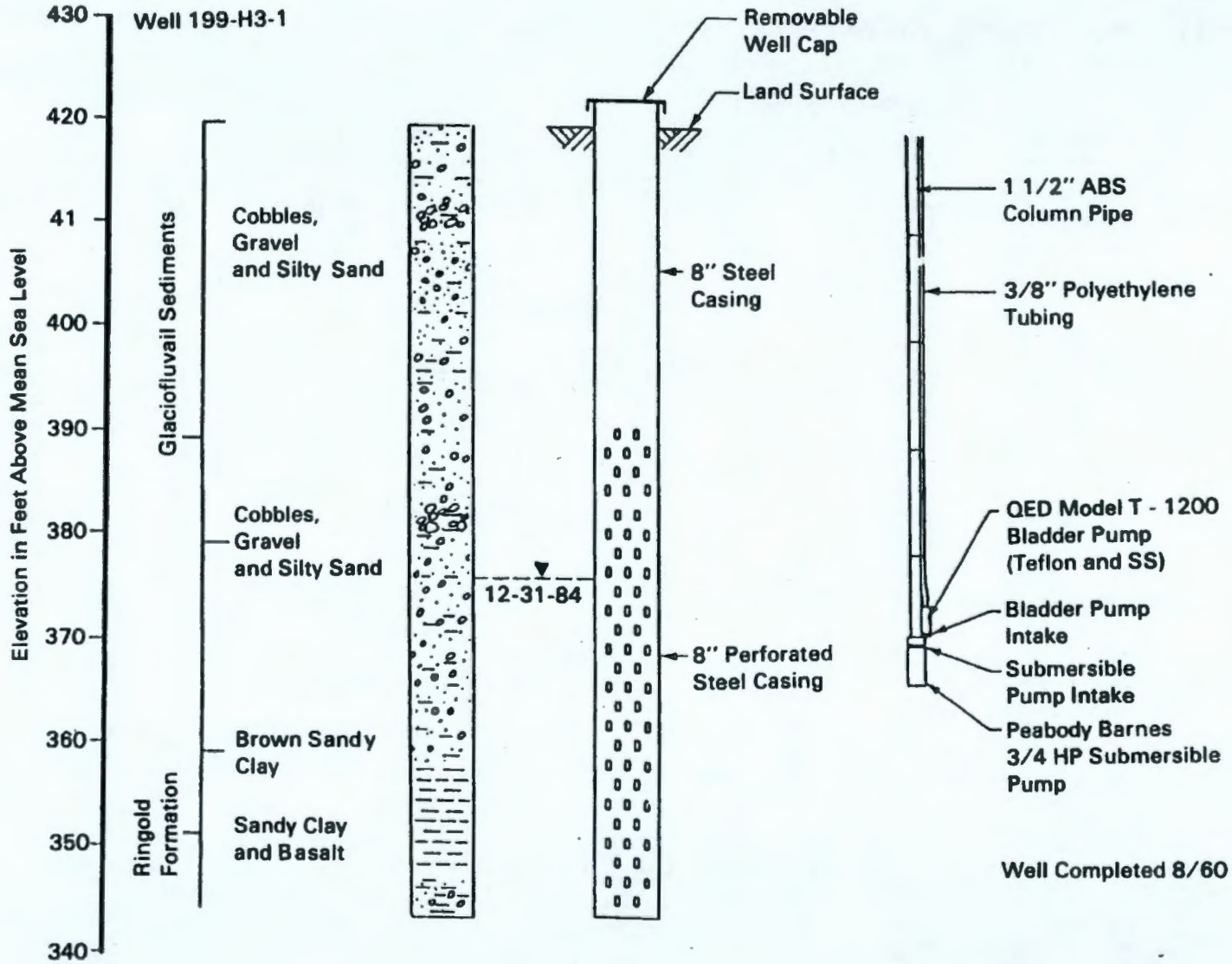

FIGURE 19. Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H3-1

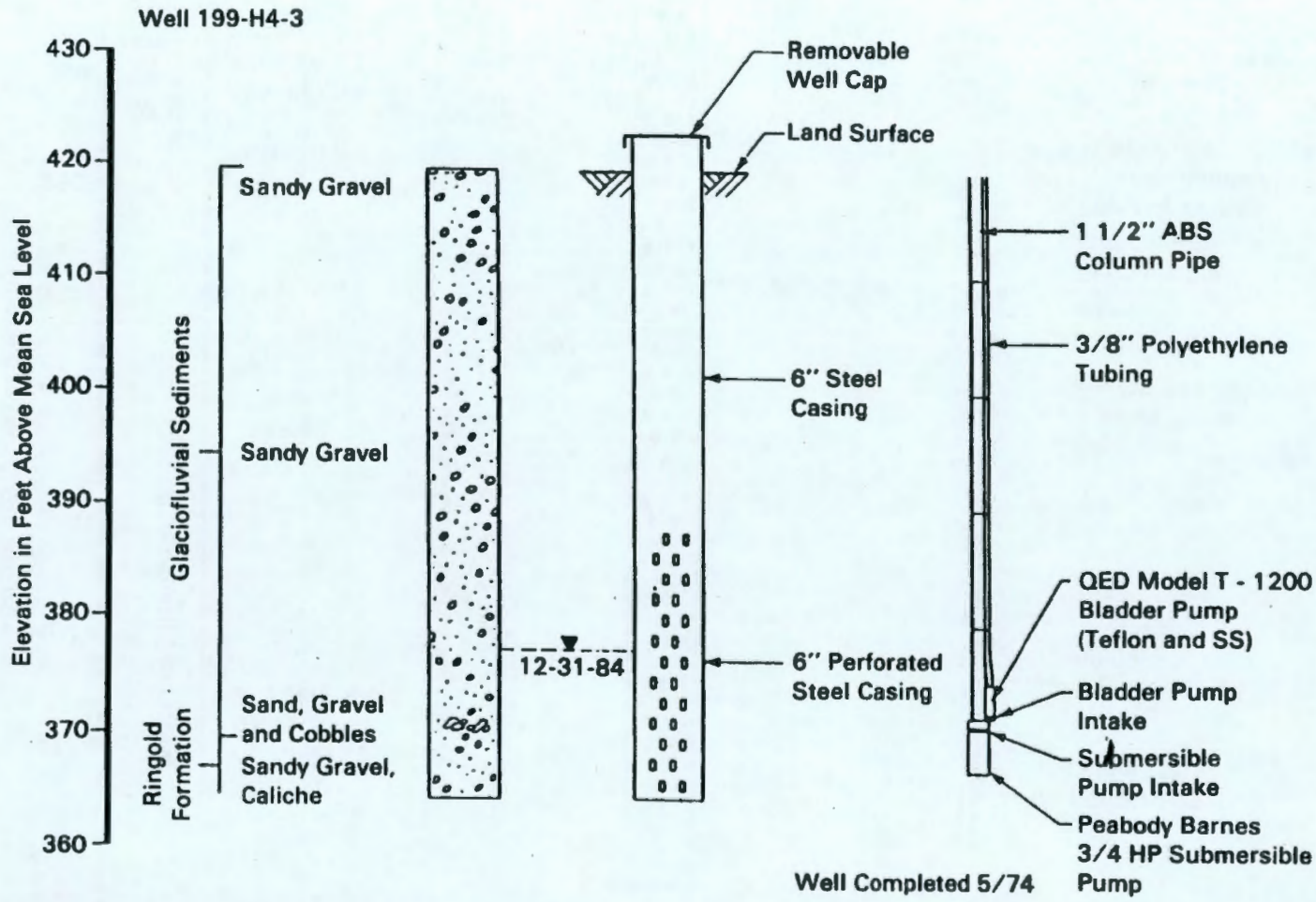

FIGURE 20. Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H4-3

to begin collecting two aliquots: one to be filtered and analyzed for dissolved metals, and one to be nonfiltered and analyzed for total recoverable metals.

Chain-of-custody procedures (Appendix B) are followed to ensure the integrity of the samples from time of collection through data reporting. These procedures provide specifications for labeling, sealing, and tracking the samples. Extensive documentation, including field logbooks and Chain-of-Custody forms, is maintained.

Water-Level Measurements

Additional water-level measurements, besides those taken prior to sampling, are obtained using written procedures (Appendix B) once every 2 weeks from a network of selected wells located in and around the 100-H Area. These regular measurements were initiated in February 1985. The 13 wells currently included in the network are listed below.

699-85-40A	199-H3-1
699-88-41	199-H4-3
699-89-35	199-H4-4
699-90-34	199-H4-5
699-90-45	199-H4-6
699-91-37	
699-97-43	
699-99-42	

In addition to these periodic measurements, continuous data have been taken in a few of the wells nearest the basins, initially with float-type, mechanical, water-level recorders and subsequently with pressure transducers. At the present time, these transducers are installed in wells 199-H4-4 and 199-H4-5. Measurements from the transducers are recorded every 30 minutes by a multi-channel data logger.

The data obtained from this effort are entered into the data base and are used to draw water-table maps and determine ground-water flow directions. The measurements are also used to support the modeling work being conducted.

Sample Analysis

A contract is in place with the United States Testing Company (UST) for the analysis of environmental samples collected on the Hanford Site, including those obtained by the ground-water monitoring program for the 183-H Basins. UST operates analytical laboratories in Richland, Washington, and in Hoboken, New Jersey. The Richland laboratory has, until recently, conducted primarily radiological analyses in support of Hanford Site needs, while the Hoboken facility has worked extensively with nonradiological analyses and has achieved the capabilities needed to participate in the EPA's Contract Laboratory Program dealing with analysis of samples from "Superfund" sites. In 1985, to support the interim-status monitoring programs initiated at the Hanford Site, UST used the expertise available at its Hoboken facility to bring state-of-the-art, nonradiological analytical methods to the Richland laboratory. During the laboratory's startup period in June and July 1985, a few analyses were not yet available at the Richland laboratory, and the samples requiring those analyses were shipped to Hoboken. However, full capabilities are now available at the Richland facility, allowing local analysis of the samples collected under the ground-water monitoring program for the 183-H Basins. The analyses conducted on the samples and the methods currently in use at the laboratory are discussed below.

Analytical Parameters

The standard list of analyses currently being conducted on the ground-water samples is given in Table 2. This list was compiled on the basis of: 1) instructions given in EPA guidance documents, and 2) information provided by the facility manager concerning the composition of the wastes. According to an EPA guidance document regarding assessment-level programs (USEPA, undated draft), analyses must be conducted for the parameters in the Primary Drinking Water Standards and for the specific dangerous waste constituents known to have been discharged to the facility. This guidance was deemed applicable for the alternate ground-water monitoring program being conducted, and the list in Table 2 was compiled accordingly. Additional parameters, such as the contamination indicators, that are required for a detection-level program (but not necessarily for an alternate or assessment-level program) have been added to

provide consistency with other interim-status programs. These additional parameters are, however, measured only once for each sample and are not replicated four times as they would be under a detection-level program.

On a less-frequent basis (currently quarterly), samples from two wells in the network are also being analyzed for some additional parameters, including the dangerous waste constituents in WAC 173-303-9905 (Washington State Department of Ecology 1986), hereafter referred to as the 9905 list. These extra analyses, described in Table 3 (with additional details in Appendix C), provide information needed for the permitting process and further ensure that potential contaminants are not being overlooked. The two wells chosen for the extra analyses include one upgradient well (199-H3-1) and one downgradient well (199-H4-3).

In June 1986, at the end of the first year of sampling, a few small changes were made to the lists of analyses. Tables 2 and 3 reflect these recent changes, which are described in the following sentences. The first change involved dropping from the monthly list three analyses for site-specific chemicals that have consistently been below the detection limit. These three analyses are: 1) cyanide, 2) perchlorate, and 3) acid/base/neutral compounds (ABNs). Samples from selected wells will still be analyzed for these chemicals as part of the extra analyses conducted on a quarterly basis. The second change that was implemented involved decreasing the frequency of analysis for pesticides and herbicides from monthly to quarterly. Since these chemicals have been consistently below the detection limit, monthly analysis is not necessary and does not provide the extra information on seasonal variability being sought when using that frequency. Therefore, analysis for these chemicals has been cut back in frequency but still meets the regulatory requirement. The third change involved supplementing the radiological analyses conducted periodically on selected samples to include natural uranium, strontium-90, and a gamma scan. Information from these extra analyses is needed when screening levels for gross alpha and gross beta are exceeded.

Table 2. Standard List of Analyses for the 100-H Area Network

Constituent	Collection & Preservation[a,b]	Method[c]	Detection Limit, ppb[d]
Barium	P, HNO_3 to pH<2	SW-846, #6010	6
Cadmium			2
Chromium			10
Silver			10
Sodium			100
Nickel			10
Copper			10
Vanadium			5
Aluminum			150
Manganese			5
Potassium			100
Iron			50
Calcium			50
Zinc			5
Arsenic	P, HNO_3 to pH<2	SW-846, #7060	5
Mercury	P, HNO_3 to pH<2	SW-846, #7470	0.1
Selenium	P, HNO_3 to pH<2	SW-846, #7740	5
Lead	P, HNO_3 to pH<2	SW-846, #7421	5
Nitrate	P, None	70-IC[e,f]	500
Sulfate			500
Fluoride			500
Chloride			500
Radium	P, HNO_3 to pH<2	EPA Method #903.0	1 pCi/ℓ
Gross Alpha	P, HNO_3 to pH<2	EPA Method 680/4-75-001	4 pCi/ℓ

(a) P = plastic, G = glass.
(b) All samples will be cooled to 4°C upon collection.
(c) Constituents grouped together within brackets are analyzed by the same method.
(d) Detection limit units except where indicated.
(e) In-house analytical method from UST Procedure Manual, UST-RD-PM-9-80.
(f) IC = ion chromatography.
(g) Analyzed quarterly on selected wells.
(h) DAI = direct aqueous injection.
(i) Analyzed on quarterly basis only.
(j) MPN = most probable number.

Table 2. Standard List of Analyses for the 100-H Area Network (cont)

Constituent	Collection & Preservation[a,b]	Method[c]	Detection Limit, ppb[d]
Gross Beta	P, HNO_3 to pH<2	EPA Method 680/4-75-001	8 pCi/ℓ
Natural Uranium[g]	P, HNO_3 to pH<2	20-U-03[e]	4 pCi/ℓ
Strontium-90[g]	P, HNO_3 to pH<2	20-Sr-02[e]	5 pCi/ℓ
Gamma Scan[g]	P, HNO_3 to pH<2	30-GS & 40-07[e]	20 pCi/ℓ (Cs)
Total Organic Halogen	G, no headspace	SW-846, #9020	100
Total Organic Carbon	G, H_2SO_4 to pH<2	Std. Methods #505	1000
Ammonium ion	G, H_2SO_4 to pH<2	Std. Methods #417 A-E	50
Hydrazine	G, None	70-DAI[e,h]	3000
Endrin	G, None	SW-846, #8080[i]	1
Methoxychlor			1
Toxaphene			1
Lindane (4 isomers)			1
2,4-D	G, None	SW-846, #8150[i]	1
2,4,5-TP silvex			1
1,1,1-Trichloroethane	G, no headspace	SW-846, #8240	10
Perchloroethylene			10
Chloroform			10
Methylene chloride			10
Coliform bacteria	P, None	Std. Methods #908A	2.2 MPN[j]

(a) P = plastic, G = glass.
(b) All samples will be cooled to 4°C upon collection.
(c) Constituents grouped together within brackets are analyzed by the same method.
(d) Detection limit units except where indicated.
(e) In-house analytical method from UST Procedure Manual, UST-RD-PM-9-80.
(f) IC = ion chromatography.
(g) Analyzed quarterly on selected wells.
(h) DAI = direct aqueous injection.
(i) Analyzed on quarterly basis only.
(j) MPN = most probable number.

Table 2. Standard List of Analyses for the 100-H Area Network (cont)

Constituent	Collection & Preservation[a,b]	Method[c]	Detection Limit, ppb[d]
Temperature	Field measurement	See Appendix B	0.1°C
Specific conductance	Field measurement	See Appendix B	1 μmho
pH	Field measurement	See Appendix B	0.01 pH unit

(a) P = plastic, G = glass.
(b) All samples will be cooled to 4°C upon collection.
(c) Constituents grouped together within brackets are analyzed by the same method.
(d) Detection limit units except where indicated.
(e) In-house analytical method from UST Procedure Manual, UST-RT-PM-9-80.
(f) IC = ion chromatography.
(g) Analyzed quarterly on selected wells.
(h) DAI = direct aqueous injection.
(i) Analyzed on quarterly basis only.
(j) MPN = most probable number.

Table 3. Additional Analytical Parameters

Constituent	Collection & Preservation[a,b]	Method[c]	Detection Limit, ppb[d]
Beryllium	P, HNO_3 to pH<2	SW-846, #6010	5
Osmium			300
Strontium			300
Antimony			100
Thallium	P, HNO_3 to pH<2	SW-846, #7840	200
Thiourea	G, None	SW-846, #8330 (modified)	200
1-acetyl-2-thiourea			200
1-(o-chlorophenyl) thiourea			200
Diethylstilbesterol			200
Ethylenethiourea			200
1-naphthyl-2-thiourea			200
N-phenylthiourea			200
DDD	G, None	SW-846, #8180	1
DDE			1
DDT			1
Heptachlor			1
Heptachlor epoxide			1
Dieldrin			1
Aldrin			1
Chlordane			1
Endosulfan I			1
Endosulfan II			1
Chlorobenzilate			100
2,4,5-T	G, None	SW-846, #8150	1
Cyanide	P, NaOH to pH<12	SW-846, #9010	10
Perchlorate	P, None	70-IC[e,f]	1000
Phosphate			1000

(a) P = plastic, G = glass.
(b) All samples will be cooled to 4°C upon collection.
(c) Constituents grouped together within brackets are analyzed by the same method.
(d) Detection limit units except where indicated.
(e) In-house analytical method from UST Procedure Manual, UST-RD-PM-9-80.
(f) IC = ion chromatography.
(g) DAI = direct aqueous injection.
(h) Listed in Table C.1 of Appendix C.
(i) Listed in Table C.2 of Appendix C.

Table 3. Additional Analytical Parameters (cont)

Constituent	Collection & Preservation[a,b]	Method[c]	Detection Limit, ppb[d]
Carbophenothion	G, None	SW-846, #8140	2
Tetraethylpyrophosphate			100
Disulfoton			2
Dimethoate			5
Methyl parathion			2
Parathion			2
Citrus red #2	G, None	AOAC #34.015B	1000
Paraldehyde	G, None	70-DAI[e,g]	3000
Cyanogen bromide			3000
Cyanogen chloride			3000
Acrylamide			3000
Allyl alcohol			3000
Chloral			3000
Chloroacetaldehyde			3000
3-Chloropropionitrile			3000
Cyanogen			3000
Dichloropropanol			3000
Ethyl carbamate			3000
Ethyl cyanide			3000
Ethylene oxide			3000
Fluoroacetic acid			3000
Glycidylaldehyde			3000
Isobutyl alcohol			3000
Methyl hydrazine			3000
n-propylamine			3000
2-propyn-1-ol			3000
1,1-Dimethyl hydrazine			3000
1,2-Dimethyl hydrazine			3000
Acetronitrile			3000

(a) P = plastic, G = glass.
(b) All samples will be cooled to 4°C upon collection.
(c) Constituents grouped together within brackets are analyzed by the same method.
(d) Detection limit units except where indicated.
(e) In-house analytical method from UST Procedure Manual, UST-RD-PM-9-80.
(f) IC = ion chromatography.
(g) DAI = direct aqueous injection.
(h) Listed in Table C.1 of Appendix C.
(i) Listed in Table C.2 of Appendix C.

Table 3. Additional Analytical Parameters (cont)

Constituent	Collection & Preservation[a,b]	Method[c]	Detection Limit, ppb[d]
Tetrachloromethane	G, None	SW-846, #8240	10
Methylethyl ketone			10
1,1,2-Trichloroethane			10
1,1,2-Trichloroethylene			10
Xylene-o,p			10
Xylene-m			10
Formaldehyde			500
Additional volatiles[h]			10
Hexachlorophene	G, None	SW-846, #8270	10
Naphthalene			10
Phenol			10
Kerosene			10 ppm
Hexachlorobenzene			10
Pentachlorobenzene			10
1,2-Dichlorobenzene			10
1,3-Dichlorobenzene			10
1,4-Dichlorobenzene			10
1,2,3-Trichlorobenzene			10
1,2,4-Trichlorobenzene			10
1,3,5-Trichlorobenzene			10
1,2,3,4-Tetrachlorobenzene			10
1,2,3,5-Tetrachlorobenzene			10
1,2,4,5-Tetrachlorobenzene			10
Additional semi-volatiles[i]			10

(a) P = plastic, G = glass.
(b) All samples will be cooled to 4°C upon collection.
(c) Constituents grouped together within brackets are analyzed by the same method.
(d) Detection limit units except where indicated.
(e) In-house analytical method from UST Procedure Manual, UST-RD-PM-9-80.
(f) IC = ion chromatography.
(g) DAI = direct aqueous injection.
(h) Listed in Table C.1 of Appendix C.
(i) Listed in Table C.2 of Appendix C.

Analytical Methods

A summary of the methods used for the standard list of analyses conducted monthly is given in Table 2. Where available, EPA methods described in SW-846 (USEPA 1982) are used. In instances where a method is not available in SW-846, another standard method from EPA or from Standard Methods for the Examination of Water and Wastewater (American Public Health Association 1985) is employed if possible. If no standard methods are available for a particular constituent, UST uses an in-house method approved by PNL. The written procedures followed by UST are documented in their methods manual, UST-RD-PM-9-80 (UST 1986). A brief description of the methods being used for each category of constituent is provided below, and additional detail concerning the protocols followed is contained in Appendix D.

- Metals are measured by either the Inductively Coupled Plasma (ICP) method, the Graphite Furnace Atomic Absorption (GFAA) method, or the Cold Vapor Atomic Absorption method.
- Inorganic anions are determined by ion chromatography.
- Ammonium ion is determined by specific ion electrode.
- Volatile and semivolatile organic chemicals are determined by Gas Chromatography/Mass Spectrometry (GC/MS). Substances identified in samples by the GC/MS technique are verified by using a computerized library search system to compare the suspect mass spectra to the mass spectrum of a standard of the suspected substance.
- Pesticides and herbicides are measured by gas chromatography with an appropriate detector.
- Total Organic Carbon (TOC) is determined by the combustion-infrared method.
- Total Organic Halogens (TOX) are measured by carbon absorption and microcoulometric titration.
- Coliform count is determined by multiple tube fermentation.
- Gross alpha and gross beta are measured by evaporation of the sample and counting of the residue.

- Radium is measured by precipitation, weighing, and counting.
- Temperature, pH, and conductivity are determined in the field according to the instructions provided with the measuring instruments. The procedures used for these measurements are included with the sample collection methods in Appendix B.

Methods for the additional analytical parameters for this monitoring program are given in Table 3. As with the standard list of analyses in Table 2, approved standard methods from EPA or the Association of Official Analytical Chemists are used.

Table E.1 of Appendix E contains the 9905 list of dangerous waste constituents and indicates the corresponding analytical methods. Table E.1 also contains cross-references to other tables (E.2 through E.10), which sort these constituents according to analytical method. Two categories of compounds on the 9905 list are not analyzed: 1) constituents that are unstable in water, and 2) constituents for which an adequate analytical method is unavailable.

Data Handling and Verification

Analytical data obtained from laboratory measurements at UST are entered into UST's computerized system and are subsequently transferred to a PNL computer via magnetic tape. Both organizations follow rigorous data handling and verification procedures, as described below, to ensure that errors are not made during entry or transfer.

UST's Data Handling Procedures

Relevant information concerning analysis of the samples is entered into logbooks that are maintained for each analytical procedure. This information may include calibration data, sample data, instrument conditions, matrix spike recoveries, standards preparation, etc. Other data needed to support sample results, such as chromatograms, charts, tables, etc., are labelled and stored in a secure area.

Sample data generated by the analysts at the UST Hazardous Substance Analysis Laboratory are entered into UST's main computer by a data handler. The

data sheets provided by the analysts for this purpose must include:

- sample identification
- sample result in appropriate units
- extraction date (if any)
- analysis date
- dilutions (if any)
- matrix spike recoveries
- reagent blank results
- any other quality control results.

A copy of the analysts' data sheets are also provided to the laboratory supervisor or director for review.

Sample data for radionuclides from the UST Radiochemistry Laboratory are derived from raw counting data and a computer program that converts the counts into concentration units. These results are checked by the director of the UST Radiochemistry Laboratory before being transmitted to PNL.

The data are entered using written procedures (UST 1986). Discrepancies and anomalies are resolved at this time. For all analyses except TOX, TOC, and radionuclides, results below the contractual detection limits are entered as equal to the detection limit. For those stated exceptions, the actual results are entered into the computer. During data entry, an asterisk is automatically added by the computer to all results at or below the detection limit. These asterisks are replaced by the less-than (<) symbols when the file is entered into the PNL data base.

After all data for a sample set have been entered, an internal report is generated to verify that the data have been correctly entered. If corrections are needed, a second report is generated for verification. Finally, the data are copied onto a magnetic tape in the format specified by PNL. A hardcopy summary report and data file listing are generated and delivered to PNL with the tape and copies of the analysts' data sheets. Deliveries of data to PNL are generally made once per week.

PNL's Data Handling Procedures

Analytical data received by PNL on magnetic tape from UST are immediately entered into the Hanford Ground-Water Data Base, according to procedures contained in the data base management guide and user's manual (Mitchell, Fruland, and Rieger 1986). This computerized data base, maintained on a DEC VAX[a], is used to store analytical data, hydrographs, well-structure descriptions, and drilling logs for Hanford Site wells. Data collected in the field during sample collection, including several water-quality measurements, are entered manually. Once entered into the data base, the laboratory and field data can be accessed for manipulation and evaluation using various programs, and printed or plotted in a number of different formats.

Procedures for routine verification of the data files have been established. One of these procedures involves a test for outliers that is conducted during entry of the analytical data. This test involves checking each new data point for a particular well against the trend set by that well's recent history, using a program called ANATREND. Based on the established trend for a well, the program computes the predicted value for the next sampling date and sets an upper and lower limit of 2.09 standard deviations. Approximately 95% of the values are expected to fall within these limits, and a new data point is considered to be an outlier if it falls outside of these limits. A printout of suspected outliers is generated, and any apparent problems are then resolved as appropriate.

Other tests are conducted on the data file to ensure that each data field contains only permissible values. As the data are entered, the values in a data field (such as the well code field) are checked by the computer program against a list of allowable values; the record is rejected if there is not a match and is later investigated to determine appropriate action.

Additional verification of the data files is accomplished by manually checking each result on the analysts' data sheets received from the laboratory against a hard-copy report generated upon entering the data into the PNL data

(a) DEC VAX is a registered trademark of the Digital Equipment Corporation, Maynard, Massachusetts.

base. A special field in the data base, containing the initials of the person conducting the verification, is used to denote that a given data point has been checked. Discrepant data identified through this process are investigated with assistance from the laboratory. Following resolution, modifications are made to the data files as needed. This tedious and time-consuming process helps to ensure that the data contained in the data base have not been altered during transfer and entry.

Data Evaluation

On a continuing basis, the analytical data provided by UST are listed and statistically and graphically summarized to identify which constituents have been found in the ground water and to determine the range and average level of the constituents in each well. The graphs and tables in a later section of this chapter entitled "Results" illustrate the data evaluation methods used during the past year. These evaluations are essential in developing an understanding of the temporal and spatial variation in constituent concentrations in the ground water of the 100-H Area. Statistical methods are also used on a continuing basis to examine quality control data and thereby determine if the laboratory is performing satisfactorily or if modifications to the analytical procedures are needed.

Quality Assurance

Quality assurance (QA) for the 183-H ground-water monitoring program is conducted in accordance with PNL's Quality Assurance Manual. A QA plan describing the manner in which specific QA requirements are to be met has been prepared for this project, and a copy of the document is included in Appendix F.

Quality Control

A comprehensive quality control (QC) effort has been established for this project. The purpose of this effort is to determine and document the quality of the analytical results being produced by the laboratory and to institute corrective actions as needed. The QC effort has two main components: 1) routine internal checks performed by UST, and 2) external checks conducted by PNL to independently evaluate UST's performance. The scope of these efforts is described in the following sections.

UST's Internal QC Effort

The internal QC effort performed by UST includes general practices applicable to a wide range of analyses and also the specific procedures stipulated for particular analyses. The quality control and quality assurance programs at UST are documented in Quality Control Manual (Hembree, Lardy, and Swoboda 1986) and the Quality Assurance Manual (Hembree and Lardy 1986). A summary of UST's QC procedures and data is given in Hazardous Substance Analysis Quality Control Report for the Period June 17, 1985 through March 31, 1986 (Hembree and Rao, 1986). Table D.1 in Appendix D contains a summary of the specific QC requirements pertaining to each analysis.

The general QC procedures used for all inorganic analyses are as follows:

- standard curve, daily
- verification of standard (to ± 10%), every 10 samples
- blank, each extraction batch
- random matrix spike for 10% of the samples.

For all organic analyses, the following general QC requirements apply:

- five point curve, verified every 12 hours
- random matrix spike for 10% of the samples
- blank, each extraction batch
- internal standards and surrogates, with each sample (for all analyses requiring these).

Data obtained from the matrix spikes, blanks, and surrogates are presented in control charts, which indicate whether or not a process is in statistical control.

External QC Effort

The external QC effort conducted by PNL to evaluate the laboratory's performance features interlaboratory comparisons as well as submission to UST of spiked samples, replicates, and blanks. The purpose and scope of each of these are discussed below.

Interlaboratory comparisons using field samples are conducted to determine if the results obtained by the primary laboratory, UST, are comparable to those

obtained from other laboratories. The three following Hanford Site laboratories are used to check UST's results: 1) the Hanford Environmental Health Foundation (HEHF), 2) Westinghouse Hanford Company (WHC), and 3) PNL. Comparisons are currently being conducted for anions, volatile organics, and metals. Each month, replicate samples from selected wells are delivered to the participating laboratories. Capabilities of these local laboratories vary, and distribution of the samples is conducted accordingly, as follows:

- anions: HEHF and WHC
- volatile organics: PNL
- metals: HEHF.

Spiked samples are submitted to UST to estimate the bias of analytical laboratory procedures and to determine when this bias exceeds control limits. Two types of spiked samples are being used: 1) blind, spiked samples prepared by PNL; and 2) spiked samples prepared under an established multi-laboratory comparison program.

Blind, spiked samples containing metals, anions, herbicides, pesticides, and volatile organic compounds (halomethanes) have been submitted on a quarterly basis beginning in January 1986. These samples were prepared by PNL with materials supplied by Environmental Resource Associates (ERA). Additional spiked samples prepared with materials supplied by the EPA were added in June 1986. Constituents included are ammonium ion, cyanide, acid/base/neutral (ABN) compounds, and a wider variety of pesticides and volatile organic compounds. Materials will be used to monitor the performance of various analyses, including semi-volatile organics (by direct injection), thiourea, phosphorus pesticides, ethylene glycol, sulfide, and perchlorate.

UST has also received and analyzed spiked samples submitted under the EPA-sponsored Water Pollution Laboratory Performance Evaluation Study WP016 and the Water Supply Laboratory Performance Evaluation Study WS018.

Replicate analyses of field samples are conducted to establish how much variability might be expected in the laboratory measurements performed on nearly identical samples. In each of the first three samplings, replicate samples (three or four) were collected from several wells. These replicates received full analysis. Further replication has been postponed pending evaluation of the results obtained and subsequent planning for a routine replication effort. Submission of replicates to UST is scheduled to be resumed in late 1986. A set of wells exhibiting a range of concentrations has been selected for this effort.

Blanks are submitted to UST to determine whether environmental conditions encountered during collection and transportation of samples have affected the results obtained by analysis. One blank is submitted with each volatile organics sample. In addition, a blank for every analysis conducted is submitted each sampling period.

RESULTS

The ground-water monitoring effort described in detail above has generated a very large amount of information. As a result of the effort, several thousand new data points have been added to the Hanford Ground-Water Data Base within the last year. This information is summarized and evaluated below.

Types of Constituents Detected

Analytical data obtained from samples collected in the 100-H Area during the past year have indicated the presence of metals, anions, radionuclides, and a few volatile organic chemicals. More details concerning each of these types of constituents are provided in the following paragraphs.

The metals that have been detected in all five wells on a consistent basis include chromium, sodium, potassium, barium, and calcium. Other metals observed in fewer wells or on a less frequent basis include copper, manganese, nickel, vanadium, aluminum, iron, zinc, and strontium. Of the metals that currently have a Primary Drinking Water Standard, only chromium has consistently exceeded the standard of 50 ppb, with concentrations up to 1,130 ppb in well 199-H4-3.

The anions chloride, nitrate, and sulfate have consistently been detected in all five wells. Fluoride has occasionally been detected. Nitrate has exceeded the Primary Drinking Water Standard of 45,000 ppb in a number of instances, with concentrations up to 2,890,000 ppb in well 199-H4-3; fluoride has also exceeded its standard of 1,400 ppb in a few cases, with concentrations up to 1,960 ppb in well 199-H4-3. Ammonium (a cation) has also been consistently detected.

The volatile organic chemical chloroform has been detected frequently in all wells except 199-H3-1. Chloroform concentrations have been low, not exceeding 32 ppb.

The analyses for gross alpha and gross beta have indicated the presence of radionuclides. Gross alpha results have exceeded the 15 pCi/ℓ level expressed in the Drinking Water Standard, although the subtraction of uranium would probably bring the concentration below that level. The gross beta results have, in some cases, been above the 50 pCi/ℓ screening level at which more information is needed before calculating dose. To obtain more information on the radiological status of the ground water, the alpha and beta analyses are now being supplemented (as mentioned previously) with uranium, strontium-90, and gamma scans.

Data Listings and Summaries

Table 4 is a summary of results obtained for samples collected from June 1985 through May 1986. The table shows, for each constituent, several important pieces of information, including the following:

- constituent code used in the data base (CONCODE)
- abbreviated constituent name (CONNAME)
- analytical units used for storage and reporting of data (ANALUNIT)
- detection limit (DETLIMIT)
- number of samples analyzed for this constituent (SAMPLES)
- number of samples for which the results were below detection (BELOWDL)
- standard, if any (MAXLIMIT)
- regulatory agency that set the standard (REGAGEN)
- full name of the constituent (FULLNAME).

Also on Table 4 is a column marked "ALLBELOW." Those constituents for which all results were below the detection limit have three asterisks in this column. This table therefore allows easy identification of the numerous constituents that were not detected during the past year of sampling.

In Table 4 (and in other tables to be discussed later), the constituents are divided into six categories for convenience: 1) contamination indicators, 2) parameters in the Primary Drinking Water Standards, 3) constituents indicative of water quality, 4) site-specific constituents, 5) site-specific "tag-alongs," and 6) constituents on the 9905 list. The first three categories are those required under the regulations for interim-status detection programs. The fourth category contains site-specific chemicals identified by the facility managers as possibly being present in the wastes. Additional constituents that are not specifically requested but were analyzed because they belong to a group analysis are contained in the fifth category. Finally, the sixth category contains the additional analyses that must be performed in order to obtain information needed for the permitting process.

Additional summary information for all constituents that had at least one value above the detection limit is presented in Table 5. In addition to some of the basic information presented in Table 4 (e.g., constituent name, analytical units, detection limit), Table 5 contains:

- simple arithmetic mean of all values (MEAN)
- median, or ordered middle, of all values (MEDIAN)
- standard deviation of all values (STTDEV)
- coefficient of variation [100 (STDDEV/MEAN)] for all values (COEFFVAR)
- minimum reported value (MINIMUM)
- maximum reported value (MAXIMUM).

It should be noted that the mean, standard deviation, and coefficient of variation on Table 5 were calculated as though the values met the assumptions of random sampling. Estimation problems posed by replicates, values below detection limits, and spatial and temporal variability have been ignored at this stage of the evaluation.

TABLE 4. Summary of Analyses Conducted from June 1985 through May 1986

Constituent List=Contamination Indicators

CONCODE	CONNAME	ANALUNIT	DETLIMIT	SAMPLES	BELOWDL	ALLBELOW	MAXLIMIT	REGAGEN	FULLNAME
191	CONDUCT	UMHO	.	55	0		.		Conductivity
199	PH		.	55	0		.		pH
C68	TOX	PPB	100	64	55		.		Total organic halogen
C69	TOC	PPB	1000	64	10		.		Total organic carbon

Constituent List=Drinking Water Standards

CONCODE	CONNAME	ANALUNIT	DETLIMIT	SAMPLES	BELOWDL	ALLBELOW	MAXLIMIT	REGAGEN	FULLNAME
109	COLIFRM	MPN	3	70	66		1	EPA	Coliform bacteria
111	BETA	PCI/L	8	70	0		50	EPA	Gross beta
181	RADIUM	PCI/L	1	70	61		5	EPA	Radium
212	LOALPHA	PCI/L	4	70	5		15	EPA	Gross alpha
A06	BARIUM	PPB	6	72	0		1000	EPA	Barium
A07	CADMIUM	PPB	2	72	65		10	EPA	Cadmium
A08	CHROMUM	PPB	10	72	1		50	EPA	Chromium
A10	SILVER	PPB	10	72	72	***	50	EPA	Silver
A20	ARSENIC	PPB	5	72	62		50	EPA	Arsenic
A21	MERCURY	PPB	.1	72	68		2	EPA	Mercury
A22	SELENUM	PPB	5	72	70		10	EPA	Selenium
A33	ENDRIN	PPB	1	72	72	***	.2	EPA	Endrin
A34	METHLOR	PPB	1	72	72	***	100	EPA	Methoxychlor
A35	TOXAENE	PPB	1	72	72	***	5	EPA	Toxaphene
A36	a-BHC	PPB	1	72	72	***	4	EPA	Alpha-BHC
A37	b-BHC	PPB	1	72	72	***	4	EPA	Beta-BHC
A38	g-BHC	PPB	1	72	72	***	4	EPA	Gamma-BHC
A39	d-BHC	PPB	1	72	72	***	4	EPA	Delta-BHC
A51	LEADGF	PPB	5	72	69		50	EPA	Lead (graphite furnace)
C72	NITRATE	PPB	500	70	2		45000	EPA	Nitrate
C74	FLUORID	PPB	500	70	49		1400	EPA	Fluoride
H13	2,4-D	PPB	1	71	71	***	100	EPA	2,4-D
H14	2,4,5TP	PPB	1	71	71	***	10	EPA	2,4,5-TP silvex

Constituent List=Quality Characteristics

CONCODE	CONNAME	ANALUNIT	DETLIMIT	SAMPLES	BELOWDL	ALLBELOW	MAXLIMIT	REGAGEN	FULLNAME
A11	SODIUM	PPB	100	72	0		.		Sodium
A17	MANGESE	PPB	5	72	46		.		Manganese
A19	IRON	PPB	50	72	16		.		Iron
C57	PHENOL	PPB	10	72	72	***	.		Phenol
C73	SULFATE	PPB	500	70	1		.		Sulfate
C75	CHLORID	PPB	500	70	1		.		Chloride

TABLE 4. Summary of Analyses Conducted from June 1985 through May 1986 (cont)

Constituent List=Site Specific

CONCODE	CONNAME	ANALUNIT	DETLIMIT	SAMPLES	BELOWDL	ALLBELOW	MAXLIMIT	REGAGEN	FULLNAME
A03	STRONUM	PPB	300	51	31		.		Strontium
A04	ZINC	PPB	5	51	17		.		Zinc
A05	CALCIUM	PPB	50	51	0		.		Calcium
A12	NICKEL	PPB	10	72	58		.		Nickel
A13	COPPER	PPB	10	72	53		1300	EPAP	Copper
A14	VANADUM	PPB	5	72	37		.		Vanadium
A16	ALUMNUM	PPB	150	72	48		.		Aluminum
A18	POTASUM	PPB	100	72	0		.		Potassium
A67	1,1,1-T	PPB	10	54	49		200	EPAP	1,1,1-trichloroethane
A70	PERCENE	PPB	10	54	50		.		Perchloroethylene
A80	CHLFORM	PPB	10	47	9		.		Chloroform
A93	METHYCH	PPB	10	33	19		.		Methylene chloride
C70	CYANIDE	PPB	10	70	70	***	.		Cyanide
C77	PERCHLO	PPB	1000	70	70	***	.		Perchlorate
C80	AMMONIU	PPB	50	70	24		.		Ammonium ion

Constituent List=Site Specific tag-alongs

CONCODE	CONNAME	ANALUNIT	DETLIMIT	SAMPLES	BELOWDL	ALLBELOW	MAXLIMIT	REGAGEN	FULLNAME
A01	BERYLAM	PPB	5	51	51	***	.		Beryllium
A02	OSMIUM	PPB	300	51	51	***	.		Osmium
A15	ANTIONY	PPB	100	72	72	***	.		Antimony
A61	TETRANE	PPB	10	54	54	***	5	EPAP	Tetrachloromethane
A62	BENZENE	PPB	10	54	54	***	5	EPAP	Benzene
A63	DIOXANE	PPB	500	54	54	***	.		Dioxane
A64	METHONE	PPB	10	54	54	***	.		Methyl ethyl ketone
A65	PYRIDIN	PPB	500	54	54	***	.		Pyridine
A66	TOLUENE	PPB	10	54	54	***	2000	EPAP	Toluene
A68	1,1,2-T	PPB	10	54	54	***	.		1,1,2-trichloroethane
A69	TRICENE	PPB	10	54	54	***	5	EPAP	Trichloroethylene
A71	OPXYLE	PPB	10	54	54	***	440	EPAP	Xylene-o,p
B14	M-XYLE	PPB	10	54	54	***	440	EPAP	Xylene-m
B61	12-dben	PPB	10	72	72	***	.		1,2-dichlorobenzene
B62	13-dben	PPB	10	72	72	***	.		1,3-dichlorobenzene
B63	14-dben	PPB	10	72	72	***	.		1,4-dichlorobenzene
B89	HEXCBEN	PPB	10	72	72	***	.		Hexachlorobenzene
C26	PENTCHB	PPB	10	72	72	***	.		Pentachlorobenzene
C37	TETRCHB	PPB	10	72	72	***	.		1,2,4,5-tetrachlorobenzene
C43	TRICHLB	PPB	10	72	72	***	.		1,2,4-trichlorobenzene
C54	HEXACHL	PPB	10	72	72	***	.		Hexachlorophene
C55	NAPHTHA	PPB	10	72	72	***	.		Naphthalene
C56	123TRI	PPB	10	72	72	***	.		1,2,3-trichlorobenzene
C58	135TRI	PPB	10	72	72	***	.		1,3,5-trichlorobenzene
C59	1234TE	PPB	10	72	72	***	.		1,2,3,4-tetrachlorobenzene
C60	1235TE	PPB	10	72	72	***	.		1,2,3,5-tetrachlorobenzene
C71	FORMALN	PPB	500	54	54	***	.		Formalin
C76	PHOSPHA	PPB	1000	70	70	***	.		Phosphate
C79	KEROSEN	PPB	10000	72	72	***	.		Kerosene

TABLE 4. Summary of Analyses Conducted from June 1985 through May 1986 (cont)

----------Constituent List=WAC 173-303-9905----------

CONCODE	CONNAME	ANALUNIT	DETLIMIT	SAMPLES	BELOWDL	ALLBELOW	MAXLIMIT	REGAGEN	FULLNAME
A23	THALIUM	PPB	10	18	14		.		Thallium
A24	THIOURA	PPB	200	18	18	***	.		Thiourea
A25	ACETREA	PPB	200	18	18	***	.		1-acetyl-2-thiourea
A26	CHLOREA	PPB	200	18	18	***	.		1-(o-chlorophenyl) thiourea
A27	DIETROL	PPB	200	18	18	***	.		Diethylstilbesterol
A28	ETHYREA	PPB	200	18	18	***	.		Ethylenethiourea
A29	NAPHREA	PPB	200	18	18	***	.		1-naphthyl-2-thiourea
A32	PHENREA	PPB	200	18	18	***	.		N-phenylthiourea
A40	DDD	PPB	1	18	18	***	.		DDD
A41	DDE	PPB	1	18	18	***	.		DDE
A42	DDT	PPB	1	18	18	***	.		DDT
A43	HEPTLOR	PPB	1	18	18	***	0	EPAP	Heptachlor
A44	HEPTIDE	PPB	1	18	18	***	0	EPAP	Heptchlor epoxide
A46	DIELRIN	PPB	1	18	18	***	.		Dieldrin
A47	ALDRIN	PPB	1	18	18	***	.		Aldrin
A48	CHLDANE	PPB	1	18	18	***	0	EPAP	Chlordane
A49	END01	PPB	1	18	18	***	.		Endosulfan I
A52	END02	PPB	1	2	2	***	.		Endosulfan II
A72	ACROLIN	PPB	10	18	18	***	.		Acrolein
A73	ACRYILE	PPB	10	18	18	***	.		Acrylonitrile
A74	BISTHER	PPB	10	18	18	***	.		Bis(chloromethyl) ether
A75	BROMONE	PPB	10	18	18	***	.		Bromoacetone
A76	METHBRO	PPB	10	18	18	***	.		Methyl bromide
A77	CARBIDE	PPB	10	18	18	***	.		Carbon disulfide
A78	CHLBENZ	PPB	10	18	18	***	.		Chlorobenzene
A79	CHLTHER	PPB	10	18	18	***	.		2-chloroethyl vinyl ether
A81	METHCHL	PPB	10	18	18	***	.		Methyl chloride
A82	CHMTHER	PPB	10	18	18	***	.		Chloromethyl methyl ether
A83	CROTONA	PPB	10	18	18	***	.		Crotonaldehyde
A84	DIBRCHL	PPB	10	18	18	***	.		1,2-dibromo-3-chloropropane
A85	DIBRETH	PPB	10	18	18	***	.		1,2-dibromoethane
A86	DIBRMET	PPB	10	18	18	***	.		Dibromomethane
A87	DIBUTEN	PPB	10	18	18	***	.		1,4-dichloro-2-butene
A88	DICDIFM	PPB	10	18	18	***	.		Dichlorodifluoromethane
A89	1,1-DIC	PPB	10	18	18	***	.		1,1-dichloroethane
A90	1,2-DIC	PPB	10	18	18	***	5	EPAP	1,2-dichloroethane
A91	TRANDCE	PPB	10	18	18	***	70	EPAP	Trans-1,2-dichloroethene
A92	DICETHY	PPB	10	18	18	***	7	EPAP	1,1-dichloroethylene
A94	DICPANE	PPB	10	18	18	***	5	EPAP	1,2-dichloropropane
A95	DICPENE	PPB	10	18	18	***	.		1,3-dichloropropene
A96	NNDIEHY	PPB	10	18	18	***	.		N,N-diethylhydrazine
A97	1,1-DIM	PPB	3000	18	18	***	.		1,1-dimethylhydrazine
A98	1,2-DIM	PPB	3000	18	18	***	.		1,2-dimethylhydrazine
A99	HYDRSUL	PPB	10	18	18	***	.		Hydrogen sulfide
B01	IODOMET	PPB	10	18	18	***	.		Iodomethane
B02	METHACR	PPB	10	18	18	***	.		Methacrylonitrile
B03	METHTHI	PPB	10	18	18	***	.		Methanethiol
B04	PENTACH	PPB	10	18	18	***	.		Pentachloroethane
B05	1112-tc	PPB	10	18	18	***	.		1,1,1,2-tetrachlorethane
B06	1122-tc	PPB	10	18	18	***	.		1,1,2,2-tetrachlorethane

TABLE 4. Summary of Analyses Conducted from June 1985 through May 1986 (cont)

Constituent List=WAC 173-303-9905

CONCODE	CONNAME	ANALUNIT	DETLIMIT	SAMPLES	BELOWDL	ALLBELOW	MAXLIMIT	REGAGEN	FULLNAME
B08	BROMORM	PPB	10	18	18	***	.		Bromoform
B09	TRCMEOL	PPB	10	18	18	***	.		Trichloromethanethiol
B10	TRCMFLM	PPB	10	18	18	***	.		Trichloromonofluoromethane
B11	TRCPANE	PPB	10	18	18	***	.		Trichloropropane
B12	123-trp	PPB	10	18	18	***	.		1,2,3-trichloropropane
B13	VINYIDE	PPB	10	18	18	***	1	EPAP	Vinyl chloride
B15	DIETHY	PPB	10	18	18	***	.		Diethylarsine
B19	ACETILE	PPB	3000	18	18	***	.		Acetonitrile
B20	ACETONE	PPB	10	18	18	***	.		Acetophenone
B21	WARFRIN	PPB	10	18	18	***	.		Warfarin
B22	ACEFENE	PPB	10	18	18	***	.		2-acetylaminofluorene
B23	AMINOYL	PPB	10	18	18	***	.		4-aminobyphenyl'
B24	AMIISOX	PPB	10	18	18	***	.		5-(aminomethyl)-3-isoxazolol
B25	AMITROL	PPB	10	18	18	***	.		Amitrole
B26	ANILINE	PPB	10	18	18	***	.		Aniline
B27	ARAMITE	PPB	10	18	18	***	.		Aramite
B28	AURAMIN	PPB	10	18	18	***	.		Auramine
B29	BENZCAC	PPB	10	18	18	***	.		Benz[c]acridine
B30	BENZAAN	PPB	10	18	18	***	.		Benz[a]anthracene
B31	BENDICM	PPB	10	18	18	***	.		Benzene, dichloromethyl
B32	BENTHOL	PPB	10	18	18	***	.		Benzenethoil
B33	BENDINE	PPB	10	18	18	***	.		Benzidine
B34	BENZBFL	PPB	10	18	18	***	.		Benzo[b]fluoranthene
B35	BENZJFL	PPB	10	18	18	***	.		Benzo[j]fluoranthene
B36	PBENZQU	PPB	10	18	18	***	.		P benzoquinone
B37	BENZCHL	PPB	10	18	18	***	.		Benzyl chloride
B38	BIS2CHM	PPB	10	18	18	***	.		Bis(2-chloroethoxy) methane
B39	BIS2CHE	PPB	10	18	18	***	.		Bis(2-chloroethyl) ether
B40	BIS2EPH	PPB	10	19	18		.		Bis(2-ethylhexyl) phthalate
B41	BROPHEN	PPB	10	18	18	***	.		4-bromophenyl phenyl ether
B42	BUTBENP	PPB	10	18	18	***	.		Butyl benzyl phthalate
B43	BUTDINP	PPB	10	18	18	***	.		2-sec-butyl-4,6-dinitrophenol
B44	CHALETH	PPB	10	18	18	***	.		Chloroalkyl ethers
B45	CHLANIL	PPB	10	18	18	***	.		P-chloroaniline
B46	CHLCRES	PPB	10	18	18	***	.		P-chloro-m-cresol
B47	CHLEPOX	PPB	10	18	18	***	.		1-chloro-2,3-epoxypropane
B48	CHLNAPH	PPB	10	18	18	***	.		2-chloronaphthalene
B49	CHLPHEN	PPB	10	18	18	***	.		2-chlorophenol
B50	CHRYSEN	PPB	10	18	18	***	.		Chrysene
B51	CRESOLS	PPB	10	18	18	***	.		Cresols
B52	CYCHDIN	PPB	10	18	18	***	.		2-cyclohexyl-4,6-dinitrophenol
B53	DIBAHAC	PPB	10	18	18	***	.		Dibenz[a,h]acridine
B54	DIBAJAC	PPB	10	18	18	***	.		Dibenz[a,j]acridine
B55	DIBAHAN	PPB	10	18	18	***	.		Dibenz[a,h]anthracene
B56	DIBCGCA	PPB	10	18	18	***	.		7H-dibenzo[c,g]carbazole
B57	DIBAEPY	PPB	10	18	18	***	.		Dibenzo[a,e]pyrene
B58	DIBAHPY	PPB	10	18	18	***	.		Dibenzo[a,h]pyrene
B59	DIBAIPY	PPB	10	18	18	***	.		Dibenzo[a,i]pyrene
B60	DIBPHTH	PPB	10	18	18	***	.		Di-n-butyl phthalate
B64	DICHBEN	PPB	10	18	18	***	.		3,3'-dichlorobenzidine

TABLE 4. Summary of Analyses Conducted from June 1985 through May 1986 (cont)

Constituent List=WAC 173-303-9905

CONCODE	CONNAME	ANALUNIT	DETLIMIT	SAMPLES	BELOWDL	ALLBELOW	MAXLIMIT	REGAGEN	FULLNAME
B65	24-dchp	PPB	10	18	18	***		.	2,4-dichlorophenol
B66	26-dchp	PPB	10	18	18	***		.	2,6-dichlorophenol
B67	DIEPHTH	PPB	10	18	18	***		.	Diethyl phthalate
B68	DIHYSAF	PPB	10	18	18	***		.	Dihydrosafrole
B69	DIMETHB	PPB	10	18	18	***		.	3,3'-dimethoxybenzidine
B70	DIMEAMB	PPB	10	18	18	***		.	P-dimethylaminoazobenzene
B71	DIMBENZ	PPB	10	18	18	***		.	7,12-dimethylbenz[a]anthracene
B72	DIMEYLB	PPB	10	18	18	***		.	3,3'-dimethylbenzidine
B73	THIONOX	PPB	10	18	18	***		.	Thiofanox
B74	DIMPHAM	PPB	10	18	18	***		.	Alpha,alpha-dimethylphenethylamine
B75	DIMPHEN	PPB	10	18	18	***		.	2,4-dimethylphenol
B76	DIMPHTH	PPB	10	18	18	***		.	Dimethyl phthalate
B77	DINBENZ	PPB	10	18	18	***		.	Dinitrobenzene
B78	DINCRES	PPB	10	18	18	***		.	4,6-dinitro-o-cresol and salts
B79	DINPHEN	PPB	10	18	18	***		.	2,4-dinitrophenol
B80	24-dint	PPB	10	18	18	***		.	2,4-dinitrotoluene
B81	26-dint	PPB	10	18	18	***		.	2,6-dinitrotoluene
B82	DIOPHTH	PPB	10	18	18	***		.	Di-n-octyl phthalate
B83	DIPHAMI	PPB	10	18	18	***		.	Diphenylamine
B84	DIPHHYD	PPB	10	18	18	***		.	1,2-diphenylhydrazine
B85	DIPRNIT	PPB	10	18	18	***		.	Di-n-propylnitrosamine
B86	ETHMINE	PPB	10	18	18	***		.	Ethyleneimine
B87	ETHMETH	PPB	10	18	18	***		.	Ethyl methanesulfonate
B88	FLUORAN	PPB	10	18	18	***		.	Fluoranthene
B90	HEXCBUT	PPB	10	18	18	***		.	Hexachlorobutadiene
B91	HEXCCYC	PPB	10	18	18	***		.	Hexachlorocyclopentadiene
B92	HEXCETH	PPB	10	18	18	***		.	Hexachloroethane
B93	INDENOP	PPB	10	18	18	***		.	Indeno(1,2,3-cd)pyrene
B94	ISOSOLE	PPB	10	18	18	***		.	Isosafrole
B95	MALOILE	PPB	10	18	18	***		.	Malononitrile
B96	MELPHAL	PPB	10	18	18	***		.	Melphalan
B97	METHAPY	PPB	10	18	18	***		.	Methapyrilene
B98	METHNYL	PPB	10	18	18	***		.	Metholonyl
B99	METAZIR	PPB	10	18	18	***		.	2-methylaziridine
C01	METCHAN	PPB	10	18	18	***		.	3-methylcholanthrene
C02	METBISC	PPB	10	18	18	***		.	4,4'-methylenebis(2-chloroaniline)
C03	METACTO	PPB	10	18	18	***		.	2-methyllactonitrile
C04	METACRY	PPB	10	18	18	***		.	Methyl methacrylate
C05	METMSUL	PPB	10	18	18	***		.	Methyl methanesulfonate
C06	METPROP	PPB	10	18	18	***		.	2-methyl-2-(methylthio) propionaldehyde-o-
C07	METHIOU	PPB	10	18	18	***		.	Methylthiouracil
C08	NAPHQUI	PPB	10	18	18	***		.	1,4-naphthoquinone
C09	1-napha	PPB	10	18	18	***		.	1-naphthylamine
C10	2-napha	PPB	10	18	18	***		.	2-naphthylamine
C11	NITRANI	PPB	10	18	18	***		.	P-nitroaniline
C12	NITBENZ	PPB	10	18	18	***		.	Nitrobenzine
C13	NITPHEN	PPB	10	18	18	***		.	4-nitrophenol
C14	NNIBUTY	PPB	10	18	18	***		.	N-nitrosodi-n-butylamine
C15	NNIDIEA	PPB	10	18	18	***		.	N-nitrosodiethanolamine
C16	NNIDIEY	PPB	10	18	18	***		.	N-nitrosodiethylamine

TABLE 4. Summary of Analyses Conducted from June 1985 through May 1986 (cont)

Constituent List=WAC 173-303-9905

CONCODE	CONNAME	ANALUNIT	DETLIMIT	SAMPLES	BELOWDL	ALLBELOW	MAXLIMIT	REGAGEN	FULLNAME
C17	NNIDIME	PPB	10	18	18	***	.		N-nitrosodimethylamine
C18	NNIMETH	PPB	10	18	18	***	.		N-nitrosomethylethylamine
C19	NNIURET	PPB	10	18	18	***	.		N-nitroso-N-methylurethane
C20	NNIVINY	PPB	10	18	18	***	.		N-nitrosomethylvinylamine
C21	NNIMORP	PPB	10	18	18	***	.		N-nitrosomorpholine
C22	NNINICO	PPB	10	18	18	***	.		N-nitrosonornicotine
C23	NNIPIPE	PPB	10	18	18	***	.		N-nitrosopiperidine
C24	NITRPYR	PPB	10	18	18	***	.		Nitrosopyrrolidine
C25	NITRTOL	PPB	10	18	18	***	.		5-nitro-o-toluidine
C27	PENTCHN	PPB	10	18	18	***	.		Pentachloronitrobenzene
C28	PENTCHP	PPB	10	18	18	***	220	EPAP	Pentachlorophenol
C29	PHENTIN	PPB	10	18	18	***	220	EPAP	Phenacetin
C30	PHENINE	PPB	10	18	18	***	.		Phenylenediamine
C31	PHTHEST	PPB	10	18	18	***	.		Phthalic acid esters
C32	PICOLIN	PPB	10	18	18	***	.		2-picoline
C33	PRONIDE	PPB	10	18	18	***	.		Pronamide
C34	RESERPI	PPB	10	18	18	***	.		Reserpine
C35	RESORCI	PPB	10	18	18	***	.		Resorcinol
C36	SAFROL	PPB	10	18	18	***	.		Safrol
C39	TETRCHP	PPB	10	18	18	***	.		2,3,4,6-tetrachlorophenol
C40	THIURAM	PPB	10	18	18	***	.		Thiuram
C41	TOLUDIA	PPB	10	18	18	***	.		Toluenediamine
C42	OTOLHYD	PPB	10	18	18	***	.		O-toluidine hydrochloride
C44	245-trp	PPB	10	18	18	***	.		2,4,5-trichlorophenol
C45	246-trp	PPB	10	18	18	***	.		2,4,6-trichlorophenol
C46	TRIPHOS	PPB	10	18	18	***	.		O,O,O-triethyl phosphorothioate
C47	SYMTRIN	PPB	10	18	18	***	.		Sym-trinitrobenzene
C48	TRIPHOS	PPB	10	18	18	***	.		Tris(2,3-dibromopropyl) phosphate
C49	BENZOPY	PPB	10	18	18	***	.		Benzo[a]pyrene
C50	CHLNAPH	PPB	10	18	18	***	.		Chlornaphazine
C51	BIS2ETH	PPB	10	18	18	***	.		Bis(2-chloroisopropyl)ether
C52	HEXAENE	PPB	10	54	54	***	.		Hexachloropropene
C53	HYDRAZI	PPB	3000	18	18	***	.		Hydrazine
C61	TETEPYR	PPB	100	18	18	***	.		Tetraethylpyrophosphate
C62	CHLLATE	PPB	100	39	39	***	.		Chlorobenzilate
C63	CARBPHT	PPB	2	18	18	***	.		Carbophenothion
C64	DISULFO	PPB	2	18	18	***	.		Disulfoton
C65	DIMETHO	PPB	5	18	18	***	.		Dimethoate
C66	METHPAR	PPB	2	18	18	***	.		Methyl parathion
C67	PARATHI	PPB	2	18	18	***	.		Parathion
C87	CITRUSR	PPB	1000	18	18	***	.		Citrus red
C88	CYANBRO	PPB	3000	18	18	***	.		Cyanogen bromide
C89	CYANCHL	PPB	3000	18	18	***	.		Cyanogen chloride
C90	PARALDE	PPB	3000	18	18	***	.		Paraldegyde
C91	STRYCHN	PPB	50	39	39	***	.		Strychnine
C92	MALHYDR	PPB	500	39	39	***	.		Maleic hydrizide
C93	NICOTIN	PPB	100	39	39	***	.		Nicotinic acid
C94	ACRYIDE	PPB	3000	18	18	***	0	EPAP	Acrylamide
C95	ALLYLAL	PPB	3000	18	18	***	.		Allyl alcohol
C96	CHLORAL	PPB	3000	18	18	***	.		Chloral

TABLE 4. Summary of Analyses Conducted from June 1985 through May 1986 (cont)

----------Constituent List=WAC 173-303-9905----------

CONCODE	CONNAME	ANALUNIT	DETLIMIT	SAMPLES	BELOWDL	ALLBELOW	MAXLIMIT	REGAGEN	FULLNAME
C97	CHLACET	PPB	3000	18	18	***		.	Chloroacetaldehyde
C98	CHLPROP	PPB	3000	18	18	***		.	3-chloropropionitrile
C99	CYANOGN	PPB	3000	18	18	***		.	Cyanogen
H01	DICPROP	PPB	3000	18	18	***		.	Dichloropropanol
H03	ETHCARB	PPB	3000	18	18	***		.	Ethyl carbamate
H04	ETHCYAN	PPB	3000	18	18	***		.	Ethyl cyanide
H05	ETHOXID	PPB	3000	18	18	***		.	Ethylene oxide
H06	ETHMETH	PPB	3000	18	18	***		.	Ethyl methacrylate
H07	FLUOROA	PPB	3000	18	18	***		.	Fluoroacetic acid
H08	GLYCIDY	PPB	3000	18	18	***		.	Glycidylaldehyde
H09	ISOBUTY	PPB	3000	18	18	***		.	Isobutyl alcohol
H10	METZINE	PPB	3000	18	18	***		.	Methyl hydrazine
H11	PROPYLA	PPB	3000	18	18	***		.	N-propylamine
H12	PROPYNO	PPB	3000	18	18	***		.	2-propyn-1-ol
H15	2,4,5-T	PPB	1	17	17	***		.	2.4.5-T
I99	UNKNOWN	PPB	0	1	0			.	

TABLE 5. Analytical Data, June 1985 through May 1986, Summarized by Constituent

Constituent List=Contamination Indicators

	CONSTIT		SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
191	CONDUCT	UMHO	55	.	0	.	846	511	837	99.0	293	3680
199	PH		55	.	0	.	7.7	7.7	0.446	5.8	6.7	8.9
C68	TOX	PPB	64	100	55	.	143	33.4	442	309.1	8.2	2860
C69	TOC	PPB	64	1000	10	.	2360	1610	1980	83.8	330	9210

Constituent List=Drinking Water Standards

CONSTIT			SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
109	COLIFRM	MPN	70	3	66	1	3.6	3	3.36	93.2	3	23
111	BETA	PCI/L	70	8	0	50	175	11.7	308	175.8	4.59	1160
181	RADIUM	PCI/L	70	1	61	5	0.0827	0.0702	0.117	141.5	-0.0999	0.611
212	LOALPHA	PCI/L	70	4	5	15	54.3	4.99	119	219.2	0.112	637
A06	BARIUM	PPB	72	6	0	1000	58.6	46	40.4	69.0	15	248
A07	CADMIUM	PPB	72	2	65	10	2.28	2	1.38	60.4	2	13
A08	CHROMUM	PPB	72	10	1	50	349	326	320	91.7	10	1130
A20	ARSENIC	PPB	72	5	62	50	5.24	5	0.927	17.7	5	11
A21	MERCURY	PPB	72	0.1	68	2	0.397	0.1	1.27	318.5	0.1	7.4
A22	SELENUM	PPB	72	5	70	10	5.21	5	1.31	25.2	5	15
A51	LEADGF	PPB	72	5	69	50	4.94	5	0.599	12.1	0	5.81
C72	NITRATE	PPB	70	500	2	45000	298000	52400	601000	201.9	14500	2890000
C74	FLUORID	PPB	70	500	49	1400	596	500	254	42.7	500	1960

TABLE 5. Analytical Data, June 1985 through May 1986, Summarized by Constituent (cont)

Constituent List=Quality Characteristics

	CONSTIT	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
A11	SODIUM PPB	72	100	0	.	89200	19300	149000	167.2	8200	636000
A17	MANGESE PPB	72	5	46	.	14.6	5	18.7	128.4	5	76
A19	IRON PPB	72	50	16	.	281	179	340	120.9	50	2010
C73	SULFATE PPB	70	500	1	.	67700	59500	45300	66.9	28900	328000
C75	CHLORID PPB	70	500	1	.	5880	5300	2160	36.8	2600	9870

Constituent List=Site Specific

	CONSTIT	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
A03	STRONUM PPB	51	300	31	.	371	300	127	34.3	300	968
A04	ZINC PPB	51	5	17	.	41.8	20	47.6	113.9	5	162
A05	CALCIUM PPB	51	50	0	.	62400	58000	28500	45.6	15700	177000
A12	NICKEL PPB	72	10	58	.	16.6	10	17.4	105.0	8	90
A13	COPPER PPB	72	10	53	1300	17.8	10	18.7	105.0	10	105
A14	VANADUM PPB	72	5	37	.	10.3	5	8.82	86.1	5	41
A16	ALUMNUM PPB	72	150	48	.	217	150	145	66.8	150	926
A18	POTASUM PPB	72	100	0	.	5780	5400	2000	34.7	3470	14300
A67	1,1,1-T PPB	54	10	49	200	10.7	10	2.63	24.7	10	24.4
A70	PERCENE PPB	54	10	50	.	10.1	10	0.72	7.1	10	15
A80	CHLFORM PPB	47	10	9	.	19.6	21.5	7.38	37.7	10	32
A93	METHYCH PPB	33	10	19	.	183	10	375	204.3	2.8	1500
C80	AMMONIU PPB	70	50	24	.	123	130	68.5	55.8	30	270

TABLE 5. Analytical Data, June 1985 through May 1986, Summarized by Constituent (cont)

Constituent List=WAC 173-303-9905

	CONSTIT	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
A23	THALIUM PPB	18	10	14	.	11.4	10	3.16	27.8	10	21
B40	BIS2EPH PPB	19	10	18	.	10.2	10	0.707	7.0	10	13
I99	UNKNOWN PPB	1	0	0	.	9	9	.	.	9	9

Tables G.1 and G.2 in Appendix G contain basically the same information as Table 5 described above. However, those tables are organized in a slightly different fashion, giving more detailed results by well and sampling date.

Tables 6 and 7 present information on how the wells compared with respect to constituent concentrations. Each well was assigned a rank for each of the constituents (except those on the 9905 list), where the rank 1 was assigned to the well with the lowest concentration for a given constitutent, 2 to the well with the next highest concentration, and so on up to 5, which was the rank given to the well with the highest concentration for that constituent. Then, for each well, the ranks for all constituents were added to provide total scores. These scores can be compared to see which wells have the highest levels of contamination. The two tables (6 and 7) present information on rankings of the maximum and the median, respectively. Of particular note are the overall rankings for the maximum at the bottom of Table 6. Well 199-H4-3 ranked highest, as might be expected since it is closest to the 183-H Basins. Well 199-H3-1 ranked second although it is farthest from the facility and is not expected to be influenced by the basins. Ranks for the other wells are generally as would be expected given their distance from and hydraulic position relative to the 183-H Basins.

Table G.3 in Appendix G contains the raw analytical data for those constituents that had at least one value above the detection limit.

Graphs of the Data

Graphs have been prepared with the analytical data obtained during the last year. These graphs show trends over time for each well, with the well being denoted by the last digit of its designation (i.e., 199-H4-3 = 3, 199-H4-4 = 4, 199-H4-5 = 5, 199-H4-6 = 6, and 199-H3-1 = 1). Before preparing these graphs, all replicate values were averaged. The solid line on each graph represents the detection limit.

Several graphs of particular interest are presented and discussed within this section, and the remainder are contained in Appendix H.

The graph for conductivity is presented in Figure 21. The data from well 199-H4-3, which is the closest well to the 183-H Basins, are notably higher

TABLE 6. Analytical Data, June 1985 through May 1986, Summarized by Constituent Ranks - Maximum

------Ranked Statistic=MAXIMUM Constituent List=Contamination Indicators------

Constituent			H3-1	H4-6	H4-3	H4-4	H4-5
191	CONDUCT	UMHO	3	2	5	4	1
199	PH		5	1	3.5	3.5	2
C68	TOX	PPB	5	1	4	3	2
C69	TOC	PPB	2	1	4	5	3
Sub-total			15	5	16.5	15.5	8

------Ranked Statistic=MAXIMUM Constituent List=Drinking Water Standards------

Constituent			H3-1	H4-6	H4-3	H4-4	H4-5
109	COLIFRM	MPN	1.5	3	4.5	4.5	1.5
111	BETA	PCI/L	4	1	5	3	2
181	RADIUM	PCI/L	1	2	4	3	5
212	LOALPHA	PCI/L	2	1	5	4	3
A06	BARIUM	PPB	4	1	5	3	2
A07	CADMIUM	PPB	1	5	4	2.5	2.5
A08	CHROMUM	PPB	2	1	5	4	3
A20	ARSENIC	PPB	3	1.5	1.5	4	5
A21	MERCURY	PPB	4	1.5	3	5	1.5
A22	SELENUM	PPB	2.5	2.5	2.5	2.5	5
A51	LEADGF	PPB	1.5	1.5	4	5	3
C72	NITRATE	PPB	3	2	5	4	1
C74	FLUORID	PPB	2	3	5	1	4
Sub-total			31.5	26	53.5	45.5	38.5

------Ranked Statistic=MAXIMUM Constituent List=Quality Characteristics-------

Constituent			H3-1	H4-6	H4-3	H4-4	H4-5
A11	SODIUM	PPB	3	2	5	4	1
A17	MANGESE	PPB	4	5	3	1	2
A19	IRON	PPB	2	1	3	5	4
C73	SULFATE	PPB	4	2	5	3	1
C75	CHLORID	PPB	4	3	5	1	2
Sub-total			17	13	21	14	10

----------Ranked Statistic=MAXIMUM Constituent List=Site Specific----------

Constituent			H3-1	H4-6	H4-3	H4-4	H4-5
A03	STRONUM	PPB	4	2	5	2	2
A04	ZINC	PPB	4	5	1	3	2
A05	CALCIUM	PPB	4	2	5	1	3
A12	NICKEL	PPB	2	2	5	4	2
A13	COPPER	PPB	2	1	5	4	3
A14	VANADUM	PPB	5	2	3	1	4
A16	ALUMNUM	PPB	5	2	4	1	3
A18	POTASUM	PPB	4	2	5	3	1
A67	1,1,1-T	PPB	4	2.5	5	1	2.5
A70	PERCENE	PPB	2	5	4	2	2
A80	CHLFORM	PPB	1	2	5	3	4
A93	METHYCH	PPB	5	1	4	2	3
C80	AMMONIU	PPB	1.5	5	3	1.5	4
Sub-total			43.5	33.5	54	28.5	35.5
Total			107	77.5	145	103.5	92

TABLE 7. Analytical Data, June 1985 through May 1986, Summarized by Constituent Ranks - Median

--Ranked Statistic=MEDIAN Constituent List=Contamination Indicators--

Constituent	H3-1	H4-6	H4-3	H4-4	H4-5
191 CONDUCT UMHO	3	2	5	4	1
199 PH	4	5	2	1	3
C68 TOX PPB	1	3	4	5	2
C69 TOC PPB	3	2	5	4	1
Sub-total	11	12	16	14	7

--Ranked Statistic=MEDIAN Constituent List=Drinking Water Standards--

Constituent	H3-1	H4-6	H4-3	H4-4	H4-5
109 COLIFRM MPN	3	3	3	3	3
111 BETA PCI/L	3	2	5	4	1
181 RADIUM PCI/L	1	4	5	3	2
212 LOALPHA PCI/L	3	1	5	4	2
A06 BARIUM PPB	4	1	5	3	2
A07 CADMIUM PPB	3	3	3	3	3
A08 CHROMUM PPB	1.5	1.5	5	4	3
A20 ARSENIC PPB	3	3	3	3	3
A21 MERCURY PPB	3	3	3	3	3
A22 SELENUM PPB	3	3	3	3	3
A51 LEADGF PPB	3	3	3	3	3
C72 NITRATE PPB	3	2	5	4	1
C74 FLUORID PPB	3	3	3	3	3
Sub-total	36.5	32.5	51	43	32

---Ranked Statistic=MEDIAN Constituent List=Quality Characteristics--

Constituent	H3-1	H4-6	H4-3	H4-4	H4-5
A11 SODIUM PPB	3	2	5	4	1
A17 MANGESE PPB	2	5	4	2	2
A19 IRON PPB	1	4	3	5	2
C73 SULFATE PPB	4	2	5	3	1
C75 CHLORID PPB	5	3	4	2	1
Sub-total	15	16	21	16	7

--------Ranked Statistic=MEDIAN Constituent List=Site Specific-------

Constituent	H3-1	H4-6	H4-3	H4-4	H4-5
A03 STRONUM PPB	5	2	4	2	2
A04 ZINC PPB	1.5	5	1.5	3	4
A05 CALCIUM PPB	5	2	4	1	3
A12 NICKEL PPB	2.5	2.5	5	2.5	2.5
A13 COPPER PPB	2.5	2.5	5	2.5	2.5
A14 VANADUM PPB	5	2.5	2.5	2.5	2.5
A16 ALUMNUM PPB	3	3	3	3	3
A18 POTASUM PPB	4	3	5	2	1
A67 1,1,1-T PPB	3	3	3	3	3
A70 PERCENE PPB	3	3	3	3	3
A80 CHLFORM PPB	1	2	5	3	4
A93 METHYCH PPB	2.5	4	2.5	5	1
C80 AMMONIU PPB	4	3	2	1	5
Sub-total	42	37.5	45.5	33.5	36.5
Total	104.5	98	133.5	106.5	82.5

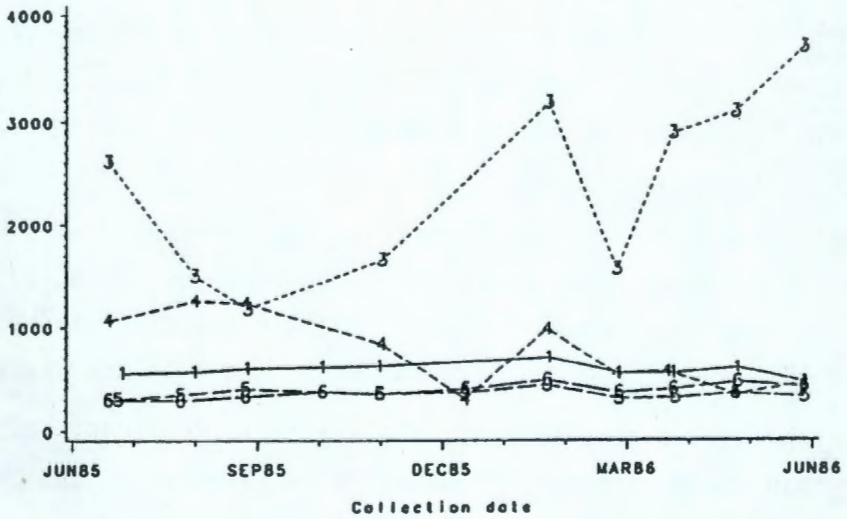

FIGURE 21. Conductivity Measurements (µmho)for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

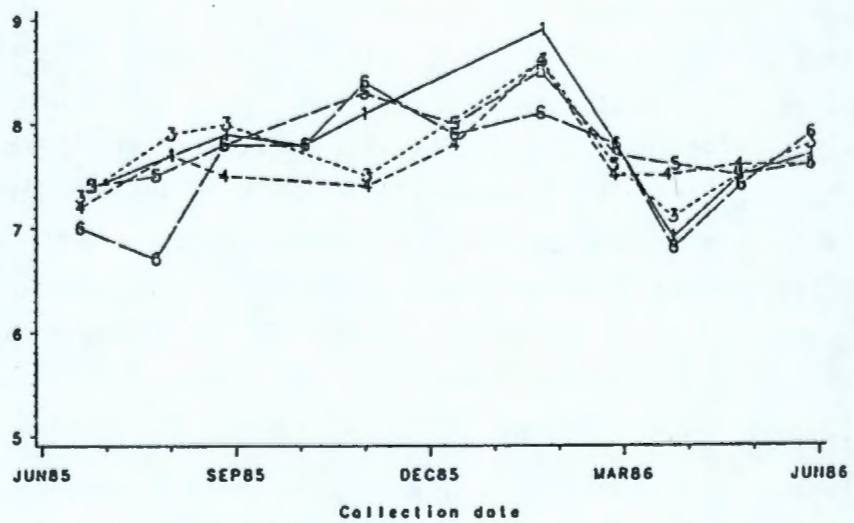

FIGURE 22. pH Measurements (pH units) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

than the other wells, and the range of values is greater. Figure 22 contains the data for pH. This graph shows that the values for all wells are close to neutral.

Well 199-H4-3 generally has the highest values for all three of the radiological analyses: alpha, beta, and radium (Figures 23 through 25, respectively). Well 199-H4-4 generally has the second highest values, at least for alpha and beta (Figures 23 and 24).

Well 199-H4-3 generally has the highest values for many of the metals, notably barium, chromium, sodium, nickel, and copper (Figures 26 through 30). For manganese and zinc, the values for well 199-H4-6 are generally higher than the other wells (Figures 31 and 32); the reason for this is not yet known.

For the anions nitrate and sulfate, the values for well 199-H4-3 are notably higher than the values for the other wells (Figures 33 and 34); however, well 199-H3-1 has generally higher values for chloride (Figure 35).

For the volatile organic chemical chloroform, concentrations are generally higher in well 199-H4-3 (Figure 36).

Observations Regarding the Data

A few general observations can be made concerning the data collected during the first year of sampling. Examination of the data shows that the concentrations of a few constituents, i.e., nickel and copper, are consistently high in well 199-H4-3 but are virtually undetected elsewhere (Figures 29 and 30). This may indicate a near-field effect with essentially no plume. Another pattern exists for conductivity, alpha, and beta (Figures 21, 23, and 24, respectively), where concentrations are high in well 199-H4-3, lower in 199-H4-4, and very low in the other wells, possibly indicating a narrow plume. A wider plume may be indicated by chromium, whose concentrations are high in well 199-H4-3, lower in well 199-H4-4, and still lower in 199-H4-5 (Figure 27).

With only one year of monthly data available at this time, it is difficult to interpret the variations over time that occur for given constituents and wells. As additional data become available from the existing and new wells, it will be possible to begin statistical evaluations for time trends and seasonal cycles, but such efforts are currently premature.

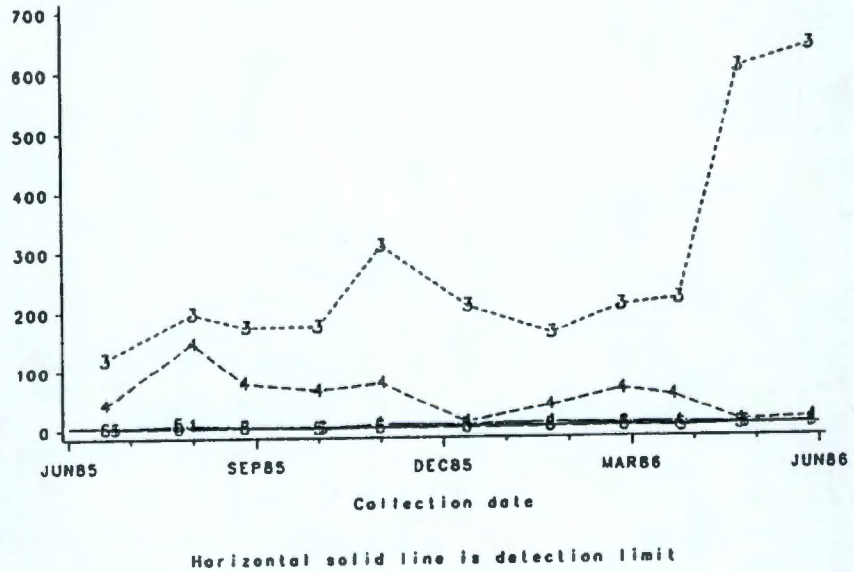

FIGURE 23. Alpha Concentrations (pCi/ℓ) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

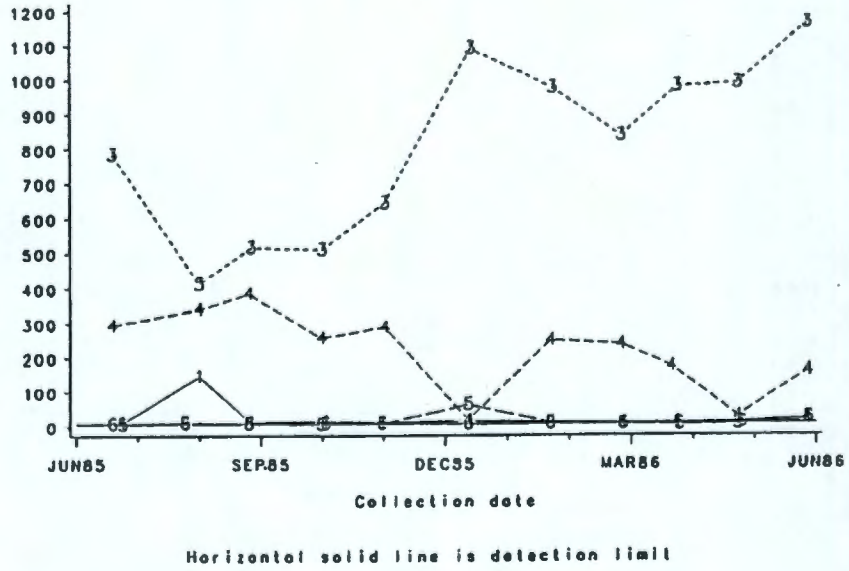

FIGURE 24. Beta Concentrations (pCi/ℓ) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

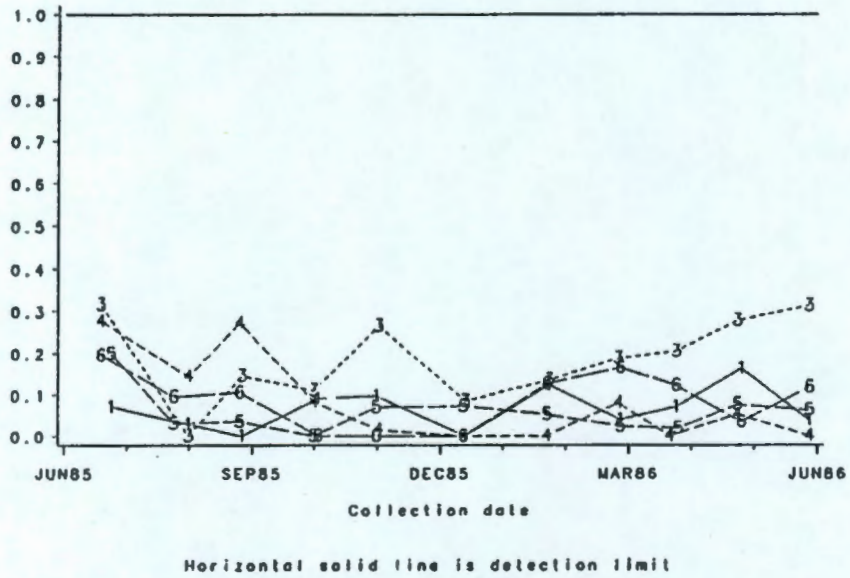

FIGURE 25. Radium Concentrations (pCi/ℓ) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

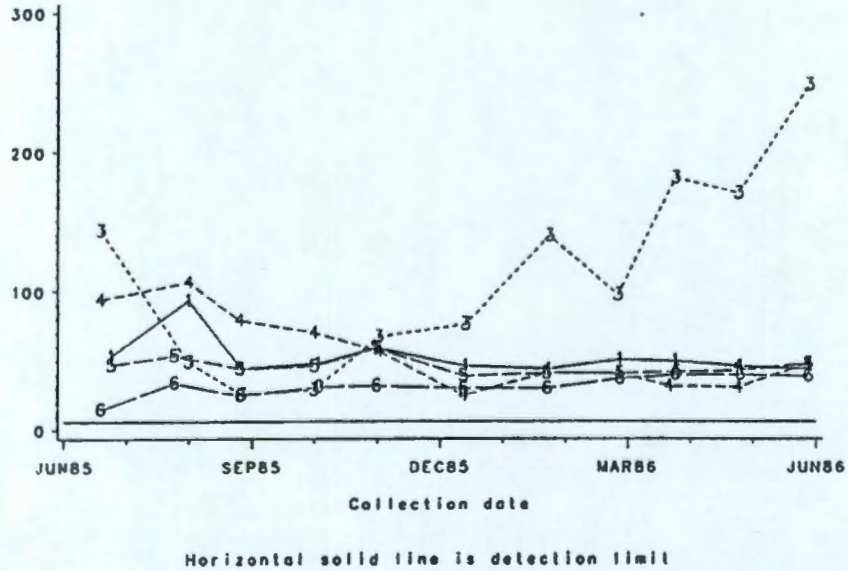

FIGURE 26. Barium Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

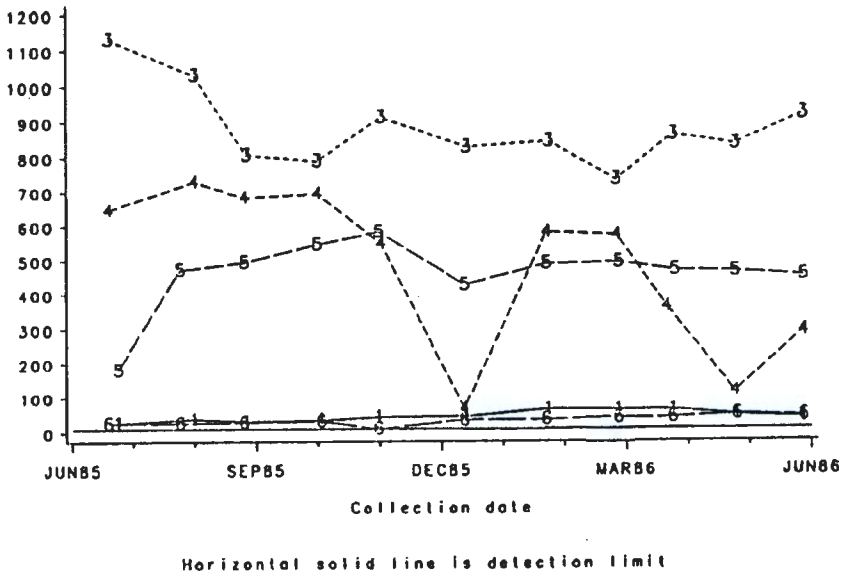

FIGURE 27. Chromium Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

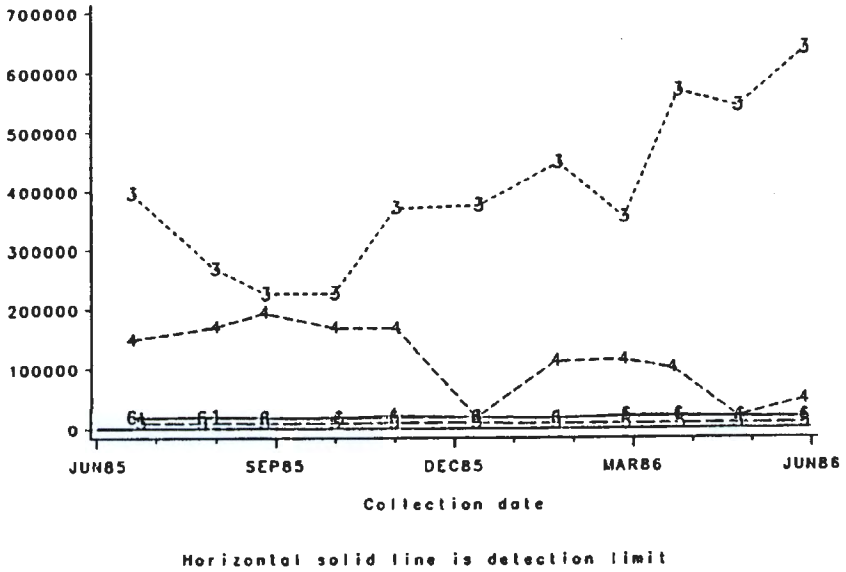

FIGURE 28. Sodium Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

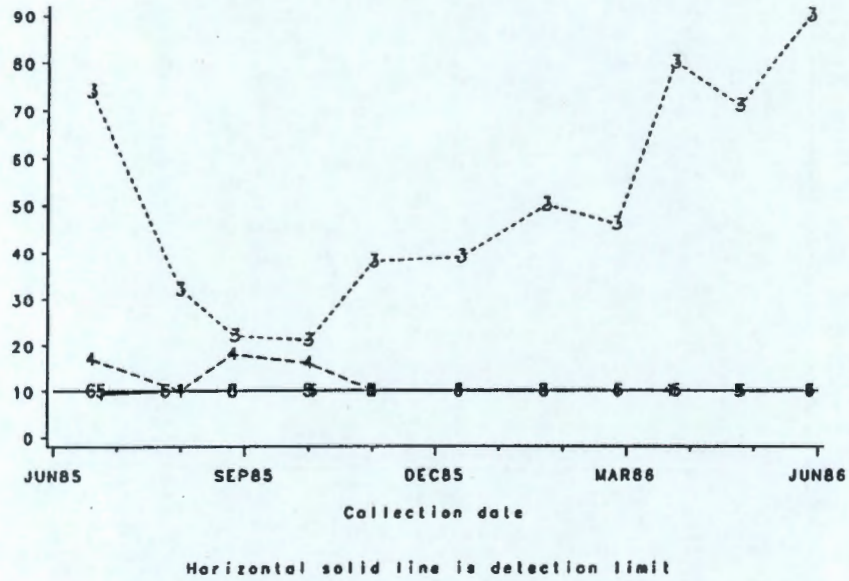

FIGURE 29. Nickel Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

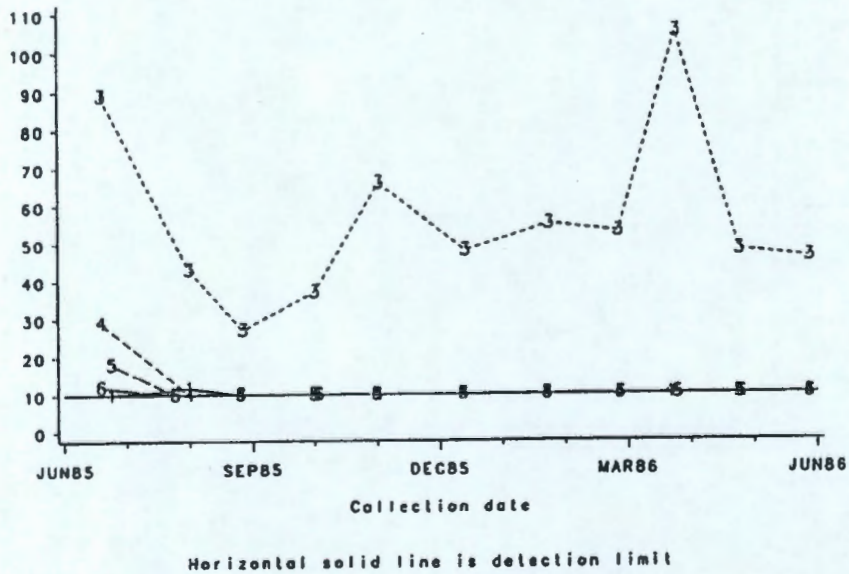

FIGURE 30. Copper Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

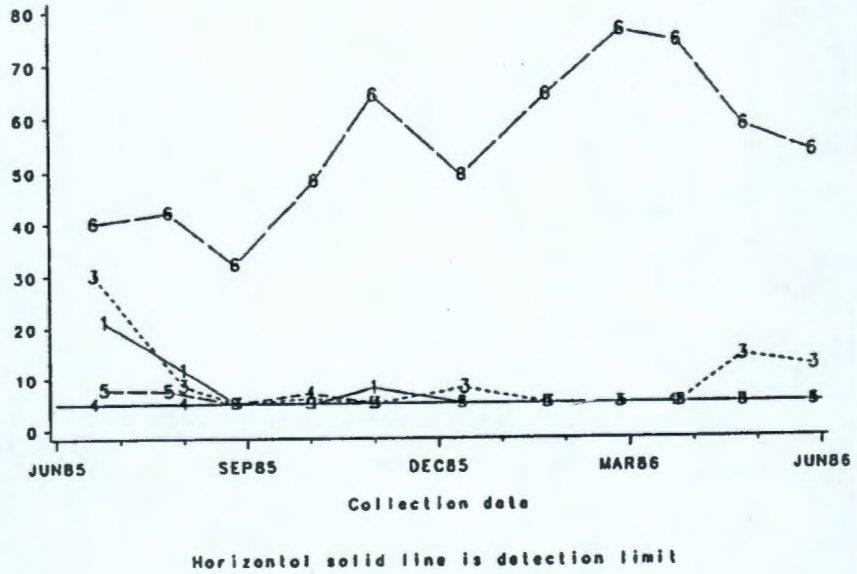

FIGURE 31. Manganese Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

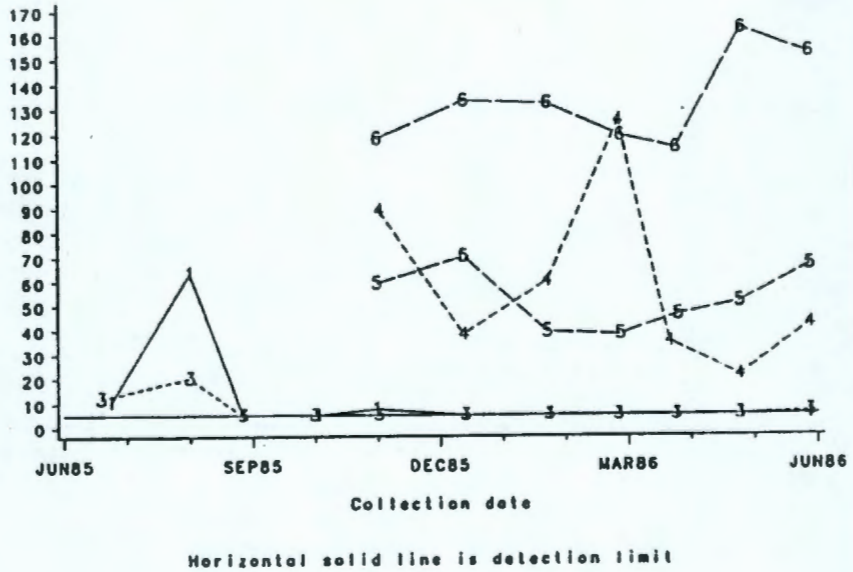

FIGURE 32. Zinc Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

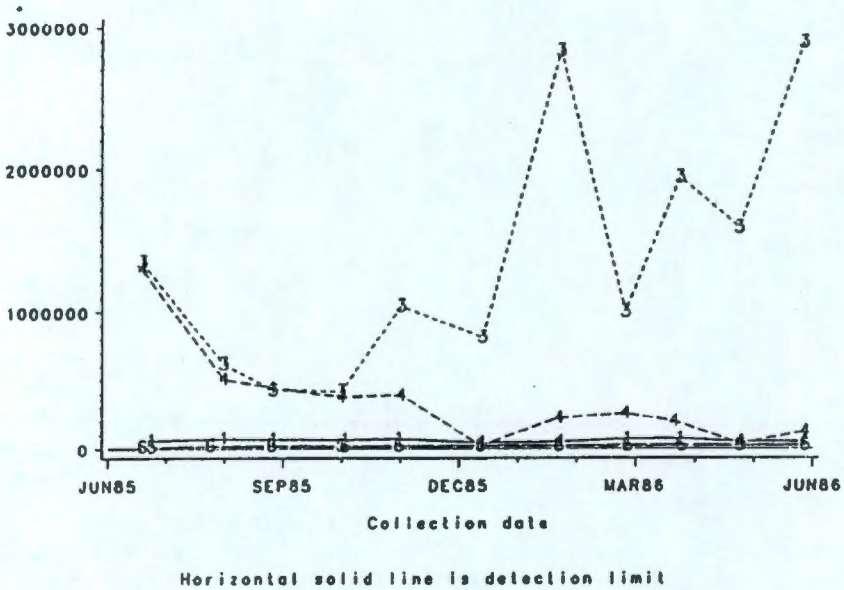

FIGURE 33. Nitrate Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

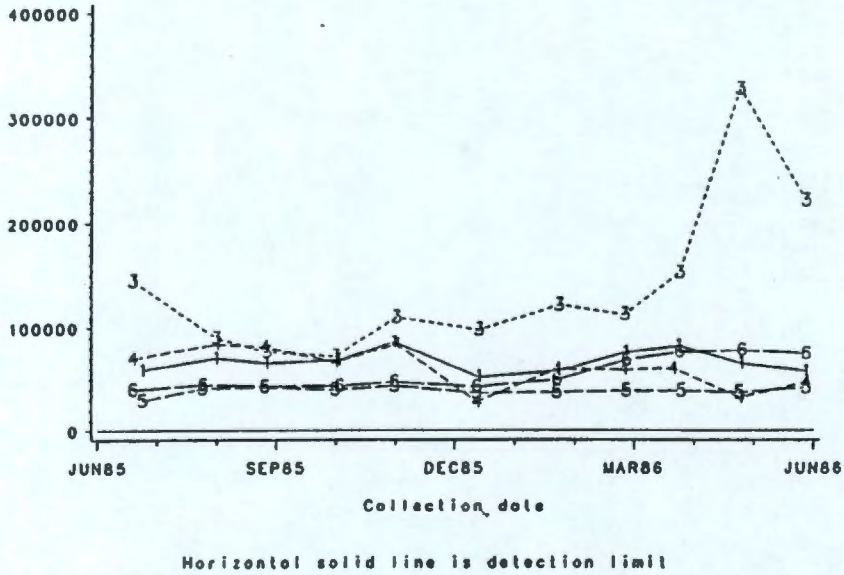

FIGURE 34. Sulfate Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

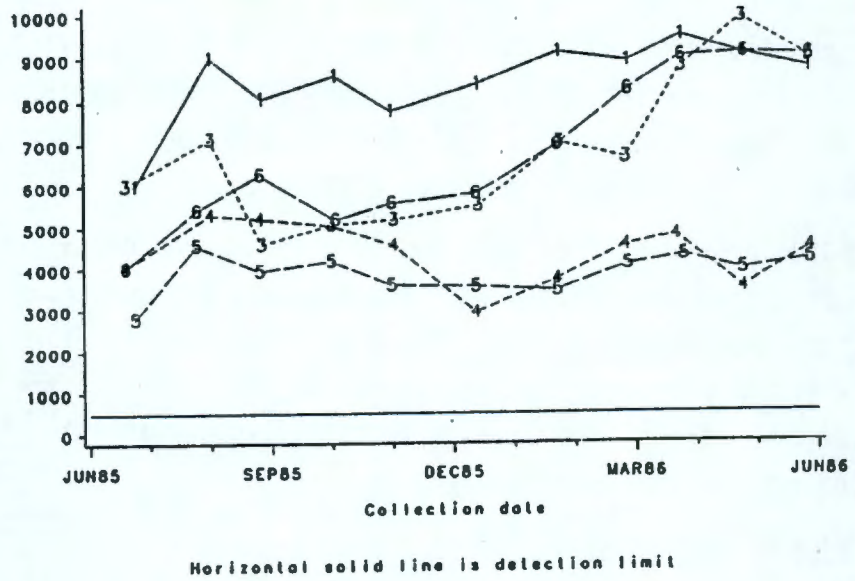

FIGURE 35. Chloride Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

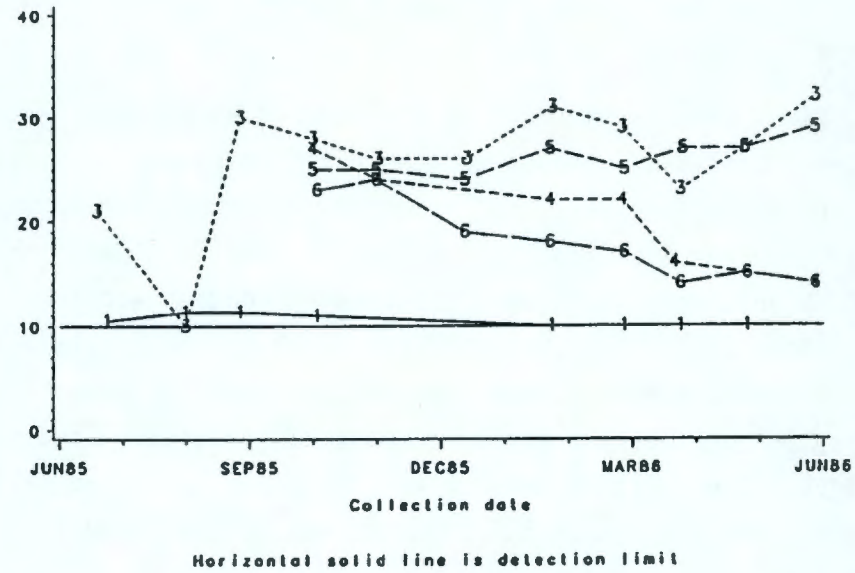

FIGURE 36. Chloroform Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

QC Program Results

The scope of the QC effort was described in a previous section of this chapter. The results obtained in UST's internal QC effort, as well as the results obtained for interlaboratory comparisons and spiked samples, are described in the following sections. Also included in these sections are a description and status of the corrective actions taken.

When problems are identified from the QC effort, procedures are immediately established to identify the nature of the problem, corrective actions, and the impacts to the data. The time frame for verifying that corrective actions have been effective depends on the nature of the problem. For example, several samples may have to be collected and analyzed to verify that a sampling problem has been resolved.

Results of UST's Internal QC Effort

As mentioned previously, matrix spikes, blanks, and surrogates are used by UST to provide information on the quality of the analytical work. This information may then be used to determine if changes should be made to the analytical methods. Control charts that show data for these QC samples are given by UST in their quality control report (Hembree and Rao 1986). A summary of this information follows.

Blanks. Blank samples prepared with deionized water and the appropriate reagents for each analysis are used to ensure that glassware and reagents are not contaminated with the analytes of interest. Control charts for the blanks show generally good results (less than detection limit). Some high scattered values for TOC blanks were found in a period when reagent water was stored in plastic jugs. However, reagent water is not added to the samples, so the analytical results should not have been affected. High blank concentrations for sodium obtained in early months appear to have been caused by sodium leaching from the beakers. Sample concentration are typically 10,000 to 25,000 ppb, compared to the highest blank of 552 ppb. Hence, the sample data should not be affected significantly.

Matrix Spikes. Matrix spikes are prepared by adding known amounts of constituents to field samples. Recoveries obtained with matrix spikes are

used to estimate overall constituent recovery. In general, the matrix spike recoveries reported by UST are acceptable. There are some cases, as described below, in which matrix spike recoveries fall outside the normal acceptance range.

The scatter in recoveries is sometimes large, when the concentration of the analyte is high. This situation occurs in analyses of sodium, potassium, calcium, nitrate, and sulfate.

In the anion analysis, the fluoride recoveries have sometimes been troublesome. Dilution, required because of high concentrations of other ions, has led to large errors. Additionally, fluoride by ion chromatography is subject to interferences by the presence of organics. Chloride recoveries are sometimes excessively high when the nitrate concentration is high because the chloride peak gets lost in the nitrate tail. A couple of phosphate spikes have been out of range, possibly caused by the matrix.

Low recoveries of osmium and antimony have been noted and are being investigated by UST.

Matrix spike recoveries for a few volatile organic compounds, ABNs, and herbicides have been high for various reasons. The analytical results have not been affected because the concentrations of analytes in the samples were less than the detection limit.

TOX and TOC recoveries were found to be above limits in 3 out of 40 analyses and 6 out of 40 analyses, respectively. No definable reason has been provided by UST.

Surrogate Recovery. A surrogate is a compound, similar in behavior to the analyte of interest, added to the sample prior to analysis to monitor the efficiency of extraction. Some intermittant baseline shift in analysis for volatile organic chemicals has occurred but has not affected results because there were no peaks in those samples. Scatter was observed initially in the surrogate recovery data for ABNs, but the data became more consistent when a continuous extrator was used in place of a separatory funnel.

Radioactivity. Spike data (radiochemical yield) for alpha and beta analyses are acceptable. The analysis for total radium shows a bias on the high

side, by approximately 20%. UST has taken corrective action, as described in a later section.

Interlaboratory Comparisons Conducted Using Field Samples

As described previously, interlaboratory comparisons have been routinely conducted using replicate field samples. Comparisons conducted for selected constituents, including anions, metals, and volatile organics, have shown that UST's results are generally comparable to those obtained from other laboratories. Details of the evaluations conducted are provided below according to constituent type.

Anions. Interlaboratory comparisons have been conducted for five anions: fluoride, chloride, nitrate, phosphate, and sulfate. The best results for use in interlaboratory comparisons have been provided by chloride, nitrate, and sulfate, because the values for fluoride and phosphate in the replicate sample sets used for this effort have usually been below the detection limits for one or more of the participating laboratories.

Evaluation of the data received from the three participating laboratories indicates that agreement is good, although in some cases the data have shown statistically significant differences. The results for one set of comparisons conducted with data for chloride, nitrate, and sulfate from October 1985 are shown in Figures 37 through 39, respectively. Additional information concerning these comparisons, including the data tables for each sample set and results of evaluation with EPA performance limits, are contained in Appendix I.

Metals. Interlaboratory comparisons have been conducted for six metals: barium, cadmium, chromium, copper, lead, and sodium. Cadmium and lead in the replicate sample sets used for this effort have almost always been below the detection limit for both of the participating laboratories, making comparisons for those constituents less informative. Data for chromium are more suitable for comparison, and one set of results from February 1986 is presented in Figure 40.

The two participating laboratories have shown generally good agreement for all of the metals except barium. The reason for the disparity in the barium results is currently being investigated, but is believed to result from

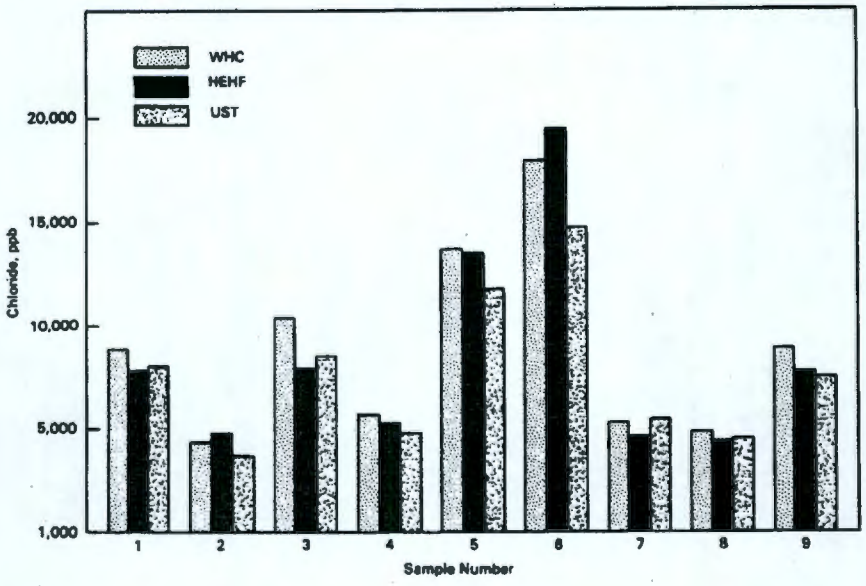

FIGURE 37. Interlaboratory Comparison Results for Chloride, October 1985

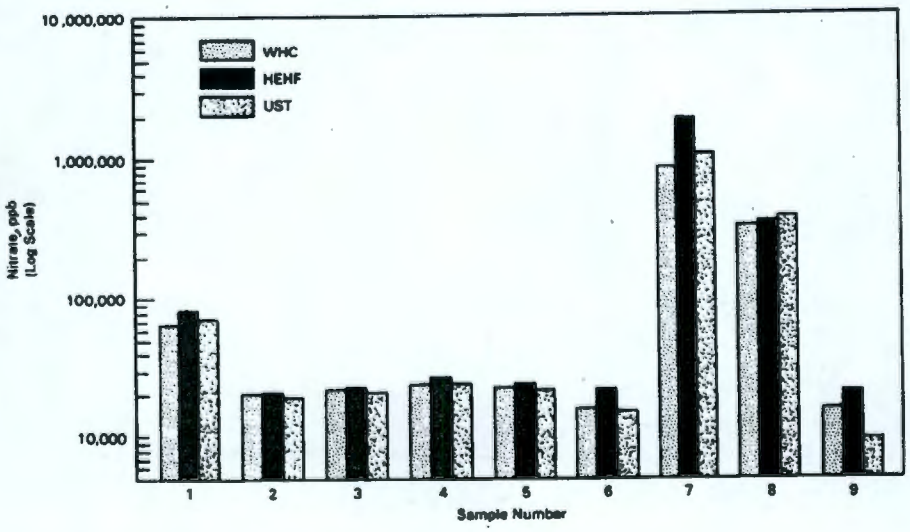

FIGURE 38. Interlaboratory Comparison Results for Nitrate, October 1985

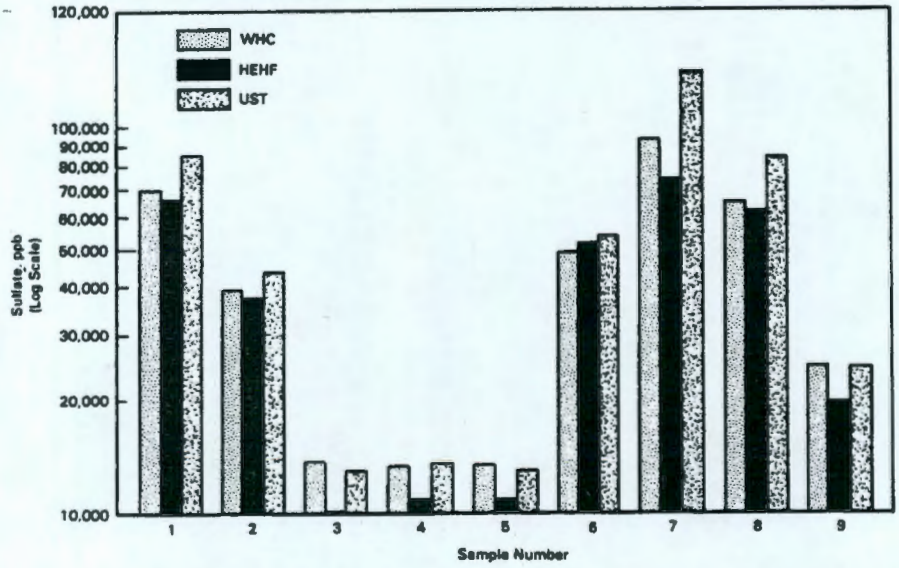

FIGURE 39. Interlaboratory Comparison Results for Sulfate, October 1985

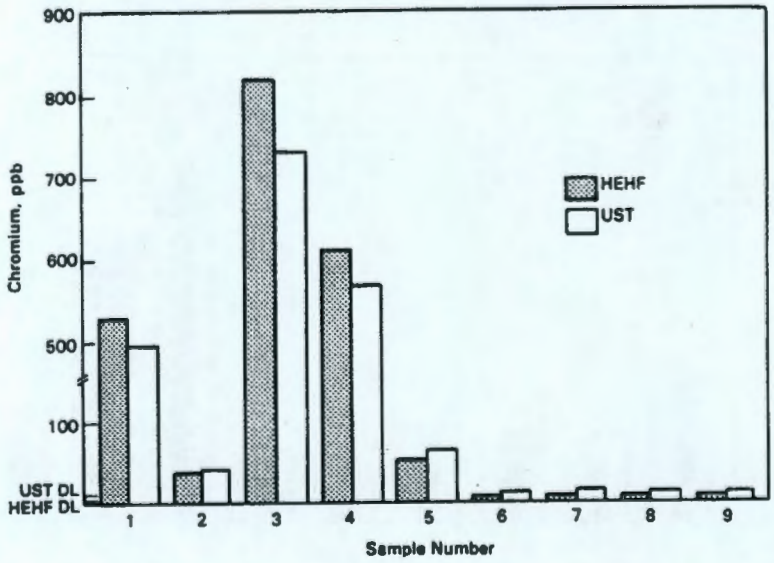

FIGURE 40. Interlaboratory Comparison Results for Chromium, February 1986

matrix interference or a difference in the analytical methods used; the ICP method used by UST is thought to be less likely to run into problems with interferences than atomic absorption spectroscopy, used by HEHF. Additional information on the comparisons for metals is included in Appendix I.

Volatile Organic Chemicals. Interlaboratory comparisons have been conducted for three volatile organic chemicals: 1,1,1-trichloroethane, chloroform, and perchloroethylene. Results for trichloroethane and perchloroethylene in the replicate sample sets used for this effort have nearly always been below UST's detection limit of 10 ppb; therefore, the most informative comparisons are those conducted for chloroform.

The results obtained for chloroform by the two participating laboratories have generally shown good agreement, particularly in more recent months. In the first set of replicate samples analyzed for volatiles (collected in November/December 1985), the results from the PNL laboratory were generally 20 to 50% higher than the results from the UST laboratory. Agreement between the laboratories has improved considerably with time, as indicated by the data tables and comparisons to EPA performance limits (Appendix I).

The data for one set of chloroform comparisons (conducted with data from February 1986) are shown in Figure 41. The differences between the PNL and UST results for all samples in this set were within acceptable limits (defined as two standard deviations based on EPA Performance Evaluation Study regressions).

Spiked Samples Prepared by PNL

In general, UST did an excellent job of identifying and quantifying components of the first quarterly submission of spiked samples. The performance on the analysis of ions was the main apparent weakness. Upon receiving the results from the first set of spiked samples, UST changed the dilution procedure for anion analyses.

The results from UST, grouped by constituent type, are compared with a target range in the following tables. The target ranges are based on EPA Performance Evaluation Studies. Results that are outside the target range are marked with an asterisk (*) and discussed below.

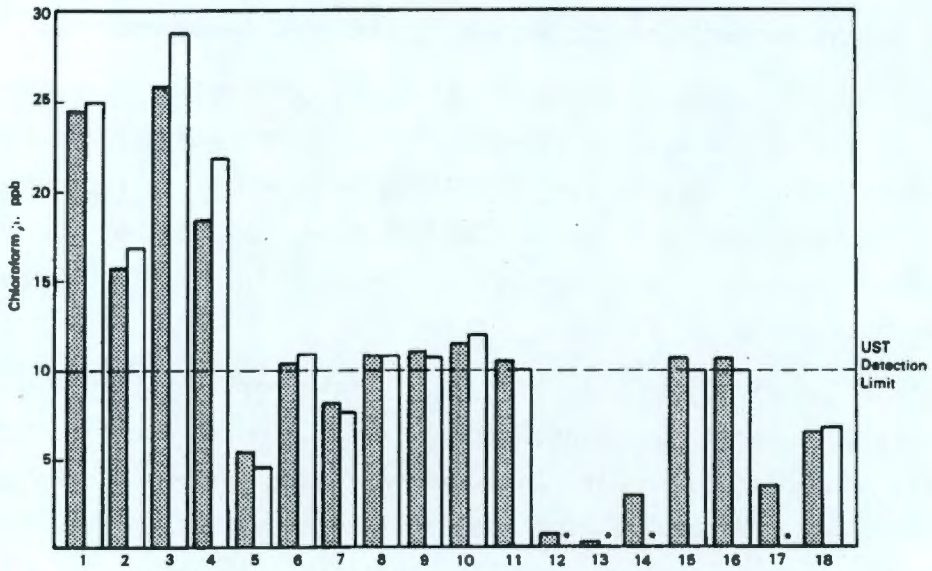

FIGURE 41. Interlaboratory Comparison Results for Chloroform, February 1986

Metals. The results of the January and April 1986 analyses for metals are shown in Table 8. The January analyses were within range, except for silver, which is the most likely metal to plate out. A call to ERA, the sample vendor, indicated that addition of an acid preservative would be desirable for metal samples. UST indicated that it would acidify the remaining sample material and run the test again. However, it is not known at what point in the sample preparation the silver may have been lost.

Results of the second set of quarterly spiked samples were not as good, with 7 out of 10 metals analyses outside the target range. The results for the three metals analyzed by GFAA (i.e, arsenic, selenium, and lead) were all outside limits, with one constituent value above and two below the target range. The results for four out of seven of the metals analyzed by ICP were

above the target range. UST has been contacted concerning the apparent problem and is investigating the situation.

Ions. The results of anion analyses conducted on the spiked samples for January, which were analyzed by both UST and WHC, are shown in Table 9. Although the spiked samples were prepared primarily to check UST's performance, leftover aliquots were submitted to WHC. Information on WHC's performance on analysis of spiked samples was of interest due to participation of that laboratory in the interlaboratory comparisons.

For the January sample set, UST's results for fluoride and sulfate were out of the target range. When UST was questioned about the results for these constituents, the lab sheets were examined and the analysis values were revised, based on a previous dilution. Still, neither of these analyses reflect the optimum dilution. The dilution procedure has since been modified. The anion analyses by WHC were within the target range in all cases.

April data for the ion analyses are shown in Table 10. The analysis provided by UST for sulfate was acceptable, but the values for fluoride and nitrate were slightly high. The April data from WHC were all within the target range.

Pesticides and Herbicides. Tables 11 and 12 show that the pesticides and herbicides analyzed were within the target range in all cases. However, since the results for 2,4-D and 2,4,5-TP Silvex in the January analysis were below the UST contractual detection limits, the results were reported by telephone to PNL, and do not appear in the data base. Concentrations of endrin and lindane found in the April sample are also below the contractual detection limits, and thus are not in the data base.

TABLE 8. Analytical Results of Spiked Samples Containing Metals, January and April 1986

	January 1986		April 1986	
Metals	UST Analysis	Target Range (ppb)	UST Analysis	Target Range (ppb)
Arsenic	42	36 to 56	67*	99 to 125
Barium	228	210 to 250	307	273 to 333
Cadmium	30	20 to 34	23	22 to 28
Chromium	45	31 to 53	47*	37 to 45
Iron	134	123 to 151	317*	219 to 267
Lead	71	62 to 90	73.2*	55 to 69
Manganese	125	111 to 151	158*	121 to 147
Mercury	1.0	1.0 to 1.5	6.15*	3.9 to 4.9
Selenium	23	17 to 33	28.7*	46 to 56
Silver	13*	78 to 106	25	22 to 30

* This result is outside of the target range.

TABLE 9. Analytical Results of Spiked Samples Containing Anions, January 1986

Ions	UST Analysis	WHC Analysis	Target Range
Fluoride	3,357*[a]	3,500	3,400 to 4,200
Nitrate	17,900	17,600	15,900 to 20,400
Chloride	<500	<100	---[b]
Sulfate	53,760*[a]	51,000	42,000 to 52,000
Phosphate	<1,000	<200	---[b]

* This result is outside of the target range.
(a) Revised value, taken from a previous dilution (ten times more concentrated than that from which the original reported values were taken). Original reported values: 3,030 ppb fluoride and 41,800 ppb sulfate.
(b) Target range not provided by the sample vendor.

TABLE 10. Analytical Results of Spiked Samples Containing Anions, April 1986

Ions	UST Analysis	WHC Analysis	Target Range
Fluoride	2,020*	1,420	1,400 to 2,000
Nitrate	20,600*	18,800	17,300 to 19,900
Chloride	<500	<300	---[a]
Sulfate	64,300	60,300	53,000 to 73,000
Phosphate	<1,000	<500	---[a]

* This result is outside of the target range.
(a) Target range not provided by the vendor.

TABLE 11. Analytical Results of Spiked Samples Containing Pesticides and Herbicides, January 1986

Pesticides	UST Analysis	Target Range
2,4-D	0.26 [a]	0.19 to 1.0
2,4,5-TP Silvex	0.85 [a]	0.45 to 2.5
Toxaphene	5.2	3.1 to 8.5

(a) Result below detection level; not reported in data base.

TABLE 12. Analytical Results of Spiked Samples Containing Pesticides and Herbicides, April 1986

Pesticides	UST Analysis	Target Range
Endrin	0.49[a]	0.24 to 0.88
Methoxychlor	2.35	1.7 to 4.5
Lindane	0.65[a]	0.48 to 0.96

(a) Result below detection level; not reported in data base.

Volatile Organic Compounds. The results of analysis (by UST and PNL) of the halomethane sample submitted in January are shown in Table 13. All results obtained for the January samples were satisfactory. The PNL laboratory did not provide results for three of the constituents because of a lack of standards. These standards have now been ordered.

The UST result for bromoform is not contained in the data base because it was below the UST detection limit.

TABLE 13. Analytical Results of Spiked Samples Containing Volatile Organic Compounds (Halomethanes), January 1986

Volatile Organics	UST Analysis	PNL Analysis	Target Range
Chloroform	16	17.6	11 to 23
Bromodichloromethane	9.6	---[a]	5.8 to 13
Chlorodibromomethane	5.3	---[a]	2.0 to 8.0
Bromoform	<10	---[a]	1.6 to 3.4

(a) PNL did not analyze for this compound because the laboratory was not set up for it. To solve this problem, standards have been ordered.

The results of the April analysis, shown in Table 14, indicate concentrations somewhat below the target range. However, this is likely due to problems encountered during preparation of the spiked samples; i.e., a septum was perforated when solution was injected into the vial. This procedure will not be used in the future.

TABLE 14. Analytical Results of Spiked Samples Containing Volatile Organic Compounds (Halomethanes), April 1986

Volatile Organics	UST Analysis[a]	PNL Analysis[a]	Target Range
Chloroform	9.9*	7.33	11 - 21
Bromodichloromethane	22*	---[b]	23 - 46
Chlorodibromomethane	8.3*	---[b]	10 - 17.5
Bromoform	20	---[b]	17.5 - 35

* This result is outside of the target range.
(a) Problems were encountered with capping this batch; the top was perforated, very likely causing loss of volatiles.
(b) PNL did not analyze for this compound because the laboratory was not set up for it. Standards have now been ordered.

Spiked Samples Submitted Under EPA-Sponsored Studies

At the request of PNL, UST has participated in EPA Performance Evaluation Studies. The results from the first of these studies, designated Water Pollution Performance Evaluation Study Number 16 (WP016), have been received. UST was commended on its excellent performance. Comments concerning specific results are provided below, and the performance data are contained in Appendix I.

UST's results for all of the following were acceptable: metals, nutrients and demands, polychlorinated biphenyls, volatile halocarbons, volatile aromatics, total cyanide, and non-filterable residue. All of the minerals analyses were also acceptable, with the exception of fluoride, for which UST's values were high. The results for one of the two fluoride samples were outside of acceptable limits, and those for the other were within warning limits.

All of UST's pesticide results were acceptable, although the value for DDD was on the upper bound of acceptance. A warning flag was set for this

analysis. In addition, the oil and grease analyses (which are not included on the list of analyses for the field samples from the 100-H Area) were flagged; one of the two analyses performed was unacceptable and the results for the other were within warning limits.

The outlying values are currently being investigated by UST. The use of a different analytical method for fluoride (i.e, specific ion electrode instead of ion chromatography) has been suggested as a possible solution to the problems encountered in this analysis.

UST also participated in an EPA interlaboratory comparison program that involved analysis of spiked samples for alpha and beta activity in water. UST's results for the alpha analyses seemed to be biased on the high side compared with the other participating laboratories. UST's beta results were all within expected limits.

Factors Potentially Affecting the Data

As the sampling and analysis effort has progressed during the last year, minor problems have arisen that could potentially affect the quality of the data. A discussion of these problems and the corrective actions taken is presented in the following sections.

Contamination of the Bladder Pumps

The manufacturer of the bladder pumps used for this effort notified PNL in September 1985 that some of the pumps may have been contaminated with low levels of three organic chemicals: 1,1,1-trichloroethane, tetrachoroethylene, and methylene chloride. Investigations conducted by the manufacturer indicated that small concentrations of these chemicals were present in a Teflon[a] lubricant which had been used sporadically in assembling the pumps. The contaminated pumps were found to yield concentrations of these chemicals up to several hundred parts per billion, although a decline in concentrations was noted to occur after purging. According to the manufacturer, in most cases the contaminated pumps could be easily identified, because the three chemicals were found to be present in a certain ratio. The manufacturer indicated that replacement

(a) Teflon is a trademark of E. I. DuPont de Nemours, Co., Wilmington, Delaware.

of any suspect pumps would solve the problem, because investigations had shown that the contamination was contained within the pumps and that the wells should not have been affected.

Examination of the data collected from the 100-H Area wells at that time revealed that the pumps in those wells were apparently unaffected. However, a few of the 300 Area wells (being sampled under a corresponding project) had shown low concentrations of these chemicals, and therefore the pumps in some of the 300 Area wells were removed and replaced with clean pumps.

Preservation of Samples to be Analyzed for Metals

As noted previously, samples to be analyzed for metals were acidified upon collection without being filtered. While most of the samples appeared to have low particulate levels, the samples may have been altered to an unknown degree via leaching of metals by the acid from any particulates that may have been present. Thus, the reported concentrations for the metals may not accurately reflect the dissolved portion, which is more readily available for transport and environmental uptake. Future analysis of both filtered and nonfiltered samples (for dissolved and total recoverable metals, respectively) should prevent this type of problem.

Alterations to Analytical Methods

Implementation at UST of the analytical work for this project resulted in minor problems with a few of the analyses. The problems and the corrective actions taken are described below.

Ammonium Ion. An error in preparation of the standard solution led to incorrect reporting of data; the reported results were all low by a factor of ten. The data were corrected and resubmitted to PNL in February 1986. A second problem arose with this analysis when it became evident that a change in November 1985 to a higher grade of sulfuric acid used as a preservative had resulted in a marked decline in the ammonium concentrations being detected. Low concentrations of ammonium ion are usually present in sulfuric acid, but a lower grade of acid may be expected to have more ammonium than a higher grade. To determine if the change in acid may have affected the results obtained for the field samples, blank samples were spiked with both grades of acid and were

then analyzed for ammonium. Recent evaluation of the resulting data has shown that the lower grade of acid probably contributed additional ammonium to the field samples, but the exact amount of the difference would be difficult to quantify. The affected data will accordingly be flagged with an explanatory comment.

Gross Beta. The gross beta analysis recommended by EPA is slightly different than the method traditionally used by UST, and this difference led to incorrect calculation of some of the gross beta results. The EPA method requires use of an absorber for alpha radiation and conversion of net counts to disintegrations per minute with Cs-137 efficiencies. UST had used the absorber but had erroneously converted the net counts of the gross beta analyses to disintegrations per minute with the Sr-Y-90 efficiencies (traditionally used by UST) rather than the Cs-137 efficiencies. The results were recalculated and resubmitted to PNL in December 1985; they were generally about 30% higher than the previously-reported results.

Lead. Investigation of some lead results obtained during the first few months of sampling showed that the ICP method in use at that time was not as sensitive for the low levels of lead being detected as the GFAA method would be. Increased sensitivity was judged to be desirable, and therefore use of GFAA for lead analyses was initiated in November 1985. All lead samples measured by ICP prior to this change were reanalyzed by GFAA.

Antimony. The calibration standard was found to be too low by a factor of five. One result was affected and has subsequently been corrected.

Mercury. The instructions used for preparation of the mercury standards were incorrect. A small number of results were found to be affected and have subsequently been corrected.

Osmium. The osmium standards appear to be unstable, and UST is concerned that the field samples may behave similarly. UST has initiated tests to investigate and solve the problem.

Silver. Matrix spike recoveries for silver have been on the low side. Investigation by UST has shown that this is not due to a matrix effect but

rather to the quantity of hydrochloric acid (HCL) in the sample digestion. With increased HCL used during sample preparation, recoveries have improved considerably. However, a bias is still present, so the investigation is continuing. Sample results are not likely to be affected, because the amount of HCL normally used is adequate for the low levels of silver present in the samples.

Radium. The analysis for radium has shown a bias on the high side. UST is presently checking the calibration efficiency curve and current spike solution, with the belief that the problem results from a biased calibration efficiency curve. A new calibration curve was prepared and put into service in April 1986. Radium has been detected in only a few samples, so the effect on the total data set is expected to be small.

Presence of Methylene Chloride in Blanks and Field Samples

Methylene chloride has been detected in a number of the blank samples sent for analysis. This chemical is ubiquitous in laboratories and, as a result, it frequently causes a sample contamination problem that can be difficult to solve. Nonetheless, attempts were made to track down and eliminate the source of this chemical in the blanks. It was finally discovered that methylene chloride had been employed in the precleaning process for the container used by PNL to obtain and store the deionized water needed to prepare the blanks. Containers cleaned in this way are no longer used for this purpose.

Concentrations of methylene chloride have also recently been detected in some of the field samples. However, the pattern does not appear to indicate a ground-water contamination problem, because the concentrations are frequently much higher in the upgradient and far-field wells than in the wells closest to the facility. Furthermore, the concentrations of methylene chloride have risen and fallen dramatically from month to month, rather than showing the gradual changes usually exhibited as a result of plume movement or hydrologic phenomena. The possibility of bottle contamination is currently being investigated.

Potential Laboratory Differences

During the first two months of sampling (June and July 1985), a number of the analyses were performed at the Hoboken, New Jersey, location of UST pending

final preparation of these new capabilities at the Richland laboratory. The analyses performed at Hoboken included metals, pesticides, herbicides, volatile organics, and semi-volatile organics. The majority of these analyses revealed less-than-detectable concentrations, and similar results were reported by the Richland laboratory in subsequent months. However, some of the constituents, particularly the metals, were present in measureable concentrations, allowing some limited comparisons of the results obtained by the two laboratories.

Examination of the data for certain metals (i.e, barium, cadmium, copper, manganese, vanadium, and aluminum) reveals that the results from the first 2 months appear to be relatively high compared to results from subsequent months. Two possibilities exist: 1) the values measured by Hoboken during the first 2 months correctly reflect a temporally variable ground-water condition, or 2) some aspect of the analysis was different between the Hoboken and Richland laboratories.

Regarding the first possibility, seasonal changes in the hydrology could potentially affect the measured concentrations to the degree observed. The data from a similar period in 1986 have not yet all been received and evaluated to determine whether a similar pattern was exhibited this year. Confirmation of such a seasonal trend could take several years.

Concerning the second possibility, an identifiable difference between the two laboratories would be difficult to substantiate due to a number of potential complicating factors. As mentioned previously, the samples were acidified without filtration. If particulates were present, agitation of the samples during transport across the country could have dissolved additional materials. Also, the ICP analysis used for these samples is subject to spectral differences that can cause some variation in measurement.

To investigate the potential for differences between the laboratories, paired samples were collected from a number of wells in October 1985, and one sample from each pair was delivered to each of the two laboratories. Analyses were conducted for the list of constituents done by Hoboken in the first 2 months. As expected, most of the results from both laboratories were less than the detection limit with the exception of metals. For many of the same

metals mentioned previously, the Hoboken and Richland results were different. In cases where at least one of the samples in a pair was above the detection limit, the Hoboken laboratory almost always reported higher results than the Richland laboratory. This pattern was most notable for zinc, barium, vanadium, aluminum, manganese, iron, and arsenic. In addition, the Hoboken laboratory had higher matrix spike recoveries for a number of the metals than the Richland laboratory. Quantification of the difference between the two laboratories, either with the original values or with the paired samples collected in October, is not possible due to the limited number of results.

UST has confirmed that the same analytical methods and detection limits were used at both laboratories. A review of the internal laboratory quality control data derived from blanks and matrix spikes reveals that both laboratories were performing adequately. Without conclusive evidence to support the suspicion of a problem with the data for the first two months, these data have been treated as viable data for this report. However, the considerations discussed above should be kept in mind as these data are evaluated.

DESCRIPTION AND RESULTS OF GROUND-WATER FLOW MODELING FOR THE 100-H AREA

Ground-water flow modeling for the 100-H Area has recently been conducted to better define the hydrologic system and provide support to the monitoring effort. The specific objectives of the modeling project were to: 1) characterize the ground-water movement beneath the basins and adjacent to the Columbia River to assist in estimating the probable extent of contamination; and 2) provide guidance for placing additional monitoring wells, should they be needed to fully define the extent of contamination. Initial results of this project are now available, and they provide valuable information on the hydrogeology. The scope of the project and the main conclusions are summarized in this section, and additional details can be found in Mitchell and Williams (1985).

The project consisted of two main phases: data collection and hydrologic modeling. The data collection phase included a review of relevant information in the literature, as well as collection of field data. The information gathered in the first phase was then used in developing a conceptual model, calibrating a numerical model, and performing the simulations. Later, the

flow model was used to assess the possibility of a reversed gradient resulting from above-normal river stage. Each of these activities is described below.

Data Collection

Continuous water-level measurements made in three of the wells in this area (199-H4-4, 199-H4-5, and 199-H4-6) were compared with changes in the river stage. Graphs showing the fluctuations of the river and of the water level in each of the three wells for February 1985 are presented in Figures 42 through 44. As shown on Figure 45, the wells located near the river (199-H4-4 and 199-H4-5) exhibit greater water-level fluctuations in response to changes in river stage than well 199-H4-6, which is located farther inland. Also, wells located near the river show daily fluctuations (up to 2 ft) that are superimposed on the seasonal changes. These daily fluctuations do not appear in well 199-H4-6, which shows only seasonal water-level trends (Mitchell and Williams 1985).

The zone of the Columbia River's influence on the ground-water flow system at the 100-H Area has been determined, based on the continuous water-level measurements discussed above and also on some weekly water-level measurements taken in the first half of 1985 in a network of wells in the vicinity of the 100-H Area. This zone of river influence and also the computer model boundaries are shown in Figure 46. It should be noted that the flow rates in the Columbia River were unusually low during the year that these measurements were made; therefore, it is possible that the zone of influence would be somewhat larger given more normal river flow rates (Mitchell and Williams 1985).

The weekly water-level measurements mentioned above were also used to construct water-table maps and determine ground-water flow directions. The flow directions were found to vary from northeast to southeast and directions in between. The flow directions were transient; that is, the flow direction was not constant for any extended period of time. The calculated velocity of ground-water flow between the basins and the river ranged from 4.0 to 7.0 ft/day (Mitchell and Williams 1985).

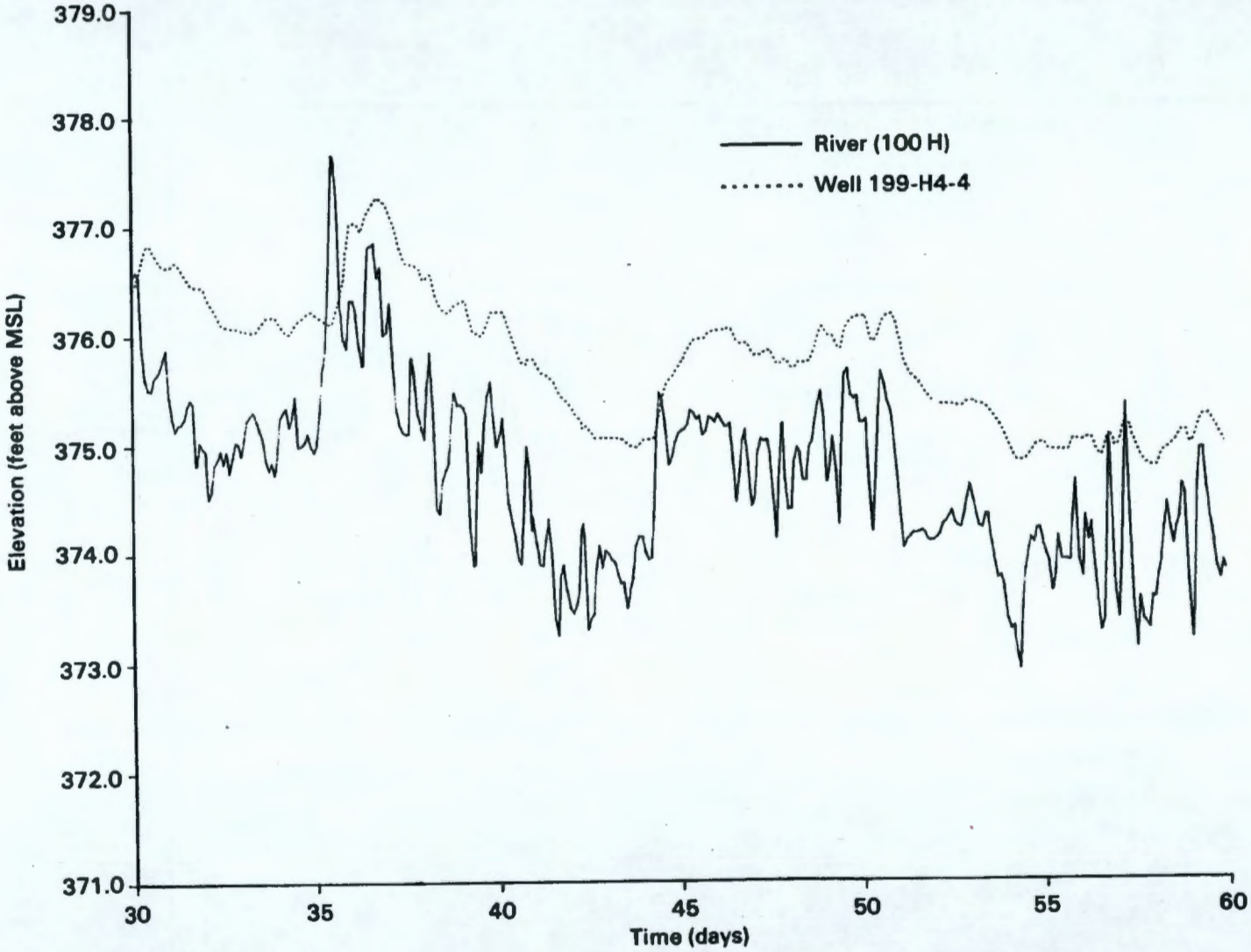

FIGURE 42. Water-Level Measurements for Well 199-H4-4 Plotted with Columbia River Stage During Days 30-60 of 1985

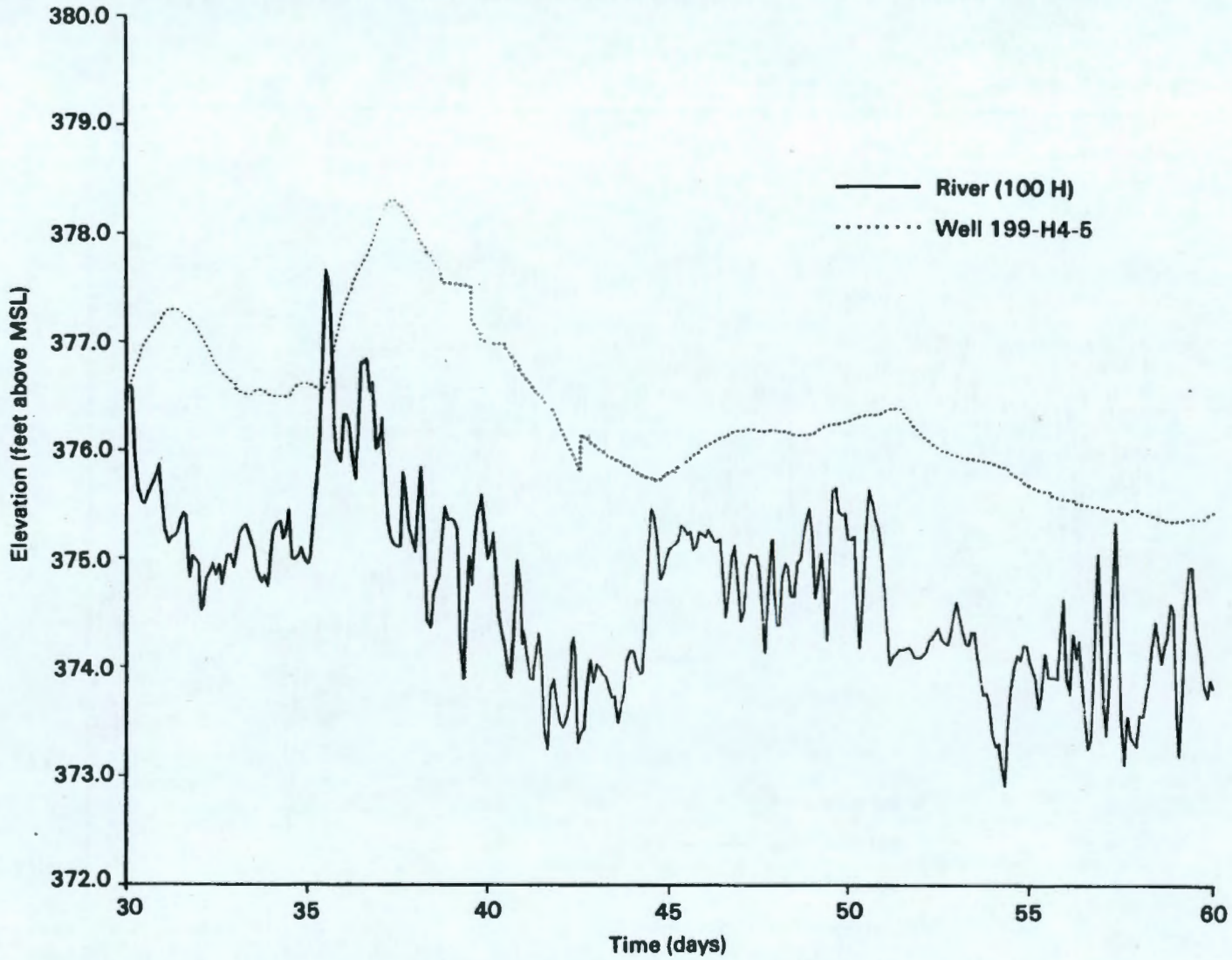

FIGURE 43. Water-Level Measurements for Well 199-H4-5 Plotted with Columbia River Stage During Days 30-60 of 1985

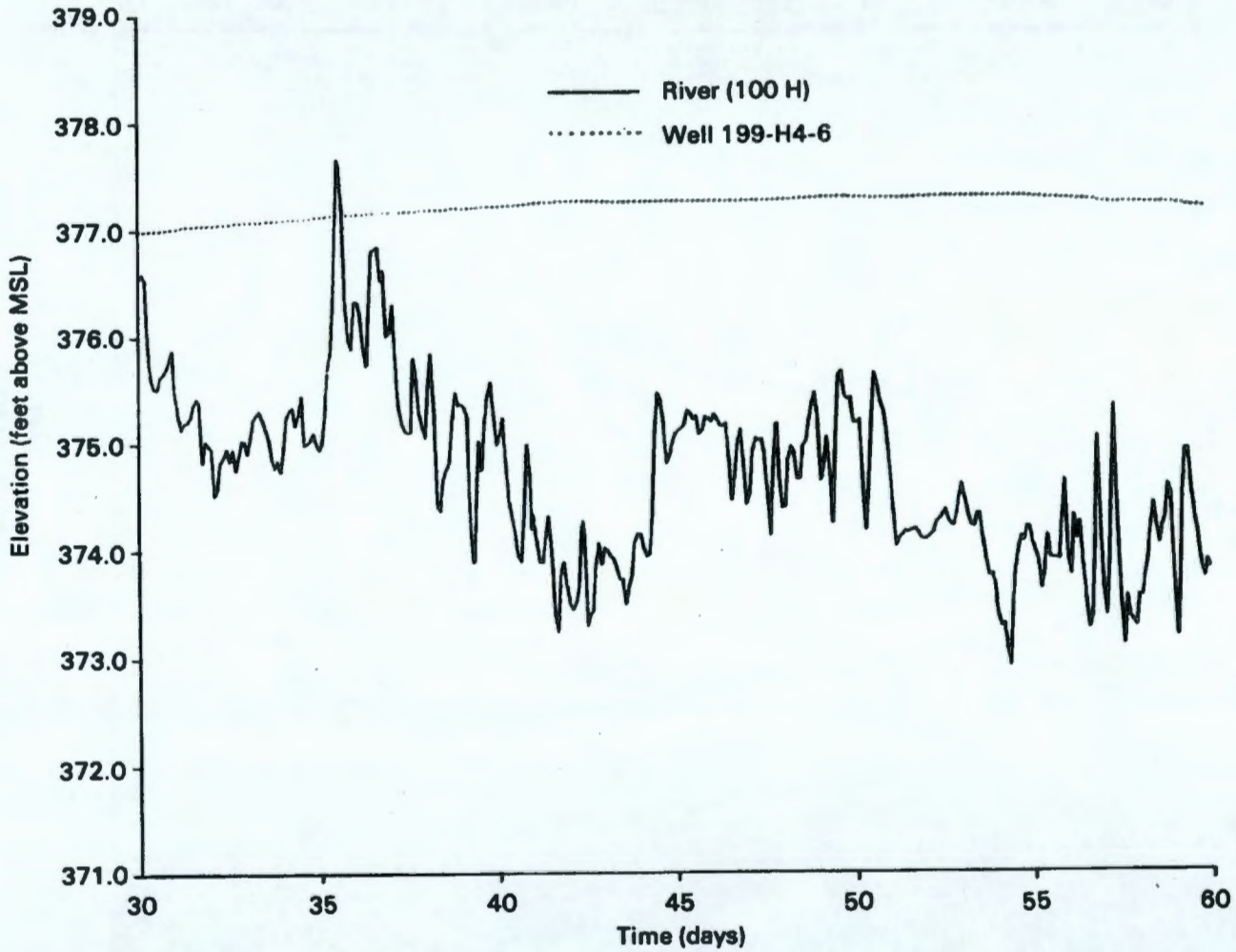

FIGURE 44. Water-Level Measurements for Well 199-H4-6 Plotted with Columbia River Stage During Days 30-60 of 1985

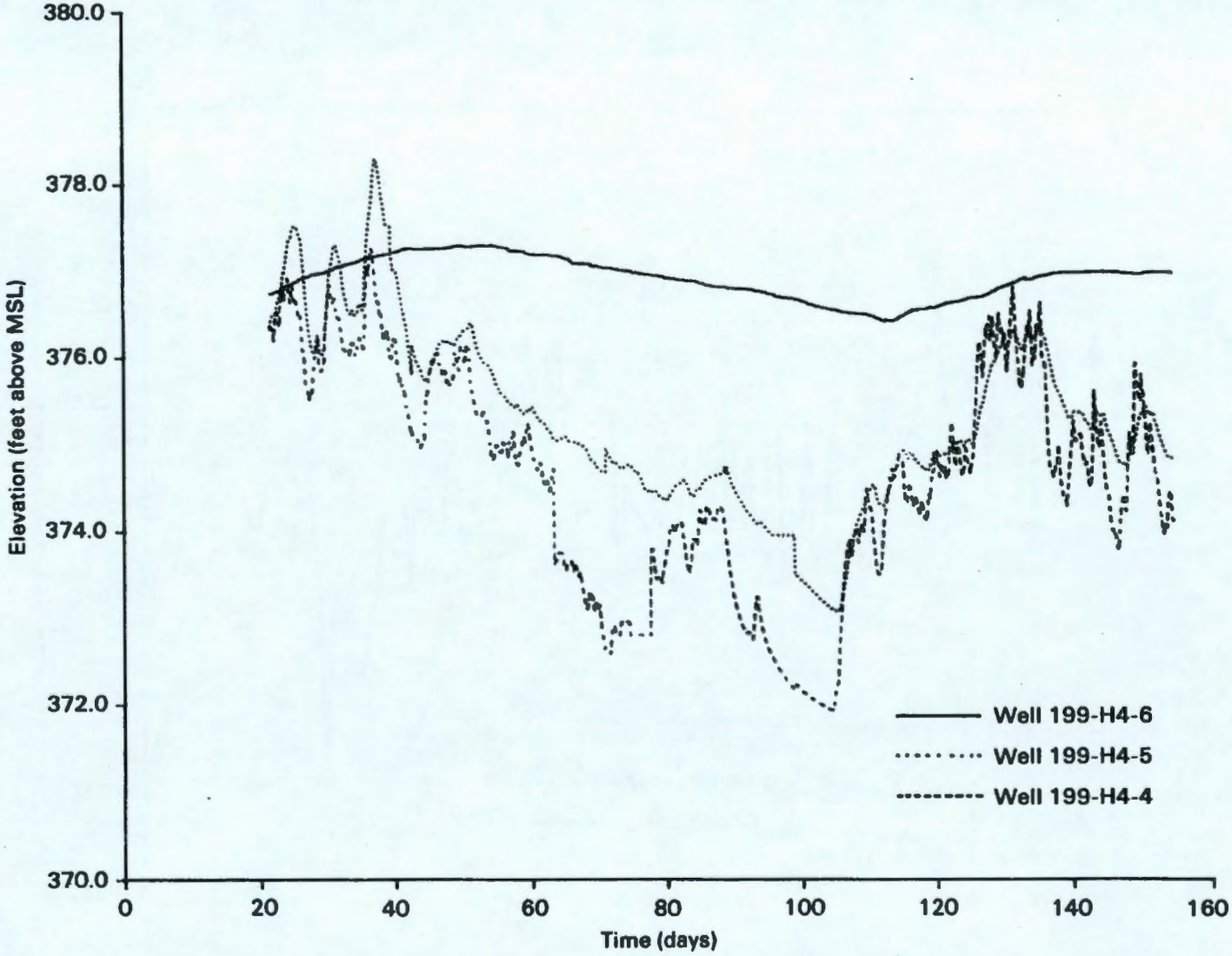

FIGURE 45. Hydrographs of Continuously Monitored Wells in the 100-H Area

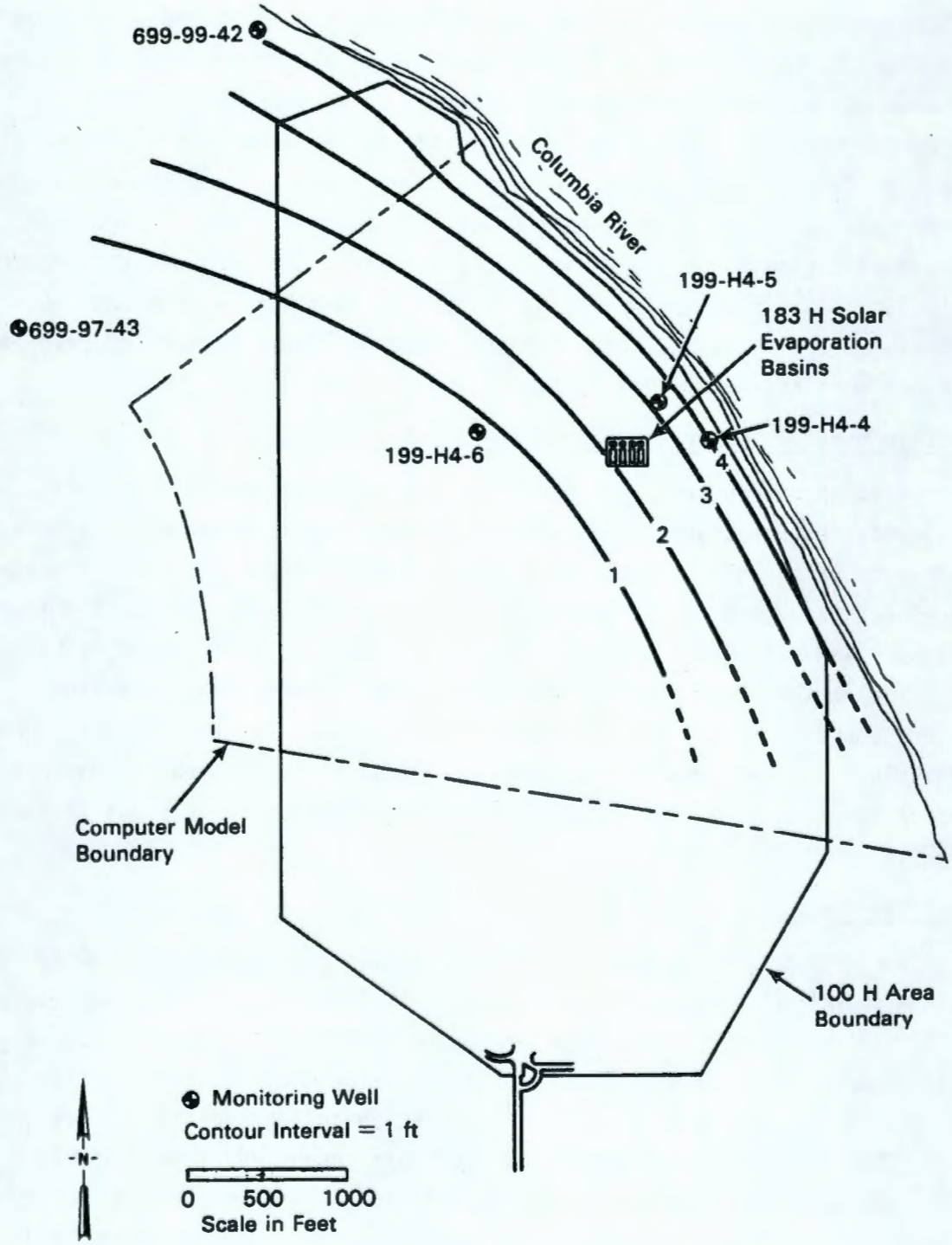

FIGURE 46. Maximum Water-Level Change (ft) Due to Columbia River Stage Fluctuations

Collection of water-level data under this effort revealed that the gradient can sometimes be reversed, so that the direction of ground-water flow is away from the river. The continuous water-level measurements taken in 1985 indicate the existence of a reverse gradient on an occasional basis. Hydrographs of all three wells, when plotted on the same figure (Figure 45), show that water levels in wells near the river (199-H4-4 and 199-H4-5) were higher than or almost as high as the water level in the more inland well (199-H4-6) during January and May. At these times the ground-water gradient would slope away from the river. Given a more normal flow rate for the Columbia River, it is possible that there may be longer periods of reversed gradient than indicated here (Mitchell and Williams 1985).

Development of a Conceptual Flow Model

Based on the information summarized above, a conceptual model was developed. It was assumed that the predominant ground-water flow direction is toward the river and that the river causes periods of local reversed gradient. Therefore, transient flow modeling was chosen over steady state. The model grid used was a finite difference grid with a node spacing of 200 ft (Figure 47). The northern and southern boundaries were drawn along streamlines. The western boundary was modeled as a recharge boundary, and the eastern boundary (the Columbia River) was represented as a constant head at each node that was changed for each time step to simulate fluctuations of river stage (Mitchell and Williams 1985).

Model Calibration

Two periods were chosen for initial transient calibration efforts. These periods were: 1) January 22 to 30 (a time of flattened or reversed gradient), and 2) the month of March (a time period representing a strong hydraulic gradient toward the river). Calibration of the flow model resulted in the selection of a conductivity of 315 ft/day for the unconfined aquifer, which is close to the 279 ft/day estimated by an aquifer test conducted at well 199-H3-1 in 1978. The modeled responses at the well locations are very close to actual hydrographs, with the exception of exaggerated highs and lows observed in well 199-H4-4. The gradients shown between wells in the model are comparable to those observed in the field.

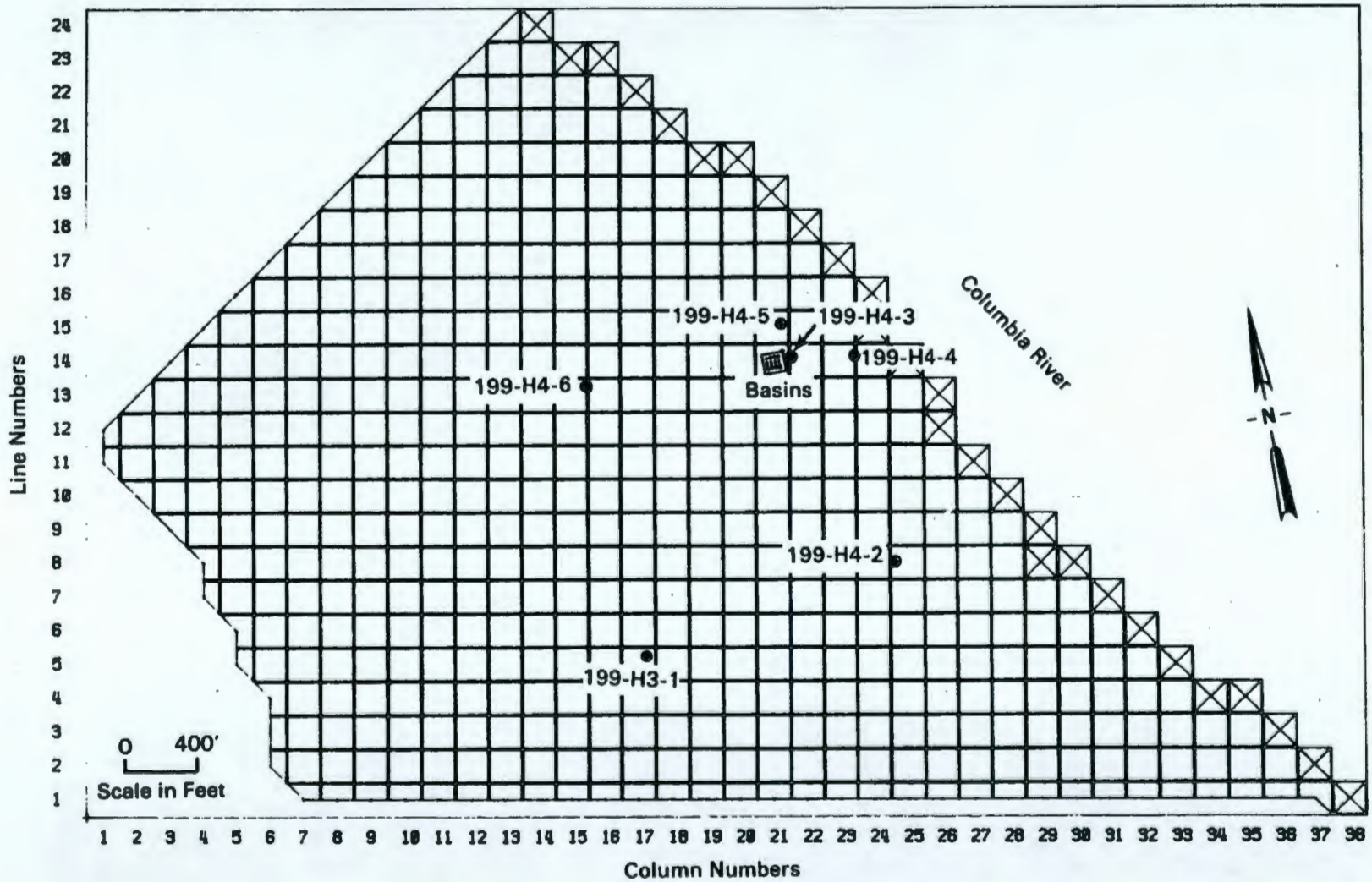

FIGURE 47. Grid Used for the Modeling Project, Including Locations of 183-H Basins and Monitoring Wells.

Simulations

Pathlines from the basin to the river were produced for each simulated day within the two time periods specified above. These pathlines were allowed to travel to the river as if the water-table surface calculated for that day was at equilibrium. The pathlines for the first and second time periods are shown in Figures 48 and 49, respectively. The area covered by the pathlines falls between wells 199-H4-4 and 199-H4-5, and this is estimated to be the area with the highest concentrations (Mitchell and Williams 1985).

The water table contours shown in the figures represent one time frame and are only examples of simulated surfaces. As described under the section entitled "Model Calibrations," these surfaces are most accurate in the vicinity of the basins.

Based on the results described above, recommendations were made for installing two new wells: one to be located between wells 199-H4-4 and 199-H4-5, and the other to be located north of 199-H4-4. The first well would serve the purpose of better determining concentrations within the contaminant plume, and the second would help to improve the characterization of the aquifer's hydraulic properties. These recommendations were used in defining the locations for two of the new wells that are going to be installed, as described in a later chapter of this document entitled "Planned Expansion of the Ground-Water Monitoring Program."

Assessment of the Potential for a Reversed Gradient

The flow model was also used to assess the possibility of a reversed gradient (i.e., away from the river in a westerly and/or southerly direction) resulting from above-normal river stage. The basic objective of this effort was to determine if the existing upgradient wells to the west and south of the basins are truly upgradient of the facility and if the basins are a likely source of contamination for these wells.

The calibration was assumed to be sufficient for performing these simulations. The western boundary was changed to a constant-head boundary. Since water-level histories for wells outside the modeled region indicated

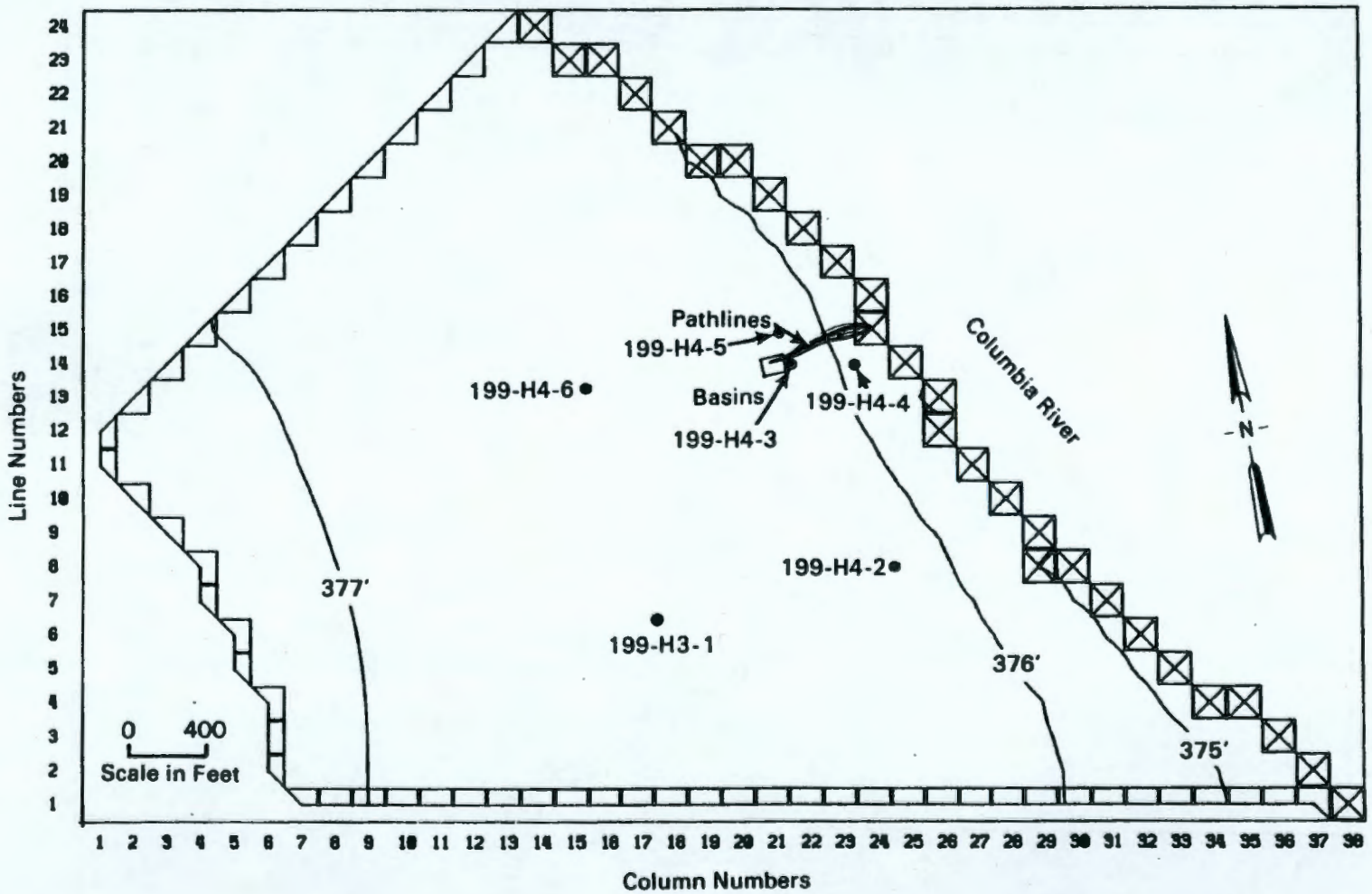

FIGURE 48. Simulated Pathlines from the 183-H Basins for January 22-30, 1985

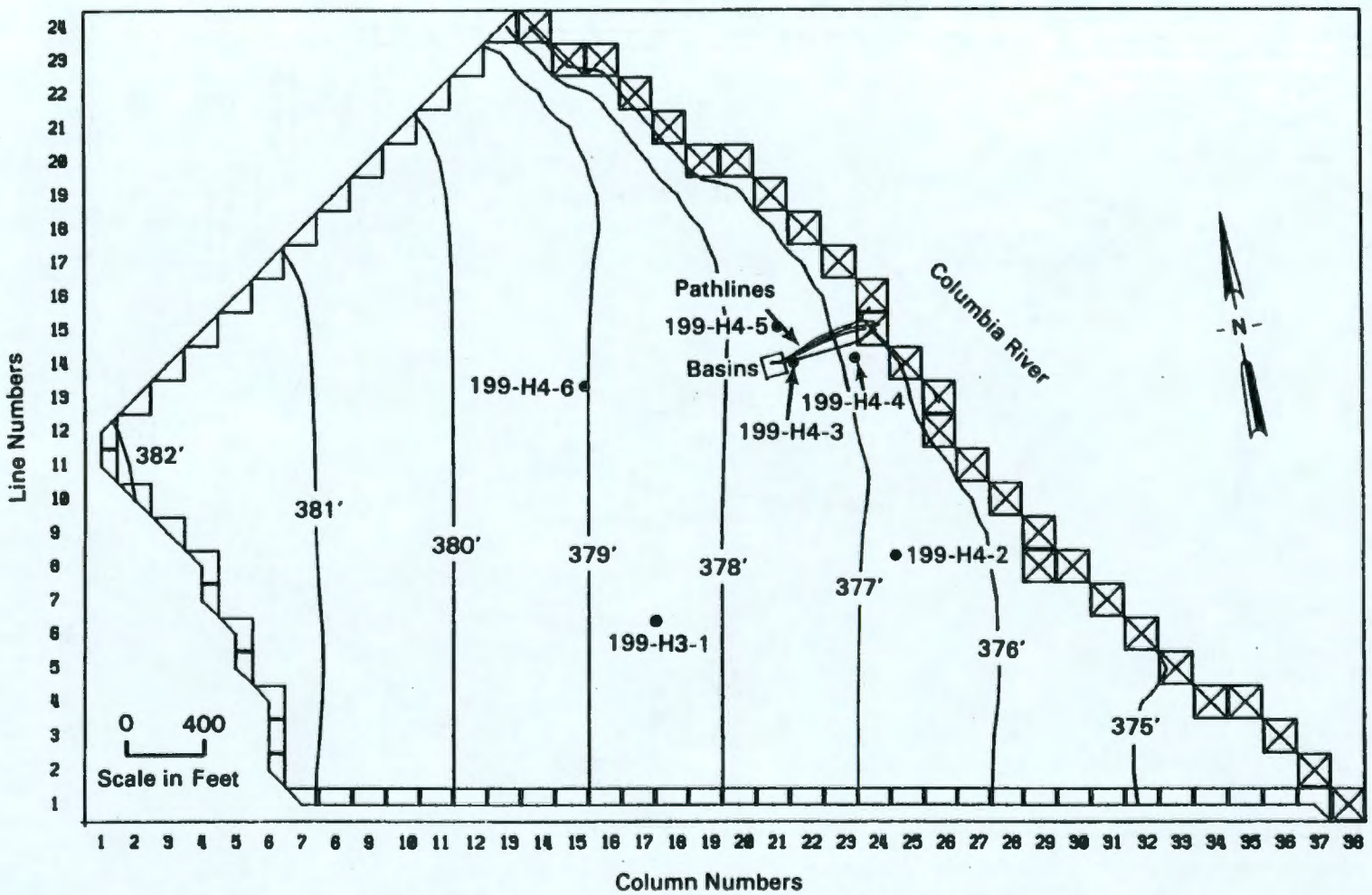

FIGURE 49. Simulated Pathlines from the 183-H Basins During March 1985

approximately steady-state conditions during recent years, the western boundary was held at those elevations during the simulation. The model predicted that only an unrealistically high river stage would result in a reversed (although primarily southerly) gradient under steady state conditions. A transient simulation predicted that a southerly flow direction would exist for about 16 weeks when the river stage at the 100-H Area was raised quickly from 376 ft and then held at 380 ft above mean sea level. Steady-state conditions were reached after 32 weeks. The pathline distance from beneath the basins was about 64 ft (not reaching the existing upgradient wells) during the transient period of southerly gradient (Figure 50). After 16 weeks, the travel direction shifted toward the river again.

These modeling results must be qualified with the limitations of the calibration, as follows: 1) the model was calibrated to ground-water elevations and river stages collected during a year of below-average flow rates; and 2) the model response to rising river stage at well 199-H4-5 was not as good (i.e., as close to the measured response) as at the other wells. Also, the region of interest during model calibration was smaller than for this application. The positions of the boundaries on the simulations may have affected the pathline positions. The conclusion was drawn, however, that the basins are probably not a source of contamination for the existing upgradient wells.

Future Modeling Work

The ground-water flow modeling conducted to date has been a valuable tool used in supporting the monitoring effort. The modeling work will be continued with improvements to the flow model calibration and calibration of the transport model for one constituent. These improvements will allow further site characterization and estimation of the rate and extent of contamination. Details on the work to be performed are contained in the section entitled "Ground-Water Flow and Transport Modeling."

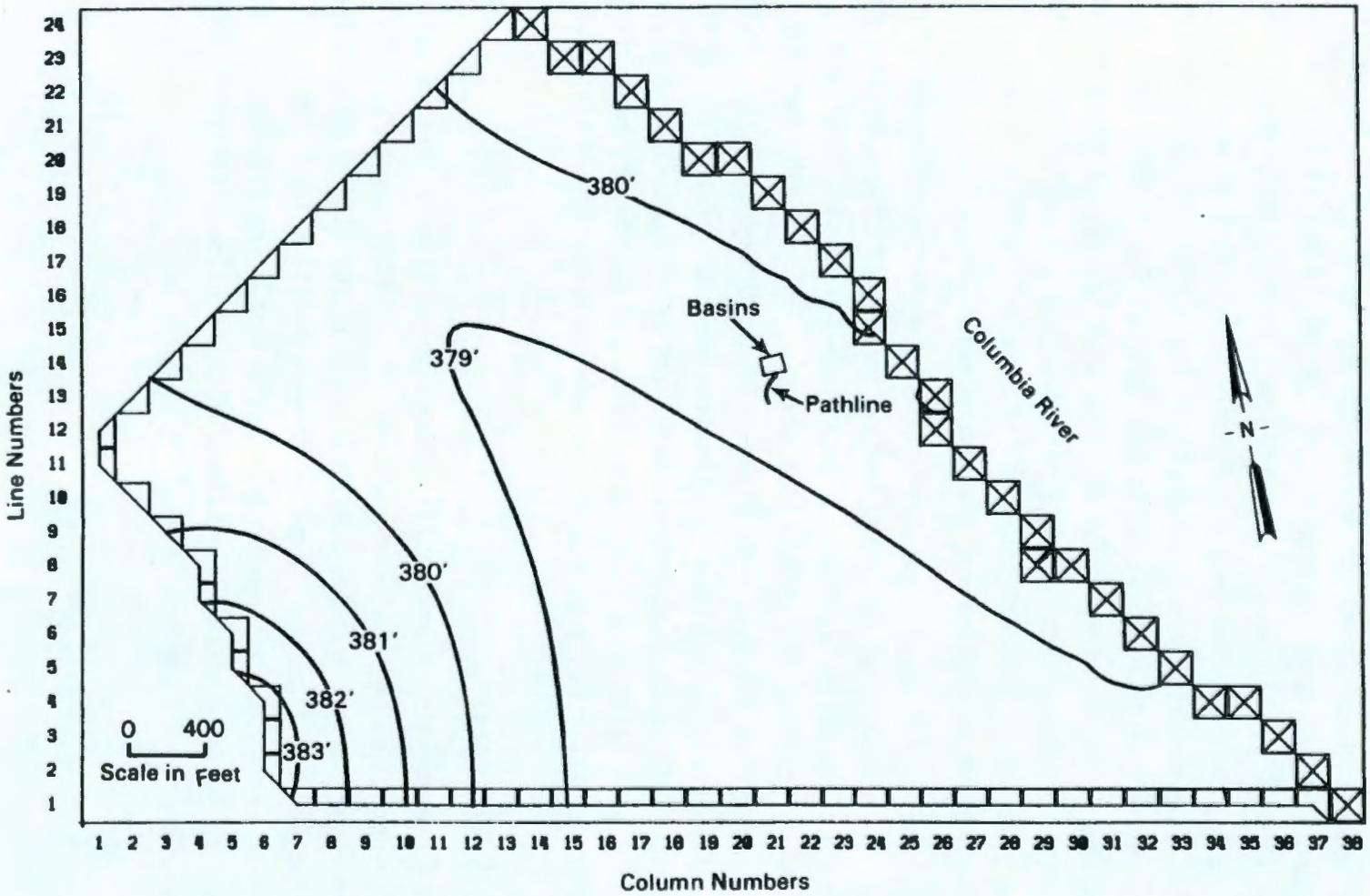

FIGURE 50. Pathline During a Period of Simulated Southerly Gradient

PLANNED EXPANSION OF THE GROUND-WATER MONITORING PROGRAM

As noted previously, the existing ground-water monitoring program for the 183-H Basins is now being revised and expanded to meet two primary objectives: 1) to collect additional site-specific information, as needed to more fully characterize the area and support decisions concerning the monitoring well network for the 183-H Basins, and 2) to conduct an expanded sampling and analysis effort designed to determine the extent of contamination originating from the basins and the rate of movement of contaminants. The intended scope of work, schedule of implementation, and reports to be produced are discussed in the following sections.

APPROACH TO BE TAKEN

Installation of new wells and subsequent sampling of the expanded well network will meet the objectives described above. These activities form the basis of the planned effort, which will be conducted in phases. Information obtained as the work progresses may be used to alter plans for subsequent phases. Therefore, although tentative plans for the entire effort are described here, some alterations, particularly in well locations and design, should be expected and will be negotiated as they arise.

Well Installations

As stated previously, a phased approach will be used for well installation; information obtained as the first wells are drilled, tested, and sampled may be used to modify the designs and locations currently planned for other wells. Modifications may also be made on the basis of information obtained through use of tools such as ground-water modeling, statistical analysis, and borehole geophysics, which will be applied as appropriate.

The new well installations will consist of single wells and well clusters. The placement and design of the wells planned for the first and second drilling phases are described in the next two sections.

First Drilling Phase

Three well clusters and seven single wells will be installed during the first drilling phase. Well and cluster locations for this first phase (and also the second phase) are shown on Figure 51, and the purpose and need for each of these installations is provided below.

- Single Wells

  -Single wells W1, W2, and W3 are needed to gather data required to characterize the geology underlying the basins and to measure concentrations close to the basins, at the point of compliance.

  -Single wells W4, W5, and W6 are needed for geologic characterization and for locating the edges of the plume in the downgradient direction, close to the river.

  -Single well W7 is needed for geologic characterization and for determining contaminant concentrations upgradient of the basins.

These single wells will be completed in the upper portion of the uppermost aquifer. The primary purpose for installation of these wells is horizontal expansion of the sampling network to enable better delineation of plumes, but these wells will also be used to gain more hydrogeologic information. Therefore, each well will be drilled to the top of the clays to verify the presence of this layer and will then be plugged or otherwise modified so that they can be used for sampling the top portion of the aquifer. The design of these wells is shown in Figure 52.

- Well Clusters

  -The first cluster (C1) is to be installed in the area potentially having the maximum concentrations, as indicated by recent modeling work.

  -The second cluster (C2) is to be installed in a location that was not as accurately simulated by the model as the rest of the area, indicating a need for additional characterization data.

-The third cluster (C3) is to be installed upgradient of the basins to allow collection of potentiometric data needed to construct flow nets, which are required for determining and illustrating vertical flow components.

These well clusters will be used to determine vertical gradients, assist with geologic characterization, and enable hydrologic testing of different zones within the aquifer. Each cluster will consist of three wells, spaced about 25 ft apart in a triangular arrangement. A tentative schematic drawing of a well cluster is shown in Figure 53. The first well (Well A) will be completed at the top of the aquifer, with a 15-ft screen extending a few feet above the water table to allow for fluctuations (Figure 52). The total depth of Well A will be about 50 ft. The second well (Well B) will be drilled to

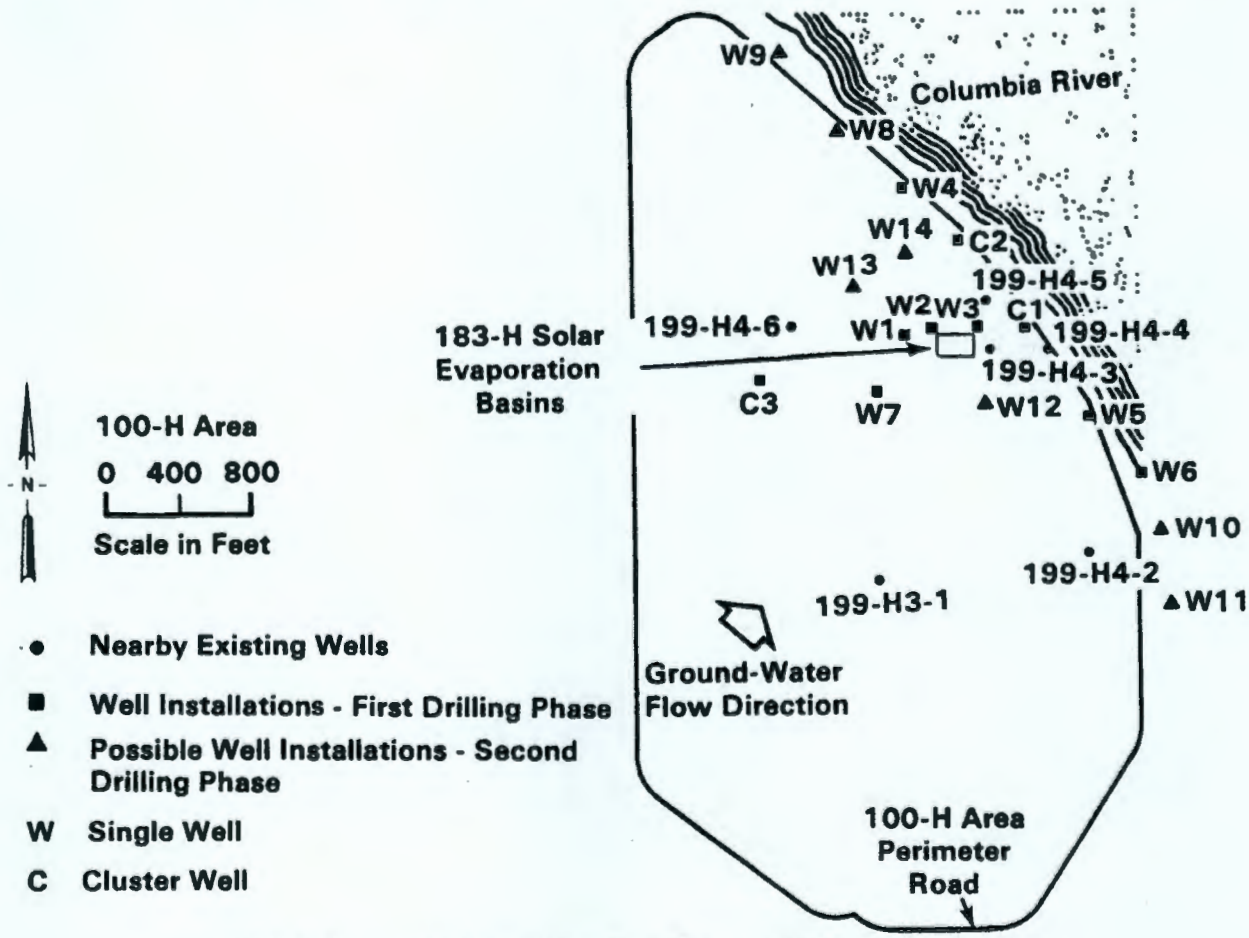

FIGURE 51. Location Map for Planned Well Installations

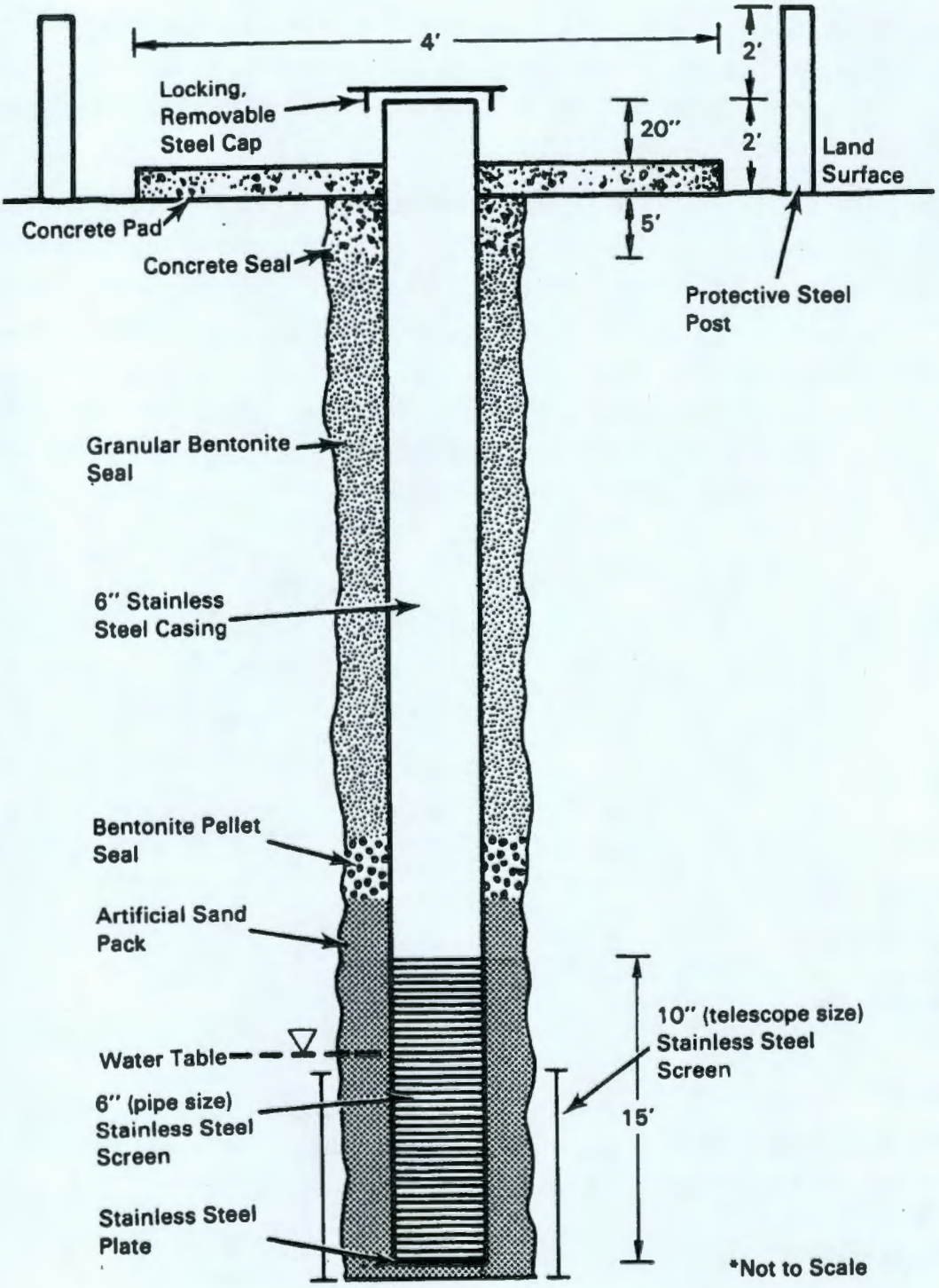

FIGURE 52. Planned Design for Shallow Wells Completed in the Hanford Gravels

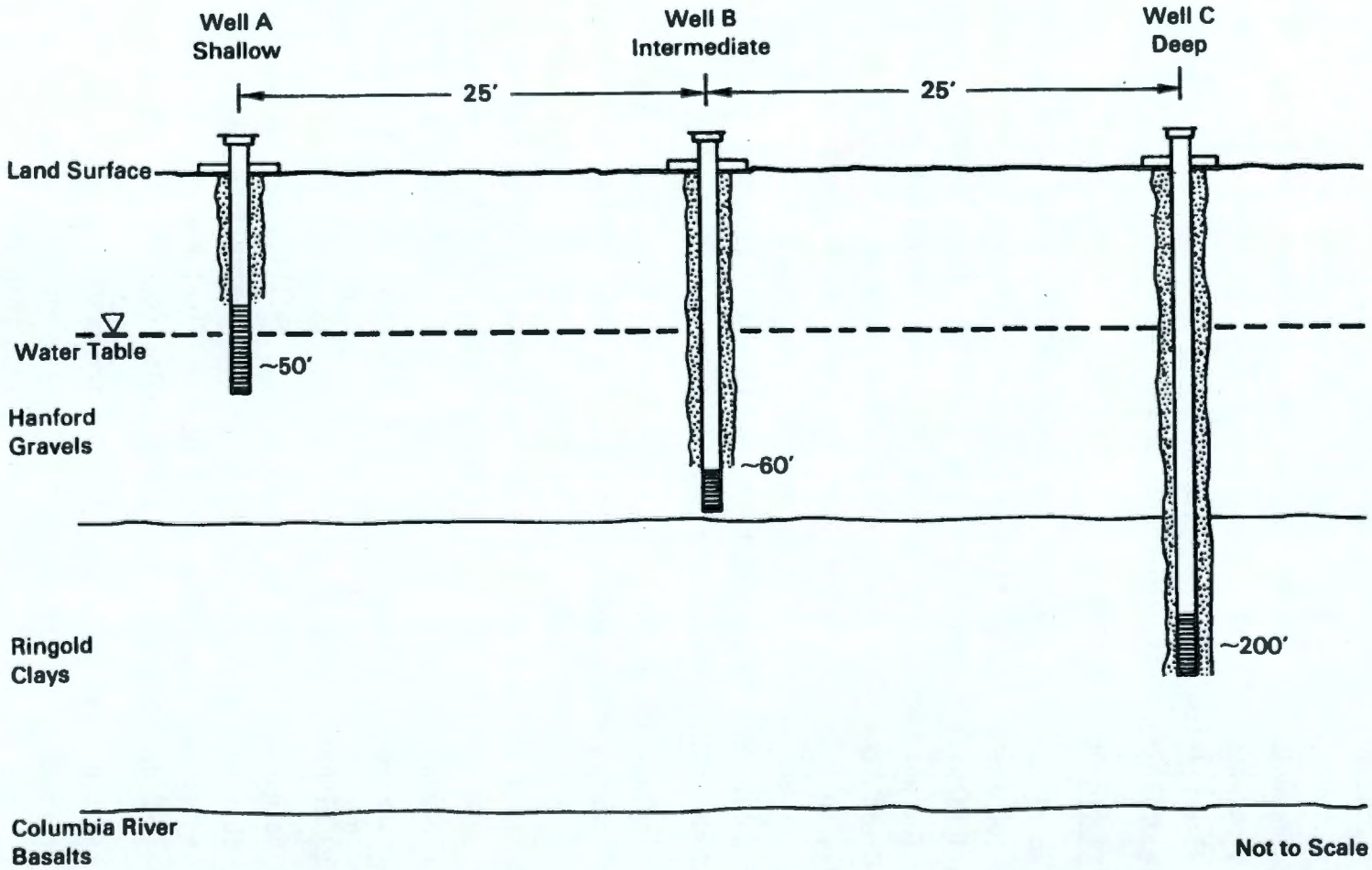

FIGURE 53. Cross Sectional View of a Well Cluster Completion

the top of the Ringold clays (at a depth of about 60 ft) and will be completed in the zone just above the clays (Figure 54). The screen for Well B will be fairly short to allow collection of head measurements that are more discrete. The third well (Well C) will be drilled into the Ringold clays to a total depth of approximately 200 ft. The screen length for this well will be 10 ft (Figure 55). The planned screen lengths and completion intervals may be modified during drilling to fit the conditions encountered.

Second Drilling Phase

Results obtained during the first drilling phase will be used to finalize plans for the second drilling phase, and an interim report complete with recommendations will be produced at the end of the first drilling phase. Final plans for well installations under the second drilling phase will then be negotiated with the USEPA and the Washington State Department of Ecology. However, to give an indication of the possible scope of the entire effort, tentative plans for the second drilling phase are presented below. Only single wells are planned for the second phase, and they will have the same design as the single wells installed during the first phase.

Single wells W8, W9, W10, and W11 (Figure 51) may be needed to locate plume edges in the downgradient direction and to gather additional characterization data. The need for these wells and/or their exact locations will be established during the first drilling phase. If contamination is found in water obtained from W4, then W8 and possibly W9 will be needed to locate the northern edge of the plume. Similarly, W10 and possibly W11 will be needed to locate the southern edge of the plume if contamination is found in W6.

Well Construction Details

The new wells will be installed by a drilling contractor using one or more cable tool rigs, as needed to meet the established schedule. The driller will be required to provide proof of qualifications and experience and will be supervised during drilling by a PNL geologist.

Because these wells will be used for gathering water-quality data, care will be taken to ensure that the wells are properly installed and that contamination is not introduced during drilling. Accordingly, all equipment, casings

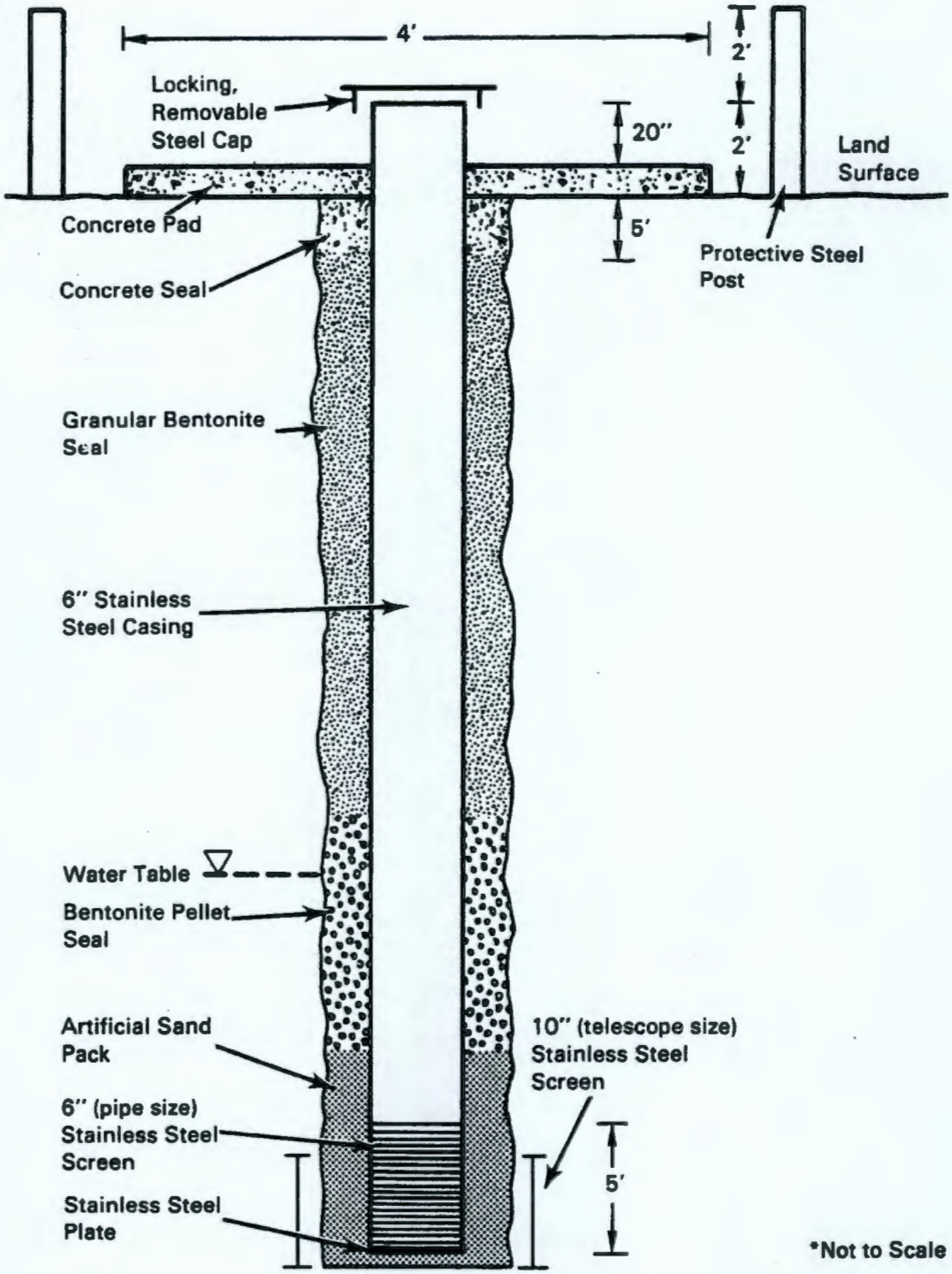

FIGURE 54. Planned Design for Intermediate-Depth Wells Completed just Above the Ringold Clays

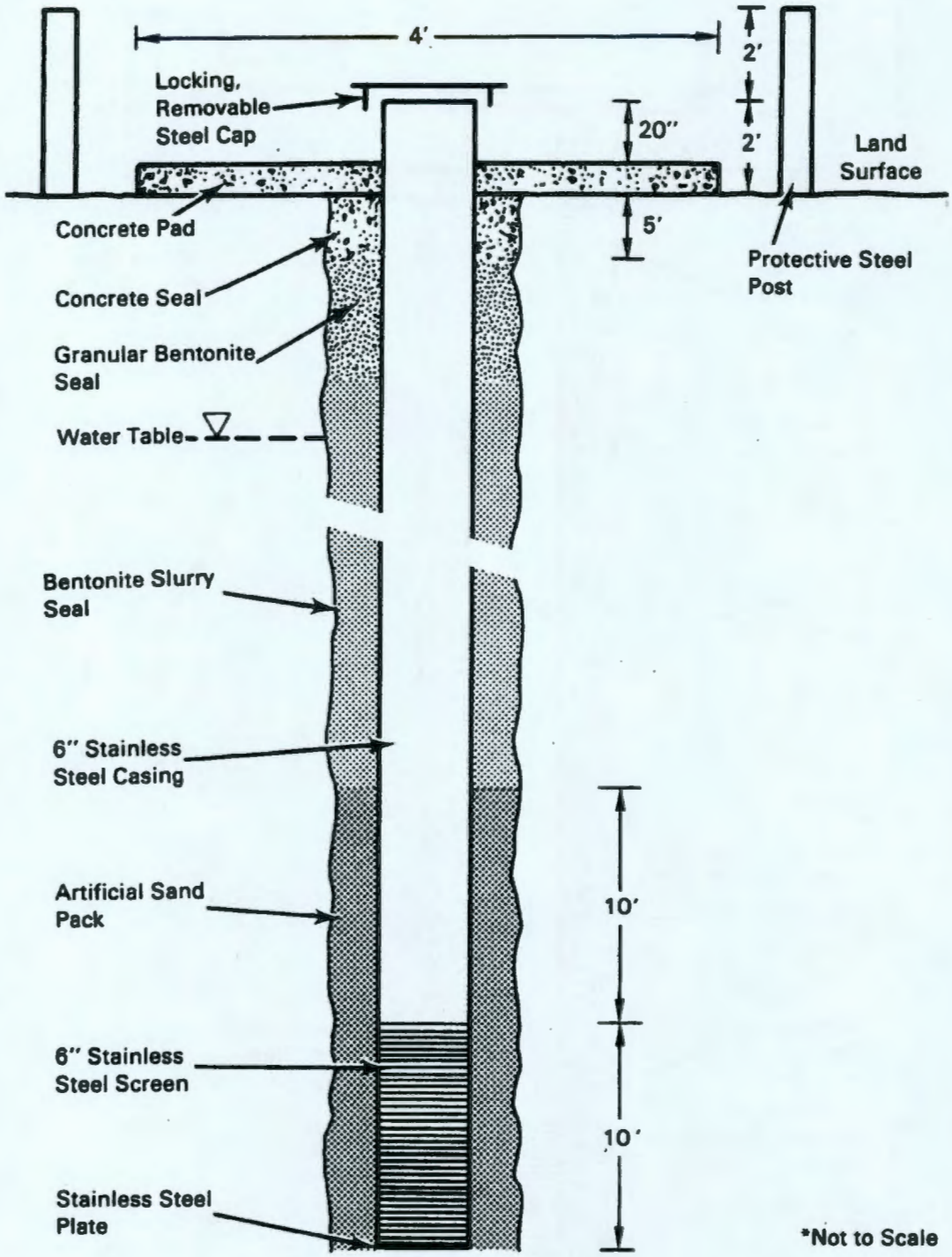

FIGURE 55. Planned Design for Deep Wells Completed Within the Ringold Clays

and screens will be steam-cleaned prior to use and kept off the ground. Any drilling additives or lubricants needed will be carefully selected to avoid contamination. Following completion, all new wells will be fully developed to help ensure that samples collected from them subsequently will be representative of the water in the aquifer.

The wells will be constructed with flush-coupled, 6-in.-diameter, stainless steel (Type 304) casing and screens. The casings will consist of Schedule 10 pipe with Schedule 40 couplings. During drilling, 10- or 12-in.-diameter temporary carbon steel casings will be used to hold the hole open. For the shallow and intermediate depth wells, a 10-in. stainless steel screen will be set for testing purposes when the well has reached the completion depth, and the temporary casing will be pulled back to expose the screen. The well will then be developed and tested. Following testing, the screen will be left in place and the 6-in. assembly will be placed inside. An artificial sand pack will be set between the screens and will extend 5 ft above the top of the 6-in. screen. Following emplacement of the sand pack, the temporary casing will gradually be pulled back as the annular space is sealed. A 5-ft layer of bentonite pellets will be used to seal the annular space above the sand pack. A seal of granular bentonite will fill the remaining annular space up to 5 ft below the land surface, where a concrete seal will be emplaced. The well will be finished with a concrete pad, a removable locking cap, and protective steel posts. Each well will then be redeveloped as needed. Complete details concerning the well construction are provided in the Statement of Work (Appendix J).

Following completion, each new well will be surveyed to obtain the plant location coordinates and the elevation of the top of the casing. The wells will then be given permanent names assigned according to Hanford Site conventions.

Hydrogeologic Testing and Characterization

Geologists will be present during drilling of the new wells to conduct hydrogeologic testing and characterization. They will collect information needed to more fully characterize the local conditions and to improve the

conceptual and predictive numerical models for the site. A full description of the characterization work to be conducted is provided in the following sections.

Geologic Core Analysis

Geologic material samples will be collected at 5-ft intervals and at changes in lithology. Materials encountered above the water table will be described as hand specimens in geologic field records. Typical descriptions will include estimated grain size, color, and mineralogy of major constituents. Paired samples will be collected, with one specimen from each pair submitted for laboratory analysis and the second specimen from each pair retained for archiving. The following laboratory tests will be conducted at selected horizons: 1) grain size distribution based on sieve analysis, 2) moisture content, 3) hydraulic conductivity, 4) soil moisture retention, 5) quantitative calcium carbonate, 6) bulk porosity, and 7) petrographic description of mineral content. Total organic carbon analysis will also be conducted in zones where organic fluids may be present.

Geophysical Well Logging

All of the new wells will be logged with geophysical probes following completion. The suite of logs to be made will include the following three nuclear logs, which (unlike electrical logs) can be made in cased holes: neutron-epithermal-neutron, gamma-gamma, and natural gamma. These logs give an indication of the properties of the materials around the borehole, and they provide a relatively objective and continuous record of the materials penetrated. Therefore, they are a useful supplement to the sample descriptions provided by geologists. The types of information that will be obtained from the geophysical logging effort are briefly described below.

Each of the three geophysical log types named above gives different information concerning the subsurface geology. The neutron-epithermal-neutron probe has a neutron source and a detector; the neutrons emitted interact with hydrogen in the water contained in the pore spaces of the sediments. The log produced gives an indication of the saturated porosity of the material below the water table or of the moisture content of the material above the water

table. The gamma-gamma probe contains a source of gamma radiation and a detector; the gamma photons emitted are scattered and absorbed by the materials through which they pass, and the resulting log gives an indication of the bulk density of these materials. The natural gamma probe contains only a detector, and it measures the natural radiation emitted by the sediments; the log produced gives an indication of the clay content, or, where the ground water contains radionuclides, the level of contamination (Keys and MacCary 1976).

These three logs have recently been made for all of the existing monitoring wells at the 100-H Area. Therefore, logs from both the new and old wells will be used to provide information for the characterization effort.

Soil Moisture in the Unsaturated Zone

Samples of unsaturated material will be collected using a drive barrel. These samples will be sealed in water proof containers at the drill site and submitted for laboratory analysis of in situ soil moisture. At some horizons, coarse material and boulders may prevent collection of samples for soil moisture analysis. However, this should not result in a significant loss of data, because the moisture content of coarse material above the water table is usually quite low.

Permeameter Tests

Saturated materials at selected horizons below the water table will be collected with a split spoon device and submitted for permeameter tests to determine laboratory values of vertical and horizontal permeability. This test gives an approximation of the hydraulic conductivity of that horizon. Samples collected in soft or flowing sand units are commonly too disturbed to reconstitute in situ permeabilities, so some loss of data may occur if these types of units are encountered.

Hydraulic Gradient Determinations

Collection of water-level measurements will continue at the site during and following well drilling. The new wells will be surveyed following construction to establish the elevation of a permanently marked measurement point. The measurement point will serve as the single reference point for all water-

level measurements. Horizontal and vertical hydraulic gradients will be established by collection of water-level measurements from all wells at the site and also river-stage measurements for the Columbia River. These measurements will indicate the potential for fluid movement and the general direction of flow. As indicated above, hydraulic gradients are influenced by the river level and can be expected to change on a daily basis. Continuous recorder measurements and the long-term record of ground-water observations at the site will be used to define hydraulic gradients.

Aquifer Testing

Aquifer tests will be conducted on most, if not all, of the new wells to be installed. These tests will provide crucial information on aquifer properties and will thereby support estimations of the rate of movement of contaminants. The objectives, strategy, and evaluation techniques for these tests are described below.

Objectives. The purpose of aquifer testing is to determine the large-scale hydraulic characteristics of in situ geologic materials. These tests define site hydrology more accurately than single-point laboratory analyses such as permeameter tests. The field testing program will be carefully designed, in order to characterize the site to the maximum extent possible with the available wells. This characterization allows the conceptual and numerical models to become more detailed and thus more accurate. Observation wells will be used as additional data sources whenever possible. Electronic pressure transducers and automatic data loggers will be used where feasible during testing. Steel tape and calibrated electric tape measurements will be used to verify transducer calibration.

Each geologic formation beneath the 183-H Basins requires a separate testing program based on generalized aquifer characteristics, location of the well in relation to the contaminant plume, and the probable influence of the Columbia River. The test plan for each formation is given below.

Test Strategy for the Hanford Formation. The high transmissivity of the Hanford Formation may require a pumping rate of up to 500 gpm to adequately stress the aquifer. The drawdown in these wells may be slight, and the

influence of the Columbia River must be accounted for in the data analysis. The river is expected to act as a recharge boundary early in the aquifer tests. The wells will be pumped until this hydraulic boundary is reached or steady-state conditions are obtained. The recovery period will be equal to the pumping period or until initial conditions are re-established. The drawdown in observation wells may be indiscernible or absent at a distance. This factor will limit the number of observation wells to those nearest the pumping well. Well clusters (consisting of wells that are completed at various depths) will be monitored during the testing to determine vertical hydraulic conductivity.

Test Strategy for the Middle Ringold Formation. Wells in the Middle Ringold Formation are expected to have a greater degree of variability in hydrologic properties than the Hanford Formation. The aquifer characteristics depend on variations in local stratigraphy. During drilling, as the well reaches total depth, bailing tests may be conducted to estimate formation permeability and design the aquifer tests to be performed. Aquifer testing will be conducted at relatively low discharge rates so that the test period is appropriately long. Observation wells will be used as additional data sources whenever possible, although the range of pumping influence may be fairly small and may therefore restrict the observation wells to those nearest the pumping well. Wells at the same location completed in other units will be monitored to determine vertical conductivity.

Monitoring of the Columbia River. As indicated above, the water levels in the river influence ground-water levels. The Columbia River will be monitored for water-level elevation adjacent to the site. Long-term variations can be determined by correlation with the river gage located at the 100-N Area. Short-term variations at the site will be observed in the period before and during aquifer testing. A previous analysis of the site (Mitchell and Williams 1985) indicated that the Columbia River can induce water-table fluctuations up to 2 ft in height and at distances of over 500 ft from the river. Statistical analysis indicates that the time lag of ground water to surface water correlation can be up to 8 days. That is, river level 8 days previous to aquifer tests can be incorporated in water-level observations. The rapid and unpredict-

able nature of river level changes precludes a simple method for removing these perturbations from the aquifer test data. These effects will be most notable close to the river and in highly transmissive units. The Ringold silts and clays have a much lower transmissivity, which may effectively damp short-term river changes.

Analysis of the Aquifer Testing Data. Aquifer testing data will be interpreted as an iterative process of analyzing the formation parameters and predicting aquifer response. The data from each test will undergo Theis and Cooper/Jacob analysis (Freeze and Cherry 1979) to determine approximate formation parameters. These values will be compared with nearby values for the same unit and with the overall values previously estimated by Mitchell and Williams (1985) during numerical model calibration. The estimated values of transmissivity and storativity will then be used for an analysis of the effects of the Columbia River on aquifer test results. River level measurements and estimated site transmissivities will be used in the model developed by Mitchell and Williams (1985) to estimate the ground-water level fluctuations attributable to surface water changes. These effects will be removed from the data and the data re-analyzed with the Theis or Cooper/Jacob methods (Freeze and Cherry 1979). The analysis will start with wells adjacent to the river and progressively update the site transmissivity values toward the more distant wells. The iterative process of revising the spatial distribution of transmissivity and analyzing aquifer response will continue until the aquifer parameters converge or the site is described to the extent possible. Aquifer testing may also include existing wells on a selective basis. The decision to test existing wells will be based on the knowledge of site properties and the quality of data obtained from tests at the wells installed during the first drilling phase.

Sampling and Analysis

The routine monthly sampling effort already in progress will be continued and then expanded as new wells are completed and added to the network. The existing effort has been discussed in detail in a previous chapter; therefore, only a summary is provided here. Some eventual changes to the current routine, such as a reduction in sampling frequency from monthly to quarterly (or to

some other appropriate frequency), are to be expected and will be negotiated as they arise.

The new wells planned for installation will be developed immediately following completion and will be equipped with sampling devices within 90 days. Ground-water samples will be collected from the new and existing wells according to the established procedures in use (Appendix B). Water-level measurements will be taken before sampling, and the wells will be purged according to the borehole volume removal procedure. It is expected that a dedicated purging and sampling device will be installed in each of the new wells, although a final decision concerning the device to be used has not yet been made. Operational problems have been encountered with the bladder pumps currently in use, and therefore other options besides the present dual-pump system (consisting of a submersible pump and a bladder pump) are being considered. If possible, it would be desirable to replace the dual-pump system with a single pump capable of: 1) purging a 6-in. well in a relatively short time period, and 2) providing samples that are representative of the ground water and have not been altered by the sampling device. A newly developed piston pump which may provide this type of service is currently being investigated.

Nondedicated sampling devices (i.e., Teflon[a] bailers) may be used for sampling prior to procurement and installation of the dedicated pumps. If bailers are used, they will be cleaned after each use to prevent cross contamination.

The appropriate preservation practices for each analysis will be followed. These practices, summarized in Tables 2 and 3, are those currently in use for the existing sampling effort, with one exception involving the metals analysis. In accordance with recent EPA guidance, samples to be analyzed for metals will be split into two aliquots: one to be filtered and analyzed for dissolved metals, and one to be nonfiltered and analyzed for total recoverable metals. Samples currently being collected are analyzed only for total recoverable metals, according to recommendations in earlier guidance documents (USEPA 1983).

(a) Teflon is a trademark of E. I. DuPont de Nemours, Co., Wilmington, Delaware.

The samples will be sealed and transported to the laboratory using the established chain-of-custody procedures (Appendix B). The analyses to be conducted are those currently being run on samples collected under the existing effort, as described in a previous chapter and listed in Tables 2 and 3. Also, the QA/QC procedures presently in use will be continued.

Data Evaluation

Analytical data for ground-water samples collected as part of the expanded monitoring program will be statistically and graphically evaluated to develop an understanding of the spatial and temporal variations in the data. The evaluations conducted on data collected during the first drilling phase will be integrated with data collected during the past year to provide guidance on the final design for the second-phase effort. The graphical time plots for the first year of monitoring (Figures 21 through 36) will be continued and supplemented by plots that show the horizontal and vertical variations in concentrations. These plots will help identify contaminant plumes and changes over time (trends and/or seasonal cycles) that are or may become apparent as the additional data collected over time are obtained. This identification will aid in the determination of the extent of contamination and the rate of movement of contaminants in this dynamic hydrologic system.

The data will be listed in tables and summarized in ways similar to those presented in Tables 4 through 7. In addition, since a longer time-span of data will be available, attempts will be made to statistically characterize the correlation between river stage, water-table elevation, and constituent concentrations to develop a better understanding of the ground-water flow system and its effects on constituent concentrations.

The data will also be reviewed for adequacy, and recommendations will be made concerning the frequency of sampling, amount of replication, parameters to be measured, and level of QC needed as the work progresses. Statistical evaluation of the QC data provided by analysis of blanks, spikes, and replicates will be continued to provide an ongoing assessment of the laboratory's performance.

Method of Determining Rate and Extent of Contaminant Movement

At sites such as this one where contaminants are known to have entered the ground water, the regulations require determination of the rate and extent of contaminant movement. The methods to be used for determining these will employ field measurements, ground-water modeling, analytical data, and statistical evaluations. The strengths of each of these tools will be combined to provide the best estimates possible, as described below.

Estimating the Rate of Contaminant Movement

Field measurements such as those obtained during aquifer testing will be used to refine previous estimates of the rate of ground-water flow in the area near the 183-H Basins. These flow rate estimates will then be used to provide a rough approximation of the rate of contaminant movement. It must be recognized that numbers derived in this manner will be of limited value because they are conservative. Ground-water flow rates are usually faster than contaminant transport due to attenuation and chemical transformations.

To obtain more accurate values, additional modeling work (as described later) will be used to estimate both flow rate and direction for various conditions and also contaminant transport. Dispersion and sorption will be taken into account when the transport modeling is conducted.

Estimating the Extent of Contamination

Analytical data and statistical evaluations will be used to provide direct information concerning the current extent of contamination. Results obtained during the last year have already provided valuable indications of the presence or absence of various contaminants in each of the wells. Sampling of the new wells to be drilled will expand the analytical data base considerably and will allow construction of plume maps. The two-dimensional solute transport modeling mentioned previously and described in the next section will also be used to help estimate the extent of contamination, through calibration to the monitoring data.

Ground-Water Flow and Transport Modeling

The ground-water modeling effort for the 100-H Area, as described in a previous chapter of this document, will be continued. The planned work involves

both flow and transport modeling. At the completion of this modeling effort, a cost-effective capability will be in place for the following: 1) further site characterization; 2) estimation of the rate and extent of contaminant movement; and 3) evaluation, if needed, of impacts to the ground water of various facility closure and cleanup alternatives.

The effort will consist of: 1) the laboratory analyses required to help determine certain transport parameters, and 2) solute transport model calibration for the constituent determined to be of most interest. The laboratory analyses will involve physical and chemical tests used to determine the distribution coefficient for the selected constituent. The distribution coefficient is needed to define the attenuation of a constituent resulting from its interaction with geologic media, and this information is required for the transport modeling.

The transport model calibration effort will begin with improvement of flow model calibration using data collected recently and under the first drilling phase described in a previous section of this chapter. The required input files will be prepared, and the longitudinal and transverse dispersivity lengths will be estimated through model calibration. The results of the transport modeling will be estimated distributions of contaminant concentrations, both now and in the future. The modeling results and any resulting recommendations involving the ground-water monitoring effort will be contained in the characterization reports to be produced.

SCHEDULE OF IMPLEMENTATION

A schedule for accomplishing the planned work has been established. Milestones are as follows:

- submittal of this revised compliance plan: Sept. 12, 1986
- completion of the first drilling phase (16 wells): Dec. 31, 1986
- completion of the interim-status well network: Sept. 30, 1987.

Considerable progress has already been made on this effort. A contract for well installation was placed with Onwego Drilling of Kennewick, Washington, on August 6, 1986. The first drilling phase began in the middle of August.

REPORTS TO BE PRODUCED

Anticipated products of the planned effort will include periodic progress reports and hydrogeologic characterization reports. The progress reports will be produced on a quarterly basis and will include a description of the work completed and data obtained during the reporting period. Although some interpretation will be contained in these progress reports, much greater detail of this type will be included in the hydrogeologic characterization reports.

Interim and final hydrogeologic characterization reports will be produced at the end of the first and second drilling phases, respectively. These reports are expected to contain the following:

- narrative descriptions of the local geologic units and ground-water flow system
- geologic cross sections
- water-table maps and flow nets
- geologic, drilling, and geophysical logs
- results of the various laboratory and field tests to be conducted
- results of any modeling work conducted
- recommendations concerning future drilling and/or sampling.

Following completion of the planned drilling and characterization effort, future reports will focus primarily on the results of the expanded sampling and analysis program.

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APPENDIX A

DRILLING LOGS

APPENDIX A

DRILLING LOGS

This appendix gives drilling logs for six 100-H Area wells: 199-H3-1, 199-H4-2, 199-H4-3, 199-H4-4, 199-H4-5, and 199-H4-6. These logs contain a description of the drilling activities and of the geologic materials penetrated.

DRILLING LOG

PROJECT NO. CGI 791

RIG NO.	WELL NO.	DATE	DEPTH BEGINNING OF SHIFT
4	199-H3-1	8-24-60	0
DRILLER	**FOREMAN**	**SHIFT**	**DEPTH COMPLETION OF SHIFT**
J. D. St. George		6:30AM-5:30	5'0" casing 16'3"

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
TIME	DEPTH	TIME	DEPTH		TIME	EXPLANATION
					6:30-	Set up rig
					8:00	Built up drill bit
					10:30	Started to drill
					11:00	Welded on drive shoe 8'5"
3:00	5'0	Sample		10" minus rock & gravel	3:00	Took first sample
					3:30	Welded on casing 7'8" 16'. 3" Total

REMARKS

Used approx 35 gal water

A-7800 (8-57)

DRILLING LOG

PROJECT NO. CGI 791

RIG NO.	WELL NO.	DATE	DEPTH BEGINNING OF SHIFT
4	199-H3-1	8-25-60	10' 5 casing 16'3"
DRILLER	**FOREMAN**	**SHIFT**	**DEPTH COMPLETION OF SHIFT**
J. D. St. George		6:15AM-5:15	~~22'~~ 20 casing 24'3"

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
TIME	DEPTH	TIME	DEPTH		TIME	EXPLANATION
6:30	10' 0	Sample		Cobble & sand silty		
					11:00	Hauled water
1:15	15'	Sample		Cobble & sand silty		Very slow drilling
					1:30	Welded on casing 8', 0 24'3" Total
4:00	20'	Sample		Cobble & sand silty		

REMARKS

Used appfox 65 gals water

A-7600 (5-57)

DRILLING LOG

PROJECT NO. CGI 791

RIG NO.	WELL NO.	DATE	DEPTH BEGINNING OF SHIFT
4	199-H3-1	8-26-60	~~22~~ 20 Casing 24'3"
DRILLER	**FOREMAN**	**SHIFT**	**DEPTH COMPLETION OF SHIFT**
J. D. St. George		7:00AM-5:45	35' Casing 39' 8"

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
TIME	DEPTH	TIME	DEPTH		TIME	EXPLANATION
					7:00	Built up drill bit
					9:00	Started drilling
					9:30	Welded on casing 7'8" 32', 1" Total
11:30	25'	Sample		Gravel & sand silty		
2:00	30'	Sample		Gravel & sand silty		
					3:00	Welded on casing 7'7" 39'8" Total
5:15	35'	Sample		Small gravel sisty sand		

REMARKS

Used approx 55 gal water

A-7800 (5-57)

DRILLING LOG

PROJECT NO. CGI 791

RIG NO.	WELL NO.	DATE	DEPTH BEGINNING OF SHIFT
4	199-H3-1	8-29-60	35' casing 39' 8"
DRILLER	**FOREMAN**	**SHIFT**	**DEPTH COMPLETION OF SHIFT**
J. D. St. George		6:15AM	56' casing 55' 4"

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
TIME	DEPTH	TIME	DEPTH		TIME	EXPLANATION
					6:30	Started drilling
7:30	40'	Sample		Gravel & sand silty		Hit water at 39'
					7:45	Welded on casing 8'0" 47'8" Total
1:00	45'	Sample		Gravel & sand silty		
					1:30	Welded on casing 7'6" 55'4" Total
4:00	50'	Sample		Gravel & sand silty		

REMARKS

50' - 56' Heavy sand + gravel, get 3' 4' plug on 1' drive also when baling

Hit clay at 56'

Used approx 40 gal water

A-7890 (5-57)

page out of order

DRILLING LOG

PROJECT NO. CGI 791

RIG NO.	WELL NO.	DATE	DEPTH BEGINNING OF SHIFT
4	199-H3-1	8-30-60	56' Casing 55' 4"
DRILLER	**FOREMAN**	**SHIFT**	**DEPTH COMPLETION OF SHIFT**
J. D. St. George		6AM-6:30PM	75' Casing 77' 7"

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
TIME	DEPTH	TIME	DEPTH		TIME	EXPLANATION
					4:00	Completed perforating 4 holes perf. ft. 74' - 69',
						1 hole per ft. spiraled from 68' - 51' 4 holes
						per ft 50' - 29' static water level 37' 5"
					5:30	Developed well open to 75'
					6:30	Ready to move
						21 29 - 50 410
						22 51 [illegible] 112
						22 [illegible] - 74 410

REMARKS

Well inspected & approved by H. E. Ralph

40' perforating

77.7 total casing

A-7890 (3-57)

DRILLING LOG

PROJECT NO. CGI 791

RIG NO.	WELL NO.	DATE	DEPTH BEGINNING OF SHIFT
4	1999H3-1	8-30-60	5'56" casing 55' 4"
DRILLER	**FOREMAN**	**SHIFT**	**DEPTH COMPLETION OF SHIFT**
J. D. St. George		6:90-AM 6:30PM	75' casing 77' 7"

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
TIME	DEPTH	TIME	DEPTH		TIME	EXPLANATION
					7:45	Welded on casing 7'7" - 63' 1 Total
8:15	60'	Sample		Sandy brown clay		Static water level 37' 5
9:00	65'	Sample		Sandy brown clay and broke piece of basalt		
					9:30	Welded on casing 7' 4 - 70' 5 Total
11:00	70'	Sample		Sand & small amount clay		69' - 69' Small gravel
12:30	75'	Sample		Broken basalt & clay-sand		Welded on casing 6'2 76' 7" total
						69'-73' sandy clay with water 73' - 75 broken
						basalt gravel, hard chunks clay
					1:00	Checked well for straightness & depth(Okay)
					1:15	Welded on casing 1' 0 77' 7" Total
					1:30	Checked perforater performance
					2:00	Ready to start perforating

REMARKS

A-7890 (5-57)

HW-6.267

DRILLING LOG

199-H4-2

PROJECT NO. _____

Rig No. AEC 22-3132

Well No. 107-H-2

Driller Row

Foreman _____

Date 3/28/52

Shift _____

Depth beginning of Shift 0'

Depth completion of Shift 10'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-10:15	
					10:15-12:00	Moving to this location.
					12:00-12:30	Lunch.
12:30-1:00	5'	Gravel, sand and silt.				6" pit
1:00-2:45	10'	Gravel, sand and silt.				
					2:45-3:15	Running and alining 16'3" pipe.
					3:15-4:15	Dressing out.

REMARKS

This is a 6" well.

NW-6.287

177-114-2

DRILLING LOG

PROJECT NO. _____

Rig No. AEC 22-3132

Well No. 107-H-2

Driller Row

Foreman _____

Date 3/31/52

Shift _____

Depth beginning of Shift 10'

Depth completion of Shift 20'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-9:00	Driving & getting supplies to location
9:00-12:00	15'		Gravel and sand			
					12:00-12:30	Lunch.
					12:30-1:00	Welding 7'pipe 23'-3" OH
1:00-3:15	20'		Gravel and sand			
					3:15-4:15	Dressing out.

REMARKS

10' to 20' Gravel and Sand. Drills slow and hard. Uses Water and Caves.

HW-6.207

DRILLING LOG

199-H4-2

PROJECT NO. _____

Rig No. AEC-22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/1/52
Shift _____
Depth beginning of Shift 20'
Depth completion of Shift 30'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-8:50	Driving & Hauling Supplies to Location
8:50-10:25	25'	Gravel and Sand				
					10:25-11:05	Welding 7'pipe-30'3"-OH
11:05-12:00	27'	Gravel and Sand				
					12:00-12:30	Lunch
12:30-3:30	30'	Gravel and Sand, Caves				
					3:30-4:15	Dressing Out

REMARKS

20' to 30' Gravel and Sand, Caves Drills hard and slow. Hangs up in pipe.
Have to drive pipe every 6" to make any hole. Bails hard

HW-6.201

DRILLING LOG

199-H4-2

PROJECT NO. _____

Rig No. AEC- 22-3132

Well No. 107-H-2

Driller Row

Foreman _____

Date 4/2/1952

Shift _____

Depth beginning of Shift 30'

Depth completion of Shift 35'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:45-11:00	Driving to Sunnyside with bits.
					11:00-11:30	Welding 6'5" pipe (36'8" OH)
11:30-12:00	31'	Gravel and Sand				
					12:00-12:30	Lunch
12:30-3:00	35'	Sand and Gravel, Caves				
					3:00-3:30	Welding 6'11" pipe (43'7" OH)

REMARKS

A.11

HW-6.207

DRILLING LOG

199-H4-2

PROJECT NO. _____

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/3/52
Shift _____
Depth beginning of Shift 35'
Depth completion of Shift 53'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-8:40	Driving to location.
8:40-11:00	40'	Gravel and sand.				
11:00-11:30	42'	Sand and some gravel.		Caves and runs.		
					11:30-12:00	Welding 7'1" pipe 50'8" over hole.
					12:00-12:30	Lunch.
12:30-1:20	45'	Sand and some gravel.		Caves and runs.		
1:20-2:30	50'	Sand and some gravel.		Caves and runs.		
					2:30-3:00	Welding 7'5" pipe 58'1" over hole.
3:00-3:30	53'	Sand and gravel.				

REMARKS

Water at 36½'. 35' to 37' gravel and sand. 37' to 53' sand with very little gravel. Runs back up pipe.
I think this top water is perch water from the 107 basin and the sump about 75' south of this well.

HW-6.207

DRILLING LOG

199-H4-2

PROJECT NO. _____

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/4/52
Shift _____
Depth beginning of Shift 53'
Depth completion of Shift 85'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-8:40	Driving to location.
					8:40-9:00	Testing for water.*
9:00-9:45	55'	Sand and some gravel.				
9:45-10:50	60'	4' sand and gravel and 1' silt.				
					10:50-11:15	Welding 7'5" pipe 65'6" over hole.
11:15-12:00	65'	Heavy silt.				
					12:00-12:30	Lunch.
12:30-1:00	70'	Silty clay and rotten sand stone.				
1:00-1:15	75'	Clay, silt, sand stone, caliche and sand.				
					1:15-1:45	Welding 11' 5" pipe 76'11" over hole.
1:45-2:00	80'	Clay, rotten sand stone and sand.				
2:00-2:15	85'	Clay, rotten sand stone and sand.				

REMARKS

HW-6.207

DRILLING LOG

199-H4-2

PROJECT NO. _____

Rig No. ABC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/5/52
Shift _____
Depth beginning of Shift 85'
Depth completion of Shift 95'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					2:15-2:45	Welding 11'6" pipe 88'5" over hole.
2:45-3:00	90'	Sand and silt like sand stone.				
3:00-3:15	95'	Sand, silt and caliche.				
					3:15-4:15	Dressing out.

REMARKS

* Water was 27.7' from land surface level. Water is very warm. This water must be perch water because land elevation is 419.569' and the river level is 373.1'.
Shut water off when I drove pipe to 64'. Shut water off from 60' to 68'.
This silt is a reddish brown in color when it first comes out of hole, 59' to 65'.
Hit more water at 68'.

HW-6.287

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC-22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/7/52
Shift _____
Depth beginning of Shift 95'
Depth completion of Shift 135'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-8:30	Driving to Location.
8:45-9:15	100'	Sandy clay and silt.			8:30-8:45	Testing for water. *
					9:15-9:45	Welding 10'-4" pipe (98'-9" OH)
10:15-11:00	105'	Sandy clay ,silt,and chips of basalt.			9:45-10:15	Welding 9'-8" pipe (108'-4" OH)
11:00-11:30	110'	Sandy clay, silt,and chips of basalt.				
11:30-12:00	115'	Sandy clay, silt and caliche.			12:00-12:30	Lunch.
1:00-1:30	120'	Sandy clay, silt and caliche.			12:30-1:00	Welding 10'-4" pipe (118'-8" OH)
1:30-1:50	125'	Sandy clay, silt and caliche.			1:50-2:20	Welding 10'-7" pipe (129'-3" OH)
2:20-2:40	130'	Sandy clay, silt and chips of basalt.				
2:40-3:00	135'	Sandy clay, silt and chips of basalt.				
					3:00-3:30	Welding 10'-3" pipe (139'-6" OH)
					3:30-4:15	Dressing out.

REMARKS

*Water was 31' from ground level.

From 95' to 135' Sandy clay and silt with a few chips of basalt in this formation. I still have a hole full of water, must be a small hole at one of the joints thats lets the upper water come in.

HW-6.267

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC-22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/8/52
Shift _____
Depth beginning of Shift 135'
Depth completion of Shift 165'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-9:30	Driving and Hauling Supplies.
9:30-10:00	140'	Sandy clay and Silt.				
10:00-10:30	145'	Sandy clay and Silt.				
10:30-11:00	150'	Sandy clay, Silt and Basalt chips.			11:00-11:30	Welding 9'-9" Pipe (149'-3" OH)
					11:30-12:00	Cleaning out Hole.
12:30-1:25	155'	Sandy clay and Silt, sand.			12:00-12:30	Lunch.
1:55-2:40	160'	Sandy clay, silt and sand.			1:25-1:55	Welding 9'-2" Pipe (158'-5" OH)
2:40-3:30	165'	Sandy clay, silt and sand.				

REMARKS

From 135' to 150' Heavy sandy clay and silt, some Basalt gravel and chips. 150' to 165' Layers of heavy clay, silt then heavy layer of B. & W. Sand . Drills slow and hard to mix.
Still have lots of water in hole, must be following pipe down.

HW-6.207

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/9/52
Shift _____
Depth beginning of Shift 165'
Depth completion of Shift 190'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:45-9:00	Picking up supplies and driving to location.
					9:00-9:40	Welding 9'4" pipe 167'9" over hole.
					9:40-10:30	Cleaning out hole.
10:30-10:45	170'	Sandy clay, silt and basalt chips.				
10:45-11:15	175'	Reddish brown clay, yellow sandy clay and silt.				
					11:15-11:45	Welding 9'6" pipe 178'6" over hole.
					11:45-12:00	Cleaning out.
					12:00-12:30	Lunch.
					12:30-12:55	Cleaning out.
12:55-1:30	180'	Yellow sandy clay and silt.				
1:30-2:05	185'	Yellow sandy clay and silt.				

REMARKS

HW-6.287

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/9/52
Shift _____
Depth beginning of Shift 165'
Depth completion of Shift 190'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
2:05-2:40	190'	Yellow sandy clay and silt with basalt gravel.				
					2:40-3:10	Welding 8'5" pipe 186'11" over hole.
					3:10-3:15	Cleaning out.
					3:15-4:15	Dressing out.

REMARKS

Water was 61' from land surface level at 9:40 A.M.
After driving pipe it takes from 20 to 40 minutes to get hole cleaned out.
This sand and silty clay formation bridged the hole over about 50' from bottom.
The last two mornings have had to drill thro this bridge.
From 165' to 190' sand, clay and silt. Streaks of reddish brown sandy silt. Small amount of small gravel, lots of fine sand.

HW-6.297

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/10/52
Shift _____
Depth beginning of Shift 190'
Depth completion of Shift 200'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-10:50	Went to Sunnyside for bits.
					10:50-11:45	Cleaning out sand and muck in hole.
11:45-12:00	191'	Hit gray sand and gravel.				
					12:00-12:30	Lunch.
					12:30-1:00	Hole had 30' of sand in it, cleaning out.
1:00-1:30	195'	1' gray sand, brown sandy silt.				
					1:30-2:00	Welding 10'2" pipe 197'1" over hole.
2:00-3:15	200'	1' gray sand, brown sandy silt.				
					3:15-4:15	Dressing out.

REMARKS

Water was 85' from land surface level. Might have water shut off as I can bail it down.
There was 50' of fine sand and muck in hole. At 190' to 192' gravel the size of golf balls. A lot of gray sand, caves and runs back up hole.
Water in this gravel because hole filled back up 70' of what I had it bailed down.

HW-6.287

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/11/52
Shift _____
Depth beginning of Shift 200'
Depth completion of Shift 230'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:45-8:30	Driving to location.
					8:30-9:50	Cleaning out hole.
					9:50-10:20	Welding 8' pipe 205'1" over hole.
					10:20-11:00	Cleaning out hole.
11:00-11:35	205'	Whitish sandy ash and some rock chips.				
11:35-12:00	210'	Brown sand, silt and mud.				
					12:00-12:30	Lunch.
					12:30-12:50	Cleaning out hole. 20' of muck.
12:50-1:25	215'	Gray muck, sand, very fine.				
					1:25-2:05	Welding 10'11" pipe 216' over hole.
					2:05-2:30	Cleaning out hole. 25' of muck.
2:30-2:45	220'	Gray muck and very fine sand.				
2:45-3:00	225'	Gray muck and very fine sand.				
3:00-3:15	230'	Gray muck and very fine sand.				

REMARKS

Water was 63' from land surface level. Sand was bridged over 60' from botton.
Had to drill thro this 60' of sand to get to bottom. Drilled up this sand 10' from bottom. Ran bailer 16 times. Thick heavy sand, had to add pipe with 3' of open hole. Sand ran back up pipe 15', at 11:00 A.M. I have taken 33 bailers of sand out of hole and just got on bottom. I took out 40 bailers of mud by the time I made 5'. From 215' to 230' gray caliche mud, stand up. Can bail this formation. I ran my bailer 64' times today to keep this lousy sand out.

HW-6.207

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/14/52
Shift _____
Depth beginning of Shift 230'
Depth completion of Shift 235'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-9:00	Driving to Hutment.
					9:00-12:00	Cutting pipe and getting supplies.
					12:00-12:30	Lunch.
					12:30-1:15	Cleaning out hole. 60' of sand in hole
1:15-1:55	235'					
					1:55-2:30	Welding 10'7" pipe 226'7" over hole.
					2:30-3:30	Drilling out slug and cleaning out.
					3:30-4:15	Dressing out.

REMARKS

Water was 70' from land surface level at 12:30 P.M.

There was 60' of muck in hole at 12:30 P.M. Made five foot of hole and had over 30' of sand in hole.

HW-6.287

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/15/52
Shift _____
Depth beginning of Shift 235'
Depth completion of Shift 250'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:45-9:00	Loading pipe in Richland.
					9:00-9:45	Driving to location.
					9:45-10:30	Cleaning muck out of hole.40' in pipe.
					10:30-11:00	Welding 11'2" pipe 237'9" over hole.
					11:00-11:30	Cleaning 30' of muck out of hole.
11:30-12:00	240'	Sand, some silt and basalt chips.			12:00-12:30	Lunch.
					12:30-1:00	Cleaning out hole.
1:00-1:15	245'	Sand, some silt, and basalt chips.				
					1:15-1:45	Welding 9'9" pipe 247'6" over hole.
2:15-2:45	250'	4' sand and 1' clay.			1:45-2:15	Cleaning out hole.
					2:45-3:15	Welding 8'2" pipe 255'8" over hole.
					3:15-3:30	Cleaning out hole.
					3:30-4:15	Dressing out.

REMARKS

Water was 65' from land surface level at 9:45 A.M.. Sand running in every time I get out of pipe. At 249' Hit some sticky sandy clay. Am going to set pipe into this formation and see if I can shut off sand and water.

HW-6.287

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/16/52
Shift _____
Depth beginning of Shift 250'
Depth completion of Shift 270'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:45-8:30	Driving to location.
					8:30-9:20	Cleaning out muck. 60' in hole, 10
						bailers full.
9:20-9:50	255'	Clay, shale and sandstone.				
					9:50-10:15	Changing bits.
10:15-10:45	260'	Clay, shale and sandstone.				
10:45-11:45	265'	Clay, shale and sandstone.				
					11:45-12:00	Welding 10'4" pipe 266' over hole.
					12:00-12:30	Lunch.
					12:30-1:00	Cleaning out hole. 10' of muck.
1:00-2:00	270'	Clay, shale and sandstone.			2:00-2:30	Welding 9'10" pipe 275'10" over hole.
					2:30-3:15	Cleaning out hole.
					3:15-4:15	Dressing out.

REMARKS

Water was 75' from land surface level. Ran bailer 10 times lowered water 35'
250' to 270' slick clay, gray ash, shale and sandstone. Few pebbles of gravel.
Muds up. Slow to drill. At 265' more gray ash. Muds up worse, also 170'.
Hole is still making water.

HW-6.287

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/17/52
Shift _____
Depth beginning of Shift 270'
Depth completion of Shift 290'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-8:45	Driving to location.
					8:45-9:30	Bailing out muck in hole. 20'.
9:30-10:55	275'	Blue shale, fine gravel and layer sand.				
					10:55-11:25	Welding 7'4" pipe 283'2" over hole.
11:25-12:00	277'	Blue shale, fine gravel and layer sand.				
					12:00-12:30	Lunch.
12:30-1:00	280'	Green clay and fine gravel.				
1:00-1:45	285'	Black stiff mud.				
1:45-2:15	290'	Black stiff mud.				
					2:15-2:45	Welding 7'7" pipe 290'9" over hole.
					2:45-3:15	Driving pipe and cleaning out hole.

REMARKS

Water was 125' from land surface level at 8:30 A.M. Water was 60' from land surface at 10:45 A.M. AT 270' to 272' layer of blue clay with gravel inbeded in it. Betwen 272' and 274' layer of sandy white mud. 274' to 275' layer of blue clay with gravel. I took out 20 bailers of muck to get this five feet of hole. These layers of sand carry water and this sand will pump back up the pipe. This action started right after I went into the Ringold fromation. 275' to 280' green clay and fine gravel. 280' to 290' black tight Volcanic mud. Pipe drives into this black mud like you were driving a nail thro heavy rubber. Shut water off when I went into blue shale.

HW-6.287

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/18/52
Shift _____
Depth beginning of Shift 290'
Depth completion of Shift 310'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-11:15	Driving to Sunnyside after bits.
11:15-12:00	292'	Black mud.				
					12:00-12:30	Lunch.
12:30-1:30	295'	Black mud.				
					1:30-2:15	Welding 7'3" pipe 298' over hole.
2:15-2:35	300'	Black mud and shale.				
2:35-3:05	305'	Black mud.				
3:05-3:15	310'	Black mud.				
					3:15-4:15	Dressing out.

REMARKS

290' to 310' Black mud except for a hard shale formation about 1' thick at 300'. Drills slow. Muds up, makes a lot of mud. Takes a lot of water to mix this formation.

HW-6.267

DRILLING LOG

199-H4-2

PROJECT NO. _____

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/21/52
Shift _____
Depth beginning of Shift 310'
Depth completion of Shift 320'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:45-10:00	Wailting to get equipment greased.
					10:00-11:15	Driving & hauling supplies to location.
					11:15-11:45	Welding 7'3" pipe 305'3" over hole.
					11:45-12:00	Driving pipe.
					12:00-12:30	Lunch.
					12:30-1:30	Welding 6'11" pipe & driving pipe 312'2" over hole.
					1:30-2:00	Cleaning out hole.
2:00-2:45	315'	Black mud.				
2:45-3:15	320'	Black mud.				
					3:15-4:15	Dressing out.

REMARKS

Must be a small pin hole* in pipe because the hole had 75' of water in it, and also some tan silt and fine sand. It took 68 hours for 50' gallons to run in. Pipe moves very slow into this formation.

* This pin hole is 30' from the bottom of pipe.

HW-6.287

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/22/52
Shift _____
Depth beginning of Shift 320'
Depth completion of Shift 331'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:45-8:45	Driving to location and hauling supplies.
					8:45-9:15	Welding 6'11" pipe 319'1" over hole.
					9:15-9:45	Driving pipe.
9:45-10:45	325'	Black mud.				
					10:45-11:15	Welding 7' pipe 326'1" over hole.
11:15-12:00	328'	Black mud like shale.				
12:30-1:00	330'	Black mud like shale.				
					1:00-1:30	Welding 6'5" pipe 332'6" over hole.
					1:30-2:00	Driving pipe. Moving very slow.
2:00-3:15	331'	Acts like basalt.				
					3:15-4:15	Dressing out.

REMARKS

325' to 330' drills hard and slow. Got pieces of hard gray shale when dry, black when wet.
Bails good, comes out of hole slick and slimy.
Slower to drill past 330'. Pipe moves very slow and hard. Takes about 6 minutes to get a foot driven.
Water is completely shut off.

HW-6.207

199-H4-2

DRILLING LOG

PROJECT NO. _____

Rig No. ABC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/23/52
Shift _____
Depth beginning of Shift 331'
Depth completion of Shift 340'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:45-8:45	Driving to location.
					8:45-8:55	Driving pipe. Pipe does not move.
					8:55-9:05	Bailing out hole clean.
9:05-11:00	334'	Shale. Tough as hell.				
					11:00-12:00	Changing rope socket and putting on jars.
					12:00-12:30	Lunch.
12:30-1:00	335'	Hard black shale.				
1:00-2:30	340'	Black shale, green clay. This looks like rotten basalt.				
					2:30-3:15	Preparing to fish for bit.
						Knock off box on stem, must have hit something very hard.

REMARKS

Drive pipe for 10 minutes and moved it about ½". Drove pipe after making 1' and it is still moving very slow.
At 2:30 P.M. Knocked off box on stem.

HW-6.267

DRILLING LOG

199-H4-2

PROJECT NO. _____

Rig No. AEC 22-3152
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/24&25/52
Shift _____
Depth beginning of Shift 340'
Depth completion of Shift 340'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:45-8:45	Driving to location.
					8:45-3:15	Fishing for bit.
					3:15-4:15	Dressing out.
					7:45-8:45	Driving to location.
					8:45-2:45	Fishing for bit. Got it out at 2:45 P.M.
					2:45-3:15	Breaking down fishing tools.
					3:15-4:15	Dressing out.

REMARKS

Lost bit April 23 at 2:30 P.M. Got bit out April 25 at 2:45 P.M.
Bit had fell over against the side wall of hole.
Had a hard time getting it straight again. Had to have slip socket turned down inside so I could get over bit.

HW-6.267

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC 22-3132
Well No. 197-H-2
Driller Row
Foreman _____

Date 4/28/52
Shift _____
Depth beginning of Shift 340'
Depth completion of Shift 365'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:45-8:45	Driving to location.
					8:45-10:30	Breaking down fishing tools and loading them.
11:00-11:30	345'	Green, black and white shale or clay.				
11:30-12:00	350'	Green, black and white shale or clay.				
					12:00-12:30	Lunch.
12:30-1:15	355'	Green shale, black shale, white sand and basalt chips.				
1:15-2:15	360'	Basalt, rotten or weathered.				
2:15-3:15	365'	Basalt, rotten or weathered.				
					3:15-4:15	Dressing out.

REMARKS

This is a 6" well. Pipe is 332'6" long with 1'6" above ground.
Hit basalt at 335'.
340' to 355' green, black and white shale or clay.
355' to 365' rotten basalt. Hole making water in the basalt. Had 20' in hole after bailing 10 times at 360'.
At 365' had 40' of water in hole.

HW-6.287

DRILLING LOG

PROJECT NO. _____

199-HH-2

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Low
Foreman _____

Date 4/29/52
Shift _____
Depth beginning of Shift 365'
Depth completion of Shift 380'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-8:30	Driving to 200 East.
					8:30-10:00	Unloading fishing tools and motor.
					10:00-10:15	Driving to 100 H area.
					10:15-11:00	Testing for water. *
11:00-12:00	370'	Basalt. Break at 370'.				
					12:00-12:30	Lunch.
12:30-2:00	375'	Ash, sand, silt, blue clay, shale, gravel and sandstone.				
2:00-3:15	380'	Ash, sand, silt, blue clay, shale, gravel and sandstone.				

REMARKS

* Water was 16.3' from land surface level at 10:15 A.M.

Jack Ford, my helper failed to show up today.

This water in this well is coming out of the basalt. Ran out of the basalt at 370'. Hit a little bit of everything at 375' and 380'.

While drilling at 380' the water rose up in the pipe ½' above ground surface.

HW-6.207

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEC 22-3132
Well No. 107-H-2
Driller Row
Foreman _____

Date 4/30/52
Shift _____
Depth beginning of Shift 380'
Depth completion of Shift 386'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-9:40	Driving and hauling supplies to location.
					9:40-11:15	Repairing machine.
11:15-12:00	381'	Top of second layer of basalt.				
					12:00-12:30	Lunch.
12:30-2:45	385'	Basalt. *				
2:45-3:15	386'	Basalt and blue mud.				
					3:15-4:15	Dressing out.

REMARKS

Water was 25' from land surface lever at 10:00 A.M.
Water was 10' from land surface level at 12:40 P.M.
Water was 5' from land surface level at 2:30 P.M.
There was 20' of gray sand in hole at 11:15. This sand must have shut off water last night.
Sand in this sample came out of break.
380' to 386' drills slow and hard. Bails hard.

HW-6.287

DRILLING LOG

199-H4-2

199-H4-2

PROJECT NO. _____

Rig No. AEC 22-3132

Well No. 107-H-2

Driller Row

Foreman _____

Date 5/1/52

Shift _____

Depth beginning of Shift 386' Hole complete

Depth completion of Shift _____

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:48-9:30	Driving, hauling pipe and perforator.
					9:30-11:15	Welding 7'6" & 7'1" & 8' pipe.
						355'1" over hole.
					11:15-12:00	Cleaning out hole.
					12:00-12:30	Lunch.
					12:30-1:00	Driving pipe and cleaning out hole.
					1:00-3:15	Welding 6'1" & 9'8" pipe 370'10" over hole.
					3:15-4:15	Dressing out.
						Cut off 6' of pipe, making total of 364'8"
						over hole.

ON 5/2/52 PERF 25-50 5 CU.FT/RND/FT.

REMARKS

This is a 6" well. Well is cleaned out to bottom. Water was 35.8' from land surface level at 9:30 A.M.

Pipe drives very slow.

Bottom of hole 386'. Pipe over hole 364'8". 18" above ground, 363'2" in hole.

Drove pipe to 362'8" then it stopped. Drove for 15 minutes and only moved pipe 2".

Drove pipe 8' in this rottem basalt before it stopped.

DRILL LOG	BY [illegible]	RIG 2	WELL NUMBER 100-H-7-3 10-H	COMPUTER NUMBER	PROJECT OR WORK ORDER NO.
	DATE [illegible] 5-6-88		DEPTH 0' TO 15'		SUBCONTRACT NO. 763

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
11.2	5'	D	Dry	60% gravel 40% sand		
	10'	D	Dry	50% gravel 50% sand		
	15'	D	Dry	60% gravel 40% sand		

REMARKS:

A-6000-021 (...14) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ____STANDING WATER

DRILL LOG

BY	RIG	WELL NUMBER	COMPUTER NUMBER	PROJECT OR WORK ORDER NO.
Kevin Bales	2	199-H-4-3 100-H		
DATE: Mar 20 1974	8:00 AM to 4:30	DEPTH: 15' to 46'		SUBCONTRACT NO. 263

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
16.2	20'	D	Dry	60% sand 40% gravel		
26.2	25'	C	Dry	60% sand 40% gravel		
32.2	30'	D	Dry	60% sand 40% gravel		
45.0	35'	D	Dry	60% sand 40% gravel		
	40'	D	Dry	60% sand 40% gravel		

REMARKS:

A-6000-021 (1-74) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ____STANDING WATER

DRILL LOG	BY Harvell Baker	RIG 2	WELL NUMBER 199-W-4-3	COMPUTER NUMBER	PROJECT OR WORK ORDER NO.
	DATE June 29, 1974	5:00 to 3:30	DEPTH 46' TO 49'		SUBCONTRACT NO. 76.3

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
49.0	49'	P	dry	Caliche		
				The specimens 12:00 to 1:00 missing upon sitting up		

REMARKS:

A-6000-921 (. /4) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ____STANDING WATER

DRILL LOG	BY Thomas H. Barber	RIG 2	WELL NUMBER 199-H-4-3 KCH	COMPUTER NUMBER	PROJECT OR WORK ORDER NO
	DATE 5/21/74	8:20 to 1:30	DEPTH 40' TO 40'		SUBCONTRACT NO. 763

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
45'						
				changing tools		
				Tab special work 12:00-1:30 moving rig out because of building demolition		

REMARKS:

A-6000-021 (. -74) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ____STANDING WATER

DRILL LOG	BY [illegible]	RIG 2	WELL NUMBER 199-H-4-3 KCA	COMPUTER NUMBER	PROJECT OR WORK ORDER NO.
	DATE [illegible]	3" & 4"	DEPTH 43' TO 55'		SUBCONTRACT NO. 763

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
4.36	45'	P	dry	sand gravel cobble		
5.36'	49'	P	dry	sand gravel cobble		
✓	50'	P	drop	ringoll		
	55'	P	drop	ringoll & cobble		
				2½ hrs standby 2" & 4" waiting for instruction on perforations		

REMARKS:

A-6000-021 (. 74) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ____STANDING WATER

DRILL LOG

BY	RIG	WELL NUMBER	COMPUTER NUMBER	PROJECT OR WORK ORDER NO.
[illegible]	2	[illegible]-4-3		
DATE [illegible]	9:00 to 4:00	DEPTH 55' TO 55'		SUBCONTRACT NO. 363

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
58'6"						
				5 hr specialmark 9:00 to 12:00 perforating well 340'6" to		
				12:30 to 2:30 55'0" water level 18 feet		
				[illegible]		
				[illegible]		
				[illegible]		
				[illegible]		
				[illegible]		
				[illegible]		
				[illegible]		
				[illegible]		
				[illegible]		
				[illegible]		
				[illegible]		

REMARKS: 58'6" of casing 55' of drilling

A-6000-021 (4) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

DRILL LOG	BY Troy	RIG White	WELL NUMBER 3 H4-4	COMPUTER NUMBER	PROJECT OR WORK ORDER NO. A-
	DATE 6/1/83		DEPTH 0 TO 5'		SUBCONTRACT NO. JTJ-1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
13 3/10" Casing	4'	Hand Tool		Set up rig - after moving from Exxon	5:47 AM	
				Plant and returning to get my Truck	11:35 AM	
				Cleaned around rig - Tightened Spudding		
				Wheel Bolts - greased Spud Gears Started		
				Drilling Surface Seal - Hauled Some		Put in Spoils Gas
				Water over in Tank To drill and use		(Rig White)
				Shut Down - grease clutches - cleaned		
				up Finished well log Headed for Home	5:55 PM	
				8 hours		

REMARKS:

DRILL LOG

BY: Troy	HIS: White	3 4-4	COMPUTER NUMBER:
DATE: 6/2/83		DEPTH: 5' to 10'	

PROJECT OR WORK ORDER NO.: B-29416
SUBCONTRACT NO.: JAS 1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION (% EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.)	TIME	DRILLING COMMENTS
				Started Drilling at 7:00 - after I		
				checked oil, water, and added 5 gals Gas		5 gals Gas
				Drilling is in Large To Small Gravel		
				and Medium To Coarse Sand - 10" is		
	5'		Dry	going in very good not Driving it		
				(Basically) Drilling still the same - down		
				To 9' 6" with Hole and Casing - Cleared		
				around rig some more and Tighten Mirrors		
				on Truck Cab - Bleeding off Brakes some		
				more on rig Tank still doesn't work very good.		
				Left for Home 3:00 PM		
				8 hours		

REMARKS:

A-6000-025 D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

DRILL LOG

BY: Troy
DATE: 6/3/83
RIG: White
HOLE NO.: 3H 4-4
DEPTH: 10 TO 20
SUBCONTRACT NO.: R-20 416
JAJ-1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION (INCLUDE EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.)	TIME	DRILLING COMMENTS
	10	Hard Tool	Wet	Larger To Medium Gravel - Course Sand	7:25	Started at 7:00
				Added 3gals water To drill with - greased		
				rig, added 5gals Gas To Tank		5gals Gas
				Drilling slow To get Casing To go in easily		
				with out Drilling Head on it!		
	15	"	"	Medium To Small Gravel sand sand	11:40	
	20	"	"	Small Gravel, Course Fine sand and	3:00	
				1 or 2 large Gravel		

8 hours

REMARKS:

A-6000-82 (74)

D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE _ STANDING WATER

DRILL LOG

BY: Troy
DATE: 4/8/83
RIG: White
WELL NUMBER: 3 H4-4
DEPTH: 45 to 54"
COMPUTER NUMBER:
PROJECT OR WORK ORDER NO: 5-30116
SUBCONTRACT NO: JAT 1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION (% EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.)	TIME	DRILLING COMMENTS
54½"	50'	Hard Tool		Started rig - added (2 gal) water to radiator	700	
	50-55	—	wet	Sand & Gravel fine Fine - extra fine	1200	
				Welded on 54½" (6")		
				Have some water - sand is very bad - had		
				to get out bottom of casing - some small		
				gravel still limits settled out bottom		
				of casing but sand keeps filling up to		
				50' - Bailed hole for three hours		
				Hauled cement and barrel to mix		
				to #3 well from #2 well ready for		
				tomorrow		
				Put in 5 gals Gas		5 gals
				Left for Home	300	
				Total 5 hours		5 gals gas

REMARKS:

A-6000-021 (4)

D-DRIVE BARREL H-HAND TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

DRILL LOG

BY: Troy
DATE: 6/9/83
RIG: White
WELL NUMBER: 3 H4-4
DEPTH: 54' TO 54'
COMPUTER NUMBER:
PROJECT OR WORK ORDER NO: A-30 YIC
SUBCONTRACT NO.: JW 1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
35.2"	50'	—		Put in (3) gals gas in welder and (2) gals in rig		5 gals gas
5' Blank 10' Screen 7' Blank including Packer					7:10 am	
				Ran Screen Pulled Pipe Back 15'		
— 14 Feet of water				Cut off 24" above Ground - Bailed water		
standing in Hole -				for cement - Mixed (2) five sacks cement		
This gives state of				Poured in hole - Pulled Surface Lines mixed (3)		
36'				Three more sacks Poured in - mixed (6) more		
				To fill Total of (19) fifteen sacks - Bailed		15 Sacks Cement
				Hole for (1) one hour Total —		4 hours development
				Loaded rig Down - cleaned up area (Bayard)		
				Started digging Underside Post Holes - Set Post		
				Painted them and well head with (2) Two coats		
				Primer - went to well #1 and started digging		
				Post Holes - cleaned up garbage and		
				Hauled to dumpster at 25th ave on way		
				To Town - left for home	3:20	
				Total 8 hours		5 gals gas

REMARKS:

A-6000-021 (.4) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ⊻ STANDING WATER

DRILL LOG

BY	RIG	WELL NUMBER	COMPUTER NUMBER	PROJECT OR WORK ORDER NO.
Troy	White	#1 #2 #3 H4-4		B-30416
DATE 5/16/83		DEPTH 0 to 0		SUBCONTRACT NO. JAI 1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
				Finished Doing Barricade Post on well #1	7:00 AM	Left the well
				Dug Post Holes and set Post on well #2		
				Painted well Head and Barricade Post on	7:30	1 Crew Gone White
				well #1 #3 with 2 coats Primer - Painted		Truck
				all three with Two Coats finish yellow		
				Cleaned up well sites Trimed 6" Casing		
				with Torch - Finished Fixing Mast Braces		
				pins and welded X Braces - Fixed Brakes		
				- Fixed Generator Bracket - Checked oil water		
				and gas in rig motor and Truck motor,		
				dropped off well samples from wells #1,2,3		
				at Brads office with copys of well logs		
				No radiation on any samples or in		
				any of the three wells		
				will need to pickup left over Cement		
				pipe and drill Tools and water Barrels		
				and tank this morning I did by picking		
				up White Truck -	3:47	

REMARKS:

Total hours

Diesel Gas Total 832,000 in Rig tank

A-6000-021 (1-.

D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

DRILL LOG

BY: Troy #0438
DATE: 4/27/83
RIG: WHITE
WELL NUMBER: 4-5
DEPTH: 0 TO 5'
COMPUTER NUMBER:
PROJECT OR WORK ORDER NO.: B-30 416
SUBCONTRACT NO.: JAJ-1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION (% EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.)	TIME	DRILLING COMMENTS
0	5'	Drive Barrel	Dry Lab	(M) Gravel - Mount Saint Helens ash - (S) Gravel 2" To 5" (70%) (2%) (20%)	4:00 PM	Started drilling at 12:35 AM
				(F) Sand (5%) Top Soil (3%)		Stopped drilling at 3:35 PM
						Left Job at 4:06 PM

REMARKS: Used Drive Barrel on this First 5' But will Have To Put on drill bit To go on as The Gravel is To Large!

Total Hours Today include 2 Construction meeting This morning (7 hrs)

A-6000-021 (1-74)

D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

DRILL LOG

BY: Troy Smith
DATE: 4/28/83
RIG: WHITE
WELL NUMBER: H4-5
DEPTH: 5' TO 10'
COMPUTER NUMBER:
PROJECT OR WORK ORDER NO: B-30416
SUBCONTRACT NO.: JAJ-1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION (% EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.)	TIME	DRILLING COMMENTS
8' of 12"	9'	Hard TOOL	WET #1 of 2	(S) Gravel 20% (M) Gravel 70% (C) Sand 10% (River Bottom Sands and Gravels)	10:00 AM	Started Drilling at 7:35
	10'	"	" #2 of 2	" " " "	2:45 PM	added 5 gals water
						Stopped drilling at 3:40 PM
						Left Job at 4:00 PM

REMARKS: Used Drill bit all day, is going slow through this Gravel - Casing is Following Drilling Down To W Hours for To day is (8 hrs)

A-6006-021 (. .4)

D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ____ STANDING WATER

DRILL LOG

BY: Troy Orozco
DATE: 4/29/83
RIG: WHITE
WELL NUMBER: H-4-5
DEPTH: 19' TO 13'
COMPUTER NUMBER:
PROJECT OR WORK ORDER NO: B-30 416
SUBCONTRACT NO: JAJ-1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION (% EACH GRAIN SIZE, COLOR, HOMOGENEOUS, CALICHE, ETC)	TIME	DRILLING COMMENTS
8' / 12"	8'	Hand Tool	—	(L) Gravel To medium 90% (S) Gravel and Sand (F) 10% Bailed Hole at	8:00 AM	Started Work
					8:27 AM	added 5 gals of Water / Started Drilling
15'6" / 10"	12'	—	—	Surface Liner To hold Hole open - Free set in Hole	11:04	Hole is Caving Back
				Extra Larger Gravel 8" To 15" approximately 50% Bailed Hole	1:05	Drilling Slow added 2 gals water
						Stoped Drilling at 3:30 PM
						Had to pull Liner Back (3) Times
						Left Job at 4:38 PM

REMARKS: Stoped Drilling at 3:30 PM - Had To put Voltage regulator on rig motor, checked oil added (1 quart) put (5) gals gas in rig - put water in Batterys on rig & welder - was Low. $1:05
$5.45 Total Hours for Today is (8 hours 30 minutes)

A-8000-021 (1-74)

D-DRIVE BARREL H-HAND TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

DRILL LOG

BY: Troy #0438
DATE: 5/2/83
RIG: UHIT
WELL NUMBER: H4-5
DEPTH: 13' to 12'
PROJECT OR WORK ORDER NO: B-30416
SUBCONTRACT NO: JAJ-1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION (% EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.)	TIME	DRILLING COMMENTS
8' / 12"	8'	—	—	Started Late - Motor went out of Pickup on Way Here.	9:35 AM	Started Drilling at 10:00 AM
15'6" / 10"	15'6"	Hard Tool	Wet #1 of 3	Got Casing Down To Bottom of Hole Finally	1:30 PM	Still Drilling Hard
	15'			Bailed Hole at 15' Got Samples #1 of 3	12:58 PM	
	20'		Wet #2 of 3	Light Clay, Larger To Medium River Gravel Bailed Hole at 20'	5:15 PM	Stopped Drilling
19'6" / 6"	20'	—		Set in Hole and Tied 6" Hard Tool	5:45 PM	Left Job for Home

REMARKS:

Total Hours 8 hours

A-6000-021 (4) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

DRILL LOG

BY: Zi
DATE: 5/3/83
RIG: White
WELL NUMBER: H4-5
DEPTH: 17' to 21'
PROJECT OR WORK ORDER NO: B-30416
SUBCONTRACT NO: JAJ-154

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION (% EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.)	TIME	DRILLING COMMENTS
					700hrs	Start at Rig, 1 Gravel Drilling
17'6"	17'	Hand Tool	—	Welded on 5 [illegible]	730hrs	[illegible]
17'6"	20'	"	WET	(2) Gravel Packed Filters / [illegible] Sand	[illegible]	[illegible]
					340hrs	Start [illegible]

REMARKS:

(8 hours [illegible])

A-6000-021 (. /4)

D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ____STANDING WATER

DRILL LOG

BY	RIG	WELL NUMBER	COMPUTER NUMBER	PROJECT OR WORK ORDER NO
Troy	White	145		B-[illegible]/16
DATE 5/4/83		DEPTH 21' to 27'		SUBCONTRACT NO. 3 [illegible]

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
—			—	Too [illegible] 73[illegible] 11:20		
[illegible]	27'	Hand Tool	—	(2) Gravel (M) Gravel (S) Gravel (C) Sand Large [illegible] 2"&18" [illegible] (21) [illegible]	11:[illegible]	Average [illegible] [illegible] day

REMARKS:

Started at 11.45 AM to 6:45 PM (7 hours) Total

A-6000-021 (4) D-DRIVE BARREL H-HARD TOOL L-LARGE M-METHOD S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

DRILL LOG	BY Bigham	RIG white	WELL NUMBER H4-5	COMPUTER NUMBER	PROJECT OR WORK ORDER NO B-30416
	DATE 5/5/83		DEPTH 27 to 35		SUBCONTRACT NO. JAJ-1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
34'6"	30	H	Wet	SAND, GRAVEL, COBBLES, BOULDERS		
6'4"						
36'2"	35	H	Wet	SAME		
				EXTREMLY HARD DRILLING GOES FROM ONE BOULDER TO ANOTHER		

REMARKS:

A-6000-021 (5-74) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ____ STANDING WATER

DRILL LOG

BY: Bigham
DATE: 5/6/83
RIG: White
WELL NO.: N4-5
DEPTH: 35 to 48
B 30116
SUBCONTRACT NO.: JAJ-1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION (% EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.)	TIME	DRILLING COMMENTS
36'2"				WENT out OF Boulders at 36'		
8	40	H	wet	SAND + GRAVEL some cobbles		
44'2"						
10'	45	H	wet	SAME		
54'2"						
				WATER BEARING 36' to 48'		

REMARKS:

A-6000-021 (4) D-DRIVE BARREL H-HAND TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE — STANDING WATER

DRILL LOG

DATE: Bigham 5/9/83

RIG: white

WELL NUMBER: H4-5

DEPTH: 48 TO 60

COMPUTER NUMBER:

PROJECT OR WORK ORDER NO.: B-30416

SUBCONTRACT NO.: JAJ-1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
54'2"						
	50	H	Wet	Brown sandy silt		
	55	H	Wet	SAME		
	60	H	Wet	SAME		
				went into silt at 48'		

REMARKS:

A-6000-021 (1/74) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ____STANDING WATER

DRILL LOG

DATE 5/10/83

DRILLER Bigham

SITE White

WELL NUMBER H4-5

DEPTH TO

B-30416

SUBCONTRACT NO. JAJ-1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
				set screen in well		
				pulled casing back		
				Poured surface seal	135 gal	
				developed 2 hrs		
				screen section 27' 10" long		
				top of screen assembly 32' 2" from ground		
				16' tail pipe		
				10' 4" screen with weld rings		
				1' 6" packer on top		
				static 36 Ft		

REMARKS:

A-6000-021 4) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE — STANDING WATER

DRILL LOG

BY: Bigham
DATE: 5/11/83

RIG: white

DEPTH: 1 to 14-5

B-30416
SUBCONTRACT NO.
JAI-1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
				developed well 2 hrs		
				moved rig + tools to next site		
				starter went out on rig - took in to be repaired		

REMARKS:

A-6000-02 (4) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE STANDING WATER

DRILL LOG

BY: Bigham
DATE: 5/12/83
RIG: White
WELL NUMBER: 2H 4-6
DEPTH: 0 to 8
COMPUTER NUMBER:
PROJECT OR WORK ORDER NO.: B-30416
SUBCONTRACT NO.: JAJ 1542

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
7'	5	D	Dry	sand gravel + cobbles		

REMARKS:

A-6000-021 4) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

DRILL LOG	BY Bigham	RIG White	WELL NUMBER 114-6	COMPUTER NUMBER	PROJECT OR WORK ORDER NO. B-30416
	DATE 5/13/83		DEPTH 8 TO 15		SUBCONTRACT NO. IAJ-1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
	10	D	D	SAND GRAVEL COBBLES		
				hit Boulder at 14'		
				put on Hard tools		

REMARKS:

A-6000-021 (1-74) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ____STANDING WATER

DRILL LOG

BY: Troy
DATE: 5/16/83
RIG: white
WELL NUMBER: 2
DEPTH: 15 TO
COMPUTER NUMBER:
PROJECT OR WORK ORDER NO.: B-30416
SUBCONTRACT NO.: JAI 1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION (% EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.)	TIME	DRILLING COMMENTS
		Hand Tool		Started at 7:00 - Picked up whites air Sawi		
				and Gloves - Greased rig - oil (OK) - Gas (OK)		
				Checked Drill string for joints tight or loose (OK)		
				Will have to fix tape seeker screw -		
	15'		WET	Looks like medium to Small Gravel with a Little Sand - (Coarse) mixed in.	9:00	Started Drilling at 7:30 Took Sample at 7:00
				Drilling pretty Good so far 20' and	10:04	Will set in 20'3"
(20'3"	with	Drive Shoe)		have Casing in The Hole with Drive shoe		Casing let Falling
	20'		WET	Small - medium - Large Gravel - with fine sil		Down
				and medium Sand	2:00	Shut Down
				8 hours Rig Time - (12 minutes welding)	3:06	Headed for home
				Total 8 hours		

REMARKS:

A-6000-021 (.

D-DRIVE BARREL H-HAND TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

DRILL LOG

BY: Troy
DATE: 5/17/83
RIG: White
WELL NUMBER: 2
DEPTH: 20' TO 27'
COMPUTER NUMBER:
PROJECT OR WORK ORDER NO: B-30416
SUBCONTRACT NO.: JAJ 1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION (% EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.)	TIME	DRILLING COMMENTS
		Hard Tool		7:00 - Crossed rig - checked oil - water		
				Fixed choke -		
	25'		Wet	Same as yesterday no Change - (1) one Large	12:10	Water Broke
				Welder - Hydric ring off Test Casing		Down - Will use
				Down.		jiggy welder 7:11
						Water Broke Down - hose
						Fixed -
26'3"	27'	—		Welded on 6' of casing. Bumped	12:30	
				Down with drive clamps - went in		
				very good. added 3 gals. Water	3:10	Left For Home
						Put in 10 gals
						of Gas in
						Rig Motor
						$12.00

REMARKS:

Total 8 hours

A-6000-021 (. 4) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

DRILL LOG

BY	RIG	WELL NUMBER	COMPUTER NUMBER	PROJECT OR WORK ORDER NO
Troy	White	144-HLW 2		B-30416
DATE 5/18/83		DEPTH 27 TO 31		SUBCONTRACT NO. JAJ 1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
26'3"	27' Of Hole	Rn. J Hard Tool	— —	Start 700 Hrs -		
				Drilled on large Boulder - pulled casing		
				Back (2') Two feet, Removed Boulder so casing		
	30'	Hard Tool	WET	Would Go on Down - Broke Tool - Rope Sock	200	
				Cut off (10') of Line, made Back up - Drove		
				Casing Down - welded on 2'10" of Casing		
				Drove Down - Drilled out Bottom - cleaned		
				Crane on Rig used New pump Hole well		
				Bring out Tomorrow with Cement.	300	Left for Home
				8 hours Total		

REMARKS:

900-021 (1-76) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ____ STANDING WATER

DRILL LOG	BY Troy	RIG White	WELL NUMBER 2	COMPUTER NUMBER	PROJECT OR WORK ORDER NO B-30416
	DATE 5/19/83		DEPTH 31' TO 36'		SUBCONTRACT NO. JAJ1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
35'7"	35'	Hard Tool	Wet	700 Stand - Hung Brace on rig - can't get pin in - put welding rods in temporary		Had to jump rig to start. Drilling Hard Put in 10 gals Gas $12.00
				medium Gravel and large Gravel and Boulders		
39'7"	36'	—		welded on 4' of casing for Tomorrow Drilling Hard and slow large Gravel and Rocks - a little Coarse Sand.	20'	Go Home
				8 hours Total		

REMARKS:

A-6000-02 (-74) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

DRILL LOG

BY	RIG	WELL NUMBER	COMPUTER NUMBER	PROJECT OR WORK ORDER NO
Troy	White	2		B-304416
DATE 5/20/87		DEPTH 36' TO 40'		SUBCONTRACT NO. JAJ 1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
37'7"	36'	Hard Tool	—	Started - Greased rig, Put in (12 ounces oil)	7:00	
				Strung out some more line to drill with		
				Trim out casing — Put in Sgal Gas —	8:45	$6.00
				Starting to Drill Better - added Jgal water		
40'	45'	Hard Tool		Welded on 1'3" of Casing		
	40		—	Light, medium, Coarse sand and pea Gravel	207	
				Casing is Free Setting now Hard to		
				Hold Back - no water yet		
					300	left for Home
				8 hours Total		

REMARKS: $30.00

25 Gals Gas Total 1 quart oil

A-6000-02. 7-83 D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ____ STANDING WATER

DRILL LOG

BY: Troy
DATE: 5/22/83
RIG: White
WELL NUMBER: 2
DEPTH: 40' to 54
COMPUTER NUMBER:
FIELD OR WORK ORDER NO: 15-32-416
SUBCONTRACT NO: JAJ 1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION (% EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.)	TIME	DRILLING COMMENTS
46'	45' of Hole	Hand Tool	WET	Start 710		
	45			Small Gravel - Corse Sand		
	50'	"	"	" " " " + Some water	103	
	54'	"	"	" " - Pea Gravel - Water - Corse Sand		
54'	54'	"	—	and Fine Sand - Static of 41'		
				Baled Hole for 1 hour		
				Left for Shop To Turn in	300	
				Drill Logs and stop by College		
				Total added on Today		
				8 hours		

REMARKS:

A-60 (1-78) D-DRIVE BARREL H-HAND TOOL L-LARGE M-M... S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

DRILL LOG	BY Troy DATE 5/24	RIG White	WELL NUMBER 1-[illegible] DEPTH 54 TO 55'	COMPUTER NUMBER	PROJECT OR WORK ORDER NO. B-20 416 SUBCONTRACT NO. JAJ 1641

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALCITE, ETC.	TIME	DRILLING COMMENTS
54'	54'	Hand Tool	—	7:00 AM - STATIC 13' or (41' from well head)		
				Greased Rig - (Put in 10 gal's Gas)		$12.00
				Drilled and bailed Bottom of hole		
				will stand open only to bottom of casing		
	(54'	To 39')		5' of 5" screen with Bottom end welded		
				10' of screen and 1'6" of 5" casing		
				with Packer - installed in the Bottom		
				Have 2' of screen above water static		
48' of 6" casing				Pulled 14' of 6" - cut off 24" above		
				ground level - grouted - 14 sacks according		126
				To mix - pulled surface liner - Installed		
				Packer cap with Hasp Lock Hinge -		
				Cleaned up area, Bailed Hole for		
				(3) more Hours - Layed down rig	96 hr/sack	
				returned Tools and pipe - loaded		
				air bottles + gauges in rig - checked		
				oil' water' Gas' (OK) - Secured		
				Load - - - also Broke drive barrel		
				and Jaws - Broken	2b9	

REMARKS: Waited for Dale so He could Follow me To Exxon area
Drove Rig To Exxon + Park Neat To Pickup my Pickup 2 Hours

A-6500 (1-74) D-DRIVE BARREL H-HAND TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE ___ STANDING WATER

APPENDIX B

PROCEDURES FOR SAMPLE COLLECTION, CHAIN-OF-CUSTODY, AND FIELD MEASUREMENTS

APPENDIX B

PROCEDURES FOR SAMPLE COLLECTION, CHAIN-OF-CUSTODY, AND FIELD MEASUREMENTS

This appendix gives procedures used in the RCRA Compliance Monitoring Project for sample collection, chain-of-custody and field measurements. These procedures have been extracted from PNL's Environmental Monitoring Procedures manual (Earth Sciences Department, 1986).

13.0 HAZARDOUS MATERIALS SAMPLING

Introduction

Environmental monitoring for a wide variety of hazardous chemicals has recently been implemented at the Hanford Site. Samples to be analyzed for these materials must, in many cases, receive special treatment. Accordingly, new procedures that are specifically designed to preserve the integrity of these samples have been developed.

The procedures to be used during collection and transportation of the samples are contained in this section. All aspects of sampling, including pump operation, borehole purging, and field measurements (water level, pH, specific conductivity, and temperature) are described. The chain-of-custody procedures used to track and protect the samples are also included.

13.1 WATER-LEVEL MEASUREMENT PROCEDURE

Introduction

Water-level measurements are taken each time a well is sampled, before it is purged. These measurements are taken as depth-to-water from the top of the well casing. They must be subtracted from the surveyed elevation of the casing given in Hanford Wells to obtain the elevation of the water table. The water-table elevations obtained for all wells in the sampling network during a particular sampling episode can be used to produce a contour map showing the ground-water surface at the time that the measurements were made. These contour maps can be used to help characterize the ground-water flow system and to ensure that the sampling network is adequate.

Graduated steel measuring tapes are more accurate than electrical tapes and so should be used for official measurements. However, an electrical tape can be used to determine the approximate depth to water.

Equipment

The following equipment will be needed:

- steel measuring tape with attached weight
- blue carpenter's chalk
- a copy of Hanford Wells (PNL-5397)
- electrical tape
- engineer's measuring tape
- field record forms.

Graduated Steel Tape Method

Chalk the 1-ft section of steel tape below the zero reading point.

Find the elevation of the measuring point and the estimated water level in Hanford Wells, or use an electric tape to find the approximate depth to water.

Lower the steel tape from the well's measuring point (marked with paint on the top of the casing) to the estimated water level. Note the amount of tape that is in the well by reading the tape at the measuring point. This value is referred to as the "hold point."

Remove the steel tape and check the wetted portion below the zero reading point.

NOTE: If the chalked portion is not wet, repeat the procedure, but allow more of the tape to go down the well (i.e., use a greater hold point).

Add the unwetted length of the chalked portion of the tape to the hold point value to obtain the depth-to-water measurement.

If the chalked portion is not wet, repeat until the water level is marked on the chalked portion of the tape.

Repeat the procedure until two steel tape measurements agree within ±0.05 ft.

Record the depth-to-water measurements, time of measurements, measuring device, and the name of the person taking the measurements on the field record form.

Electric Tape Method

Lower the electric tape from the measuring point into the borehole until the buzzer and the light indicate contact with the water.

Mark the electric tape at the measuring point and identify the nearest graduation on the electric tape.

If the water level is deeper than the nearest graduation marked on the tape, add the difference to the depth identified to obtain the true depth to water.

If the water level is shallower than the nearest graduation marked on the tape, subtract the difference from the depth identified to obtain the true depth to water.

Record the depth-to-water measurements, time of measurements, measuring device, and the name of the person taking the measurements on the field record form.

NOTE: This measurement should be used only as an approximate depth to water, because the electric tape is less reliable than the steel tape.

13.2 HAZARDOUS MATERIALS SAMPLE COLLECTION PROCEDURES

Introduction

These procedures are intended for use in collecting ground-water samples that will be analyzed for hazardous chemicals.

Equipment

The following equipment may be needed in the field during sampling:

- truck-mounted air compressor and generator
- bladder-pump controller box
- bladder-pump hoses (set of 2)
- extra discharge line for bladder pump
- extra discharge line for submersible pump
- Teflon bailer
- pH and conductivity meter
- digital thermometer
- steel measuring tape
- blue chalk
- electrical tape
- engineer's measuring tape
- a copy of Hanford Wells (PNL-5397)
- stopwatch or watch with second hand
- bucket or jug (for measuring flow rate)
- distilled water
- ziplock bags
- ice chests with ice
- plastic gloves
- aprons
- towels
- indelible marker
- extra sample labels
- sample seals
- a copy of all relevant procedures
- sample containers with caps and liners (including extras)
- field record forms
- chain-of-custody forms
- sample-analysis request forms.

Sampling Precautions

Do not smoke, eat, or handle any objects not necessary for sampling while performing sampling procedures.

Do not sample downwind of any potential sources of volatile organics such as car exhausts or open fuel tanks. These could contaminate the sample. If any such sources are unavoidable, make a note of them on the field record forms.

Leave caps on the sample containers until just before filling.

Avoid handling the Teflon bottle cap liners. Do not use any liner that falls out of the cap and onto the ground.

Wear gloves when taking samples and when handling containers, especially those with added preservative.

Sample Collection Using Submersible Pump

Take water-level measurements according to the water level measurement procedure.

Check to see that the hose bibb for the submersible pump is open.

CAUTION. Be sure the power switch to the 230-V outlets is turned off!

Plug the power cord into one of the 230-V outlets on the generator on the truck and into the outlet at the well head.

Start the electric generator.

Turn the power switch on to begin pumping process. Be sure not to handle energized power cords. If the pump does not work properly, as indicated by a lack of air flow out the discharge hose or by failure of the generator to "lug" down, turn the switch off immediately. After waiting a few seconds, turn the switch on and off several times rapidly, finally pausing in the ON position to determine if the pump has started to function properly.

After the water begins to flow from the outlet, pump the well for the length of time indicated in Table 13.1 (or for an adjusted pumping time, as explained in Table 13.1), and until pH, temperature, and specific conductivity stabilize. If the well being sampled is not listed in the table, pump for a minimum of 15 minutes and check for stabilization of the pH, temperature, and specific conductivity.

NOTE: Some wells pump down after a period of time. If the well pumps dry while purging, it does not generally mean that a sample cannot be collected. A sample can still be obtained by following these steps:

1. Turn off the submersible pump when the well pumps dry.

2. Wait for the well to recharge. This should be about 15 minutes, but may take as long as 30 minutes.

3. Measure the depth to water using the electrical tape. Make sure that the water level is above the pump intake.

4. Turn the submersible pump back on. Collect the samples that are designated for collection with the submersible pump.

Table 13.1. Calculated Pumping Times

Well Number	Calculated Time (min)
(199) H3-1	24
H4-3	5*
H4-4	4*
H4-5	8*
H4-6	5*
(399) 1-1	30
1-2	42
1-3	25
1-4	34
1-5	4*
1-6	6*
1-7	17
1-8	29
2-1	32
3-7	60
3-10	18
4-1	35
4-7	35
8-2	33
(699) S30-E15A	9*
S19-E13	12*

* All wells will be pumped a minimum of 15 minutes, even if the calculated time is less.

NOTE: These pumping times are based on voiding three bore-volumes of water from the well at a pumping rate of 10 gpm. To calculate an adjusted pumping time based on a field measurement of flow rate:

1. Divide the size of the container (in gal) by the number of seconds it took to fill. Multiply by 60 to get the new pumping rate (per minute).

2. Multiply the calculated time given in Table 13.1 by 10 and then divide by the new pumping rate to get the new pumping time.

Measure the pH, temperature, and specific conductivity of the discharged water at least three times during purging, according to the standard procedures for measuring pH and conductivity. The pH will be considered stable when two consecutive measurements agree within 0.2 pH units. Temperature will be considered stable when two consecutive measurements agree within 0.2°C. Conductivity will be considered stable when two consecutive measurements agree within 10 µmhos. If pH, temperature, and conductivity do not stabilize within the calculated purging time, contact the technical supervisor before collecting samples.

Enter time, date, and your initials on all sample labels.

Record information on field record form as it becomes available. The information that must be recorded on the field record forms is described in Section 13.3 (Chain-of-Custody Procedures).

Check the labels on the sample containers to determine which ones can be filled using the submersible pump. (A blue line on the right side of the sample label indicates that the submersible pump should not be used to fill that particular container.)

Fill the appropriate sample containers as described under "General Sample Collection Procedure."

Attach a sample seal to each container and place it in a cooler or ice chest.

Sample Collection Using Bladder Pump

If the well has a dedicated bladder pump, turn on the air compressor and use the procedure described below. If the well does not have a bladder pump, use the procedures given for the Teflon bailer to collect the remaining samples.

Attach the compressor to the bladder-pump pressure inlet on the face of the controller panel, using the female portion of the coupling supplied.

Connect either end of the controller's red air hose to the pump supply on the right side of the control panel. Connect the other end of the controller air hose to the quick-connect nipple located in the well cap assembly.

Attach the appropriately labeled extension line to the bladder-pump discharge line.

Five to fifteen pumping cycles are required to purge the air from the bladder pump and tubing. Full water flow from the sample supply tube should then begin. After water flows from the outlet tube, run the bladder pump for at least five minutes before taking samples.

To reduce the water-flow rate during sample collection, turn the throttle control on the left side of the control panel in the counterclockwise direction. To increase the flow rate, turn the throttle control clockwise.

To optimize pumping efficiency for a specific well depth, refer to the pump manufacturer's operating instructions.

Sample Collection Using Teflon Bailer

Unclasp the metal bailer from the winch line and replace it with the Teflon bailer.

Disengage the winch clutch and slowly lower the bailer into the water.

Engage the winch clutch when the bailer strikes the water surface.

Allow about 30 seconds for the sample tube to fill.

Turn on the electric winch and slowly raise the Teflon bailer to the surface.

Lower and rinse the bailer twice before collecting a sample.

Unscrew the cap of the sample container, being careful not to touch the lip of the bottle or the inside of the Teflon liner. Avoid touching the mouth of the Teflon bailer.

Unclasp the Teflon bailer.

Pour the water from the bailer into the sample container slowly to prevent trapping any air bubbles. Avoid splashing or agitating the water while the sample container is being filled.

General Sample Collection Procedure

Unscrew the cap from the sample container, being careful not to touch the lip of the bottle or the inside of the Teflon liner. Also avoid touching the mouth of the discharge line.

Fill the sample bottle slowly by placing the outlet tube against the inner side of the sample bottle to prevent trapping any air bubbles. Avoid splashing or agitating the water while the bottle is being filled.

NOTE: For those bottles requiring no headspace, the bottle should be filled completely so that a meniscus forms. Cap the bottle immediately, turn it upside down, tap it a few times and check for air bubbles in the sample. If a bubble exists, discard the sample and repeat the sampling procedures until an air-free sample is obtained. There is an exception to this if the bottle to be filled contains a preservative, in which case only one attempt will be made to obtain an air-free sample.

As each container is filled, attach a sample seal to it and place it in a cooler or ice chest.

Survey the sample container with a GM instrument. If the count is greater than 200 c/m, record it on the field record form and use Radiation Work Procedure 318-EE-1. Contact the EM Supervisor for instructions concerning where the sample is to be taken.

Turn off the air compressor.

Turn the power switch off and then turn the generator off. Unplug the power cord.

Complete the chain-of-custody and sample-analysis request forms.

Deliver the sample to the appropriate laboratory for analysis as soon as possible, following chain-of-custody procedures. If it cannot be delivered to the lab the same day, store the sample in a refrigerator located inside a locked building or within a secured area. The refrigerator must maintain a constant temperature of 4°C (39°F). Leave the cooler to be used when the samples are delivered.

<u>Teflon Bailer Cleaning Procedure</u>

Wash the inside and the outside of the bailer with a mild mixture of dish soap and water.

Rinse the bailer twice with tap water.

Store the bailer in a sealable plastic bag between uses.

13.3 CHAIN-OF-CUSTODY PROCEDURES

Introduction

To ensure the integrity of the samples from the time of collection through data reporting, the history of the custody of each sample will be documented according to these procedures. A sample is considered to be under a person's custody if it is in any of the following states: 1) in his physical possession; 2) in his view after he has taken possession; 3) secured by him so that no one can tamper with the sample; or 4) secured by him in an area which is restricted to authorized personnel. Anyone having custody of samples must comply with the procedures described below.

Delivery Procedures

Sample Labels

Fill out and affix gummed paper labels to the sample containers prior to or at the time of sample collection. The label to be used is shown in Exhibit 13.1. The well number noted on the label identifies the well location where the sample was collected.

Sample Seals

Attach gummed paper seals to the samples immediately upon sample collection, before the samples leave your custody. Attach the seal in such a way that the sample cannot be opened without breaking the seal.

Field Record Form

Record (in black ink) all pertinent information about each sample collected on a field record form and insert into a logbook. It will be a bound book with consecutively numbered pages. An example field record form is shown in Exhibit 13.2.

Chain-of-Custody Form

A chain-of-custody form will accompany all samples from the time they are collected until they are disposed of after analysis and reporting. A single form will be used for as many samples as possible. The form to be used is shown in Exhibit 13.3. Each person who handles the sample and signs the form will return a copy of the form to the company contact whose name appears on the top line.

(sample number) - company code (list of analyses)

(well number)

(bottle preparation)

SAMPLE SIZE: _____ LAB: _____

DATE/TIME: _____

COLLECTOR: _____

Exhibit 13.1. Sample Label

Battelle

FIELD RECORD

Well Number _____ Date _____

Pumping Time: Precalculated _____

Now _____

Submersible (Time On) _____

Blower (Time On) _____

CALCULATIONS

SAMPLES COLLECTED

SAMPLE NO.	VOLUME	PUMP	COLLECTOR

FIELD MEASUREMENTS

WATER LEVEL

Time											
pH											
Temp											
Cond											

FIELD OBSERVATIONS _____

Data Presented By _____ Data Checked By _____

Chain-of-Custody Form No. _____ Laboratory Record Book No. _____

Page No. _____

Exhibit 13.2. Example Field Record Form

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

CHAIN OF CUSTODY

Company Contact: _____ Telephone: _____

Samples Collected by: _____ Date: _____ Time: _____

Sample Location: _____

Ice Chest No.: _____ Field Logbook Page No.: _____

Remarks: _____

Method of Shipment: _____

Sample Identification

CHAIN OF POSSESSION

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

EXHIBIT 13.3. Chain-of-Custody Form

SAMPLE ANALYSIS REQUEST

Pacific Northwest Laboratory
P O Box 999
Richland WA 99352

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

Collector _____ Received by _____

Date /Time Sampled _____ Title _____

Company Contact _____ Date _____ Time _____

CHAIN OF CUSTODY NO. _____

SAMPLE ID _____

UST SAMPLE ID _____

COMMENTS

	CODE	CONSTITUENT	1	2	3	4	5	6	7	8	9	10	11	12	13
1	725	ICP METALS 6010													
2	726	ICP METALS 6010 ENHANCED													
3	A20	ARSENIC													
4	A21	MERCURY													
5	A22	SELENIUM													
6	A23	THALLIUM													
7	A24	THIOUREA 8330													
8	727	METHOD 8330 ENHANCED													
9	A51	LEAD BY GFAA													
10	757	PCB													
11	728	PESTICIDES 8080													
12	729	PESTICIDES 8080 ENHANCED													
13	730	VOA METHOD 8240													
14	731	VOA METHOD 8240 ENHANCED													
15	732	A/B/N 8270													
16	733	A/B/N 8270 ENHANCED													
17	734	PESTICIDES METHOD 8140													
18	C68	TOX													
19	C69	TOC													
20	C70	CYANIDE													
21	735	NITRATE, SULPHATE,.... (IC)													
22	C77	PERCHLORATE													
23	C78	SULFIDE													
24	C80	AMMONIUM ION													
25	C81	ETHYLENE GLYCOL													
26	109	COLIFORM BACTERIA													
27	181	RADIUM													
28	112	ALPHA													
29	111	BETA													
30	C86	DIOXIN													
31	C87	CITRUS RED #2													
32	191	CONDUCTIVITY													
33	199	pH													
34	736	DIRECT AQUEOUS INJECTION													
35	738	HERBICIDE 2,4-D, 2,4,5-TP SILVEX													
36	737	HERBICIDE 8150 ENHANCED													

DR2:[7,9]66

EXHIBIT 13.4. Sample-Analysis Request Form

Sample-Analysis Request Form

UST requires that a sample-analysis request form accompany all samples delivered to the lab. The form to be used is shown in Exhibit 13.4. The field portion of the form will be completed by the sample collector; the laboratory portion will be completed by laboratory personnel.

You will normally deliver samples directly to the laboratory on the day of collection. If they cannot be delivered on the day of collection, you must store them in a refrigerator in a locked building. (No shipping of the samples will be necessary, due to the lab's proximity to the site.) All samples will be accompanied by a chain-of-custody form and a sample-analysis request form. Deliver samples only to authorized laboratory personnel.

Laboratory Acceptance Procedures

The chain-of-custody does not end at the laboratory door, and therefore the laboratory must ensure the continuity of its record by following these procedures:

Receiving Department

Remove the sample cooler from the delivery vehicle and bring it into the receiving area.

Check the sample cooler for any obvious damage.

Sign the chain-of-custody and sample-analysis request forms.

If you transfer custody of the cooler to one or more intermediates before it is delivered to the Sample Custodian, the chain-of-custody form must reflect every change of custody.

Sample Custodian

When the sample cooler is delivered to you (or your designated alternate), sign the chain-of-custody form. Then return one copy to the sender and retain the remaining copies. The sample cooler is now your responsibility (or that of your designated alternate). You must now log the samples in.

Examine the sample coolers. On the sample log-in form (Exhibit 13.5), record

- presence/absence of custody seal(s) on the samples
- condition of custody seal(s).

Open the sample coolers, examine the sample documents, and record on the sample log-in form whether chain-of-custody form(s) are present.

UST-RD SAMPLE LOG-IN FORM

DATE:

TIME:

COOLER ID :
CLIENT SAMPLE ID:
UST-RD ID :
NUMBER OF BOTTLES IN COOLER :
IS CHAIN OF CUSTODY FORM PRESENT? :
CHAIN OF CUSTODY NUMBER :
IS SAMPLE ANALYSIS REQUEST FORM PRESENT? :

* IS THE CUSTODY SEAL ON THE COOLER INTACT? :

* ARE THE CUSTODY SEALS ON THE BOTTLES INTACT? :

* DO THE SAMPLE LABELS AGREE WITH THE CHAIN OF CUSTODY SHEET? :

* DO THE SAMPLE LABELS AGREE WITH THE SAMPLE ANALYSIS REQUEST SHEET? :

---

* IF ANSWER IS 'NO', PLEASE EXPLAIN BELOW IN DETAIL.

SAMPLES LOGGED IN BY: _____

REVIEWED BY SAMPLE CUSTODIAN: _____
Govind Rao

Exhibit 13.5. Sample Log-In Form

Remove sample containers and record on sample log-in form:

- condition of samples (intact, broken, leaking, etc.)
- presence/absence of sample labels and sample seals
- any discrepancy with chain-of-custody form(s).

If discrepancies are found, contact the sender for clarification.

Once all samples have been properly logged in, send a copy of the sample log-in form to the company contact named on the chain-of-custody form.

Use an internal numbering system for identification of all samples.

Assign internal numbers to the samples and record the numbers on the sample log-in form alongside the corresponding sample number assigned by the collector.

Place the properly labeled sample containers in the secure storage area.

13.4 TEMPERATURE MEASUREMENT PROCEDURE

Introduction

Temperature measurements are taken during and after purging of the well, just prior to sample collection. Measurements taken during purging are used to help ensure that the well bore has been sufficiently evacuated, as indicated by stabilization of the temperature. (The pH and conductivity are measured at the same time for the same reason.) The temperature is considered stable when two consecutive measurements agree within 0.2°C. The final temperature measurement is taken just prior to sampling and is recorded as an analytical value for the sample. The digital thermometers are regularly checked against a standard thermometer for accuracy.

Equipment

The following equipment will be needed:

- digital thermometer
- field record forms.

Temperature Measurement Procedure

Turn on the digital thermometer. Make sure that the switch is positioned so that the measurements will be in degrees centigrade.

Place the probe into the stream of water being discharged from the pump.

The temperature is indicated by a flashing display, which will normally fluctuate for a few seconds. Wait until fluctuation ceases (i.e., until the same temperature is indicated on three consecutive flashes), and then record the temperature on the field record form.

13.5 CONDUCTIVITY CALIBRATION AND MEASUREMENT PROCEDURES

Introduction

Conductivity measurements are taken during and after purging of the well, just prior to sample collection. Measurements taken during purging are used to help ensure that the well bore has been sufficiently evacuated, as indicated by stabilization of the conductivity. (The pH and temperature are measured at the same time for the same reason.) Conductivity is considered stable when two consecutive measurements agree within 10 μmhos. The final conductivity measurement is taken just prior to sampling and is recorded as an analytical value for the sample. The conductivity meter should be calibrated once a day, before it is taken to the field to begin sampling.

Equipment

The following equipment will be needed:

- conductivity meter
- distilled or deionized water
- small screwdriver
- standard solution
- field record forms.

Conductivity Calibration Procedure

Internal Standard

Empty the sample cup on the meter. Rinse it out with distilled or deionized water. Dry the cup thoroughly.

Turn the range switch to TEST.

Press the OPERATE button.

Use the small screwdriver to adjust the CALIBRATE until the meter or display reads 8.

NOTE: This is to be done as a rough calibration or battery check.

Standard Solution

Empty the sample cup. Rinse it out with distilled or deionized water.

Fill the cup with standard solution.

Turn the MODE switch to conductivity.

Turn the RANGE selector switch to the correct range for the standard solution.

Press the OPERATE button.

Use the small screwdriver to adjust the CALIBRATE until the meter or display reads the solution value.

NOTE: Do not return the conductivity standard solution to the container. Always discard it.

Conductivity Measurement Procedure

Check that the conductivity meter is properly calibrated by using the internal standard.

Remove the cap from the sample cup.

Rinse the cup with the water to be tested and dump it several times. Then fill the cup with the sample.

Turn the conductivity RANGE switch to the correct range.

	Range in µmhos
X1.	0 - 10
X10.	0 - 100
X100.	0 - 1,000
X1,000.	0 - 10,000

Turn the MODE switch to CONDUCTIVITY.

Press the OPERATE button on the side of the meter.

Read the conductivity on the digital display to the nearest µmho and record on field record form. Multiply the meter reading times the scale factor to obtain the correct placement of the decimal point.

After taking the reading, dump the sample and refill the cup with distilled water.

Replace the cap.

13.6 pH CALIBRATION AND MEASUREMENT PROCEDURE

Introduction

Measurements of the pH are taken during and after purging of the well, just prior to sample collection. Measurements taken during purging are used to help ensure that the well bore has been sufficiently evacuated, as indicated by stabilization of the pH. (Conductivity and temperature are measured at the same time for the same reason.) The pH is considered stable when two consecutive measurements agree within 0.2 pH units. The final pH measurement is taken just prior to sampling and is recorded as an analytical value for the sample. The pH instrument should be calibrated once a day, before it is taken to the field for sampling.

Equipment

The following equipment will be needed:

- pH meter
- distilled or deionized water
- small screwdriver
- buffer solutions
- field record forms.

pH Calibration Procedure

Wash the meter's sample cup with distilled water.

Fill the cup with 4.0 buffer solution.

Turn the MODE switch to pH.

Press the OPERATE button. Use the small screwdriver to adjust the ZERO to make the display read 4.00 pH on the upper meter scale or on the digital display.

Discard the buffer solution. Wash the cup twice with distilled or deionized water.

Fill the cup with 10.00 buffer solution.

Adjust the SLOPE to make the display read 10.00 pH.

Rinse the cup again and refill it with 4.0 pH buffer solution. Recheck the 4.0 pH value and adjust the ZERO if necessary.

Single Buffer Calibration

After the SLOPE is calibrated the first time each day, it may be left alone for subsequent calibration. Recheck the slope as desired.

Calibrate with a buffer solution that is close to the range of interest. If the process pH is from 6.0 to 9.0, use a 7.0 buffer solution for single-point calibration.

With the buffer solution in the cup, recalibrate only the STD to make the display read the desired value.

NOTE: Do not return buffer solutions to their containers. Always discard them.

pH Measurement Procedure

Ensure that the pH instrument is properly calibrated.

Remove the cap from the sample cup.

Rinse the cup with the water to be tested several times. Then fill the cup with the sample.

Turn the MODE selector switch to pH.

Press the OPERATE button on the side of the meter.

Read the pH on the upper meter scale or on the digital display to the nearest tenth of a unit. Record the value on the field record form.

Dump the sample and refill the cup with distilled water.

Replace the cap.

APPENDIX C

ADDITIONAL VOLATILE AND SEMI-VOLATILE COMPOUNDS

APPENDIX C

ADDITIONAL VOLATILE AND SEMI-VOLATILE COMPOUNDS

This appendix is an extension of Table 3 in the text and includes two lists of additional organic compounds for which analyses are performed. The lists are presented in tables entitled Additional Volatile Organics (C.1) and Additional Semi-Volatile Organics (C.2).

Table C.1. Additional Volatile Organics

acrolein
acrylonitrile
bis(chloromethyl) ether
bromoacetone
methyl bromide
carbon disulfide
chlorobenzene
2-chloroethyl vinyl ether
methyl chloride
chloromethyl methyl ether
crotonaldehyde
1,2-dibromo-3-chloropropane
1,2-dibromoethane
dibromomethane
1,4-dichloro-2-butene
dichlorodifluoromethane
1,1-dichloroethane
1,2-dichloroethane
trans-1,2-dichloroethene
1,1-dichloroethylene
1,2-dichloropropane
1,3-dichloropropene
N,N-diethylhydrazine
hydrogen sulfide
iodomethane
methacrylonitrile
methanethiol
pentachloroethane
1,1,1,2-tetrachlorethane
1,1,2,2-tetrachlorethane
bromoform
trichloromethanethiol
trichloromonofluoromethane
trichloropropane
1,2,3-trichloropropane
vinyl chloride
diethylarsine
methyl methacrylate
ethyl methacrylate
benzene
dioxane
pyridine
toluene

Table C.2. Additional Semi-Volatile Organics

acetophenone
warfarin
2-acetylaminofluorene
4-aminobyphenyl
5-(aminomethyl)-3-isoxazolol
amitrole
aniline
aramite
auramine
benz[c]acridine
benz[a]anthracene
benzene, dichloromethyl
benzenethiol
benzidine
benzo[b]fluoranthene
benzo[j]fluoranthene
p benzoquinone
benzyl chloride
bis(2-chloroethoxy) methane
bis(2-chloroethyl) ether
bis(2-ethylhexyl) phthalate
4-bromophenyl phenyl ether
butyl benzyl phthalate
2-sec-butyl-4,6-dinitrophenol
chloroalkyl ethers
p-chloroaniline
p-chloro-m-cresol
1-chloro-2,3-epoxypropane
2-chloronaphthalene
2-chlorophenol
chrysene
cresols
2-cyclohexyl-4,6-dinitrophenol
dibenz[a,h]acridine
dibenz[a,j]acridine
dibenz[a,h]anthracene
7H-dibenzo[c,g]carbazole
dibenzo[a,e]pyrene
dibenzo[a,h]pyrene
dibenzo[a,i]pyrene
di-n-butyl phthalate
maleic hydrazide
nicotinic acid
strychnine
3,3'-dichlorobenzidine
2,4-dichlorophenol
2,6-dichlorophenol
diethyl phthalate
dihydrosafrole
3,3'-dimethoxybenzidine
p-dimethylaminoazobenzene
7,12-dimethylbenz[a]anthracene
3,3'-dimethylbenzidine
thiofanox
alpha,alpha-dimethylphenethylamine
2,4-dimethylphenol
dimethyl phthalate
dinitrobenzene
4,6-dinitro-o-cresol and salts
2,4-dinitrophenol
2,4-dinitrotoluene
2,6-dinitrotoluene
di-n-octyl phthalate
diphenylamine
1,2-diphenylhydrazine
di-n-propylnitrosamine
ethyleneimine
ethyl methanesulfonate
fluoranthene
hexachlorobutadiene
hexachlorocyclopentadiene
hexachloroethane
indeno(1,2,3-cd)pyrene
isosafrole
malononitrile
melphalan
methapyrilene
metholonyl
2-methylaziridine
3-methylcholanthrene
4,4'-methylenebis(2-chloroaniline)
2-methyllaconitrile
methyl methanesulfonate
2-methyl-2-(methylthio) propionaldehyde-o-(methylcarbonyl)oxime
methylthiouracil
1,4-naphthoquinone
1-naphthylamine
2-naphthylamine
p-nitroaniline
nitrobenzine
4-nitrophenol
N-nitrosodi-n-butylamine

TABLE C.2. Additional Semi-Volatile Organics (cont)

N-nitrosodiethanolamine
N-nitrosodiethylamine
N-nitrosodimethylamine
N-nitrosomethylethylamine
N-nitroso-N-methylurethane
N-nitrosomethylvinylamine
N-nitrosomorpholine
N-nitrosonornicotine
N-nitrosopiperidine
nitrosopyrrolidine
5-nitro-o-toluidine
pentachloronitrobenzene
pentachlorophenol
phenacetin
phenylenediamine
phthalic acid esters
2-picoline
pronamide
reserpine
resorcinol
safrol
2,3,4,6-tetrachlorophenol
thiuram
toluenediamine
o-toluidine hydrochloride
2,4,5-trichlorophenol
2,4,6-trichlorophenol
0,0,0-triethyl phosphorothioate
sym-trinitrobenzene
tris(2,3-dibromopropyl) phosphate
benzo[a]pyrene
chlornaphazine
bis(2-chloroisopropyl)ether
hexacloropropene

APPENDIX D

ANALYTICAL METHODS AND QUALITY CONTROL PROCEDURES

APPENDIX D

ANALYTICAL METHODS AND QUALITY CONTROL PROCEDURES

This appendix presents a brief description of each chemical and radiochemical analysis that is performed on samples in accordance with the compliance effort. Following this description, Table D.1 summarizes the quality control procedures that are part of each analytical procedure.

DESCRIPTION OF ANALYSES

Temperature, pH, and Conductivity are determined in the field according to field instrument instructions.

Coliform Count is determined by multiple tube fermentation.

Most Metals are measured by either the Inductively Coupled Plasma (ICP) method or the Graphite Furnace Atomic Absorption (GFAA) method. In either case, the sample is first acid-digested. In the ICP method, the digest is then nebulized, with the resultant aerosol being transported to the plasma torch where excitation occurs. The atomic emission is then measured by an optical spectroscopic technique. In the GFAA method, the digest is dried, ashed, and atomized in a graphite tube furnace. The constituent concentration is proportional to the absorption of hollow-cathode radiation during atomization.

Mercury is measured by the Cold-Vapor Atomic Absorption technique. The mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance is measured as a function of mercury concentration.

Inorganic Anions are determined by Ion Chromatography (IC). After being injected into the ion chromatograph, the sample is pumped through three different ion exchange columns to convert the anions in the sample to their

corresponding acids. The separated anions in their acid form are measured using an electrical-conductivity cell.

Volatile and Semi-volatile Organic Chemicals are determined by Gas Chromatography/Mass Spectrometry (GC/MS). Volatile organic chemicals are introduced to the mass spectrometer by the purge-and-trap method, in which the volatile components are converted from an aqueous phase to a vapor phase, trapped on a sorbent column, and then desorbed onto a gas chromatographic column. This column is heated to elute the components, which are then detected by the mass spectrometer. Semi-volatile organic chemicals are extracted using the continuous liquid-liquid extraction method. After being placed in the continuous extraction apparatus, the sample is extracted for 16 hours with the appropriate solvent. The extract is then collected, dried, and concentrated. The extract is eluted from a gas chromatographic fused-silica capillary column, and the eluted components are then detected by the mass spectrometer.

Certain Organic Constituents are analyzed by direct aqueous injection, which requires no preparatory steps before the samples are injected into the gas chromatograph and detected by the mass spectrometer. Substances identified in samples by GC/MS techniques are verified by comparing the suspect mass spectra to the mass spectrum of a standard of the suspected substance. A computerized mass-spectrometry library search system is used that is capable of providing a forward comparison using the standard spectra contained in the Environmental Protection Agency/National Institute of Health mass spectral data base.

Pesticides and Herbicides are measured by gas chromatography with an appropriate detector. Extractions are performed as necessary. Positive concentrations are verified by reanalysis of the extract using a confirmation gas chromatography column or by GC/MS.

Total Organic Halogens (TOX) are measured after the sample is passed through a column containing activated carbon. The column is washed to remove trapped inorganic halides, and the carbon is then analyzed to convert the adsorbed organohalides to a titratable species that can be measured by a microcoulometric detector.

Total Organic Carbon (TOC) is determined by the combustion-infrared method. The sample is sparged with hydrochloric acid to remove inorganic carbon. The homogenized sample is vaporized with an oxidative catalyst, thereby converting the organic carbon to CO_2. The CO_2 is measured by means of a nondispersive infrared analyzer.

Ammonium Ion is measured with a specific ion electrode.

Total Alpha-Emitting Radionuclide measurements are made after the samples are evaporated and the salts and solids are dissolved in nitric acid and extracted from the acid by the diethyl ether method. Each sample is then evaporated, dried on a counting dish, and measured by the ZnS scintillation counter. The chemical yield is about 83%.

Total Beta-Emitting Radionuclides are measured after each sample has been evaporated onto a 1-in. counting dish. The residue is then counted with a gas-flow proportional counter.

Gamma-Emitting Radionuclide data are obtained by analyzing 500 mℓ samples in 0.47-ℓ polyethylene bottles. An NaI or a Lithium Drifted Germanium [Ge(Li)] detector are used to count the samples. The standards are traceable to the National Bureau of Standards. The gamma-emitting radionuclides of primary interest are ^{137}Cs and ^{60}Co. Other gamma-emitting radionuclides may be measured as necessary.

Radium is collected from the water samples by coprecipitation. The precipitate is then dried, weighed, and alpha-counted.

Uranium (natural) is determined with fluorometric techniques following purification by hexone extraction.

Strontium-90 is precipitated with fuming nitric acid, scavenged with barium chromate, precipitated as a carbonate, and counted on a planchet using a gas-flow proportional counter. The yttrium-90 decay product is separated and counted after 15 days.

TABLE D.1. Summary of Methods and QC Procedures

Constituent or Group	Analysis Method	QC Procedures
Ethylene Glycol	Direct Aqueous Injection GC with Flame Ionization Detector	-Calibration curve daily -Mid-range standard every 10th sample (±10% of curve) -Fortified sample after every 10th sample (estimate matrix effects) -Standard and fortified sample at end of run
Phosphorus Pesticides	GC with Flame Photometric Detector (FPD) with Phosphorus Filter	-Standard (prepared once per week) for 5-point calibration curve -Mid-range standard every 10th sample to verify (±10%) -Matrix spike after every 10th sample
Herbicides	GC/Electron Capture Detector (ECD)	-3-point calibration curve daily -Mid-range standard after every 10th sample (±10%) -Verification standard at end of batch -Matrix spikes after every 10 samples (no surrogate)
Organochlorine Pesticides	GC/ECD	-Dibutylchlorendate (DBC) surrogate -Reagent blank with every extraction batch -Matrix spike after every 10th sample -Calibration curve for each compound -Mid-range standard after every 10th sample (±10%) -Calibration checked with mid-range standards prior to beginning a run
Acid/Base/Neutral (ABN) Semi-Volatile Organic Analysis	GC/MS with Capillary Column (Method 8270)	-MS tuning verified every 12-hour shift -Initial 5-point calibration for each analyte -Calibration - verification checked every 12-hour shift (±20%) -Six surrogate compounds added, recoveries checked -Matrix spikes
Volatile Organic Analysis	GC/MS Purge and Trap (Method 8240)	-MS tuning verified every 12-hour shift -5-point calibration for each analyte -Calibration verified each 12-hour shift (±20%) -System blanks run before standards -Reagent blank with each batch -Minimum three surrogate compounds, recovery monitored -Matrix spike recoveries monitored
Anions	IC	-7-point calibration curve (3-point for perchlorate) -Mid-range standard to verify internal calibration (±10%) -Mid-range standard, blank (deionized water) and matrix spike after every 10th sample. Sample with values over highest calibration standard are diluted and reanalyzed

TABLE D.1. Summary of Methods and QC Procedures (cont)

Constituent or Group	Analysis Method	QC Procedures
Metals (As, Se, Pb, Tl)	GFAA	-Calibration curve -Blanks, standard, samples in duplicate (average reported) (rerun in case of large variation) -Spike every 10th sample -Standard compared with calibration/ new calibration curve if necessary -Standard every 10 samples to check recovery and operating conditions
Citrus Red #2	Spectrophotometer	-5-point calibration curve -Matrix spikes every 10th sample -Samples exceeding calibration standards are diluted and reanalyzed -Standard and blank are verified at end of run and/or after 15 samples
Ammonium Ion	Specific Ion Electrode (Standard Method 417E)	-Electrode slope determined -Calibration standards, blank plus 7-point curve -Matrix spike after very 10th sample -Blank and standard for verification after 10th sample (or beginning and end of smaller run) -Samples above highest standard are diluted
Sulfide	Titration (SW-846 Method 9030)	-Calibration by blank and three standards -Matrix spike after every 10th sample -Every 10th sample or end of run, analyze blank and verification standard
Thiourea	High Performance Liquid Chromatography (HPLC)	-5-point calibration curve, verified every 8 hr and/or at conclusion of run (must be within 10%) -After routine analysis, every 10th matrix spike -Dilution, in case concentration is over highest calibration
Cyanide	UV/VIS Spectrophotometer, Colorimetric Method (after distillation)	-Absorbance wavelength determined by scan of prepared blanks and standards, repeated for each batch of coloring reagent -Fresh standards run daily, 4-point calibration -Blank and matrix spike every 10 samples
TOC	TOC Analyzer with Infrared Analyzer (Standard Method 505)	-5-point calibration curve plus blank, each batch -Matrix spike after every 10th sample -Calibration is verified with blank and standard, which must be within ±10% of initial calibration, after each run -If a sample falls above the highest calibration standard, it is diluted and reanalyzed

TABLE D.1. Summary of Methods and QC Procedures (cont)

Constituent or Group	Analysis Method	QC Procedures
Mercury	Cold Vapor Atomic Absorption (Method 7470)	-Calibration, blank and four standards prepared for each batch -Duplicate and matrix spike every 10 samples -One verification standard for every 10 samples -Quality control sample from outside source at least every other batch
TOX	Carbon Absorption, Microcoulometric Titration (Method 9020)	-Calibration involves: -Two titration cell standards (to ±5%) -Nitrate wash blanks (method blanks) -Instrument calibration standards after eight pyrolysis determinations and after cleaning or reconditioning -Every sample run in duplicate -Matrix spike on 10% of sample, percent recovery determination -Outside standard analyzed weekly
Metals	ICP Spectrograph (Method 6010)	-Calibration involves: -Warm-up, configuration, calibration procedure, flush system with blank between each sample -Dilute samples if above high standard -One reagent blank with each batch -Duplicate samples for 10% -Matrix spike on 10% of samples -Check standardization by analyzing quality control standards, 10% of samples (to within (±10%) -Calibration blanks, 10% -Run standard after batch (check drift)
Coliform Bacteria	Presumptive Test, Confirmation Test	-Reagents are routinely analyzed for contamination -Media are autoclaved and analyzed with every batch -Every 10th sample is analyzed in duplicate
Radioactivity:		
Radium	Precipitate, Weigh, Count	-Blank and spike samples
Alpha Direct (AD)	Evaporate, Count	-Blank and spike samples
Beta Direct (BD)	Evaporate, Count	-Blank and spike samples

APPENDIX E

DANGEROUS WASTE CONSTITUENTS LIST BY CATEGORY

APPENDIX E

DANGEROUS WASTE CONSTITUENTS LIST BY CATEGORY

Table E.1 presents the Dangerous Waste Constituents List from WAC 173-303-9905 (9905 list). The table gives a number to each of 375 constituents, lists the method of analysis, and gives a cross-reference to one of nine other tables, which list the constituents by analytical category.

Categories included in the following tables are Volatile Organics (E.2), Semi-Volatile Organics (E.3), Organics by GC/MS Direct Injection (E.4), Constituents That Only Require Analysis for Metal Species (E.5), Pesticides and Herbicides (E.6), Compounds to be Analyzed by Class (E.7), Miscellaneous Organics and Inorganics (E.8), Constituents Unstable in Water (E.9), and Constituents for Which Adequate Analysis is Unavailable (E.10).

TABLE E.1. Dangerous Waste Constituents List

	Constituent	Method[a]	Table
1	Acetonitrile	GC/MS, Dir. Inj.	E.4
2	Acetophenone	SW-846, 8270	E.3
3	Warfarin	SW-846, 8270	E.3
4	2-Acetylaminofluorene	SW-846, 8270	E.3
5	Acetyl chloride	Unstable	E.9
6	1-Acetyl-2-thiourea	SW-846, 8330	E.8
7	Acrolein	SW-846, 8240	E.2
8	Acrylamide	GC/MS, Dir. Inj.	E.4
9	Acrylonitrile	SW-846, 8240	E.2
10	Aflatoxins	Unavailable	E.10
11	Aldrin	SW-846, 8080	E.6
12	Allyl alcohol	GC/MS, Dir. Inj.	E.4
13	Aluminum phosphide	Unstable	E.9
14	4-Aminobiphenyl	SW-846, 8270	E.3
15	Mitomycin C	Unavailable	E.10
16	5-(Aminomethyl)-3-isoxazolol	SW-846, 8270	E.3
17	Amitrole	SW-846, 8270	E.3
18	Aniline	SW-846, 8270	E.3
19	Antimony and compounds	SW-846, 6010	E.5
20	Aramite	SW-846, 8270	E.3
21	Arsenic and compounds	SW-846, 7060	E.5
22	Arsenic acid	SW-846, 7060	E.5
23	Arsenic pentoxide	SW-846, 7060	E.5
24	Arsenic trioxide	SW-846, 7060	E.5
25	Auramine	SW-846, 8270	E.3
26	Azaserine	Unavailable	E.10
27	Barium and compounds	SW-846, 6010	E.5
28	Barium cyanide	SW-846, 6010	E.5
29	Benz(c)acridine	SW-846, 8270	E.3
30	Benz(a)anthracene	SW-846, 8270	E.3
31	Benzene	SW-846, 8240	E.2
32	Benzenearsonic acid	Unavailable	E.10
33	Benzene, dichloromethyl	SW-846, 8270	E.3
34	Benzenethiol	SW-846, 8270	E.3
35	Benzidine	SW-846, 8270	E.3
36	Benzo(b)fluoranthene	SW-846, 8270	E.3
37	Benzo(j)fluoranthene	SW-846, 8270	E.3
38	Benzo(a)pyrene	SW-846, 8270	E.3
39	p Benzoquinone	SW-846, 8270	E.3
40	Benzotrichloride	Unstable	E.9
41	Benzyl chloride	SW-846, 8270	E.3
42	Beryllium and compounds	SW-846, 6010	E.5
43	Bis(2-chloroethoxy)methane	SW-846, 8270	E.3
44	Bis(2-chloroethyl) ether	SW-846, 8270	E.3
45	Chlornaphazine	SW-846, 8270	E.3
46	Bis(2-chloroisopropyl) ether	SW-846, 8270	E.3

TABLE E.1. Dangerous Waste Constituents List (cont)

	Constituent	Method[a]	Table
47	Bis(chloromethyl) ether	SW-846, 8240	E.2
48	Bis(2-ethylhexyl) phthalate	SW-846, 8270	E.3
49	Bromoacetone	SW-846, 8240	E.2
50	Methyl bromide	SW-846, 8240	E.2
51	4-Bromophenyl phenyl ether	SW-846, 8270	E.3
52	Brucine	Unavailable	E.10
53	2-Butanone peroxide	Unstable	E.9
54	Butyl benzyl phthalate	SW-846, 8270	E.3
55	2-sec-Butyl-4,6-dinitrophenol	SW-846, 8270	E.3
56	Cadmium and compounds	SW-846, 6010	E.5
57	Calcium chromate	SW-846, 6010	E.5
58	Calcium cyanide	SW-846, 9010	E.8
59	Carbon disulfide	SW-846, 8240	E.2
60	Carbon oxyfluoride	Unstable	E.9
61	Chloral	GC/MS, Dir. Inj.	E.4
62	Chlorambucil	Unavailable	E.10
63	Chlordane	SW-846, 8080	E.6
64	Chlorinated benzenes	SW-846, 8270	E.3
65	Chlorinated ethane	SW-846, 9020	E.7
66	Chlorinated fluorocarbons	SW-846, 9020	E.7
67	Chlorinated naphthalene	SW-846, 9020	E.7
68	Chlorinated phenol	SW-846, 9020	E.7
69	Chloroacetaldehyde	GC/MS, Dir. Inj.	E.4
70	Chloroalkyl ethers	SW-846, 8270	E.3
71	P-Chloroaniline	SW-846, 8270	E.3
72	Chlorobenzene	SW-846, 8240	E.2
73	Chlorobenzilate	SW-846, 8080	E.6
74	p-Chloro-m-cresol	SW-846, 8270	E.3
75	1-Chloro-2,3-epoxypropane	SW-846, 8270	E.3
76	2-Chloroethyl vinyl ether	SW-846, 8240	E.2
77	Chloroform	SW-846, 8240	E.2
78	Methyl chloride	SW-846, 8240	E.2
79	Chloromethyl methyl ether	SW-846, 8240	E.2
80	2-Chloronaphthalene	SW-846, 8270	E.3
81	2-Chlorophenol	SW-846, 8270	E.3
82	1-(o-Chlorophenyl)thiourea	SW-846, 8330	E.8
83	3-Chloropropionitrile	GC/MS, Dir. Inj.	E.4
84	Chromium and compounds	SW-846, 6010	E.5
85	Chrysene	SW-846, 8270	E.3
86	Citrus red No. 2	AOAC, 34.015 B	E.8
87	Coal tars	SM,505	E.7
88	Copper cyanide	SW-846, 6010	E.5
89	Creosote	SM,505	E.7
90	Cresols	SW-846, 8270	E.3
91	Crotonaldehyde	SW-846, 8240	E.2
92	Cyanides	SW-846, 9010	E.8

TABLE E.1. Dangerous Waste Constituents List (cont)

	Constituent	Method[a]	Table
93	Cyanogen	GC/MS, Dir. Inj.	E.4
94	Cyanogen bromide	GC/MS, Dir. Inj.	E.4
95	Cyanogen chloride	GC/MS, Dir. Inj.	E.4
96	Cycasin	Unavailable	E.10
97	2-Cyclohexyl-4,6-dinitrophenol	SW-846, 8270	E.3
98	Cyclophosphamide	Unavailable	E.10
99	Daunomycin	Unavailable	E.10
100	DDD	SW-846, 8080	E.6
101	DDE	SW-846, 8080	E.6
102	DDT	SW-846, 8080	E.6
103	Diallate	Unavailable	E.10
104	Dibenz(a,h)acridine	SW-846, 8270	E.3
105	Dibenz(a,j)acridine	SW-846, 8270	E.3
106	Dibenz(a,h)anthracene	SW-846, 8270	E.3
107	7H-Dibenzo(c,g)carbazole	SW-846, 8270	E.3
108	Dibenzo(a,e)pyrene	SW-846, 8270	E.3
109	Dibenzo(a,h)pyrene	SW-846, 8270	E.3
110	Dibenzo(a,i)pyrene	SW-846, 8270	E.3
111	1,2-Dibromo-3-chloropropane	SW-846, 8240	E.2
112	1,2-Dibromoethane	SW-846, 8240	E.2
113	Dibromomethane	SW-846, 8240	E.2
114	Di-n-butyl phthalate	SW-846, 8270	E.3
115	Benzene, 1,2-dichloro	SW-846, 8270	E.3
116	Benzene, 1,3-dichloro	SW-846, 8270	E.3
117	Benzene, 1,4-dichloro	SW-846, 8270	E.3
118	Dichlorobenzene	SW-846, 9020	E.7
119	3,3'-Dichlorobenzidine	SW-846, 8270	E.3
120	1,4-Dichloro-2-butene	SW-846, 8240	E.2
121	Dichlorodifluoromethane	SW-846, 8240	E.2
122	1,1-Dichloroethane	SW-846, 8240	E.2
123	1,2-Dichloroethane	SW-846, 8240	E.2
124	trans-1,2-Dichloroethene	SW-846, 8240	E.2
125	Dichloroethylene	SW-846, 9020	E.7
126	1,1-Dichloroethylene	SW-846, 8240	E.2
127	Methylene chloride	SW-846, 8240	E.2
128	2,4-Dichlorophenol	SW-846, 8270	E.3
129	2,6-Dichlorophenol	SW-846, 8270	E.3
130	2,4-D	SW-846, 8150	E.6
131	Dichlorophenylarsine	Unavailable	E.10
132	Dichloropropane	SW-846, 9020	E.7
133	1,2-Dichloropropane	SW-846, 8240	E.2
134	Dichloropropanol	GC/MS, Dir. Inj.	E.4
135	Dichloropropene	SW-846, 9020	E.7
136	1,3-Dichloropropene	SW-846, 8240	E.2
137	Dieldrin	SW-846, 8080	E.6
138	1,2:3,4-Diepoxybutane	Unavailable	E.10

TABLE E.1. Dangerous Waste Constituents List (cont)

	Constituent	Method[a]	Table
139	Diethylarsine	SW-846, 8240	E.2
140	N,N-Diethylhydrazine	SW-846, 8240	E.2
141	Carbophenothion	SW-846, 8140	E.6
142	O,O-Diethylphosphoric acid, O-p-nitrophenyl ester	Unavailable	E.9
143	Diethyl phthalate	SW-846, 8270	E.3
144	Thionazin	Unavailable	E.10
145	Diethylstilbesterol	SW-846, 8330	E.8
146	Dihydrosafrole	SW-846, 8270	E.3
147	3,4-Dihydroxy-alpha-(methylamino)methyl benzyl alchol	Unavailable	E.10
148	Diisopropylfluorophosphate	Unstable	E.9
149	Dimethoate	SW-846, 8140	E.6
150	3,3'-Dimethoxybenzidine	SW-846, 8270	E.3
151	p-Dimethylaminoazobenzene	SW-846, 8270	E.3
152	7,12-Dimethylbenz(a)anthracene	SW-846, 8270	E.3
153	3,3'Dimethylbenzidine	SW-846, 8270	E.3
154	Dimethylcarbamoyl chloride	Unstable	E.9
155	1,1-Dimethylhydrazine	GC/MS, Dir. Inj.	E.4
156	1,2-Dimethylhydrazine	GC/MS, Dir. Inj.	E.4
157	Thiofanox	SW-846, 8270	E.3
158	alpha,alpha-Dimethylphenethylamine	SW-846, 8270	E.3
159	2,4-Dimethylphenol	SW-846, 8270	E.3
160	Dimethyl phthalate	SW-846, 8270	E.3
161	Dimethyl sulfate	Unstable	E.9
162	Dinitrobenzene	SW-846, 8270	E.3
163	4,6-Dinitro-o-cresol and salts	SW-846, 8270	E.3
164	2,4-Dinitrophenol	SW-846, 8270	E.3
165	2,4-Dinitrotoluene	SW-846, 8270	E.3
166	2,6-Dinitrotoluene	SW-846, 8270	E.3
167	Di-n-octyl phthalate	SW-846, 8270	E.3
168	1,4-Dioxane	SW-846, 8240	E.2
169	Diphenylamine	SW-846, 8270	E.3
170	1,2-Diphenylhydrazine	SW-846, 8270	E.3
171	Di-n-propylnitrosamine	SW-846, 8270	E.3
172	Disulfoton	SW-846, 8140	E.6
173	2,4-Dithiobiuret	Unavailable	E.10
174	Endosulfan	SW-846, 8080	E.6
175	Endrin	SW-846, 8080	E.6
176	Ethyl carbamate	GC/MS, Dir. Inj.	E.4
177	Ethyl cyanide	GC/MS, Dir. Inj.	E.4
178	Ethylenebisdithiocarbamic acid	Unavailable	E.10
179	Ethyleneimine	SW-846, 8270	E.3
180	Ethylene oxide	GC/MS, Dir. Inj.	E.4
181	Ethylenethiourea	SW-846, 8330	E.8
182	Ethylmethacrylate	SW-846, 8240	E.2

TABLE E.1. Dangerous Waste Constituents List (cont)

	Constituent	Method[a]	Table
183	Ethyl methanesulfonate	SW-846, 8270	E.3
184	Fluoranthene	SW-846, 8270	E.3
185	Fluorine	Unstable	E.9
186	2-Fluoroacetamide	Unavailable	E.10
187	Fluoroacetic acid	GC/MS, Dir. Inj.	E.4
188	Formaldehyde	SW-846, 8240	E.2
189	Formic acid	Unavailable	E.10
190	Glycidylaldehyde	GC/MS, Dir. Inj.	E.4
191	Halomethane	SW-846, 9020	E.7
192	Heptachlor	SW-846, 8080	E.6
193	Heptachlor epoxide	SW-846, 8080	E.6
194	Hexachlorobenzene	SW-846, 8270	E.3
195	Hexachlorobutadiene	SW-846, 8270	E.3
196	Lindane and isomers	SW-846, 8080	E.6
197	Hexachlorocylopentadiene	SW-846, 8270	E.3
198	Hexachloroethane	SW-846, 8270	E.3
199	Hexachlorohexahydro-endo,endo-dimethanonaphthalene	Unavailable	E.10
200	Hexachlorophene	SW-846, 8270	E.3
201	Hexachloropropene	SW-846, 8270	E.3
202	Hexaethyl tetraphosphate	Unavailable	E.10
203	Hydrazine	GC/MS, Dir. Inj.	E.4
204	Hydrocyanic acid	SW-846, 9010	E.8
205	Hydrofluoric acid	Unstable	E.9
206	Hydrogen sulfide	SW-846, 8240	E.2
207	Hydroxydimethylarsine oxide	Unavailable	E.10
208	Indeno(1,2,3-cd)pyrene	SW-846, 8270	E.3
209	Iodomethane	SW-846, 8240	E.2
210	Iron Dextran	Unavailable	E.10
211	Methyl isocyanate	Unstable	E.9
212	Isobutyl alcohol	GC/MS, Dir. Inj.	E.4
213	Isosafrole	SW-846, 8270	E.3
214	Kepone	Unavailable	E.10
215	Lasiocarpine	Unavailable	E.10
216	Lead and compounds	SW-846, 6010	E.5
217	Lead acetate	SW-846, 6010	E.5
218	Lead phosphate	SW-846, 6010	E.5
219	Lead subacetate	Unavailable	E.10
220	Maleic anhydride	Unstable	E.9
221	Maleic hydrazide	SW-846, 8270	E.3
222	Malononitrile	SW-846, 8270	E.3
223	Melphalan	SW-846, 8270	E.3
224	Mercury Fulminate	Unavailable	E.10
225	Mercury and compounds	SW-846, 7470	E.5
226	Methacrylonitrile	SW-846, 8240	E.2
227	Methanethiol	SW-846, 8240	E.2

TABLE E.1. Dangerous Waste Constituents List (cont)

	Constituent	Method[a]	Table
228	Methapyrilene	SW-846, 8270	E.3
229	Metholonyl	SW-846, 8270	E.3
230	Methoxychlor	SW-846, 8080	E.6
231	2-Methylaziridine	SW-846, 8270	E.3
232	3-Methylcholanthrene	SW-846, 8270	E.3
233	Methyl chlorocarbonate	Unstable	E.9
234	4,4'-Methylenebis(2-chloroaniline)	SW-846, 8270	E.3
235	Methyl ethyl ketone	SW-846, 8240	E.2
236	Methyl hydrazine	GC/MS, Dir. Inj.	E.4
237	2-Methyllactonitrile	SW-846, 8270	E.3
238	Methyl methacrylate	SW-846, 8240	E.2
239	Methyl methanesulfonate	SW-846, 8270	E.3
240	2-Methyl-2-(methylthio)propionaldehyde -o-(methylcarbonyl) oxime	SW-846, 8270	E.3
241	N-Methyl-N'-nitro-N-nitrosoguanidine	Unavailable	E.10
242	Methyl parathion	SW-846, 8140	E.6
243	Methylthiouracil	SW-846, 8270	E.3
244	Mustard gas	Unavailable	E.10
245	Naphthalene	SW-846, 8270	E.3
246	1,4-Naphthoquinone	SW-846, 8270	E.3
247	1-Naphthylamine	SW-846, 8270	E.3
248	2-Naphthylamine	SW-846, 8270	E.3
249	1-Naphthyl-2-thiourea	SW-846, 8330	E.8
250	Nickel and compounds	SW-846, 6010	E.5
251	Nickel carbonyl	Unavailable	E.10
252	Nickel cyanide	SW-846, 6010	E.5
253	Nicotine and salts	SW-846, 8270	E.3
254	Nitric oxide	Unavailable	E.10
255	p-Nitroaniline	SW-846, 8270	E.3
256	Nitrobenzine	SW-846, 8270	E.3
257	Nitrogen dioxide	Unstable	E.9
258	Nitrogen mustard and hydrochloride salt	Unavailable	E.10
259	Nitrogen mustard N-Oxide and hydrochloride salt	Unavailable	E.10
260	Nitroglycerine	Unavailable	E.10
261	4-Nitrophenol	SW-846, 8270	E.3
262	4-Nitroquinoline-1-oxide	Unavailable	E.10
263	Nitrosamine	SM,417	E.7
264	N-Nitrosodi-n-butylamine	SW-846, 8270	E.3
265	N-Nitrosodiethanolamine	SW-846, 8270	E.3
266	N-Nitrosodiethylamine	SW-846, 8270	E.3
267	N-Nitrosodimethylamine	SW-846, 8270	E.3
268	N-Nitroso-N-ethylurea	Unavailable	E.10
269	N-Nitrosomethylethylamine	SW-846, 8270	E.3
270	N-Nitroso-N-methylurea	Unavailable	E.10

TABLE E.1. Dangerous Waste Constituents List (cont)

	Constituent	Method[a]	Table
271	N-Nitroso-N-methylurethane	SW-846, 8270	E.3
272	N-Nitrosomethylvinylamine	SW-846, 8270	E.3
273	N-Nitrosomorpholine	SW-846, 8270	E.3
274	N-Nitrosonornicotine	SW-846, 8270	E.3
275	N-Nitrosopiperidine	SW-846, 8270	E.3
276	Nitrosopyrrolidine	SW-846, 8270	E.3
277	N-Nitrososacrosine	Unavailable	E.10
278	5-Nitro-o-toluidine	SW-846, 8270	E.3
279	Octamethylpyprophosphoramide	Unavailable	E.10
280	Osmium tetroxide	SW-846, 6010	E.5
281	Endothol	Unavailable	E.10
282	Paraldehyde	GC/MS, Dir. Inj.	E.4
283	Parathion	SW-846, 8140	E.6
284	Pentachlorobenzene	SW-846, 8270	E.3
285	Pentachloroethane	SW-846, 8240	E.2
286	Pentachloronitrobenzene	SW-846, 8270	E.3
287	Pentachlorophenol	SW-846, 8270	E.3
288	Phenacetin	SW-846, 8270	E.3
289	Phenol	SW-846, 8270	E.3
290	Phenylenediamine	SW-846, 8270	E.3
291	Phenylmercury acetate	Unavailable	E.10
292	N-Phenylthiourea	SW-846, 8330	E.8
293	Phosgene	Unstable	E.9
294	Phosphine	Unavailable	E.10
295	Phorate	Unstable	E.9
296	Famphur	Unstable	E.9
297	Phthalic acid esters	SW-846, 8270	E.3
298	Phthalic anhydride	Unstable	E.9
299	2-Picoline	SW-846, 8270	E.3
300	Polychlorinated biphenyl	SW-846, 8080	E.6
301	Potassium cyanide	SW-846, 9010	E.8
302	Potassium silver cyanide	SW-846, 6010	E.5
303	Pronamide	SW-846, 8270	E.3
304	1,3-Propanesultone	Unavailable	E.10
305	n-Propylamine	GC/MS, Dir. Inj.	E.4
306	Propylthiouracil	Unavailable	E.10
307	2-Propyn-1-ol	GC/MS, Dir. Inj.	E.4
308	Pyridine	SW-846, 8240	E.2
309	Reserpine	SW-846, 8270	E.3
310	Resorcinol	SW-846, 8270	E.3
311	Saccharin and salts	Unavailable	E.10
312	Safrol	SW-846, 8270	E.3
313	Selenious acid	SW-846, 7740	E.5
314	Selenium and compounds	SW-846, 7740	E.5
315	Selenium sulfide	SW-846, 7740	E.5
316	Selenourea	Unavailable	E.10

TABLE E.1. Dangerous Waste Constituents List (cont)

	Constituent	Method[a]	Table
317	Silver and compounds	SW-846, 6010	E.5
318	Silver cyanide	SW-846, 6010	E.5
319	Sodium cyanide	SW-846, 9010	E.8
320	Streptozotocin	Unavailable	E.10
321	Strontium sulfide	SW-846, 6010	E.5
322	Strychnine and salts	SW-846, 8270	E.3
323	1,2,4,5-Tetrachlorobenzene	SW-846, 8270	E.3
324	TCDD	EPA #613	E.10
325	Tetrachloroethane	SW-846, 8240	E.2
326	1,1,1,2-Tetrachlorethane	SW-846, 8240	E.2
327	1,1,2,2-Tetrachlorethane	SW-846, 8240	E.2
328	Tetrachlorethylene	SW-846, 8240	E.2
329	Tetrachloromethane	SW-846, 8240	E.2
330	2,3,4,6-Tetrachlorophenol	SW-846, 8270	E.3
331	Tetraethyldithiopyrophosphate	Unstable	E.9
332	Tetraethyl lead	Unavailable	E.10
333	Tetraethylpyrophosphate	SW-846, 8140	E.6
334	Tetranitromethane	Unavailable	E.10
335	Thallium and compounds	SW-846, 7840	E.5
336	Thallic oxide	SW-846, 7840	E.5
337	Thallium (1) acetate	SW-846, 7840	E.5
338	Thallium (1) carbonate	SW-846, 7840	E.5
339	Thallium (1) chloride	SW-846, 7840	E.5
340	Thallium (1) nitrate	SW-846, 7840	E.5
341	Thallium selenite	SW-846, 7840	E.5
342	Thallium (1) sulfate	SW-846, 7840	E.5
343	Thioacetamide	Unavailable	E.10
344	Thiosemicarbazide	Unavailable	E.10
345	Thiourea	SW-846, 8330	E.8
346	Thiuram	SW-846, 8270	E.3
347	Toluene	SW-846, 8240	E.2
348	Toluenediamine	SW-846, 8270	E.3
349	o-Toluidine hydrochloride	SW-846, 8270	E.3
350	Tolulene diisocyanate	Unstable	E.9
351	Toxaphene	SW-846, 8080	E.6
352	Bromoform	SW-846, 8240	E.2
353	1,2,4-Trichlorobenzene	SW-846, 8270	E.3
354	1,1,1-Trichloroethane	SW-846, 8240	E.2
355	1,1,2-Trichloroethane	SW-846, 8240	E.2
356	Trichloroethene	SW-846, 8240	E.2
357	Trichloromethanethiol	SW-846, 8240	E.2
358	Trichloromonofluoromethane	SW-846, 8240	E.2
359	2,4,5-Trichlorophenol	SW-846, 8270	E.3
360	2,4,6-Trichlorophenol	SW-846, 8270	E.3
361	2,4,5-T	SW-846, 8150	E.6
362	2,4,5-TP (Silvex)	SW-846, 8150	E.6

TABLE E.1. Dangerous Waste Constituents List (cont)

	Constituent	Method[a]	Table
363	Trichloropropane	SW-846, 8240	E.2
364	1,2,3-Trichloropropane	SW-846, 8240	E.2
365	0,0,0-Triethyl phosphorothioate	SW-846, 8270	E.3
366	sym-Trinitrobenzene	SW-846, 8270	E.3
367	Tris(1-aziridinyl) phosphine sulfide	Unstable	E.9
368	Tris(2,3-dibromopropyl) phosphate	SW-846, 8270	E.3
369	Trypan blue	Unavailable	E.10
370	Uracil mustard	Unavailable	E.10
371	Vanadic acid, ammonium salt	SW-846, 6010	E.5
372	Vanadium pentoxide	SW-846, 6010	E.5
373	Vinyl chloride	SW-846, 8240	E.2
374	Zinc cyanide	SW-846, 6010	E.5
375	Zinc phosphide	SW-846, 6010	E.5

(a) SW-846: Environmental Protection Agency (EPA). 1982. Test Methods for Evaluating Solid Waste - Chemical/Physical Methods, SW-846. EPA, Washington. D.C.

SM: American Public Health Association (APHA). 1985. Standard Methods for the Examination of Water and Wastewater. APHA, Washington, D.C.

AOAC: Journal of the Association of Official Analytical Chemists.

EPA #613: 49 CFR 209 (1984).

TABLE E.2. Volatile Organics

7	Acrolein
9	Acrylonitrile
31	Benzene
47	Bis(chloromethyl)ether
49	Bromoacetone
50	Methyl bromide
59	Carbon disulfide
72	Chlorobenzene
76	2-Chloroethyl vinyl ether
77	Chloroform
78	Methyl chloride
79	Chloromethyl methyl ether
91	Crotonaldehyde
111	1,2-Dibromo-3-chloropropane
112	1,2-Dibromoethane
113	Dibromomethane
120	1,4-Dichloro-2-butene
121	Dichlorodifluoromethane
122	1,1-Dichloroethane
123	1,2-Dichloroethane
124	trans-1,2-Dichloroethene
126	1,1-Dichloroethylene
127	Methylene chloride
133	1,2-Dichloropropane
136	1,3-Dichloropropene
139	Diethylarsine
140	N,N-Diethylhydrazine
168	Dioxane
182	Ethylmethacrylate
188	Formaldehyde
206	Hydrogen sulfide
209	Iodomethane
226	Methacrylonitrile
227	Methanethiol
235	Methyl ethyl ketone
238	Methyl methacrylate
285	Pentachloroethane
308	Pyridine
325	Tetrachloroethane
326	1,1,1,2-Tetrachlorethane
327	1,1,2,2-Tetrachlorethane
328	Tetrachlorethylene
329	Tetrachloromethane
347	Toluene
352	Bromoform
354	1,1,1-Trichloroethane
355	1,1,2-Trichloroethane
356	Trichloroethane
357	Trichloromethanethiol
358	Trichloromonofluoromethane
363	Trichloropropane
364	1,2,3-Trichloropropane
373	Vinyl chloride

TABLE E.3. Semi-Volatile Organics

2 Acetophenone
3 Warfarin
4 2-Acetylaminofluorene
14 4-Aminobyphenyl
16 5-(Aminomethyl)-3-ioxazolol
17 Amitrole
18 Aniline
20 Aramite
25 Auramine
29 Benz[c]acridine
30 Benz[a]anthracene
33 Benzene, dichloromethyl
34 Benzenethoil
35 Benzidine
36 Benzo[b]fluoranthene
37 Benzo[j]fluoranthene
38 Benzo[a]pyene
39 p Benzoquinone
41 Benzyl chloride
43 Bis(2-chloroethoxy)methane
44 Bis(2-chloroethyl) ether
45 Chlornaphazine
46 Bis(2-chloroisopropyl)ether
48 Bis(2-ethylhexyl) phthalate
51 4-Bromophenyl phenyl ether
54 Butyl benzyl phthalate
55 2-sec-Butyl-4,6-dinitrophenol
64 Chlorinated benzenes
70 Chloroalkyl ethers
71 p-chloroaniline
74 p-Chloro-m-cresol
75 1-Chloro-2,3-epoxypropane
80 2-Chloronaphthalene
81 2-Chlorophenol
85 Chrysene
90 Cresols
97 2-Cyclohexyl-4,6-dinitrophenol
104 Dibenz[a,h]acridine
105 Dibenz[a,j] acridine
106 Dibenz[a,h]anthracene
107 7H-Dibenzo[c,g]carbazole
108 Dibenzo[a,e]pyrene
109 Dibenzo[a,h]pyrene
110 Dibenzo[a,e]pyrene
114 Di-n-butyl phthalate
115 1,2-Dichlorobenzene
116 1,3-Dichlorobenzene
117 1,4-Dichlorobenzene
119 3,3'-Dichlorobenzidine
128 2,4-Dichlorophenol
129 2,6-Dichlorophenol
143 Diethyl phthalate
146 Dihydrosafrole
150 3,3'-Dimethoxybenzidine
151 p-Dimethylaminoazobenzene
152 7,12-Dimethylbenz[a]anthracene
153 3,3'-Dimethylbenzidine
157 Thiofanox
158 Alpha,alpha-Dimethlphenethylamine
159 2,4-Dimethylphenol
160 Dimethyl phthalate
162 Dinitrobenzene
163 4,6-Dinitro-o-cresol and salts
164 2,4-Dinitrophenol
165 2,4-Dinitrotoluene
166 2,6-Dinitrotoluene
167 Di-n-octyl phthalate
169 Diphenylamine
170 1,2-Diphenylhydrazine
171 Di-n-propylnitrosamine
179 Ehtyleneimine
183 Ethyl methanesulfonate
184 Fluoranthene
194 Hexachlorobenzene
195 Hexachlorobutadiene
197 Hexachlorocyclopentadiene
198 Hexachloroethane
200 Hexachlorophene
201 Hexachloropropene
203 Hydrazine
208 Indeno(1,2,3-cd)pyrene
213 Isosafrole
221 Maleic hydrazide
222 Malononitrile
223 Melphalan
228 Methapyrilene
229 Metholonyl
231 2-Methylaziridine
232 3-Methylcholanthrene
234 4,4'-Methylenebis(2-chloroaniline)
237 2-Methyllactonitrile
239 Methyl methanesulfonate
240 2-Methyl-2-(methylthio) propionaldehyde-o-(methylcarbonyl)oxime
243 Methylthiouracil

TABLE E.3. Semi-Volatile Organics (cont)

245 Naphthalene
246 1,4-Naphthoquinone
247 1-Naphthylamine
248 2-Naphthylamine
253 Nicotine and salts
255 p-Nitroaniline
256 Nitrobenzine
261 4-Nitrophenol
264 N-Nitrosodi-n-butylamine
265 N-Nitrosodiethanolamine
266 N-Nitrosodiethylamine
267 N-Nitrosodimethylamine
269 N-Nitrosomethylethylamine
271 N-Nitroso-N-methylurethane
272 N-Nitrosomethylvinylamine
273 N-Nitrosomorpholine
274 N-Nitrosonornicotine
275 N-Nitrosopiperidine
276 Nitrosopyrrolidine
278 5-Nitro-o-toluidine
284 Pentachlorobenzene
286 Pentachloronitrobenzene
287 Pentachlorophenol
288 Phenacetin
289 Phenol
290 Phenylenediamine
297 Phthalic acid esters
299 2-Picoline
303 Pronamide
309 Reserpine
310 Resorcinol
312 Safrol
322 Strychnine and salts
323 1,2,4,5-Tetrachlorobenzene
330 2,3,4,6-Tetrachlorophenol
346 Thiuram
348 Toluenediamine
349 o-Toluidine hydrochloride
353 1,2,4-Trichlorobenzene
359 2,4,5-Trichlorophenol
360 2,4,6-Trichlorophenol
365 0,0,0-Triethyl phosphorothioate
366 sym-Trinitrobenzene
368 Tris(2,3-dibromopropyl) phosphate

TABLE E.4. Organics by GC/MS Direct Injection

1	Acetonitrile
8	Acrylamide
12	Allyl alcohol
61	Chloral
69	Chloroacetaldehyde
83	3-Chloropropionitrile
93	Cyanogen
94	Cyanogen bromide
95	Cyanogen chloride
134	Dichloropropanol
155	1,1-Dimethyl hydrazine
156	1,2-Dimethyl hydrazine
176	Ethyl carbamate
177	Ethyl cyanide
180	Ethylene oxide
187	Fluoroacetic acid
190	Glycidylaldehyde
203	Hydrazine
212	Isobutyl alcohol
236	Methyl hydrazine
282	Paraldehyde
305	n-Propylamine
307	2-Propyn-1-ol

TABLE E.5. Constituents that Only Require Analysis for Metal Species

19	Antimony, NOS
21	Arsenic and compounds, NOS
22	Arsenic acid
23	Arsenic pentoxide
24	Arsenic trioxide
27	Barium and compounds
28	Barium cyanide
42	Beryllium and compounds, NOS
56	Cadmium and compounds, NOS
57	Calcium chromate
84	Chromium and compounds, NOS
88	Copper cyanide
216	Lead and compounds, NOS
217	Lead acetate
218	Lead phosphate
225	Mercury and compounds, NOS
250	Nickel and compounds, NOS
252	Nickel cyanide
280	Osmium tetroxide
302	Potassium silver cyanide
313	Selenious acid
314	Selenium and compounds, NOS
315	Selenium sulfide
317	Silver and compounds, NOS
318	Silver cyanide
321	Strontium sulfide
335	Thallium and compounds, NOS
336	Thallic oxide
337	Thallium acetate
338	Thallium carbonate
339	Thallium chloride
340	Thallium nitrate
341	Thallium selenite
342	Thallium sulfate
371	Vanadic acid, ammonium salt
372	Vanadium pentoxide
374	Zinc cyanide
375	Zinc phosphate

TABLE E.6. Pesticides/Herbicides

11	Aldrin	175	Endrin
63	Chlordane	192	Heptachlor
73	Chlorobenzilate	193	Heptachlor epoxide
100	DDD	196	Lindane and isomers
101	DDE	230	Methoxychlor
102	DDT	242	Methyl parathion
130	2,4-D	283	Parathion
137	Dieldrin	300	Polychlorinated biphenyl
141	Carbophenothion	333	Tetraethylpyrophosphate
149	Dimethoate	351	Toxaphene
172	Disulfoton	361	2,4,5-T
174	Endosulfan	362	2,4,5-TP Silvex

TABLE E.7. Compounds To Be Analyzed By Class

TOX:

65	Chlorinated ethane
66	Chlorinated fluorocarbons
67	Chlorinated naphthalene
68	Chlorinated phenol
118	Dichlorobenzene
125	Dichloroethylene
132	Dichloropropane
135	Dichloropropene
191	Halomethane

TOC:

87	Coal tars
89	Creosote

Ammonium:

263	Nitrosamine

TABLE E.8. Miscellaneous Organics and Inorganics

86	Citrus red No. 2
92	Cyanide
58	Calcium cyanide
204	Hydrocyanic acid
301	Potassium cyanide
319	Sodium cyanide
345	Thiourea
6	1-Acetyl-2-thiourea
82	1-(o-Chlorophenyl)thiourea
145	Diethylstilbesterol
181	Ethylenethiourea
249	1-Naphthyl-2-thiourea
292	N-Phenylthiourea

TABLE E.9. Constituents Unstable in Water

5	Acetyl chloride
13	Aluminum phosphide
40	Benzotrichloride
53	2-butanone peroxide
60	Carbon oxyfluoride
142	O,O Diethylphosphoric acid, O-p-nitrophenyl ester
148	Diisopropylfluorophosphate
154	Dimethylcarbamoyl chloride
161	Dimethyl sulfate
185	Fluorine
205	Hydrofluoric acid
211	Methyl isocyanate
220	Maleic anhydride
233	Methyl chlorocarbonate
257	Nitrogen dioxide
293	Phosgene
295	Phorate
296	Famphur
298	Phthalic anhydride
331	Tetraethyldithiopyrophosphate
350	Toluene diisocyanate
367	Tris (1-aziridinyl) phosphine sulfide

TABLE E.10. Constituents For Which Adequate Analysis Is Unavailable

10	Aflatoxins
15	Mitomycin C
26	Azaserine
32	Benzenearsonic acid
52	Brucine
62	Chlorambucil
96	Cycasin
98	Cyclophosphamide
99	Daunomycin
103	Diallate
131	Dichlorophenylarsine
138	1,2:3,4 Diepoxybutane
144	Thionazin
147	3,4-dihydroxy-alpha-(methylamino) methyl benzyl alcohol
173	2,4-dithiobiuret
178	Ethylenebisdithiocarbamic acid
186	2-fluoroacetamide
189	Formic acid
199	Hexachlorohyxahydro-endo, endo-dimethanonaphthalene
202	Hexaethyl tetraphosphate
207	Hydroxydimethylarsine oxide
214	Kepone
210	Iron dextran
215	Lasiocarpine
219	Lead subacetate
224	Mercury fulminate
241	N-methyl-N'-nitro-N-nitrosoguanidine
244	Mustard gas
251	Nickel carbonyl
254	Nitric oxide
258	Nitrogen mustard - HCl salt
259	Nitrogen mustard N-oxide and HCl salt
260	Nitroglycerin
262	4-nitroquinoline
268	N-Nitroso-N-ethylurea
270	N-Nitroso-N-methylurea
277	N-nitrososacrosine
279	Octamethylpyrophosphoramide
281	Endothol
291	Phenylmercury acetate
294	Phosphine
304	1,3-propanesultone
306	Propylthiouracil
311	Saccharin and salts
316	Selenourea
320	Streptozotocin
332	Tetraethyl lead
334	Tetranitromethane
343	Thioacetamide
344	Thiosemicarbazide
369	Trypan blue
370	Uracil mustard

APPENDIX F

QUALITY ASSURANCE (QA) PLAN

APPENDIX F

QUALITY ASSURANCE (QA) PLAN

This appendix presents the text of the QA Plan used for the RCRA Compliance Ground-Water Monitoring Project. The plan is used to identify specific elements of PNL's QA Program that are applicable to the project.

The QA Plan includes information on: project organization, the QA Program; design control and method review; procurement; instructions, procedures, and drawings; document control; identification and control of items; performance of inspections and tests; control of measuring and test equipment; status of inspection, test, and operating condition; nonconformance and corrective actions; and QA records and audits.

Battelle
Pacific Northwest Laboratories

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Issue Date July 31, 1986
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QA PLAN ☒ Project ☐ Service Activity

☒ 1830
☐ 1831

Project/Service Activity: Hazardous Materials Monitoring Project/RCRA Compliance Ground-Water Monitoring Project

Sponsor: DOE, Westinghouse Hanford Company, UNC Nuclear Industries

Authorized By (DOC. No.): Project Number 11329, 11249, 11665

QA Requirement Specification:

(Specify) DOE-RL Order 5700.1A, Quality Assurance, as interpreted by PNL-MA-65 with additions and further clarifications to more fully meet sponsor requirements. Geophysical logging shall be conducted in accordance with QA Plan ED-54.

The Sections or selected paragraphs of PNL-MA-65 (as identified by section of paragraph number) designated in this QA Plan are applicable to this Project/Service Activity. Additional information is also provided when useful to provide clarification of the selected requirement.

Approvals:

DATE APPROVED 7-24-86	SIGNATURE (QUALITY ENGINEER) D. R. Dahl DR Dahl
DATE APPROVED 7/25/86	SIGNATURE (Q.E. MANAGER) D. E. Ryder D. E. Ryder
DATE APPROVED 7-24-86	SIGNATURE (PROJECT/ACTIVITY MANAGER) L. S. Prater/R. Schalla Leigh S. Prater / Ronald Schalla
DATE APPROVED 7/23/86	SIGNATURE (LINE MANAGER) (a) P. E. Bramson RK Woodruff for (D7HWK)
Date Approved 7/31/86	Signature (UNC) L. W. Vance

Distribution: (Project QA Files, QAO, and others as appropriate)

See Distribution, page 19

(a) Department or Section Manager as designated by Department Policy or the Project Plan Document.

A-1060-056 (2-81)

Project: Hazardous Materials Monitoring Project/RCRA Compliance Ground-Water Monitoring Project

QA PLAN INDEX

	Applies	W/C[a]	REV[b]
1.1 Organization	●	●	
1.1.1 QAO Organization	●	0	
1.1.2 QAO Responsibilities	●	0	
2.1 QA Program	●	●	
2.1.1 Applicability	●	●	1
2.1.2 QA Plans	●	0	
2.1.3 Personnel Qualifications and Training	●	●	1
2.1.4 QA Program Review	●	0	
2.2 QA Planning	●	●	
2.2.1 Project QA Plan	●	0	
2.2.2 Activity QA Plan	0	0	
2.2.3 Revision	●	0	
2.2.4 Close-Out	●	0	
2.3 Job Quality Plan—applies to work performed by Facilities Engineering Section and Major Projects and Planning Organizations		0	
2.3.1 Requirements		0	
2.3.2 Preparation and Approval		0	
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2.3.4 Records		0	
3.1 Design Control and Method Review	0	0	
3.1.1 Design Planning	0	0	
3.1.2 Project Approach and Method	●	●	1
3.1.3 Design and Engineering Control	0	0	
3.1.3.1 Design Document Control	0	0	
3.1.3.1(3) Non-Official Engineering Drawings	●	0	1
3.1.3.2 Design Criteria	0	0	
3.1.3.3 Design Configuration Control	0	0	
3.1.3.4 Engineering Hold Points	0	0	
3.1.3.5 Modifications	0	0	
3.1.4 Calculation (Data) verification	0	0	
3.1.5 Interface Controls	0	0	
3.1.6 Design Review and Verification	0	0	
3.1.6.1 Design Data on OED	0	0	
3.1.6.2 Engineering Work in Support of Design	0	0	
3.1.6.3 Formal Design Review	0	0	
3.1.6.4 Development Testing	0	0	
3.1.7 Revisions	●	0	
4.1 Procurement—Applies if a purchase requisition is processed (procurement or subcontract)		●	
4.1.1 Procurement/Subcontract Document Preparation and Approval		●	
4.1.2 Source Inspection Activities		●	1
4.1.3 Supplier/Subcontractor Selection		0	
4.1.4 Procurement Document Close-Out		0	
5.1 Instructions, Procedures, and Drawings	●	●	1
5.1.1 Ident. & Content	●	0	
5.1.2 Transmit of QA Req.	●	0	
5.1.3 Compliance	●	0	

(a)W/C—With clarification presented in this QA Plan
(b)REV—Indicates revision number in which changes were made

Project: Hazardous Materials Monitoring Project/RCRA Compliance
Ground-Water Monitoring Project

QA PLAN INDEX (cont'd)

	Applies	W/C	REV
6.1 Document Control	●	●	
6.1.1 Control of Select Documents	●	●	
6.1.2 Revisions	●	●	
7.1 Identification and Control of Items	●	●	
7.1.1 Identification and Control	●	O	
7.1.2 Traceability	●	O	
8.1 Control of Special Processes	O	O	
8.1.1 Process Controls	O	O	
8.1.2 Process Selection	O	O	
9.1 Performance of Inspections and Tests	●	●	1
9.1.1 Receiving Inspection	●	O	
9.1.2 Other Inspections (Nonreceiving)	●	O	
9.1.3 Content of ITI	●	O	
9.1.4 Records, Tagging and Noncomformances	●	O	
10.1 Control of Measuring and Test Equipment	●	●	
10.1.1 Basic Responsiblities	●	O	
10.1.2 Performance Checks	●	O	
10.1.3 Calibration of M&TE	●	O	
10.1.4 Calibration Discrepancy	●	O	
10.1.5 New Equipment	●	O	
10.1.6 Records	●	O	
11.1 Handling, Storage and Shipping	●	O	
11.1.1 General Guidance	●	O	
11.1.2 Special Instructions	●	O	
12.1 Status of Inspection, Test & Operating Condition	●	●	
12.1.1 Status Indication Authorities	●	O	
12.1.2 Status Indication Requirements	●	O	
13.1 Nonconformance & Corrective Action	●	●	
13.1.1 Occurrences	●	O	
13.1.2 Control of Nonconforming Item	●	O	
13.1.3 Corrective Action	●	O	
14.1 QA Records	●	●	1
14.1.1 General Guidance	●	O	
14.1.2 QA Record Requirement	●	O	
14.1.3 Laboratory Record Books	●	●	
15.1 Audits — Applies when a project or activity is selected as part of the base for a QA audit.		●	
Additions	●	●	1 See Parts 1, 3, 6 and 10 of this QA Plan

1. ORGANIZATION

1.1. The relationship of the Quality Assurance Department (QAD) to other Battelle components is described in Section 1.1 of PNL-MA-65. PNL-MA-65 identifies the responsibilities of the QAD Manager, Manager of Quality Engineering, Quality Engineer, Lead Quality Assurance Auditor, and the Manager of Quality Control.

In addition:

1. The organizational structure of the HMMP and the RCRA Compliance Ground-Water Monitoring project is shown in Attachment A. As shown in the diagram, both projects fall under the supervision of the Manager for Hanford Environmental Programs. The relationship between the projects and the QAD is also shown. Analytical laboratories include the primary testing laboratory, (currently U.S. Testing) and various other laboratories used to provide quality control checks. The QC laboratories currently include facilities of PNL, HEHF and Westinghouse Hanford Company, and may include in the future an independent offsite laboratory.

2. The PNL Project Manager shall act as interface among project sponsors (UNC Nuclear Industries, Westinghouse Hanford Company, and DOE-RL) and PNL regarding technical matters. The PNL Manager for Hanford Environmental and Occupational Health Programs shall act as interface for formal communications and matters regarding commitments. Status reports will be provided on a periodic basis according to agreements between PNL and the sponsors.

3. The Project Manager is responsible for implementing this QA Plan.

4. The responsibility of the Project Quality Control Task Leader is to coordinate quality control samples, screen results of QC sample analysis, and maintain records concerning laboratory performance.

2. QA PROGRAM

2.1. This QA Plan applies to the monitoring, sampling, chemical analyses, evaluation, and modeling activities for the HMMP and RCRA Compliance projects at the Hanford Site.

2.1.1. This document is intended to apply to work being conducted by PNL under two projects: the Hazardous Materials Monitoring Project (HMMP) and the RCRA Compliance Ground-Water Monitoring Project. Unless otherwise stated, all parts of this plan shall apply to both projects.

The HMMP, which is supported by the Department of Energy, - involves monitoring for hazardous chemicals throughout the Hanford Site. The RCRA Compliance Project, supported by Westinghouse Hanford Company, and UNC Nuclear Industries involves ground-water monitoring for hazardous chemicals at the 300 Area Process Trenches and the 183-H Solar Evaporation Basins.

2.1.3. The Project Manager shall provide for the training of project personnel on the contents of this QA Plan and supporting procedures as necessary. This training shall be planned, performed, and documented as per PNL Administrative Procedure PAP-201, Rev. 1, which includes the following requirements:

a. A resume of each contributor to the projects shall be in the project files.
b. The Project Manager shall define training needs and methods.
c. Training assignment, schedule, plan, and attendance shall be documented.
d. Training records shall be retained by the Management Systems Department, Procedures and Training Coordination Section.

2.2 Revision (2.2.3). The Project Manager shall notify the Quality Engineer of changes in project scope so that a revision to this QA Plan can be prepared and issued as needed.

3. DESIGN CONTROL AND METHOD REVIEW

3.1.2 Project approach and method of investigation for HMMP is described in the Project Plan for Hazardous Materials Monitoring Project for FY 1986, dated 10-01-85. The approach and method for the RCRA Compliance Project is documented in Hazardous Waste Ground-Water Monitoring Plan (July 1985).[a] Project plans and changes in scope shall be discussed with or reviewed by the project sponsors. Such changes shall be documented in the project files. The project plan shall be approved by the Project Manager and Section Manager.

(a) New compliance plans for each area are scheduled to be issued by August 1986.

In addition:

1. Data Base Development

A computer data base management system shall be used to store and retrieve field and laboratory data. Procedures for processing data into the RCRA data base shall be documented in the Hanford Ground-Water Data Base Management Guide and User's Manual. Before this manual is published, the procedures shall be controlled in accordance with Section 6.1. The Data-Handling Task Leader shall assure that the data base user's manual is current.

Computer software used to generate project data bases (i.e., software used to transfer data to the Hanford ground-water data base) has been verified. Changes to computer software shall be verified and documented.

2. Field Records

Radiation Protection Technologists (RPTs) shall fill out completely sign and date all required sampling records (e.g., forms and field logbook), noting any conditions that could affect interpretation of results.

Information in the field logbook shall be reviewed, initialed and dated, including any changes by the Environmental Monitoring Supervisor or the Sample Collection Task Leader.

Changes to the field logbook or to other sample collection records (e.g., Chain-of-Custody forms) will be initialled by the person making the change.

3. Well Network Modification: Field Design Changes

Field design changes of drilling configuration/specifications shall be at the discretion of the PNL geologist and shall be controlled in accordance with Procedure P-4,Change Control. All field changes and concurrence communications shall be documented in the PNL geologists's field notebook and kept as a permanent project record. Any design changes shall be reflected in the as-built drawings.

4. Data Base Records Verification and Security

Data from the primary analytical laboratory shall be transferred to the data base using procedures documented in the Hanford Ground-Water Data Base Management Guide and User's Manual.

- Data on computer tapes, disks, and other memory devices shall be labeled with project name, title, and directory listing.

- Master copies of computer data on tapes, disks, and other memory devices shall be stored in a secure manner that will protect them from tampering and/or damage.

- Field data shall be entered into the data base by an assignee of the Data-Handling Task Leader and independently checked for accuracy and completeness and initialed by another assignee. Designation of assignees shall be documented.

- The Data-Handling Task Leader shall assure the security of the data by limiting access to the system as necessary. Individuals working with the data base shall change passwords at least annually.

- The Data Evaluation Task Leader shall review the data listing from the primary laboratory concurrently with transfer of data into the data base. Any suspect data will be checked with the primary laboratory and questions resolved and documented in project records.

- All data rejected by the data base shall be listed in the printout sent to the Data Evaluation Task Leader, whose responsibility it shall be to review the list and resolve with the primary laboratory questions concerning the data. Resolution of rejected data shall be documented in project files.

5. <u>Data Base Contents and Use</u>

- Each computer run reported or used for reporting information in project reports shall have a copy of the output stored as a project record. The record shall include date, data source, program listing, and software identification.

- Data and detection limits shall be reported in the data base. The magnitude of the uncertainty (bias) in each type of analysis may be estimated by the analysis of blanks and standard samples.
- The magnitude of the precision of each type of analysis shall be estimated by the analysis of replicates.

- The analysis of data shall be documented and traceable from the primary source to reported results, including all assumptions, interpretation, and calculations.

- Data from interlab comparisons should be included in the data base, and noted as such.

- Computerized data files shall contain pertinent field and lab notations that may affect the interpretation of the results.

- Data that are suspect (out of range as determined using control charts or other checks and statistical analysis) shall be flagged as such in order to caution users of such data. Suspect data will be brought to the attention of the laboratory by the Data Evaluation Task Leader for possible corrective action. Resolution of suspect data shall be documented in project records and traceable to the reviewer, data base, and date.

6. System Maintained Software and Support Software

System maintained software is software that is installed and maintained at the computer system level rather than at the user level (e.g., commercial software such as LOTUS 1-2-3, RS/1, or DISSPLA).

Support software is 1) Software that may be easily and exactly verified, and that performs a simple function such as, change in data format or plotting of data, or 2) A stream of commands or sequence of streams of commands executed to utilize system maintained software (the system maintained software generates reportable results).

When an application of such software is to be reported to a sponsor, the following control of application runs is required.

- Code documentation shall be located in files of (or available to) the user. A description of the configuration of hardware shall be included as a project record. Support and system-maintained software shall be identified by version number and date.

- Record of application runs, program and results, including a listing of the application (referenced to the application program) shall be maintained in project files and identify date, program, user, data and results document.

The user, or his designee, shall review, initial and date application runs to confirm that results are reasonable.

7. The Coupled Fluid, Energy, and Solute Transport (CFEST) Software Development/Modifications

The acquired Coupled Fluid, Energy, and Solute Transport (CFEST) code, developed under another PNL program for license-related application, will be calibrated to model ground-water flow and tritium transport in the unconfined aquifer at Hanford. The code is to be enhanced to simulate the movement of hazardous chemical constituents in ground water.

Computer software design, development and application shall be documented by the Model Enhancement Task Leader. This documentation, as a minimum, shall address the following:

- Software design/development
- Testing and verification of software and modifications
- Configuration control of software versions
- Storage of software master copies.

Computer Software Control

A code package for computer software design and development shall be maintained that includes the following documentation:

- A description of the problem to be solved or the purpose of the code
- A description of the computer language and operating system to which the code is adapted
- Input requirements
- Variables used
- Description of numerical methods and mathematical models
- A record of the programming progress, problems, and changes made
- User instructions
- Record of computer implementation of the mathematical models
- Explanation of assumptions, parameters, limitations and theory of the model
- Code listing.

Computer software developed and subsequent modifications shall be tested and verified by comparison with results from hand calculations.

For codes developed or modified under this project, verification procedures or test plans, controlled in accordance with Section 6.1, shall be prepared identifying the test cases to be run, the input data to be used, the acceptance criteria, and the expected results. The record of verification tests shall be made a part of the code package and maintained in project files. Acquired codes, such as CFEST, shall be reviewed by the Model Enhancements Task Leader for

adequacy with the project, as well as adequate documentation (i.e., user's guide/instructions, verification/tests and results). This review shall be documented and retained as a project record.

7. Technical/Management Review

A review team (see organization chart, Attachment A) shall be employed to provide technical and management review of documents.

Prior to release or issue, reports, studies, ano analyses shall be reviewed by member(s) of the review team not directly responsible for the work being reviewed. In this review, reviewers shall, as applicable, assess the adequacy of the data and equations used, duplicate calculations to check the accuracy of the calculations being reviewed, and assess the appropriateness of assumptions being made. The comments shall be documented by written response to the author and shall be resolved by the author. All records of technical/ management review shall be stored in project files.

4. PROCUREMENT

4.1. This section shall apply to all items and services that are procured via purchase requisition and purchase order or contract documents. If receiving inspection is required (as specified in PNL-MA-65, Section 4.1.1.4.), then the applicable parts of Sections 9.1 (Inspection and Test) and 12.1 (Inspection, Test, and Operating Status) shall apply.

4.1.1 Subcontractors responsible for the analysis of samples shall be required to:

- Implement the use of written procedures.
- Control the handling of samples by Chain-of-Custody procedure.
- Control the handling of data records.
- Review and verify result prior to submittal to PNL, documented by signature of lab supervisor.
- The primary analytical laboratory shall implement a documented training program that shall assure that personnel have been trained in laboratory procedures and operation of equipment as necessary.
- Implement a documented Quality Assurance System.
- Provide Quality Assurance surveillance and audits for the Quality Assurance System.

Subcontracted analytical laboratories shall implement a system for control of measurement and test equipment (i.e., calibration) and have issued written procedures for routine

analyses, a copy of which shall be kept at the lab and shall be available upon request.

The primary laboratory (currently UST) shall participate in the interlaboratory comparison program as provided by the Environmental Protection Agency (EPA) and Environmental Measurements Laboratory (EML) where practicable. Performance in these programs shall be reported to the Quality Control Task Manager as they are available.

Analytical laboratories shall maintain an internal quality control program to include the use of spiked, blank, and duplicate samples and NBS traceable standards, results of which shall be available to PNL for inspection and appraisal.

PNL shall conduct a routine quality control program that includes sending blind, spiked, blank and duplicate samples to UST. Also, PNL shall periodically send replicate field samples to UST and at least two other laboratories to see how well the laboratories agree. The Quality Control Program shall be documented, including method, results and reviews.

Evaluation of subcontractor-supplied data is addressed in Section 3, Addition 4 (Data Base Records Verification and Security), Bullet #5.

4.1.2 The Statement of Work (SOW) for subcontractors responsible for well drilling shall require subcontractors:

- Follow the requirements set forth in the Subcontract Statement of Work including method of drilling, steam cleaning of equipment, storage of construction materials, tool lubricants, drilling additives, drill cutting and water disposal, and documentation of each of the above.

- Inspections by PNL personnel are required in the Statement of Work. All inspections shall be performed by designated and qualified personnel, documented, and maintained as a record.

- Keep a drilling log which shall be available to the PNL geologist. (Instructions on the format and content of the log shall be included in the SOW.) The drilling log shall be maintained as a record.

Purchase Requisitions (PRs) shall be reviewed by an individual familiar with technical specifications of items ordered,

and shall be documented by signature/date prior to line manager or other reviews.

All procurement documents shall be reviewed by a Quality Assurance Representative prior to issue to verify that the applicable QA requirements have been included. The subcontractor's written procedures for the above-mentioned activities shall be reviewed by the Project Manager and Quality Assurance Representative.

Subcontractors with extensive QA requirements shall be approved by PNL Quality Control.

5. INSTRUCTIONS, PROCEDURES, AND DRAWINGS

5.1 Procedures that have been identified for these projects include, but are not limited to the following:

- Ground-Water Sampling (radiological and chemical), covered in PNL-MA-580, including the following procedures:
  - Water Level Measurement
  - Conductivity Calibration and Measurement
  - pH Calibration and Measurement
  - Chain-of-Custody
  - Temperature Measurement
  - Sampling of River Water, Sediment, and Vegetation (as required)
- Sample Analysis[a]
- Sample Disposal, Procedure P-1
- Data Handling and Verification[b] Procedure P-2
- Statistical Analysis of Data[b] Procedure P-3
- Indoctrination and Training (PAP-201 Rev. 1; see exceptions noted in 2.1.3)
- Software Design, Development and Application(including verification procedures/test instructions)[b]
- Geophysical well logging (QA Plan ED-54)
- Data Base Management[b][c]
- Magnetic Media Control[c]
- Change Control (well drilling), Procedure P-4

(a) Listed in Compliance Plan.
(b) Procedure under development.
(c) This will be included in Hanford Ground-Water Data Base Management Guide and User's Manual when published.

Procedures for collection of drilling samples, including both sediment and liquid sampling (including Chain-of-Custody for core samples) shall be developed and maintained as a project record.

A checklist shall be developed and implemented for Title III Inspection of new wells (see Section 9, Performance of Inspections and Tests).

6. DOCUMENT CONTROL

6.1. This section shall be applied to the procedures identified in 5.1, and any other documents identified in the future as requiring control. Additional information is provided in the following statement.

6.1.1 Controlled documents shall be reviewed by designated, authorized personnel and approved for the use by the Project Manager or designated alternate. Approval shall be indicated by signature and date on the document.

The Quality Engineer shall review all controlled documents prior to issue to help assure that the applicable QA Program requirements have been adequately met.

6.1.2 Revisions to established procedures shall receive the same controls applied to the original documents.

In addition:

The Project Manager or designated staff shall be assigned (in writing) the responsibility of distribution for all controlled documents.

7. IDENTIFICATION AND CONTROL OF ITEMS

7.1 Sample labeling and identification is covered in the Chain-of-Custody procedure, as noted in Section 5.1.

9. PERFORMANCE OF INSPECTIONS AND TESTS

9.1 PNL-MA-65 addresses receiving and other inspection, inspection/test instruction (ITI), and records, tagging, and nonconformance and shall apply to purchased items, test equipment, samples, project data and computer items.

Title III Inspection of new wells shall be performed by independent, qualified personnel in accordance with the checklist referenced in 5.1 of this plan. The completed checklist shall be retained as a project record.

10. CONTROL OF MEASURING AND TEST EQUIPMENT

10.1 Control of measuring and test equipment used shall be in accordance with this section of PNL-MA-65.

In addition:

1. It is the responsibility of the Environmental Monitoring Supervisor or Sample Collection Task Leader to ensure that appropriate project files and records are maintained for all equipment used by the RPTs.

2. Calibration records for pH/Conductivity meters labeled "user to calibrate" shall be documented in the project files. Calibration shall be in accordance with pH/Conductivity calibration procedures referenced in Section 5.1 of this QA Plan.

3. Counting equipment for radiological analyses shall be calibrated to Level 1 as specified in PNL-MA-65, Section 10.1.

11. HANDLING, STORAGE, AND SHIPPING

11.1 Procedures for Chain-of-Custody handling and transporting samples are documented in the Sampling Procedures, as noted in Section 5.1.

Procedures for disposing of samples are noted in Section 5.1 of this QA Plan.

12. STATUS OF INSPECTION, TEST & OPERATING CONDITION

12.1 PNL-MA-65 addresses status indication authorities ("lock and tag" procedures) and status indication requirements (tags) which shall apply to test and sample acquisition equipment.

13. NONCONFORMANCE & CORRECTIVE ACTION

13.1 PNL-MA-65 defines nonconformance and gives a method for implementing corrective action.

14. QA RECORDS

14.1 The Project Manager or designated alternate shall assure that a project records file is maintained that contains or references the location of the QA records (as noted). Project records shall be retained

according to the PNL Records Management Manual (PNL-MA-68). These records shall include, but are not limited to, the following documents:

Records (Record Copy) which are kept by other organizations within Battelle include the following:

Technical reports (numbered) (Technical Information)
Monthly, Quarterly reports (Non-Project) (Department manager)
Cost Runs (Finance)
Subcontracts (Legal and Contracts)
Procurement Documents (Legal and Contracts)
Resumes (Personnel)
Project Training records (QA, Management Systems)
QA Plan (QA)
QA Audits (QA)
Nonconformance and Corrective Action Reports (QA)

Project records shall include, but are not limited to, the following documents:

Project Proposal, Planning documents
Project Authorization and Directives
Project Monthly, Quarterly and Annual reports
Unpublished Manuscripts
Correspondence influencing direction of the project

Data Collection Procedures (PNL-MA-580)
Project Procedures identified in Section 5.1

Laboratory Analysis Methods
- Laboratory analysis requests
- Procedural changes/communications

Computer Code Documentation identified in Section 3

Basic Data
- Hard copy from alternate labs
- Raw data on tape
- Data Base (magnetic media)
- Calibration records
- Logbooks

Data Reduction
- Including data summary, statistical and quality control
- Records traceable to Data Base

Laboratory Record Books (numbered)
Other notebooks, logbooks
Drawings
Well inspection documentation
Reviews
Records Plan/Index (ref., MG 4.3)

Records Retention:

- Retention periods for project records (record copy only) are specified by DOE Order 1342.2.
- Nonrecord copy retention is determined by the file custodian and project manager.
- Retention times and disposition are documented in the Records Inventory and Disposition Schedule for the RCRA Ground-Water Monitoring and Hazardous Materials Monitoring Project.
- Laboratory Record Books shall be returned to the Technical Library upon completion of the project for storage indefinitely.

Records Maintenance/Storage:

Records shall be maintained in project files and subfiles. Records maintenance shall be the responsibility of those custodians listed in the Master File Index and Task/Subtask File Indexes. While in the project file state, records shall be protected from damage or loss in order to avoid potential delays or additional costs of replacement.

Records Transmittal/Disposition:

Reproducible copies of all project records with retention times of 15 years or longer shall be transmitted to the Battelle or Federal Records Center annually, after two years of records have been generated. A record of this transmittal listing all records transferred and uniquely identifying them shall be documented and retained by the Project Manager.

Prior to this transmittal, the QA representative and Project Manager or designee shall check a sample of the turnover package to verify that sponsor requirements have been met and that the records are legible and complete.

14.1.3 Laboratory Record Books

Laboratory Record Books shall be controlled in accordance with Section 14.1.3 of PNL-MA-65.

Laboratory Record Books shall be used for documenting the following activities:

- Sample Collection Notes, including field measurements, conditions, and operational checks.

15. AUDITS

15.1 Annual audits shall be performed by the PNL QA Systems and Audits Section to determine conformance with QA requirements.

DISTRIBUTION

R. L. Aaberg
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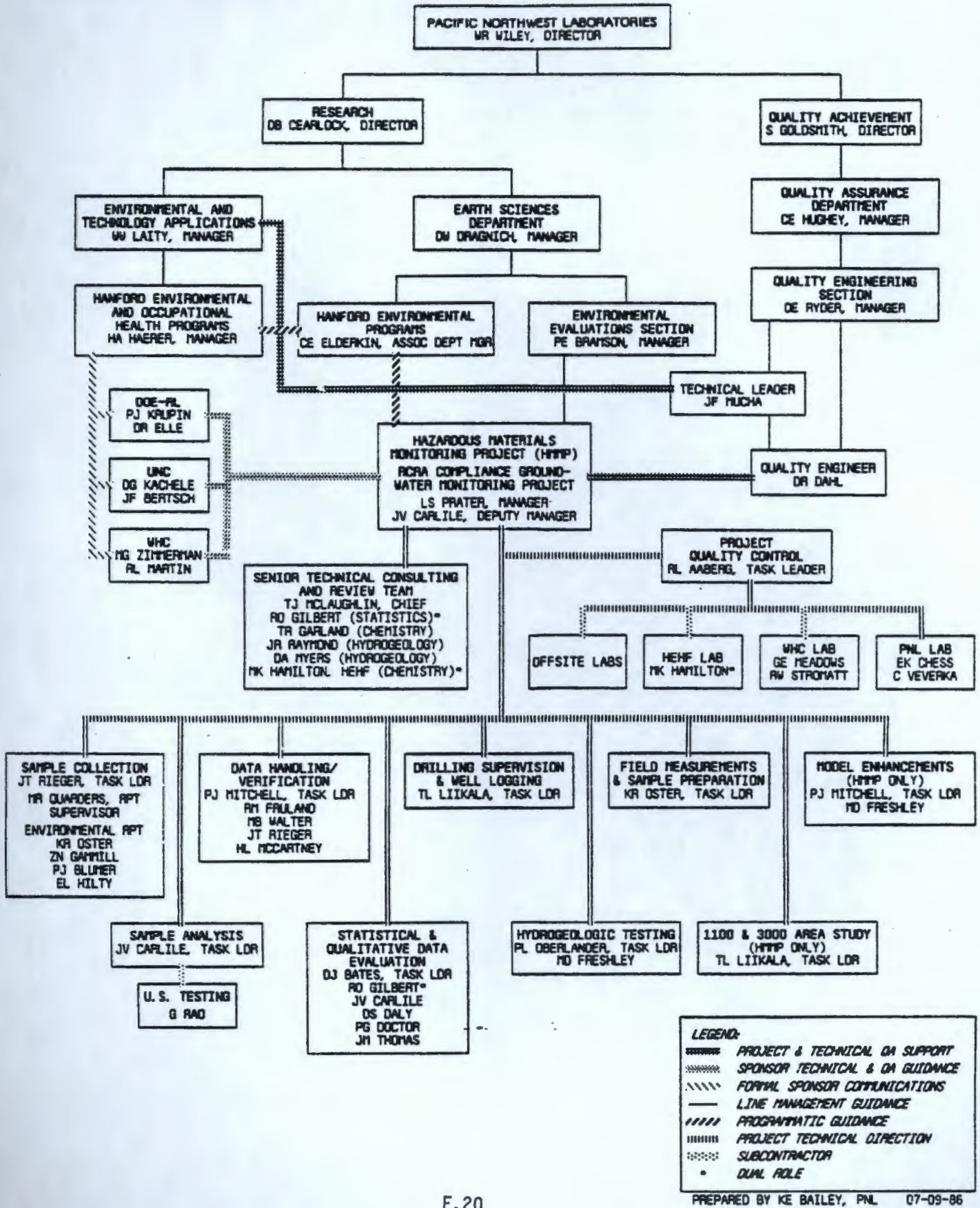

PREPARED BY KE BAILEY, PNL 07-09-86

APPENDIX G

DATA LISTINGS AND SUMMARIES

APPENDIX G

DATA LISTINGS AND SUMMARIES

Appendix G contains the summaries and raw data listings for the chemical constituent data collected from June 1985 through May 1986 for wells near the 183-H Solar Evaporation Basins. Only those constituents with at least one reported value above the detection limit are included.

Table G.1 gives summary information for each constituent measured. The data are summarized for each well and ordered on their mean values. Definitions of the terms used in this table follow:

WELLNAME = Well name
SAMPLES = Number of samples analyzed to date
DETLIMIT = Laboratory detection limit
BELOWDL = Number of samples below detection limit
ALLBELOW = Asterisks indicate that ALL samples were below detection limits
MAXLIMIT = Maximum permissible limit
MEAN = Simple arithmetic mean of all the values
MEDIAN = Median, or ordered middle, of all the values
STDDEV = Standard deviation of all the values
COEFFVAR = Coefficient of variation (100*STDDEV/MEAN) for all the values
MINIMUM = Minimum reported value
MAXIMUM = Maximum reported value

NOTE: The mean, standard deviation, and coefficient of variation statistics were calculated as though the values met the assumptions of simple random sampling. Estimation problems posed by replicates, below-detection values, and spatial and temporal variability in the data have not been addressed.

Table G.2 presents basically the same information as Table G.1 except that it is further broken down to date of sample and is restricted to only replicate sampling data to avoid unnecessary repetition of information already contained in Table G.1.

Raw data are presented in Table G.3 for those constituents that had at least one value above the detection limit. Each reported value is marked as being below the detection limit (<) where appropriate. In most cases the value reported will be the detection limit itself, but if an actual value below the detection limit is reported by the laboratory, that value is used in presentation and all subsequent data summaries. For radioactive elements, a detection limit is given, but the actual analytical value is reported and stated as below detection only if it is less than its associated counting error. Also, the column labeled "Rep" indicates field replicates taken in addition to the normal sample, with the "S" marking those replicate samples collected during October that were used for cross-comparison of the UST Hoboken and Richland laboratories. The column labeled "Lab" is empty if the analysis was done at UST-Richland and contains an "H" if the analysis was done at UST-Hoboken. Finally, an "M" in the column labeled "Concentration" indicates a missing data point.

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

15:43 TUESDAY, AUGUST 26, 1986

TABLE G.1 Summarized by Constituent-Well, sorted by Mean

----------Constituent List=Contamination Indicators Constituent Code, Name, Units=191 CONDUCT UMHO----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-5	11	.	0		.	349	349	43	12.3	302	435
199-H4-6	11	.	0		.	377	371	60.2	16.0	293	480
199-H3-1	11	.	0		.	577	577	63.4	11.0	459	702
199-H4-4	11	.	0		.	756	699	362	47.9	302	1252
199-H4-3	11	.	0		.	2370	2610	903	38.1	1177	3680

----------Constituent List=Contamination Indicators Constituent Code, Name, Units=199 PH----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-6	11	.	0		.	7.6	7.8	0.551	7.3	6.7	8.4
199-H4-4	11	.	0		.	7.64	7.55	0.375	4.9	7.2	8.6
199-H4-3	11	.	0		.	7.7	7.6	0.442	5.7	7.1	8.6
199-H3-1	11	.	0		.	7.77	7.75	0.514	6.6	6.9	8.9
199-H4-5	11	.	0		.	7.79	7.65	0.367	4.7	7.4	8.5

----------Constituent List=Contamination Indicators Constituent Code, Name, Units=C68 TOX PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-5	16	100	15		.	69.6	33	144	206.6	27.7	608
199-H4-6	10	100	8		.	80.6	33.3	107	133.1	16	364
199-H4-4	10	100	8		.	110	48	183	165.9	15	622
199-H3-1	17	100	16		.	188	18.4	689	366.2	8.2	2860
199-H4-3	11	100	8		.	266	42.3	605	227.2	27.6	2060

----------Constituent List=Contamination Indicators Constituent Code, Name, Units=C69 TOC PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-6	10	1000	4		.	1310	1200	586	44.9	405	2460
199-H4-5	16	1000	5		.	1430	1100	1440	100.7	330	6720
199-H3-1	17	1000	1		.	1770	1800	770	43.5	900	4300
199-H4-4	10	1000	0		.	3670	2840	2400	65.5	1010	9210
199-H4-3	11	1000	0		.	4390	4250	2400	54.6	1560	8890

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----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=109 COLIFRM MPN----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	17	3	17	***	1	3	3	0	0.0	3	3
199-H4-5	20	3	20	***	1	3	3	0	0.0	3	3
199-H4-6	11	3	10		1	3.09	3	0.302	9.8	3	4
199-H4-3	11	3	10		1	4.82	3	6.03	125.2	3	23
199-H4-4	11	3	9		1	4.91	3	6.01	122.4	3	23

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=111 BETA PCI/L----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-6	11	8	0		50	9.33	7.79	4.46	47.8	6.81	22.4
199-H4-5	20	8	0		50	11.6	7.17	13.3	114.6	4.59	63.6
199-H3-1	17	6	0		50	35.5	11.8	97.1	273.2	8.33	412
199-H4-4	11	8	0		50	221	249	117	53.0	18.9	384
199-H4-3	11	8	0		50	808	836	255	31.6	412	1160

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=181 RADIUM PCI/L----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	17	1	17	***	5	0.0532	0.0434	0.0569	106.9	-0.0461	0.162
199-H4-6	11	1	10		5	0.0622	0.105	0.106	170.5	-0.0999	0.195
199-H4-5	20	1	19		5	0.0708	0.0479	0.145	204.2	-0.0504	0.611
199-H4-4	11	1	9		5	0.0713	0.0521	0.118	165.1	-0.0633	0.277
199-H4-3	11	1	6		5	0.182	0.187	0.107	58.8	-0.0302	0.315

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=212 LOALPHA PCI/L----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-6	11	4	2		15	2.71	2.49	1.66	61.3	1.15	6.57
199-H4-5	20	4	2		15	3.85	2.69	5.57	144.8	0.112	26.6
199-H3-1	17	4	1		15	5.54	5.63	2.16	39.0	0.936	8.54
199-H4-4	11	4	0		15	54.6	54.7	39.7	72.8	9.58	146
199-H4-3	11	4	0		15	273	207	178	65.1	119	637

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----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A06 BARIUM PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-6	11	6	0		1000	32.1	32	7.44	23.2	15	40
199-H4-5	21	6	0		1000	47.5	45	8.57	18.0	36	73
199-H3-1	18	6	0		1000	56.7	49	30.3	53.3	43	175
199-H4-4	11	6	0		1000	56.7	48	27.1	47.8	25	106
199-H4-3	11	6	0		1000	111	97	70.8	63.6	26	248

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A07 CADMIUM PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	18	2	17		10	2.01	2	0.0236	1.2	2	2.1
199-H4-4	11	2	10		10	2.18	2	0.603	27.6	2	4
199-H4-5	21	2	18		10	2.2	2	0.529	24.1	2	4
199-H4-3	11	2	10		10	2.27	2	0.905	39.8	2	5
199-H4-6	11	2	10		10	3	2	3.32	110.6	2	13

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A08 CHROMUM PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-6	11	10	1		50	33.3	35	10.8	32.3	10	49
199-H3-1	18	10	0		50	40.2	35	13.2	32.9	23	64
199-H4-5	21	10	0		50	433	470	132	30.4	169	591
199-H4-4	11	10	0		50	480	571	235	49.0	66	729
199-H4-3	11	10	0		50	879	842	114	13.0	733	1130

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A20 ARSENIC PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-3	11	5	10		50	5	5	0	0.0	5	5
199-H4-6	11	5	11	***	50	5	5	0	0.0	5	5
199-H3-1	18	5	17		50	5.08	5	0.236	4.7	5	6
199-H4-4	11	5	10		50	5.36	5	1.21	22.5	5	9
199-H4-5	21	5	14		50	5.59	5	1.43	25.6	5	11

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----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A21 MERCURY PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-5	21	0.1	21	***	2	0.1	0.1	0	0.0	0.1	0.1
199-H4-6	11	0.1	11	***	2	0.1	0.1	0	0.0	0.1	0.1
199-H4-3	11	0.1	10		2	0.536	0.1	1.45	269.8	0.1	4.9
199-H3-1	18	0.1	16		2	0.617	0.1	1.51	245.1	0.1	5.2
199-H4-4	11	0.1	10		2	0.764	0.1	2.2	288.2	0.1	7.4

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A22 SELENUM PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	18	5	18	***	10	5	5	0	0.0	5	5
199-H4-3	11	5	11	***	10	5	5	0	0.0	5	5
199-H4-4	11	5	11	***	10	5	5	0	0.0	5	5
199-H4-6	11	5	11	***	10	5	5	0	0.0	5	5
199-H4-5	21	5	19		10	5.71	5	2.39	41.8	5	15

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A51 LEADGF PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-5	21	5	20		50	4.76	5	1.09	22.9	0	5.01
199-H3-1	18	5	18	***	50	5	5	0	0.0	5	5
199-H4-6	11	5	11	***	50	5	5	0	0.0	5	5
199-H4-3	11	5	10		50	5.01	5	0.0302	0.6	5	5.1
199-H4-4	11	5	10		50	5.07	5	0.244	4.8	5	5.81

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=C72 NITRATE PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-5	20	500	0		45000	21300	22400	3760	17.7	14500	26000
199-H4-6	11	500	1		45000	24700	27100	5600	22.7	15000	31100
199-H3-1	17	500	1		45000	64100	66600	9090	14.2	47100	79100
199-H4-4	11	500	0		45000	354000	259000	352000	99.4	23300	1300000
199-H4-3	11	500	0		45000	1360000	1040000	879000	64.8	418000	2890000

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----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=C74 FLUORID PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-6	11	500	9		1400	522	500	69.2	13.3	500	730
199-H3-1	17	500	12		1400	535	500	65.5	12.2	500	702
199-H4-5	20	500	18		1400	555	500	112	20.3	500	810
199-H4-4	11	500	6		1400	556	500	85.2	15.3	500	700
199-H4-3	11	500	6		1400	873	500	543	62.3	500	1960

----------Constituent List=Quality Characteristics Constituent Code, Name, Units=A11 SODIUM PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-5	21	100	0		.	9110	8890	656	7.2	8200	10600
199-H4-6	11	100	0		.	19100	18400	2010	10.5	16700	22500
199-H3-1	18	100	0		.	19400	19500	2120	10.9	15100	23000
199-H4-4	11	100	0		.	115000	115000	62100	54.1	18300	193000
199-H4-3	11	100	0		.	401000	375000	138000	34.3	225000	638000

----------Constituent List=Quality Characteristics Constituent Code, Name, Units=A17 MANGESE PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-4	11	5	10		.	5.18	5	0.603	11.6	5	7
199-H4-5	21	5	19		.	6	5	3.16	52.7	5	16
199-H3-1	18	5	18		.	9.08	5	8.42	92.7	5	34
199-H4-3	11	5	4		.	9.41	6	7.51	79.8	5	30
199-H4-6	11	5	0		.	54.5	53	14.1	25.8	32	76

----------Constituent List=Quality Characteristics Constituent Code, Name, Units=A19 IRON PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	18	50	7		.	172	74.5	172	99.8	50	584
199-H4-5	21	50	5		.	242	104	337	139.1	50	1460
199-H4-3	11	50	1		.	281	173	253	89.9	50	887
199-H4-6	11	50	0		.	296	286	103	34.7	134	547
199-H4-4	11	50	3		.	516	300	617	119.5	50	2010

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----------Constituent List=Quality Characteristics Constituent Code, Name, Units=C73 SULFATE PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-5	20	500	0		.	38700	39700	5140	13.3	29000	45300
199-H4-6	11	500	0		.	55700	47900	15400	27.7	40000	78300
199-H4-4	11	500	0		.	61500	60800	18900	30.7	28900	84100
199-H3-1	17	500	1		.	67400	66600	9330	13.8	52600	86200
199-H4-3	11	500	0		.	139000	113000	75600	54.3	72400	326000

----------Constituent List=Quality Characteristics Constituent Code, Name, Units=C75 CHLORID PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-5	20	500	0		.	3810	3910	685	18.0	2600	5500
199-H4-4	11	500	0		.	4350	4520	750	17.2	2920	5300
199-H4-6	11	500	0		.	6760	6260	1790	26.5	4000	9060
199-H4-3	11	500	0		.	6780	6620	1760	26.0	4570	9870
199-H3-1	17	500	1		.	8310	8470	1060	12.8	5800	9600

----------Constituent List=Site Specific Constituent Code, Name, Units=A03 STRONUM PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-4	7	300	7	***	.	300	300	0	0.0	300	300
199-H4-5	8	300	8	***	.	300	300	0	0.0	300	300
199-H4-6	7	300	7	***	.	300	300	0	0.0	300	300
199-H3-1	18	300	5		.	393	414	69	17.5	300	513
199-H4-3	11	300	4		.	475	391	221	46.6	300	968

----------Constituent List=Site Specific Constituent Code, Name, Units=A04 ZINC PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-3	11	5	8		.	7.09	5	4.76	67.2	5	20
199-H3-1	18	5	9		.	15.9	5	30.2	189.6	5	133
199-H4-5	8	5	0		.	53.5	49	13.6	25.4	38	71
199-H4-4	7	5	0		.	58.6	42	36.5	62.4	21	125
199-H4-6	7	5	0		.	133	132	18.2	13.7	114	162

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----------Constituent List=Site Specific Constituent Code, Name, Units=A05 CALCIUM PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-4	7	50	0		.	32600	31200	10300	31.5	19500	46300
199-H4-6	7	50	0		.	51000	53700	7240	14.2	37900	58000
199-H4-5	8	50	0		.	53600	54300	4280	8.0	44900	60000
199-H3-1	18	50	0		.	73500	74400	7830	10.6	60300	88700
199-H4-3	11	50	0		.	77100	64700	51100	66.3	15700	177000

----------Constituent List=Site Specific Constituent Code, Name, Units=A12 NICKEL PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	18	10	18	***	.	9.89	10	0.471	4.8	8	10
199-H4-5	21	10	21	***	.	10	10	0	0.0	10	10
199-H4-6	11	10	11	***	.	10	10	0	0.0	10	10
199-H4-4	11	10	6		.	11.9	10	3.3	27.7	10	18
199-H4-3	11	10	0		.	51.2	46	23.9	46.8	21	90

----------Constituent List=Site Specific Constituent Code, Name, Units=A13 COPPER PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-6	11	10	10		1300	10.2	10	0.603	5.9	10	12
199-H3-1	18	10	16		1300	10.3	10	1.18	11.5	10	15
199-H4-5	21	10	17		1300	11.5	10	4.2	36.5	10	27
199-H4-4	11	10	10		1300	11.7	10	5.73	48.8	10	29
199-H4-3	11	10	0		1300	56.1	48	22.8	40.7	27	105

----------Constituent List=Site Specific Constituent Code, Name, Units=A14 VANADUM PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-4	11	5	8		.	6.64	5	3.44	51.9	5	16
199-H4-6	11	5	5		.	7.27	5	4.03	55.4	5	18
199-H4-3	11	5	7		.	8.27	5	5.97	72.1	5	24
199-H4-5	21	5	14		.	11	5	11.1	100.8	5	37
199-H3-1	18	5	5		.	14.6	10	10.3	70.2	5	41

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----------Constituent List=Site Specific Constituent Code, Name, Units=A16 ALUMNUM PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-4	11	150	9		.	168	150	47.2	28.0	150	304
199-H4-6	11	150	9		.	173	150	57.2	33.0	150	332
199-H4-5	21	150	12		.	220	150	115	52.5	150	531
199-H3-1	18	150	12		.	249	150	212	85.1	150	926
199-H4-3	11	150	6		.	254	150	182	71.5	150	759

----------Constituent List=Site Specific Constituent Code, Name, Units=A18 POTASUM PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-5	21	100	0		.	4360	4180	564	13.0	3470	5740
199-H4-4	11	100	0		.	5090	4540	1150	22.6	3770	6930
199-H4-6	11	100	0		.	5450	5490	368	6.8	4880	6000
199-H3-1	18	100	0		.	6330	6050	898	14.2	5270	8240
199-H4-3	11	100	0		.	8590	8410	3290	38.3	3950	14300

----------Constituent List=Site Specific Constituent Code, Name, Units=A67 1,1,1-T PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-4	8	10	8	***	200	10	10	0	0.0	10	10
199-H4-5	9	10	8		200	10.4	10	1.33	12.8	10	14
199-H4-6	8	10	7		200	10.5	10	1.41	13.5	10	14
199-H3-1	18	10	17		200	10.7	10	2.91	27.2	10	22
199-H4-3	11	10	9		200	11.4	10	4.32	37.9	10	24.4

----------Constituent List=Site Specific Constituent Code, Name, Units=A70 PERCENE PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	18	10	18	***	.	10	10	0	0.0	10	10
199-H4-4	8	10	8	***	.	10	10	0	0.0	10	10
199-H4-5	9	10	9	***	.	10	10	0	0.0	10	10
199-H4-3	11	10	8		.	10.2	10	0.494	4.8	10	11.4
199-H4-6	8	10	7		.	10.6	10	1.77	16.6	10	15

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----------Constituent List=Site Specific Constituent Code, Name, Units=A80 CHLFORM PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	14	10	8		.	10.8	10	1.48	13.7	10	14
199-H4-6	8	10	0		.	18	17.5	3.85	21.4	14	24
199-H4-4	6	10	0		.	20.8	22	4.92	23.6	14	27
199-H4-3	11	10	1		.	25.7	27.1	8.17	24.0	10	32
199-H4-5	8	10	0		.	26.1	26	1.64	6.3	24	29

----------Constituent List=Site Specific Constituent Code, Name, Units=A93 METHYCH PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	15	10	12		.	120	10	397	332.4	10	1500
199-H4-6	4	10	0		.	172	98	205	119.0	22	470
199-H4-5	3	10	2		.	203	6.4	344	169.3	2.8	600
199-H4-3	9	10	5		.	220	10	459	208.4	10	1400
199-H4-4	2	10	0		.	455	455	163	35.7	340	570

----------Constituent List=Site Specific Constituent Code, Name, Units=C88 AMMONIU PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-4	11	50	6		.	98.7	50	66.5	67.3	30	230
199-H4-3	11	50	5		.	109	51	75.4	69.4	42	240
199-H3-1	17	50	6		.	123	138	61.9	50.4	36	230
199-H4-6	11	50	1		.	135	103	70.5	52.1	50	270
199-H4-5	20	50	6		.	138	140	71.5	51.6	30	250

----------Constituent List=WAC 173-303-9905 Constituent Code, Name, Units=A23 THALIUM PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	12	10	9		.	11.2	10	2.48	22.2	10	18
199-H4-3	6	10	5		.	11.8	10	4.49	37.9	10	21

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

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TABLE G.1 Summarized by Constituent-Well, sorted by Mean

----------Constituent List=WAC 173-303-9905 Constituent Code, Name, Units=B40 BIS2EPH PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	12	10	12	***	.	10	10	0	0.0	10	10
199-H4-3	7	10	6		.	10.5	10	1.22	11.7	10	13

----------Constituent List=WAC 173-303-9905 Constituent Code, Name, Units=I99 UNKNOWN PPB----------

WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	1	0	0		.	9	9	.	.	9	9

RCRA Compliance Ground-Water Monitoring Data
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TABLE G.2 Summarized by Constituent-Well-Collection Date
Replicate Data Only

----------Constituent List=Contamination Indicators Constituent Code, Name, Units=C68 TOX PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	100	3	.	21.7	22.2	1.84	8.5	19.7	23.3
199-H3-1	01AUG85	3	100	3	.	17.5	17	2.05	11.7	15.8	19.8
199-H3-1	27AUG85	3	100	3	.	15.2	15.7	1.36	8.9	13.7	16.3
199-H4-5	25JUL85	4	100	4	.	32.1	31.1	4.99	15.6	27.7	38.5
199-H4-5	26AUG85	4	100	4	.	30.1	29.8	0.889	3.0	29.3	31.2

----------Constituent List=Contamination Indicators Constituent Code, Name, Units=C69 TOC PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	1000	1	.	1180	1070	343	29.1	900	1560
199-H3-1	01AUG85	3	1000	0	.	1460	1440	136	9.3	1330	1600
199-H3-1	27AUG85	3	1000	0	.	2130	2130	30	1.4	2100	2160
199-H4-5	25JUL85	4	1000	1	.	1090	1100	177	16.2	870	1300
199-H4-5	26AUG85	4	1000	2	.	865	965	377	43.6	330	1200

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=109 COLIFRM MPN----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	3	3	1	3	3	0	0.0	3	3
199-H3-1	01AUG85	3	3	3	1	3	3	0	0.0	3	3
199-H3-1	27AUG85	3	3	3	1	3	3	0	0.0	3	3
199-H4-5	24JUN85	4	3	4	1	3	3	0	0.0	3	3
199-H4-5	25JUL85	4	3	4	1	3	3	0	0.0	3	3
199-H4-5	26AUG85	4	3	4	1	3	3	0	0.0	3	3

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=111 BETA PCI/L----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	8	0	50	10.5	8.42	3.69	35.0	8.4	14.8
199-H3-1	01AUG85	3	8	0	50	145	11.6	232	160.1	10.2	412
199-H3-1	27AUG85	3	8	0	50	11.7	11.8	3.29	28.0	8.42	15
199-H4-5	24JUN85	4	8	0	50	6.16	6.19	0.789	12.8	5.42	6.84
199-H4-5	25JUL85	4	8	0	50	11	8.29	7.57	68.5	5.42	22.2
199-H4-5	26AUG85	4	8	0	50	8.17	8.1	1.81	22.2	6.29	10.2

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=181 RADIUM PCI/L----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	1	3	5	0.0721	0.0678	0.0539	74.7	0.0205	0.128
199-H3-1	01AUG85	3	1	3	5	0.0266	0	0.0495	173.2	0	0.0857
199-H3-1	27AUG85	3	1	3	5	-0.00623	-0.016	0.0455	-730.6	-0.0461	0.0434
199-H4-5	24JUN85	4	1	3	5	0.199	0.117	0.308	155.2	-0.0504	0.611
199-H4-5	25JUL85	4	1	4	5	0.0305	0.042	0.0524	171.7	-0.0377	0.0757
199-H4-5	26AUG85	4	1	4	5	0.0347	0.0142	0.067	193.3	-0.0158	0.126

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TABLE G.2 Summarized by Constituent-Well-Collection Date
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----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=212 LOALPHA PCI/L----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	4	0	15	2.69	3.55	1.52	56.4	0.936	3.57
199-H3-1	01AUG85	3	4	0	15	6.91	8.57	1.49	21.5	5.63	8.54
199-H3-1	27AUG85	3	4	0	15	4.41	4.33	0.426	9.7	4.03	4.87
199-H4-5	24JUN85	4	4	0	15	1.14	1.32	0.817	72.0	0.112	1.8
199-H4-5	25JUL85	4	4	0	15	8.1	2.21	12.3	152.4	1.38	26.6
199-H4-5	26AUG85	4	4	0	15	3.22	3.24	0.506	15.7	2.62	3.76

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A06 BARIUM PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	6	0	1000	53.3	50	11.4	21.3	44	66
199-H3-1	01AUG85	3	6	0	1000	93.3	53	70.7	75.8	52	175
199-H3-1	27AUG85	3	6	0	1000	44.3	45	1.15	2.6	43	45
199-H4-5	24JUN85	4	6	0	1000	47	46	10.4	22.1	36	60
199-H4-5	25JUL85	4	6	0	1000	53.8	51.5	4.86	9.0	51	61
199-H4-5	26AUG85	4	6	0	1000	44.3	44	1.5	3.4	43	46

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A07 CADMIUM PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	2	3	10	2	2	0	0.0	2	2
199-H3-1	01AUG85	3	2	2	10	2.03	2	0.0577	2.8	2	2.1
199-H3-1	27AUG85	3	2	3	10	2	2	0	0.0	2	2
199-H4-5	24JUN85	4	2	4	10	2	2	0	0.0	2	2
199-H4-5	25JUL85	4	2	4	10	2	2	0	0.0	2	2
199-H4-5	26AUG85	4	2	2	10	2.75	2.5	0.957	34.8	2	4

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A08 CHROMUM PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	10	0	50	25.7	24	3.79	14.8	23	30
199-H3-1	01AUG85	3	10	0	50	37.3	31	11.8	31.7	30	51
199-H3-1	27AUG85	3	10	0	50	31	30	1.73	5.6	30	33
199-H4-5	24JUN85	4	10	0	50	180	180	9.95	5.5	169	192
199-H4-5	25JUL85	4	10	0	50	472	467	28.6	6.1	447	508
199-H4-5	26AUG85	4	10	0	50	493	495	19.1	3.9	470	513

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A20 ARSENIC PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	5	2	50	5.33	5	0.577	10.8	5	6
199-H3-1	01AUG85	3	5	3	50	5	5	0	0.0	5	5
199-H3-1	27AUG85	3	5	3	50	5	5	0	0.0	5	5
199-H4-5	24JUN85	4	5	1	50	5.25	5	0.5	9.5	5	6
199-H4-5	25JUL85	4	5	3	50	5.33	5	0.65	12.2	5	6.3
199-H4-5	26AUG85	4	5	3	50	5.69	5	1.39	24.3	5	7.77

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----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A21 MERCURY PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	0.1	3	2	0.1	0.1	0	0.0	0.1	0.1
199-H3-1	01AUG85	3	0.1	1	2	3.2	4.3	2.72	85.1	0.1	5.2
199-H3-1	27AUG85	3	0.1	3	2	0.1	0.1	0	0.0	0.1	0.1
199-H4-5	24JUN85	4	0.1	4	2	0.1	0.1	0	0.0	0.1	0.1
199-H4-5	25JUL85	4	0.1	4	2	0.1	0.1	0	0.0	0.1	0.1
199-H4-5	26AUG85	4	0.1	4	2	0.1	0.1	0	0.0	0.1	0.1

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A22 SELENUM PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	5	3	10	5	5	0	0.0	5	5
199-H3-1	01AUG85	3	5	3	10	5	5	0	0.0	5	5
199-H3-1	27AUG85	3	5	3	10	5	5	0	0.0	5	5
199-H4-5	24JUN85	4	5	4	10	5	5	0	0.0	5	5
199-H4-5	25JUL85	4	5	2	10	8.75	7.5	4.79	54.7	5	15
199-H4-5	26AUG85	4	5	4	10	5	5	0	0.0	5	5

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=A51 LEADGF PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	5	3	50	5	5	0	0.0	5	5
199-H3-1	01AUG85	3	5	3	50	5	5	0	0.0	5	5
199-H3-1	27AUG85	3	5	3	50	5	5	0	0.0	5	5
199-H4-5	24JUN85	4	5	4	50	5	5	0	0.0	5	5
199-H4-5	25JUL85	4	5	4	50	5	5	0	0.0	5	5
199-H4-5	26AUG85	4	5	4	50	5	5	0	0.0	5	5

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=C72 NITRATE PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	500	1	45000	59000	59000	1410	2.4	58000	60000
199-H3-1	01AUG85	3	500	0	45000	71600	68300	6480	9.0	67500	79100
199-H3-1	27AUG85	3	500	0	45000	67600	68000	2060	3.0	65700	69800
199-H4-5	24JUN85	4	500	0	45000	15100	15000	538	3.6	14500	15600
199-H4-5	25JUL85	4	500	0	45000	23800	23800	1230	5.2	22500	25100
199-H4-5	26AUG85	4	500	0	45000	24700	24900	1490	6.0	23000	26000

----------Constituent List=Drinking Water Standards Constituent Code, Name, Units=C74 FLUORID PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	500	3	1400	500	500	0	0.0	500	500
199-H3-1	01AUG85	3	500	1	1400	560	550	65.6	11.7	500	630
199-H3-1	27AUG85	3	500	3	1400	500	500	0	0.0	500	500
199-H4-5	24JUN85	4	500	4	1400	500	500	0	0.0	500	500
199-H4-5	25JUL85	4	500	0	1400	773	770	29.9	3.9	740	810
199-H4-5	26AUG85	4	500	4	1400	500	500	0	0.0	500	500

TABLE G.2 Summarized by Constituent-Well-Collection Date
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----------Constituent List=Quality Characteristics Constituent Code, Name, Units=A11 SODIUM PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	100	0	.	16900	15700	2620	15.5	15100	19900
199-H3-1	01AUG85	3	100	0	.	19900	19500	1930	9.7	18200	22000
199-H3-1	27AUG85	3	100	0	.	17900	17600	666	3.7	17500	18700
199-H4-5	24JUN85	4	100	0	.	9380	9060	836	8.9	8800	10600
199-H4-5	25JUL85	4	100	0	.	9300	9220	444	4.8	8890	9860
199-H4-5	26AUG85	4	100	0	.	8420	8390	212	2.5	8200	8710

----------Constituent List=Quality Characteristics Constituent Code, Name, Units=A17 MANGESE PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	5	1	.	21	24	14.7	70.1	5	34
199-H3-1	01AUG85	3	5	1	.	11.5	8.5	6.41	73.1	5	21
199-H3-1	27AUG85	3	5	3	.	5	5	0	0.0	5	5
199-H4-5	24JUN85	4	5	3	.	7.75	5	5.5	71.0	5	16
199-H4-5	25JUL85	4	5	3	.	7.5	5	5	66.7	5	15
199-H4-5	26AUG85	4	5	4	.	5	5	0	0.0	5	5

----------Constituent List=Quality Characteristics Constituent Code, Name, Units=A19 IRON PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	50	0	.	300	184	247	82.4	132	584
199-H3-1	01AUG85	3	50	0	.	260	235	116	44.7	158	386
199-H3-1	27AUG85	3	50	2	.	50	50	0	0.0	50	50
199-H4-5	24JUN85	4	50	0	.	467	152	662	141.9	104	1460
199-H4-5	25JUL85	4	50	0	.	286	226	220	77.0	91	599
199-H4-5	26AUG85	4	50	0	.	160	137	119	74.4	60	306

----------Constituent List=Quality Characteristics Constituent Code, Name, Units=C73 SULFATE PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	500	1	.	59300	59300	354	0.6	59000	59500
199-H3-1	01AUG85	3	500	0	.	70800	67300	6240	8.8	67100	78000
199-H3-1	27AUG85	3	500	0	.	66000	66100	2100	3.2	63800	68000
199-H4-5	24JUN85	4	500	0	.	29800	29500	957	3.2	29000	31000
199-H4-5	25JUL85	4	500	0	.	41500	41200	2180	5.2	39700	44000
199-H4-5	26AUG85	4	500	0	.	42800	42900	2530	5.9	40000	45300

----------Constituent List=Quality Characteristics Constituent Code, Name, Units=C75 CHLORID PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	500	1	.	6000	6000	283	4.7	5800	6200
199-H3-1	01AUG85	3	500	0	.	9000	9200	721	8.0	8200	9600
199-H3-1	27AUG85	3	500	0	.	8050	8210	309	3.8	7690	8240
199-H4-5	24JUN85	4	500	0	.	2780	2750	171	6.2	2600	3000
199-H4-5	25JUL85	4	500	0	.	4550	4300	661	14.5	4100	5500
199-H4-5	26AUG85	4	500	0	.	3930	3860	262	6.7	3690	4300

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TABLE G.2 Summarized by Constituent-Well-Collection Date
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----------Constituent List=Site Specific Constituent Code, Name, Units=A03 STRONUM PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	300	0	.	381	382	24	6.3	356	404
199-H3-1	01AUG85	3	300	3	.	300	300	0	0.0	300	300
199-H3-1	27AUG85	3	300	1	.	378	415	67.6	17.9	300	419

----------Constituent List=Site Specific Constituent Code, Name, Units=A04 ZINC PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	5	0	.	10.7	8	6.43	60.3	6	18
199-H3-1	01AUG85	3	5	0	.	63.3	30	60.4	95.3	27	133
199-H3-1	27AUG85	3	5	3	.	5	5	0	0.0	5	5

----------Constituent List=Site Specific Constituent Code, Name, Units=A05 CALCIUM PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	50	0	.	72500	72100	4960	6.8	67800	77700
199-H3-1	01AUG85	3	50	0	.	74600	74700	513	0.7	74000	75000
199-H3-1	27AUG85	3	50	0	.	61400	60900	1360	2.2	60300	62900

----------Constituent List=Site Specific Constituent Code, Name, Units=A12 NICKEL PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	10	3	.	9.33	10	1.15	12.4	8	10
199-H3-1	01AUG85	3	10	3	.	10	10	0	0.0	10	10
199-H3-1	27AUG85	3	10	3	.	10	10	0	0.0	10	10
199-H4-5	24JUN85	4	10	4	.	10	10	0	0.0	10	10
199-H4-5	25JUL85	4	10	4	.	10	10	0	0.0	10	10
199-H4-5	26AUG85	4	10	4	.	10	10	0	0.0	10	10

----------Constituent List=Site Specific Constituent Code, Name, Units=A13 COPPER PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	10	2	1300	10	10	0	0.0	10	10
199-H3-1	01AUG85	3	10	2	1300	11.7	10	2.69	24.7	10	15
199-H3-1	27AUG85	3	10	3	1300	10	10	0	0.0	10	10
199-H4-5	24JUN85	4	10	0	1300	18	16.5	6.98	38.8	12	27
199-H4-5	25JUL85	4	10	4	1300	10	10	0	0.0	10	10
199-H4-5	26AUG85	4	10	4	1300	10	10	0	0.0	10	10

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

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TABLE G.2 Summarized by Constituent-Well-Collection Date
Replicate Data Only

----------Constituent List=Site Specific Constituent Code, Name, Units=A14 VANADUM PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	5	0	.	32.7	29	7.23	22.1	28	41
199-H3-1	01AUG85	3	5	0	.	20	20	0	0.0	20	20
199-H3-1	27AUG85	3	5	1	.	7.67	9	2.31	30.1	5	9
199-H4-5	24JUN85	4	5	0	.	32.3	32	3.69	11.4	28	37
199-H4-5	25JUL85	4	5	4	.	5	5	0	0.0	5	5
199-H4-5	26AUG85	4	5	3	.	5	5	0	0.0	5	5

----------Constituent List=Site Specific Constituent Code, Name, Units=A16 ALUMNUM PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	150	0	.	456	223	407	89.1	220	926
199-H3-1	01AUG85	3	150	1	.	308	208	222	72.5	150	560
199-H3-1	27AUG85	3	150	3	.	150	150	0	0.0	150	150
199-H4-5	24JUN85	4	150	0	.	374	364	52.4	14.0	329	439
199-H4-5	25JUL85	4	150	0	.	288	219	165	57.5	182	531
199-H4-5	26AUG85	4	150	4	.	150	150	0	0.0	150	150

----------Constituent List=Site Specific Constituent Code, Name, Units=A18 POTASUM PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	100	0	.	5980	5400	1080	18.0	5310	7220
199-H3-1	01AUG85	3	100	0	.	7010	6980	481	6.9	6540	7500
199-H3-1	27AUG85	3	100	0	.	5460	5370	242	4.4	5270	5730
199-H4-5	24JUN85	4	100	0	.	4280	4170	454	10.6	3870	4930
199-H4-5	25JUL85	4	100	0	.	4700	4760	896	19.1	3550	5740
199-H4-5	26AUG85	4	100	0	.	4110	4110	86.6	2.1	4000	4210

----------Constituent List=Site Specific Constituent Code, Name, Units=A67 1,1,1-T PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	10	3	200	10	10	0	0.0	10	10
199-H3-1	01AUG85	3	10	3	200	10	10	0	0.0	10	10
199-H3-1	27AUG85	3	10	3	200	10	10	0	0.0	10	10

----------Constituent List=Site Specific Constituent Code, Name, Units=A70 PERCENE PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	10	3	.	10	10	0	0.0	10	10
199-H3-1	01AUG85	3	10	3	.	10	10	0	0.0	10	10
199-H3-1	27AUG85	3	10	3	.	10	10	0	0.0	10	10

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

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TABLE G.2 Summarized by Constituent-Well-Collection Date
Replicate Data Only

----------Constituent List=Site Specific Constituent Code, Name, Units=A80 CHLFORM PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	10	1	.	10.5	10.5	0.707	6.7	10	11
199-H3-1	01AUG85	3	10	1	.	11.3	10	2.31	20.4	10	14
199-H3-1	27AUG85	3	10	2	.	11.3	10	2.31	20.4	10	14

----------Constituent List=Site Specific Constituent Code, Name, Units=A93 METHYCH PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	10	3	.	10	10	0	0.0	10	10
199-H3-1	01AUG85	3	10	3	.	10	10	0	0.0	10	10
199-H3-1	27AUG85	3	10	3	.	10	10	0	0.0	10	10

----------Constituent List=Site Specific Constituent Code, Name, Units=C80 AMMONIU PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	50	0	.	168	170	7.64	4.5	160	175
199-H3-1	01AUG85	3	50	0	.	195	180	30.4	15.6	175	230
199-H3-1	27AUG85	3	50	0	.	139	130	18.6	13.4	126	160
199-H4-5	24JUN85	4	50	0	.	180	160	8.16	4.5	170	190
199-H4-5	25JUL85	4	50	0	.	230	230	16.3	7.9	210	250
199-H4-5	26AUG85	4	50	0	.	141	130	33.5	23.8	114	190

----------Constituent List=WAC 173-303-9905 Constituent Code, Name, Units=A23 THALIUM PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	10	0	.	14.7	14	3.06	20.8	12	18
199-H3-1	01AUG85	3	10	3	.	10	10	0	0.0	10	10
199-H3-1	27AUG85	3	10	3	.	10	10	0	0.0	10	10

----------Constituent List=WAC 173-303-9905 Constituent Code, Name, Units=B40 BIS2EPH PPB----------

WELLNAME	COLLDATE	SAMPLES	DETLIMIT	BELOWDL	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H3-1	24JUN85	3	10	3	.	10	10	0	0.0	10	10
199-H3-1	01AUG85	3	10	3	.	10	10	0	0.0	10	10
199-H3-1	27AUG85	3	10	3	.	10	10	0	0.0	10	10

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Contamination Indicators

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
191	CONDUCT	UMHO	.	199-H3-1	26JUN85			547
					01AUG85			561
					27AUG85			593
					03OCT85			607
					31OCT85			620
					13DEC85			M
					22JAN86			702
					25FEB86			544
					24MAR86			545
					25APR86			596
					28MAY86			459
				199-H4-3	19JUN85			2,610
					01AUG85			1,503
					27AUG85			1,177
					01OCT85			M
					01NOV85			1,654
					13DEC85			M
					22JAN86			3,170
					24FEB86			1,560
					24MAR86			2,880
					24APR86			3,080
					28MAY86			3,680
				199-H4-4	19JUN85			1,067
					01AUG85			1,252
					26AUG85			1,230
					01OCT85			M
					01NOV85			837
					12DEC85			302
					21JAN86			980
					24FEB86			542
					21MAR86			560
					24APR86			344
					28MAY86			446
				199-H4-5	24JUN85			302
					25JUL85			346
					26AUG85			401
					01OCT85			M
					31OCT85			355
					12DEC85			364
					21JAN86			435
					25FEB86			305
					25MAR86			312
					24APR86			352
					28MAY86			321
				199-H4-6	19JUN85			297
					25JUL85			293
					26AUG85			329
					03OCT85			371
					31OCT85			350
					12DEC85			399
					21JAN86			480
					25FEB86			362
					24MAR86			393
					25APR86			459
					28MAY86			415

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Contamination Indicators

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
199	PH		.	199-H3-1	26JUN85			7.40
					01AUG85			7.70
					27AUG85			7.90
					03OCT85			7.80
					31OCT85			8.10
					13DEC85			M
					22JAN86			8.90
					25FEB86			7.80
					24MAR86			6.90
					25APR86			7.50
					28MAY86			7.70
				199-H4-3	19JUN85			7.30
					01AUG85			7.90
					27AUG85			8.00
					01OCT85			M
					01NOV85			7.50
					13DEC85			M
					22JAN86			8.60
					24FEB86			7.60
					24MAR86			7.10
					24APR86			7.50
					28MAY86			7.80
				199-H4-4	19JUN85			7.20
					01AUG85			7.70
					26AUG85			7.50
					01OCT85			M
					01NOV85			7.40
					12DEC85			7.80
					21JAN86			8.60
					24FEB86			7.50
					21MAR86			7.50
					24APR86			7.60
					28MAY86			7.60
				199-H4-5	24JUN85			7.40
					25JUL85			7.50
					26AUG85			7.80
					01OCT85			M
					31OCT85			8.30
					12DEC85			8.00
					21JAN86			8.50
					25FEB86			7.70
					25MAR86			7.60
					24APR86			7.50
					28MAY86			7.60
				199-H4-6	19JUN85			7.00
					25JUL85			6.70
					26AUG85			7.80
					03OCT85			7.80
					31OCT85			8.40
					12DEC85			7.90
					21JAN86			8.10
					25FEB86			7.80
					24MAR86			6.80
					25APR86			7.40
					28MAY86			7.90

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Contamination Indicators

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
C68	TOX	PPB	100	199-H3-1	24JUN85		<	23.3
					24JUN85	1	<	22.2
					24JUN85	2	<	19.7
					01AUG85		<	19.8
					01AUG85	1	<	17.0
					01AUG85	2	<	15.8
					27AUG85		<	16.3
					27AUG85	1	<	13.7
					27AUG85	2	<	15.7
					03OCT85		<	37.9
					31OCT85		<	15.8
					13DEC85			2,860
					22JAN86		<	18.4
					25FEB86		<	8.20
					24MAR86		<	49.5
					25APR86		<	27.5
					28MAY86		<	16.3
				199-H4-3	19JUN85		<	42.3
					01AUG85		<	55.6
					27AUG85		<	36.4
					01OCT85		<	39.8
					01NOV85		<	52.8
					13DEC85			137
					22JAN86		<	36.2
					24FEB86		<	27.6
					24MAR86			2,060
					24APR86			402
					28MAY86		<	38.8
				199-H4-4	01AUG85		<	93.0
					26AUG85		<	43.1
					01OCT85		<	56.7
					01NOV85		<	35.1
					12DEC85			622
					21JAN86		<	52.9
					24FEB86		<	26.8
					21MAR86			133
					24APR86		<	15.0
					28MAY86		<	26.6
				199-H4-5	25JUL85		<	27.7
					25JUL85	1	<	28.6
					25JUL85	2	<	33.6
					25JUL85	3	<	38.5
					26AUG85		<	29.4
					26AUG85	1	<	31.2
					26AUG85	2	<	29.3
					26AUG85	3	<	30.3
					01OCT85		<	32.7
					31OCT85		<	35.9
					12DEC85			608
					21JAN86		<	38.4
					25FEB86		<	28.0
					25MAR86		<	46.1
					24APR86		<	42.1
					28MAY86		<	33.2
				199-H4-6	25JUL85		<	32.6
					26AUG85		<	31.6
					03OCT85		<	49.9
					31OCT85		<	34.0
					12DEC85			149
					21JAN86		<	26.9
					25FEB86		<	20.5
					24MAR86			364
					25APR86		<	81.3
					28MAY86		<	16.0

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Contamination Indicators

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
C69	TOC	PPB	1000	199-H3-1	24JUN85			1,560
					24JUN85	1	<	900
					24JUN85	2		1,070
					01AUG85			1,330
					01AUG85	1		1,440
					01AUG85	2		1,600
					27AUG85			2,160
					27AUG85	1		2,130
					27AUG85	2		2,100
					03OCT85			1,100
					31OCT85			2,000
					13DEC85			1,890
					22JAN86			1,800
					25FEB86			1,830
					24MAR86			1,880
					25APR86			4,300
					28MAY86			1,030
				199-H4-3	19JUN85			1,560
					01AUG85			2,490
					27AUG85			5,730
					01OCT85			1,610
					01NOV85			8,890
					13DEC85			4,090
					22JAN86			6,560
					24FEB86			4,250
					24MAR86			6,570
					24APR86			4,640
					28MAY86			1,870
				199-H4-4	01AUG85			2,970
					26AUG85			4,490
					01OCT85			9,210
					01NOV85			3,980
					12DEC85			2,630
					21JAN86			1,350
					24FEB86			2,710
					21MAR86			2,570
					24APR86			5,740
					28MAY86			1,010
				199-H4-5	25JUL85			1,120
					25JUL85	1		1,070
					25JUL85	2		1,300
					25JUL85	3	<	870
					26AUG85			1,030
					26AUG85	1	<	330
					26AUG85	2	<	900
					26AUG85	3		1,200
					01OCT85			1,060
					31OCT85			1,210
					12DEC85			1,400
					21JAN86		<	822
					25FEB86			1,630
					25MAR86			1,320
					24APR86			6,720
					28MAY86		<	905
				199-H4-6	25JUL85		<	997
					26AUG85			1,640
					03OCT85		<	405
					31OCT85		<	867
					12DEC85			1,460
					21JAN86		<	954
					25FEB86			2,460
					24MAR86			1,870
					25APR86			1,370
					28MAY86			1,030

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Drinking Water Standards

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
109	COLIFRM	MPN	3	199-H3-1	24JUN85		<	3.00
					24JUN85	1	<	3.00
					24JUN85	2	<	3.00
					01AUG85		<	3.00
					01AUG85	1	<	3.00
					01AUG85	2	<	3.00
					27AUG85		<	3.00
					27AUG85	1	<	3.00
					27AUG85	2	<	3.00
					03OCT85		<	3.00
					31OCT85		<	3.00
					13DEC85		<	3.00
					22JAN86		<	3.00
					25FEB86		<	3.00
					24MAR86		<	3.00
					25APR86		<	3.00
					28MAY86		<	3.00
				199-H4-3	19JUN85		<	3.00
					01AUG85			23.0
					27AUG85		<	3.00
					01OCT85		<	3.00
					01NOV85		<	3.00
					13DEC85		<	3.00
					22JAN86		<	3.00
					24FEB86		<	3.00
					24MAR86		<	3.00
					24APR86		<	3.00
					28MAY86		<	3.00
				199-H4-4	19JUN85		<	3.00
					01AUG85			23.0
					26AUG85		<	3.00
					01OCT85			4.00
					01NOV85		<	3.00
					12DEC85		<	3.00
					21JAN86		<	3.00
					24FEB86		<	3.00
					21MAR86		<	3.00
					24APR86		<	3.00
					28MAY86		<	3.00
				199-H4-5	24JUN85		<	3.00
					24JUN85	1	<	3.00
					24JUN85	2	<	3.00
					24JUN85	3	<	3.00
					25JUL85		<	3.00
					25JUL85	1	<	3.00
					25JUL85	2	<	3.00
					25JUL85	3	<	3.00
					26AUG85		<	3.00
					26AUG85	1	<	3.00
					26AUG85	2	<	3.00
					26AUG85	3	<	3.00
					01OCT85		<	3.00
					31OCT85		<	3.00
					12DEC85		<	3.00
					21JAN86		<	3.00
					25FEB86		<	3.00
					25MAR86		<	3.00
					24APR86		<	3.00
					28MAY86		<	3.00
				199-H4-6	19JUN85		<	3.00
					25JUL85			4.00
					26AUG85		<	3.00
					03OCT85		<	3.00
					31OCT85		<	3.00
					12DEC85		<	3.00
					21JAN86		<	3.00
					25FEB86		<	3.00
					24MAR86		<	3.00
					25APR86		<	3.00
					28MAY86		<	3.00

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Drinking Water Standards

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
111	BETA	PCI/L	8	199-H3-1	24JUN85			14.8
					24JUN85	1		8.40
					24JUN85	2		8.42
					01AUG85			10.2
					01AUG85	1		412
					01AUG85	2		11.6
					27AUG85			15.0
					27AUG85	1		8.42
					27AUG85	2		11.8
					03OCT85			14.4
					31OCT85			11.4
					13DEC85			14.8
					22JAN86			13.2
					25FEB86			10.0
					24MAR86			8.33
					25APR86			13.1
					28MAY86			18.1
				199-H4-3	19JUN85			783
					01AUG85			412
					27AUG85			516
					01OCT85			510
					01NOV85			644
					13DEC85			1,090
					22JAN86			975
					24FEB86			836
					24MAR86			977
					23APR86			987
					28MAY86			1,160
				199-H4-4	19JUN85			294
					01AUG85			340
					26AUG85			384
					01OCT85			257
					01NOV85			289
					12DEC85			18.9
					21JAN86			249
					24FEB86			237
					21MAR86			173
					23APR86			29.1
					28MAY86			159
				199-H4-5	24JUN85			6.84
					24JUN85	1		5.53
					24JUN85	2		5.42
					24JUN85	3		6.84
					25JUL85			22.2
					25JUL85	1		5.42
					25JUL85	2		8.84
					25JUL85	3		7.73
					26AUG85			7.05
					26AUG85	1		9.14
					26AUG85	2		10.2
					26AUG85	3		6.29
					01OCT85			6.41
					31OCT85			7.72
					12DEC85			63.6
					21JAN86			11.2
					25FEB86			7.29
					25MAR86			4.59
					23APR86			5.70
					28MAY86			23.4
				199-H4-6	19JUN85			7.08
					25JUL85			7.81
					26AUG85			7.70
					03OCT85			7.79
					31OCT85			8.93
					12DEC85			6.61
					21JAN86			7.14
					25FEB86			7.45
					24MAR86			10.0
					25APR86			9.52
					28MAY86			22.4

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Drinking Water Standards

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
181	RADIUM	PCI/L	1	199-H3-1	24JUN85		<	0.021
					24JUN85	1	<	0.068
					24JUN85	2	<	0.128
					01AUG85		<	0.000
					01AUG85	1	<	0.000
					01AUG85	2	<	0.086
					27AUG85		<	-0.046
					27AUG85	1	<	0.043
					27AUG85	2	<	-0.016
					03OCT85		<	0.091
					31OCT85		<	0.097
					13DEC85		<	0.000
					22JAN86		<	0.123
					25FEB86		<	0.040
					24MAR86		<	0.070
					25APR86		<	0.162
					28MAY86		<	0.039
				199-H4-3	19JUN85			0.315
					01AUG85		<	-0.030
					27AUG85		<	0.144
					01OCT85		<	0.110
					01NOV85			0.264
					13DEC85		<	0.084
					22JAN86		<	0.134
					24FEB86			0.187
					24MAR86		<	0.204
					23APR86			0.278
					28MAY86			0.312
				199-H4-4	19JUN85			0.277
					01AUG85		<	0.144
					26AUG85			0.271
					01OCT85		<	0.083
					01NOV85		<	0.015
					12DEC85		<	-0.063
					21JAN86		<	-0.018
					24FEB86		<	0.080
					21MAR86		<	-0.055
					23APR86		<	0.052
					28MAY86		<	-0.002
				199-H4-5	24JUN85		<	0.259
					24JUN85	1	<	-0.050
					24JUN85	2	<	-0.025
					24JUN85	3		0.611
					25JUL85		<	0.076
					25JUL85	1	<	0.017
					25JUL85	2	<	-0.038
					25JUL85	3	<	0.067
					26AUG85		<	0.126
					26AUG85	1	<	-0.015
					26AUG85	2	<	0.044
					26AUG85	3	<	-0.018
					01OCT85		<	-0.015
					31OCT85		<	0.070
					12DEC85		<	0.073
					21JAN86		<	0.052
					25FEB86		<	0.023
					25MAR86		<	0.019
					23APR86		<	0.076
					28MAY86		<	0.063
				199-H4-6	19JUN85		<	0.195
					25JUL85		<	0.095
					26AUG85		<	0.105
					03OCT85		<	-0.100
					31OCT85		<	-0.073
					12DEC85		<	-0.098
					21JAN86		<	0.125
					25FEB86		<	0.164
					24MAR86		<	0.121
					25APR86		<	0.034
					28MAY86			0.117

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Drinking Water Standards

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
212	LOALPHA	PCI/L	4	199-H3-1	24JUN85			3.57
					24JUN85	1		3.55
					24JUN85	2		0.936
					01AUG85			8.54
					01AUG85	1		5.63
					01AUG85	2		6.57
					27AUG85			4.03
					27AUG85	1		4.87
					27AUG85	2		4.33
					03OCT85		<	2.70
					31OCT85			8.03
					13DEC85			7.39
					22JAN86			8.18
					25FEB86			7.31
					24MAR86			6.99
					25APR86			4.88
					28MAY86			6.60
				199-H4-3	19JUN85			119
					01AUG85			196
					27AUG85			173
					01OCT85			174
					01NOV85			308
					13DEC85			207
					22JAN86			161
					24FEB86			207
					24MAR86			217
					23APR86			602
					28MAY86			637
				199-H4-4	19JUN85			40.9
					01AUG85			146
					26AUG85			77.6
					01OCT85			65.9
					01NOV85			77.5
					12DEC85			10.0
					21JAN86			38.1
					24FEB86			65.9
					21MAR86			54.7
					23APR86			9.58
					28MAY86			14.1
				199-H4-5	24JUN85			1.80
					24JUN85	1		1.79
					24JUN85	2		0.112
					24JUN85	3		0.841
					25JUL85			26.6
					25JUL85	1		1.67
					25JUL85	2		1.38
					25JUL85	3		2.76
					26AUG85			3.48
					26AUG85	1		3.76
					26AUG85	2		2.62
					26AUG85	3		3.00
					01OCT85		<	1.09
					31OCT85			2.27
					12DEC85			4.94
					21JAN86			3.29
					25FEB86			4.30
					25MAR86		<	0.821
					23APR86			4.36
					28MAY86			6.08
				199-H4-6	19JUN85			1.57
					25JUL85		<	1.39
					26AUG85			2.49
					03OCT85			1.15
					31OCT85			2.19
					12DEC85		<	1.49
					21JAN86			2.81
					25FEB86			2.60
					24MAR86			2.55
					25APR86			5.03
					28MAY86			6.57

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Drinking Water Standards

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
A06	BARIUM	PPB	6	199-H3-1	24JUN85		H	50.0
					24JUN85	1	H	44.0
					24JUN85	2	H	66.0
					01AUG85		H	175
					01AUG85	1	H	52.0
					01AUG85	2	H	53.0
					27AUG85			45.0
					27AUG85	1		43.0
					27AUG85	2		45.0
					03OCT85			48.0
					31OCT85			54.0
					31OCT85	S	H	65.0
					13DEC85			46.0
					22JAN86			44.0
					25FEB86			51.0
					24MAR86			50.0
					25APR86			46.0
					28MAY86			44.0
				199-H4-3	19JUN85		H	143
					01AUG85		H	49.0
					27AUG85			26.0
					01OCT85			29.0
					01NOV85			67.0
					13DEC85			76.0
					22JAN86			139
					24FEB86			97.0
					24MAR86			181
					24APR86			170
					28MAY86			248
				199-H4-4	19JUN85		H	94.0
					01AUG85		H	106
					26AUG85			79.0
					01OCT85			70.0
					01NOV85			57.0
					12DEC85			25.0
					21JAN86			41.0
					24FEB86			41.0
					21MAR86			32.0
					24APR86			31.0
					28MAY86			48.0
				199-H4-5	24JUN85		H	50.0
					24JUN85	1	H	42.0
					24JUN85	2	H	60.0
					24JUN85	3	H	36.0
					25JUL85		H	61.0
					25JUL85	1	H	51.0
					25JUL85	2	H	51.0
					25JUL85	3	H	52.0
					26AUG85			45.0
					26AUG85	1		43.0
					26AUG85	2		46.0
					26AUG85	3		43.0
					01OCT85			48.0
					31OCT85			45.0
					31OCT85	S	H	73.0
					12DEC85			39.0
					21JAN86			41.0
					25FEB86			41.0
					25MAR86			42.0
					24APR86			43.0
					28MAY86			48.0
				199-H4-6	19JUN85		H	15.0
					25JUL85		H	34.0
					26AUG85			25.0
					03OCT85			31.0
					31OCT85			32.0
					12DEC85			30.0
					21JAN86			30.0
					25FEB86			37.0
					24MAR86			40.0
					25APR86			40.0
					28MAY86			39.0

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Drinking Water Standards

Code	Constituent Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A07	CADMIUM	PPB	2	199-H3-1	24JUN85		H	<	2.00
					24JUN85	1	H	<	2.00
					24JUN85	2	H	<	2.00
					01AUG85		H	<	2.00
					01AUG85	1	H		2.10
					01AUG85	2	H	<	2.00
					27AUG85			<	2.00
					27AUG85	1		<	2.00
					27AUG85	2		<	2.00
					03OCT85			<	2.00
					31OCT85			<	2.00
					31OCT85	S	H	<	2.00
					13DEC85			<	2.00
					22JAN86			<	2.00
					25FEB86			<	2.00
					24MAR86			<	2.00
					25APR86			<	2.00
					28MAY86			<	2.00
				199-H4-3	19JUN85		H		5.00
					01AUG85		H	<	2.00
					27AUG85			<	2.00
					01OCT85			<	2.00
					01NOV85			<	2.00
					13DEC85			<	2.00
					22JAN86			<	2.00
					24FEB86			<	2.00
					24MAR86			<	2.00
					24APR86			<	2.00
					28MAY86			<	2.00
				199-H4-4	19JUN85		H	<	2.00
					01AUG85		H	<	2.00
					26AUG85			<	2.00
					01OCT85				4.00
					01NOV85			<	2.00
					12DEC85			<	2.00
					21JAN86			<	2.00
					24FEB86			<	2.00
					21MAR86			<	2.00
					24APR86			<	2.00
					28MAY86			<	2.00
				199-H4-5	24JUN85		H	<	2.00
					24JUN85	1	H	<	2.00
					24JUN85	2	H	<	2.00
					24JUN85	3	H	<	2.00
					25JUL85		H	<	2.00
					25JUL85	1	H	<	2.00
					25JUL85	2	H	<	2.00
					25JUL85	3	H	<	2.00
					26AUG85			<	2.00
					26AUG85	1		<	2.00
					26AUG85	2			4.00
					26AUG85	3			3.00
					01OCT85			<	2.00
					31OCT85			<	2.00
					31OCT85	S	H		3.20
					12DEC85			<	2.00
					21JAN86			<	2.00
					25FEB86			<	2.00
					25MAR86			<	2.00
					24APR86			<	2.00
					28MAY86			<	2.00
				199-H4-6	19JUN85		H		13.0
					25JUL85		H	<	2.00
					26AUG85			<	2.00
					03OCT85			<	2.00
					31OCT85			<	2.00
					12DEC85			<	2.00
					21JAN86			<	2.00
					25FEB86			<	2.00
					24MAR86			<	2.00
					25APR86			<	2.00
					28MAY86			<	2.00

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Drinking Water Standards

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
A08	CHROMUM	PPB	10	199-H3-1	24JUN85		H	30.0
					24JUN85	1	H	23.0
					24JUN85	2	H	24.0
					01AUG85		H	31.0
					01AUG85	1	H	51.0
					01AUG85	2	H	30.0
					27AUG85			33.0
					27AUG85	1		30.0
					27AUG85	2		30.0
					03OCT85			35.0
					31OCT85			35.0
					31OCT85	S	H	50.0
					13DEC85			46.0
					22JAN86			64.0
					25FEB86			62.0
					24MAR86			62.0
					25APR86			47.0
					28MAY86			40.0
				199-H4-3	19JUN85		H	1,130
					01AUG85		H	1,030
					27AUG85			805
					01OCT85			788
					01NOV85			911
					13DEC85			827
					22JAN86			842
					24FEB86			733
					24MAR86			860
					24APR86			832
					28MAY86			916
				199-H4-4	19JUN85		H	646
					01AUG85		H	729
					26AUG85			683
					01OCT85			694
					01NOV85			548
					12DEC85			66.0
					21JAN86			580
					24FEB86			571
					21MAR86			361
					24APR86			115
					28MAY86			291
				199-H4-5	24JUN85		H	192
					24JUN85	1	H	176
					24JUN85	2	H	189
					24JUN85	3	H	184
					25JUL85		H	447
					25JUL85	1	H	451
					25JUL85	2	H	482
					25JUL85	3	H	508
					26AUG85			504
					26AUG85	1		470
					26AUG85	2		513
					26AUG85	3		486
					01OCT85			545
					31OCT85			572
					31OCT85	S	H	591
					12DEC85			427
					21JAN86			489
					25FEB86			492
					25MAR86			469
					24APR86			465
					28MAY86			452
				199-H4-6	19JUN85		H	26.0
					25JUL85		H	26.0
					26AUG85			28.0
					03OCT85			31.0
					31OCT85			< 10.0
					12DEC85			35.0
					21JAN86			36.0
					25FEB86			40.0
					24MAR86			41.0
					25APR86			49.0
					28MAY86			44.0

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Drinking Water Standards

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A20	ARSENIC	PPB	5	199-H3-1	24JUN85		H		6.00
					24JUN85	1	H	<	5.00
					24JUN85	2	H	<	5.00
					01AUG85		H	<	5.00
					01AUG85	1	H	<	5.00
					01AUG85	2	H	<	5.00
					27AUG85			<	5.00
					27AUG85	1		<	5.00
					27AUG85	2		<	5.00
					03OCT85			<	5.00
					31OCT85			<	5.00
					31OCT85	S	H	<	5.00
					13DEC85			<	5.00
					22JAN86			<	5.00
					25FEB86			<	5.00
					24MAR86			<	5.00
					25APR86			<	5.00
					28MAY86			<	5.00
				199-H4-3	19JUN85		H		5.00
					01AUG85		H	<	5.00
					27AUG85			<	5.00
					01OCT85			<	5.00
					01NOV85			<	5.00
					13DEC85			<	5.00
					22JAN86			<	5.00
					24FEB86			<	5.00
					24MAR86			<	5.00
					24APR86			<	5.00
					28MAY86			<	5.00
				199-H4-4	19JUN85		H		9.00
					01AUG85		H	<	5.00
					26AUG85			<	5.00
					01OCT85			<	5.00
					01NOV85			<	5.00
					12DEC85			<	5.00
					21JAN86			<	5.00
					24FEB86			<	5.00
					21MAR86			<	5.00
					24APR86			<	5.00
					28MAY86			<	5.00
				199-H4-5	24JUN85		H		6.00
					24JUN85	1	H	<	5.00
					24JUN85	2	H		5.00
					24JUN85	3	H		5.00
					25JUL85		H		6.30
					25JUL85	1	H	<	5.00
					25JUL85	2	H	<	5.00
					25JUL85	3	H	<	5.00
					26AUG85			<	5.00
					26AUG85	1		<	5.00
					26AUG85	2			7.77
					26AUG85	3		<	5.00
					01OCT85			<	5.00
					31OCT85			<	5.00
					31OCT85	S	H		11.0
					12DEC85			<	5.00
					21JAN86			<	5.00
					25FEB86			<	5.00
					25MAR86				6.39
					24APR86			<	5.00
					28MAY86			<	5.00
				199-H4-6	19JUN85		H	<	5.00
					25JUL85		H	<	5.00
					26AUG85			<	5.00
					03OCT85			<	5.00
					31OCT85			<	5.00
					12DEC85			<	5.00
					21JAN86			<	5.00
					25FEB86			<	5.00
					24MAR86			<	5.00
					25APR86			<	5.00
					28MAY86			<	5.00

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1988

TABLE G.3 Raw Data, Constituent List = Drinking Water Standards

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A21	MERCURY	PPB	.1	199-H3-1	24JUN85		H	<	0.100
					24JUN85	1	H	<	0.100
					24JUN85	2	H	<	0.100
					01AUG85		H	<	0.100
					01AUG85	1	H		5.20
					01AUG85	2	H		4.30
					27AUG85			<	0.100
					27AUG85	1		<	0.100
					27AUG85	2		<	0.100
					03OCT85			<	0.100
					31OCT85			<	0.100
					31OCT85	S	H	<	0.100
					13DEC85			<	0.100
					22JAN86			<	0.100
					25FEB86			<	0.100
					24MAR86			<	0.100
					25APR86			<	0.100
					28MAY86			<	0.100
				199-H4-3	19JUN85		H	<	0.100
					01AUG85		H		4.90
					27AUG85			<	0.100
					01OCT85			<	0.100
					01NOV85			<	0.100
					13DEC85			<	0.100
					22JAN86			<	0.100
					24FEB86			<	0.100
					24MAR86			<	0.100
					24APR86			<	0.100
					28MAY86			<	0.100
				199-H4-4	19JUN85		H	<	0.100
					01AUG85		H		7.40
					26AUG85			<	0.100
					01OCT85			<	0.100
					01NOV85			<	0.100
					12DEC85			<	0.100
					21JAN86			<	0.100
					24FEB86			<	0.100
					21MAR86			<	0.100
					24APR86			<	0.100
					28MAY86			<	0.100
				199-H4-5	24JUN85		H	<	0.100
					24JUN85	1	H	<	0.100
					24JUN85	2	H	<	0.100
					24JUN85	3	H	<	0.100
					25JUL85		H	<	0.100
					25JUL85	1	H	<	0.100
					25JUL85	2	H	<	0.100
					25JUL85	3	H	<	0.100
					26AUG85			<	0.100
					26AUG85	1		<	0.100
					26AUG85	2		<	0.100
					26AUG85	3		<	0.100
					01OCT85			<	0.100
					31OCT85			<	0.100
					31OCT85	S	H	<	0.100
					12DEC85			<	0.100
					21JAN86			<	0.100
					25FEB86			<	0.100
					25MAR86			<	0.100
					24APR86			<	0.100
					28MAY86			<	0.100
				199-H4-6	19JUN85		H	<	0.100
					25JUL85		H	<	0.100
					26AUG85			<	0.100
					03OCT85			<	0.100
					31OCT85			<	0.100
					12DEC85			<	0.100
					21JAN86			<	0.100
					25FEB86			<	0.100
					24MAR86			<	0.100
					25APR86			<	0.100
					28MAY86			<	0.100

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Drinking Water Standards

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A22	SELENUM	PPB	5	199-H3-1	24JUN85		H	<	5.00
					24JUN85	1	H	<	5.00
					24JUN85	2	H	<	5.00
					01AUG85		H	<	5.00
					01AUG85	1	H	<	5.00
					01AUG85	2	H	<	5.00
					27AUG85			<	5.00
					27AUG85	1		<	5.00
					27AUG85	2		<	5.00
					03OCT85			<	5.00
					31OCT85			<	5.00
					31OCT85	S	H	<	5.00
					13DEC85			<	5.00
					22JAN86			<	5.00
					25FEB86			<	5.00
					24MAR86			<	5.00
					25APR86			<	5.00
					28MAY86			<	5.00
				199-H4-3	19JUN85		H	<	5.00
					01AUG85		H	<	5.00
					27AUG85			<	5.00
					01OCT85			<	5.00
					01NOV85			<	5.00
					13DEC85			<	5.00
					22JAN86			<	5.00
					24FEB86			<	5.00
					24MAR86			<	5.00
					24APR86			<	5.00
					28MAY86			<	5.00
				199-H4-4	19JUN85		H	<	5.00
					01AUG85		H	<	5.00
					26AUG85			<	5.00
					01OCT85			<	5.00
					01NOV85			<	5.00
					12DEC85			<	5.00
					21JAN86			<	5.00
					24FEB86			<	5.00
					21MAR86			<	5.00
					24APR86			<	5.00
					28MAY86			<	5.00
				199-H4-5	24JUN85		H	<	5.00
					24JUN85	1	H	<	5.00
					24JUN85	2	H	<	5.00
					24JUN85	3	H	<	5.00
					25JUL85		H	<	5.00
					25JUL85	1	H		15.0
					25JUL85	2	H		10.0
					25JUL85	3	H	<	5.00
					26AUG85			<	5.00
					26AUG85	1		<	5.00
					26AUG85	2		<	5.00
					26AUG85	3		<	5.00
					01OCT85			<	5.00
					31OCT85			<	5.00
					31OCT85	S	H	<	5.00
					12DEC85			<	5.00
					21JAN86			<	5.00
					25FEB86			<	5.00
					25MAR86			<	5.00
					24APR86			<	5.00
					28MAY86			<	5.00
				199-H4-6	19JUN85		H	<	5.00
					25JUL85		H	<	5.00
					26AUG85			<	5.00
					03OCT85			<	5.00
					31OCT85			<	5.00
					12DEC85			<	5.00
					21JAN86			<	5.00
					25FEB86			<	5.00
					24MAR86			<	5.00
					25APR86			<	5.00
					28MAY86			<	5.00

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Drinking Water Standards

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A51	LEADGF	PPB	5	199-H3-1	24JUN85			<	5.00
					24JUN85	1		<	5.00
					24JUN85	2		<	5.00
					01AUG85			<	5.00
					01AUG85	1		<	5.00
					01AUG85	2		<	5.00
					27AUG85			<	5.00
					27AUG85	1		<	5.00
					27AUG85	2		<	5.00
					03OCT85			<	5.00
					31OCT85			<	5.00
					31OCT85	S	H	<	5.00
					13DEC85			<	5.00
					22JAN86			<	5.00
					25FEB86			<	5.00
					24MAR86			<	5.00
					25APR86			<	5.00
					28MAY86			<	5.00
				199-H4-3	19JUN85				5.10
					01AUG85			<	5.00
					27AUG85			<	5.00
					01OCT85			<	5.00
					01NOV85			<	5.00
					13DEC85			<	5.00
					22JAN86			<	5.00
					24FEB86			<	5.00
					24MAR86			<	5.00
					24APR86			<	5.00
					28MAY86			<	5.00
				199-H4-4	19JUN85			<	5.00
					01AUG85			<	5.00
					26AUG85				5.81
					01OCT85			<	5.00
					01NOV85			<	5.00
					12DEC85			<	5.00
					21JAN86			<	5.00
					24FEB86			<	5.00
					21MAR86			<	5.00
					24APR86			<	5.00
					28MAY86			<	5.00
				199-H4-5	24JUN85			<	5.00
					24JUN85	1		<	5.00
					24JUN85	2		<	5.00
					24JUN85	3		<	5.00
					25JUL85			<	5.00
					25JUL85	1		<	5.00
					25JUL85	2		<	5.00
					25JUL85	3		<	5.00
					26AUG85			<	5.00
					26AUG85	1		<	5.00
					26AUG85	2		<	5.00
					26AUG85	3		<	5.00
					01OCT85			<	5.00
					31OCT85			<	5.00
					31OCT85	S	H	<	0.000
					12DEC85			<	5.00
					21JAN86			<	5.00
					25FEB86			<	5.00
					25MAR86			<	5.00
					24APR86			<	5.00
					28MAY86				5.01
				199-H4-6	19JUN85			<	5.00
					25JUL85			<	5.00
					26AUG85			<	5.00
					03OCT85			<	5.00
					31OCT85			<	5.00
					12DEC85			<	5.00
					21JAN86			<	5.00
					25FEB86			<	5.00
					24MAR86			<	5.00
					25APR86			<	5.00
					28MAY86			<	5.00

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Drinking Water Standards

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
C72	NITRATE	PPB	500	199-H3-1	24JUN85		<	M
					24JUN85	1		60,000
					24JUN85	2		58,000
					01AUG85			79,100
					01AUG85	1		68,300
					01AUG85	2		67,500
					27AUG85			65,700
					27AUG85	1		88,000
					27AUG85	2		69,800
					03OCT85			64,600
					31OCT85			72,500
					13DEC85			47,100
					22JAN86			52,400
					25FEB86			71,600
					24MAR86			74,200
					25APR86			54,100
					28MAY86			52,900
				199-H4-3	19JUN85			1,350,000
					01AUG85			821,000
					27AUG85			427,000
					01OCT85			418,000
					01NOV85			1,040,000
					13DEC85			816,000
					22JAN86			2,830,000
					24FEB86			1,000,000
					24MAR86			1,940,000
					24APR86			1,590,000
					28MAY86			2,890,000
				199-H4-4	19JUN85			1,300,000
					01AUG85			510,000
					26AUG85			444,000
					01OCT85			378,000
					01NOV85			392,000
					12DEC85			23,300
					21JAN86			225,000
					24FEB86			259,000
					21MAR86			200,000
					24APR86			38,700
					28MAY86			125,000
				199-H4-5	24JUN85			15,000
					24JUN85	1		15,000
					24JUN85	2		15,800
					24JUN85	3		14,500
					25JUL85			23,000
					25JUL85	1		22,500
					25JUL85	2		25,100
					25JUL85	3		24,500
					26AUG85			23,900
					26AUG85	1		25,900
					26AUG85	2		26,000
					26AUG85	3		23,000
					01OCT85			21,000
					31OCT85			19,300
					12DEC85			19,500
					21JAN86			19,900
					25FEB86			21,800
					25MAR86			22,300
					24APR86			22,400
					28MAY86			26,000
				199-H4-6	19JUN85			15,000
					25JUL85			20,100
					26AUG85			19,300
					03OCT85			18,800
					31OCT85			22,900
					12DEC85			29,200
					21JAN86			27,100
					25FEB86		<	29,500
					24MAR86			31,100
					25APR86			28,100
					28MAY86			30,100

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Drinking Water Standards

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
C74	FLUORID	PPB	500	199-H3-1	24JUN85		<	M
					24JUN85	1	<	500
					24JUN85	2	<	500
					01AUG85			550
					01AUG85	1	<	500
					01AUG85	2		630
					27AUG85		<	500
					27AUG85	1	<	500
					27AUG85	2	<	500
					03OCT85		<	500
					31OCT85		<	500
					13DEC85		<	500
					22JAN86			531
					25FEB86			702
					24MAR86			652
					25APR86		<	500
					28MAY86		<	500
				199-H4-3	19JUN85			1,300
					01AUG85			500
					27AUG85		<	500
					01OCT85		<	500
					01NOV85		<	500
					13DEC85		<	500
					22JAN86			1,330
					24FEB86			1,510
					24MAR86			1,960
					24APR86		<	500
					28MAY86		<	500
				199-H4-4	19JUN85			500
					01AUG85			700
					26AUG85		<	500
					01OCT85		<	500
					01NOV85		<	500
					12DEC85		<	500
					21JAN86			567
					24FEB86			695
					21MAR86			658
					24APR86		<	500
					28MAY86		<	500
				199-H4-5	24JUN85		<	500
					24JUN85	1	<	500
					24JUN85	2	<	500
					24JUN85	3	<	500
					25JUL85			810
					25JUL85	1		780
					25JUL85	2		760
					25JUL85	3		740
					26AUG85		<	500
					26AUG85	1	<	500
					26AUG85	2	<	500
					26AUG85	3	<	500
					01OCT85		<	500
					31OCT85		<	500
					12DEC85		<	500
					21JAN86		<	500
					25FEB86		<	500
					25MAR86		<	500
					24APR86		<	500
					28MAY86		<	500
				199-H4-6	19JUN85		<	500
					25JUL85			730
					26AUG85		<	500
					03OCT85		<	500
					31OCT85		<	500
					12DEC85		<	500
					21JAN86		<	500
					25FEB86		<	500
					24MAR86			507
					25APR86		<	500
					28MAY86		<	500

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Quality Characteristics

Code	Constituent Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
A11	SODIUM	PPB	100	199-H3-1	24JUN85		H	19,900
					24JUN85	1	H	15,700
					24JUN85	2	H	15,100
					01AUG85		H	22,000
					01AUG85	1	H	19,500
					01AUG85	2	H	18,200
					27AUG85			18,700
					27AUG85	1		17,500
					27AUG85	2		17,600
					03OCT85			19,500
					31OCT85			23,000
					31OCT85	S	H	22,600
					13DEC85			19,900
					22JAN86			19,200
					25FEB86			21,000
					24MAR86			20,800
					25APR86			19,500
					28MAY86			19,200
				199-H4-3	19JUN85		H	395,000
					01AUG85		H	267,000
					27AUG85			225,000
					01OCT85			226,000
					01NOV85			370,000
					13DEC85			375,000
					22JAN86			447,000
					24FEB86			355,000
					24MAR86			568,000
					24APR86			542,000
					28MAY86			638,000
				199-H4-4	19JUN85		H	148,000
					01AUG85		H	169,000
					26AUG85			193,000
					01OCT85			168,000
					01NOV85			168,000
					12DEC85			18,300
					21JAN86			113,000
					24FEB86			115,000
					21MAR86			101,000
					24APR86			20,900
					28MAY86			48,000
				199-H4-5	24JUN85		H	6,800
					24JUN85	1	H	8,880
					24JUN85	2	H	9,230
					24JUN85	3	H	10,600
					25JUL85		H	9,000
					25JUL85	1	H	8,890
					25JUL85	2	H	9,440
					25JUL85	3	H	9,860
					26AUG85			8,200
					26AUG85	1		8,710
					26AUG85	2		8,400
					26AUG85	3		8,370
					01OCT85			8,900
					31OCT85			9,780
					31OCT85	S	H	10,300
					12DEC85			9,920
					21JAN86			8,720
					25FEB86			8,630
					25MAR86			8,730
					24APR86			8,550
					28MAY86			9,300
				199-H4-6	19JUN85		H	18,200
					25JUL85		H	18,000
					26AUG85			16,700
					03OCT85			17,300
					31OCT85			18,400
					12DEC85			19,300
					21JAN86			17,200
					25FEB86			22,300
					24MAR86			22,500
					25APR86			20,700
					28MAY86			20,000

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Quality Characteristics

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A17	MANGESE	PPB	5	199-H3-1	24JUN85		H		34.0
					24JUN85	1	H		24.0
					24JUN85	2	H	<	5.00
					01AUG85		H	<	5.00
					01AUG85	1	H		8.50
					01AUG85	2	H		21.0
					27AUG85			<	5.00
					27AUG85	1		<	5.00
					27AUG85	2		<	5.00
					03OCT85			<	5.00
					31OCT85			<	5.00
					31OCT85	S	H		11.0
					13DEC85			<	5.00
					22JAN86			<	5.00
					25FEB86			<	5.00
					24MAR86			<	5.00
					25APR86			<	5.00
					28MAY86			<	5.00
				199-H4-3	19JUN85		H		30.0
					01AUG85		H		8.50
					27AUG85			<	5.00
					01OCT85				6.00
					01NOV85			<	5.00
					13DEC85				8.00
					22JAN86			<	5.00
					24FEB86				5.00
					24MAR86			<	5.00
					24APR86				14.0
					28MAY86				12.0
				199-H4-4	19JUN85		H	<	5.00
					01AUG85		H	<	5.00
					26AUG85			<	5.00
					01OCT85				7.00
					01NOV85			<	5.00
					12DEC85			<	5.00
					21JAN86			<	5.00
					24FEB86			<	5.00
					21MAR86			<	5.00
					24APR86			<	5.00
					28MAY86			<	5.00
				199-H4-5	24JUN85		H	<	5.00
					24JUN85	1	H		16.0
					24JUN85	2	H	<	5.00
					24JUN85	3	H	<	5.00
					25JUL85		H	<	5.00
					25JUL85	1	H	<	5.00
					25JUL85	2	H	<	5.00
					25JUL85	3	H		15.0
					26AUG85			<	5.00
					26AUG85	1		<	5.00
					26AUG85	2		<	5.00
					26AUG85	3		<	5.00
					01OCT85			<	5.00
					31OCT85			<	5.00
					31OCT85	S	H	<	5.00
					12DEC85			<	5.00
					21JAN86			<	5.00
					25FEB86			<	5.00
					25MAR86			<	5.00
					24APR86			<	5.00
					28MAY86			<	5.00
				199-H4-6	19JUN85		H		40.0
					25JUL85		H		42.0
					26AUG85				32.0
					03OCT85				48.0
					31OCT85				64.0
					12DEC85				49.0
					21JAN86				64.0
					25FEB86				76.0
					24MAR86				74.0
					25APR86				58.0
					28MAY86				53.0

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Quality Characteristics

Code	Constituent Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A19	IRON	PPB	50	199-H3-1	24JUN85		H		584
					24JUN85	1	H		132
					24JUN85	2	H		184
					01AUG85		H		386
					01AUG85	1	H		235
					01AUG85	2	H		158
					27AUG85			<	50.0
					27AUG85	1		<	50.0
					27AUG85	2			50.0
					03OCT85				55.0
					31OCT85			<	50.0
					31OCT85	S	H		473
					13DEC85			<	50.0
					22JAN86			<	50.0
					25FEB86				398
					24MAR86			<	50.0
					25APR86			<	50.0
					28MAY86				94.0
				199-H4-3	19JUN85		H		587
					01AUG85		H		377
					27AUG85				143
					01OCT85				80.0
					01NOV85				97.0
					13DEC85				352
					22JAN86				59.0
					24FEB86				173
					24MAR86			<	50.0
					24APR86				410
					28MAY86				468
				199-H4-4	19JUN85		H		1,110
					01AUG85		H		891
					26AUG85				457
					01OCT85				2,010
					01NOV85				300
					12DEC85				87.0
					21JAN86				76.0
					24FEB86				600
					21MAR86			<	50.0
					24APR86			<	50.0
					28MAY86			<	50.0
				199-H4-5	24JUN85		H		165
					24JUN85	1	H		1,460
					24JUN85	2	H		104
					24JUN85	3	H		139
					25JUL85		H		91.0
					25JUL85	1	H		196
					25JUL85	2	H		256
					25JUL85	3	H		599
					26AUG85				207
					26AUG85	1			66.0
					26AUG85	2			306
					26AUG85	3			60.0
					01OCT85				274
					31OCT85				51.0
					31OCT85	S	H		89.0
					12DEC85				778
					21JAN86			<	50.0
					25FEB86			<	50.0
					25MAR86			<	50.0
					24APR86			<	50.0
					28MAY86			<	50.0
				199-H4-6	19JUN85		H		547
					25JUL85		H		399
					26AUG85				282
					03OCT85				286
					31OCT85				275
					12DEC85				184
					21JAN86				287
					25FEB86				202
					24MAR86				199
					25APR86				291
					28MAY86				302

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Quality Characteristics

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
C73	SULFATE	PPB	500	199-H3-1	24JUN85		<	M
					24JUN85	1		59,500
					24JUN85	2		59,000
					01AUG85			78,000
					01AUG85	1		67,300
					01AUG85	2		67,100
					27AUG85			63,800
					27AUG85	1		68,100
					27AUG85	2		68,000
					03OCT85			88,800
					31OCT85			86,200
					13DEC85			52,600
					22JAN86			58,700
					25FEB86			76,300
					24MAR86			82,600
					25APR86			65,800
					28MAY86			58,300
				199-H4-3	19JUN85			145,000
					01AUG85			89,900
					27AUG85			76,400
					01OCT85			72,400
					01NOV85			110,000
					13DEC85			97,900
					22JAN86			122,000
					24FEB86			113,000
					24MAR86			153,000
					24APR86			328,000
					28MAY86			222,000
				199-H4-4	19JUN85			70,000
					01AUG85			84,100
					26AUG85			81,100
					01OCT85			66,900
					01NOV85			83,900
					12DEC85			28,900
					21JAN86			60,200
					24FEB86			59,700
					21MAR86			60,800
					24APR86			33,100
					28MAY86			47,400
				199-H4-5	24JUN85			30,000
					24JUN85	1		31,000
					24JUN85	2		29,000
					24JUN85	3		29,000
					25JUL85			39,700
					25JUL85	1		39,700
					25JUL85	2		44,000
					25JUL85	3		42,600
					26AUG85			41,300
					26AUG85	1		44,500
					26AUG85	2		45,300
					26AUG85	3		40,000
					01OCT85			40,200
					31OCT85			43,900
					12DEC85			37,300
					21JAN86			38,000
					25FEB86			39,400
					25MAR86			39,500
					24APR86			38,000
					28MAY86			42,500
				199-H4-6	19JUN85			40,000
					25JUL85			45,000
					26AUG85			43,800
					03OCT85			43,800
					31OCT85			47,900
					12DEC85			43,200
					21JAN86			50,200
					25FEB86			68,900
					24MAR86			76,500
					25APR86			78,300
					28MAY86			75,000

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Quality Characteristics

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
C75	CHLORID	PPB	500	199-H3-1	24JUN85		<	M
					24JUN85	1		6,200
					24JUN85	2		5,800
					01AUG85			9,200
					01AUG85	1		9,600
					01AUG85	2		8,200
					27AUG85			8,210
					27AUG85	1		7,690
					27AUG85	2		8,240
					03OCT85			8,570
					31OCT85			7,760
					13DEC85			8,360
					22JAN86			9,090
					25FEB86			8,880
					24MAR86			9,460
					25APR86			9,040
					28MAY86			8,700
				199-H4-3	19JUN85			6,000
					01AUG85			7,100
					27AUG85			4,570
					01OCT85			5,050
					01NOV85			5,160
					13DEC85			5,490
					22JAN86			6,990
					24FEB86			6,620
					24MAR86			8,730
					24APR86			9,870
					28MAY86			8,960
				199-H4-4	19JUN85			4,000
					01AUG85			5,300
					26AUG85			5,190
					01OCT85			5,030
					01NOV85			4,540
					12DEC85			2,920
					21JAN86			3,710
					24FEB86			4,520
					21MAR86			4,760
					24APR86			3,490
					28MAY86			4,440
				199-H4-5	24JUN85			2,700
					24JUN85	1		2,800
					24JUN85	2		2,600
					24JUN85	3		3,000
					25JUL85			4,100
					25JUL85	1		4,100
					25JUL85	2		4,500
					25JUL85	3		5,500
					26AUG85			4,300
					26AUG85	1		3,890
					26AUG85	2		3,630
					26AUG85	3		3,690
					01OCT85			4,160
					31OCT85			3,580
					12DEC85			3,550
					21JAN86			3,450
					25FEB86			4,050
					25MAR86			4,270
					24APR86			3,930
					28MAY86			4,160
				199-H4-6	19JUN85			4,000
					25JUL85			5,400
					26AUG85			6,260
					03OCT85			5,170
					31OCT85			5,560
					12DEC85			5,790
					21JAN86			6,930
					25FEB86			8,210
					24MAR86			8,980
					25APR86			9,060
					28MAY86			9,000

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1988

TABLE G.3 Raw Data, Constituent List = Site Specific

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A03	STRONUM	PPB	300	199-H3-1	24JUN85		H		404
					24JUN85	1	H		356
					24JUN85	2	H		382
					01AUG85		H	<	300
					01AUG85	1	H	<	300
					01AUG85	2	H	<	300
					27AUG85			<	300
					27AUG85	1			415
					27AUG85	2			419
					03OCT85				449
					31OCT85				513
					31OCT85	S	H	<	300
					13DEC85				412
					22JAN86				440
					25FEB86				482
					24MAR86				466
					25APR86				423
					28MAY86				420
				199-H4-3	19JUN85		H		458
					01AUG85		H	<	300
					27AUG85			<	300
					01OCT85			<	300
					01NOV85			<	300
					13DEC85				303
					22JAN86				550
					24FEB86				391
					24MAR86				701
					24APR86				651
					28MAY86				968
				199-H4-4	01NOV85			<	300
					12DEC85			<	300
					21JAN86			<	300
					24FEB86			<	300
					21MAR86			<	300
					24APR86			<	300
					28MAY86			<	300
				199-H4-5	31OCT85			<	300
					31OCT85	S	H	<	300
					12DEC85			<	300
					21JAN86			<	300
					25FEB86			<	300
					25MAR86			<	300
					24APR86			<	300
					28MAY86			<	300
				199-H4-6	31OCT85			<	300
					12DEC85			<	300
					21JAN86			<	300
					25FEB86			<	300
					24MAR86			<	300
					25APR86			<	300
					28MAY86			<	300

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Site Specific

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A04	ZINC	PPB	5	199-H3-1	24JUN85		H		18.0
					24JUN85	1	H		8.00
					24JUN85	2	H		6.00
					01AUG85		H		133
					01AUG85	1	H		30.0
					01AUG85	2	H		27.0
					27AUG85			<	5.00
					27AUG85	1		<	5.00
					27AUG85	2		<	5.00
					03OCT85			<	5.00
					31OCT85			<	5.00
					31OCT85	S	H		10.0
					13DEC85				5.00
					22JAN86			<	5.00
					25FEB86			<	5.00
					24MAR86			<	5.00
					25APR86			<	5.00
					28MAY86				5.00
				199-H4-3	19JUN85		H		12.0
					01AUG85		H		20.0
					27AUG85			<	5.00
					01OCT85			<	5.00
					01NOV85			<	5.00
					13DEC85			<	5.00
					22JAN86			<	5.00
					24FEB86			<	5.00
					24MAR86			<	5.00
					24APR86			<	5.00
					28MAY86				6.00
				199-H4-4	01NOV85				89.0
					12DEC85				38.0
					21JAN86				60.0
					24FEB86				125
					21MAR86				35.0
					24APR86				21.0
					28MAY86				42.0
				199-H4-5	31OCT85				47.0
					31OCT85	S	H		71.0
					12DEC85				70.0
					21JAN86				39.0
					25FEB86				38.0
					25MAR86				46.0
					24APR86				51.0
					28MAY86				66.0
				199-H4-6	31OCT85				118
					12DEC85				133
					21JAN86				132
					25FEB86				119
					24MAR86				114
					25APR86				162
					28MAY86				152

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Site Specific

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
A05	CALCIUM	PPB	50	199-H3-1	24JUN85		H	77,700
					24JUN85	1	H	67,800
					24JUN85	2	H	72,100
					01AUG85		H	74,000
					01AUG85	1	H	75,000
					01AUG85	2	H	74,700
					27AUG85			62,900
					27AUG85	1		60,300
					27AUG85	2		60,900
					03OCT85			69,300
					31OCT85			88,700
					31OCT85	S	H	75,500
					13DEC85			79,800
					22JAN86			83,100
					25FEB86			84,100
					24MAR86			72,200
					25APR86			76,600
					28MAY86			67,900
				199-H4-3	19JUN85		H	85,400
					01AUG85		H	29,400
					27AUG85			15,700
					01OCT85			16,300
					01NOV85			53,000
					13DEC85			54,100
					22JAN86			106,000
					24FEB86			64,700
					24MAR86			122,000
					24APR86			124,000
					28MAY86			177,000
				199-H4-4	01NOV85			41,900
					12DEC85			31,200
					21JAN86			19,500
					24FEB86			28,700
					21MAR86			21,400
					24APR86			39,200
					28MAY86			46,300
				199-H4-5	31OCT85			55,900
					31OCT85	S	H	51,500
					12DEC85			44,900
					21JAN86			60,000
					25FEB86			53,700
					25MAR86			54,200
					24APR86			54,500
					28MAY86			54,400
				199-H4-6	31OCT85			48,800
					12DEC85			37,900
					21JAN86			45,900
					25FEB86			58,000
					24MAR86			55,800
					25APR86			56,700
					28MAY86			53,700

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Site Specific

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A12	NICKEL	PPB	10	199-H3-1	24JUN85		H	<	10.0
					24JUN85	1	H	<	10.0
					24JUN85	2	H	<	8.00
					01AUG85		H	<	10.0
					01AUG85	1	H	<	10.0
					01AUG85	2	H	<	10.0
					27AUG85			<	10.0
					27AUG85	1		<	10.0
					27AUG85	2		<	10.0
					03OCT85			<	10.0
					31OCT85			<	10.0
					31OCT85	S	H	<	10.0
					13DEC85			<	10.0
					22JAN86			<	10.0
					25FEB86			<	10.0
					24MAR86			<	10.0
					25APR86			<	10.0
					28MAY86			<	10.0
				199-H4-3	19JUN85		H		74.0
					01AUG85		H		32.0
					27AUG85				22.0
					01OCT85				21.0
					01NOV85				38.0
					13DEC85				39.0
					22JAN86				50.0
					24FEB86				46.0
					24MAR86				80.0
					24APR86				71.0
					28MAY86				90.0
				199-H4-4	19JUN85		H		17.0
					01AUG85		H	<	10.0
					26AUG85				18.0
					01OCT85				16.0
					01NOV85			<	10.0
					12DEC85			<	10.0
					21JAN86			<	10.0
					24FEB86			<	10.0
					21MAR86			<	10.0
					24APR86			<	10.0
					28MAY86			<	10.0
				199-H4-5	24JUN85		H	<	10.0
					24JUN85	1	H	<	10.0
					24JUN85	2	H	<	10.0
					24JUN85	3	H	<	10.0
					25JUL85		H	<	10.0
					25JUL85	1	H	<	10.0
					25JUL85	2	H	<	10.0
					25JUL85	3	H	<	10.0
					26AUG85			<	10.0
					26AUG85	1		<	10.0
					26AUG85	2		<	10.0
					26AUG85	3		<	10.0
					01OCT85			<	10.0
					31OCT85			<	10.0
					31OCT85	S	H	<	10.0
					12DEC85			<	10.0
					21JAN86			<	10.0
					25FEB86			<	10.0
					25MAR86			<	10.0
					24APR86			<	10.0
					28MAY86			<	10.0
				199-H4-6	19JUN85		H	<	10.0
					25JUL85		H	<	10.0
					26AUG85			<	10.0
					03OCT85			<	10.0
					31OCT85			<	10.0
					12DEC85			<	10.0
					21JAN86			<	10.0
					25FEB86			<	10.0
					24MAR86			<	10.0
					25APR86			<	10.0
					28MAY86			<	10.0

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List - Site Specific

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A13	COPPER	PPB	10	199-H3-1	24JUN85		H		10.0
					24JUN85	1	H	<	10.0
					24JUN85	2	H	<	10.0
					01AUG85		H	<	10.0
					01AUG85	1	H		15.0
					01AUG85	2	H	<	10.0
					27AUG85			<	10.0
					27AUG85	1		<	10.0
					27AUG85	2		<	10.0
					03OCT85			<	10.0
					31OCT85			<	10.0
					31OCT85	S	H	<	10.0
					13DEC85			<	10.0
					22JAN86			<	10.0
					25FEB86			<	10.0
					24MAR86			<	10.0
					25APR86			<	10.0
					28MAY86			<	10.0
				199-H4-3	19JUN85		H		89.0
					01AUG85		H		43.0
					27AUG85				27.0
					01OCT85				37.0
					01NOV85				66.0
					13DEC85				48.0
					22JAN86				55.0
					24FEB86				53.0
					24MAR86				105
					24APR86				48.0
					28MAY86				46.0
				199-H4-4	19JUN85		H		29.0
					01AUG85		H	<	10.0
					26AUG85			<	10.0
					01OCT85			<	10.0
					01NOV85			<	10.0
					12DEC85			<	10.0
					21JAN86			<	10.0
					24FEB86			<	10.0
					21MAR86			<	10.0
					24APR86			<	10.0
					28MAY86			<	10.0
				199-H4-5	24JUN85		H		13.0
					24JUN85	1	H		27.0
					24JUN85	2	H		20.0
					24JUN85	3	H		12.0
					25JUL85		H	<	10.0
					25JUL85	1	H	<	10.0
					25JUL85	2	H	<	10.0
					25JUL85	3	H	<	10.0
					26AUG85			<	10.0
					26AUG85	1		<	10.0
					26AUG85	2		<	10.0
					26AUG85	3		<	10.0
					01OCT85			<	10.0
					31OCT85			<	10.0
					31OCT85	S	H	<	10.0
					12DEC85			<	10.0
					21JAN86			<	10.0
					25FEB86			<	10.0
					25MAR86			<	10.0
					24APR86			<	10.0
					28MAY86			<	10.0
				199-H4-6	19JUN85		H		12.0
					25JUL85		H	<	10.0
					26AUG85			<	10.0
					03OCT85			<	10.0
					31OCT85			<	10.0
					12DEC85			<	10.0
					21JAN86			<	10.0
					25FEB86			<	10.0
					24MAR86			<	10.0
					25APR86			<	10.0
					28MAY86			<	10.0

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Site Specific

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
A14	VANADUM	PPB	5	199-H3-1	24JUN85		H	41.0
					24JUN85	1	H	28.0
					24JUN85	2	H	29.0
					01AUG85		H	20.0
					01AUG85	1	H	20.0
					01AUG85	2	H	20.0
					27AUG85			9.00
					27AUG85	1	<	5.00
					27AUG85	2		9.00
					03OCT85			14.0
					31OCT85			9.00
					31OCT85	S	H	19.0
					13DEC85		<	5.00
					22JAN86		<	5.00
					25FEB86		<	5.00
					24MAR86		<	5.00
					25APR86			10.0
					28MAY86			10.0
				199-H4-3	19JUN85		H	24.0
					01AUG85		H	14.0
					27AUG85			9.00
					01OCT85			9.00
					01NOV85		<	5.00
					13DEC85		<	5.00
					22JAN86		<	5.00
					24FEB86		<	5.00
					24MAR86		<	5.00
					24APR86		<	5.00
					28MAY86		<	5.00
				199-H4-4	19JUN85		H	16.0
					01AUG85		H <	5.00
					26AUG85		<	5.00
					01OCT85			10.0
					01NOV85		<	5.00
					12DEC85		<	5.00
					21JAN86		<	5.00
					24FEB86		<	5.00
					21MAR86			5.00
					24APR86			6.00
					28MAY86			6.00
				199-H4-5	24JUN85		H	28.0
					24JUN85	1	H	37.0
					24JUN85	2	H	32.0
					24JUN85	3	H	32.0
					25JUL85		H <	5.00
					25JUL85	1	H <	5.00
					25JUL85	2	H <	5.00
					25JUL85	3	H <	5.00
					26AUG85		<	5.00
					26AUG85	1	<	5.00
					26AUG85	2		5.00
					26AUG85	3	<	5.00
					01OCT85			8.00
					31OCT85		<	5.00
					31OCT85	S	H	19.0
					12DEC85		<	5.00
					21JAN86		<	5.00
					25FEB86		<	5.00
					25MAR86		<	5.00
					24APR86		<	5.00
					28MAY86		<	5.00
				199-H4-6	19JUN85		H	18.0
					25JUL85		H <	5.00
					26AUG85			9.00
					03OCT85			10.0
					31OCT85			5.00
					12DEC85		<	5.00
					21JAN86		<	5.00
					25FEB86		<	5.00
					24MAR86		<	5.00
					25APR86			8.00
					28MAY86			5.00

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Site Specific

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
A16	ALUMNUM	PPB	150	199-H3-1	24JUN85		H	926
					24JUN85	1	H	223
					24JUN85	2	H	220
					01AUG85		H	208
					01AUG85	1	H	< 150
					01AUG85	2	H	560
					27AUG85			< 150
					27AUG85	1		< 150
					27AUG85	2		< 150
					03OCT85			< 150
					31OCT85			< 150
					31OCT85	S	H	543
					13DEC85			< 150
					22JAN86			< 150
					25FEB86			< 150
					24MAR86			< 150
					25APR86			< 150
					28MAY86			< 150
				199-H4-3	19JUN85		H	759
					01AUG85		H	237
					27AUG85			< 150
					01OCT85			< 150
					01NOV85			< 150
					13DEC85			281
					22JAN86			< 150
					24FEB86			< 150
					24MAR86			< 150
					24APR86			270
					28MAY86			349
				199-H4-4	19JUN85		H	197
					01AUG85		H	304
					26AUG85			< 150
					01OCT85			< 150
					01NOV85			< 150
					12DEC85			< 150
					21JAN86			< 150
					24FEB86			< 150
					21MAR86			< 150
					24APR86			< 150
					28MAY86			< 150
				199-H4-5	24JUN85		H	334
					24JUN85	1	H	439
					24JUN85	2	H	329
					24JUN85	3	H	394
					25JUL85		H	182
					25JUL85	1	H	186
					25JUL85	2	H	252
					25JUL85	3	H	531
					26AUG85			< 150
					26AUG85	1		< 150
					26AUG85	2		< 150
					26AUG85	3		< 150
					01OCT85			< 150
					31OCT85			< 150
					31OCT85	S	H	163
					12DEC85			< 150
					21JAN86			< 150
					25FEB86			< 150
					25MAR86			< 150
					24APR86			< 150
					28MAY86			< 150
				199-H4-6	19JUN85		H	332
					25JUL85		H	225
					26AUG85			< 150
					03OCT85			< 150
					31OCT85			< 150
					12DEC85			< 150
					21JAN86			< 150
					25FEB86			< 150
					24MAR86			< 150
					25APR86			< 150
					28MAY86			< 150

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Site Specific

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
A18	POTASUM	PPB	100	199-H3-1	24JUN85		H	7,220
					24JUN85	1	H	5,400
					24JUN85	2	H	5,310
					01AUG85		H	7,500
					01AUG85	1	H	8,980
					01AUG85	2	H	6,540
					27AUG85			5,730
					27AUG85	1		5,270
					27AUG85	2		5,370
					03OCT85			5,760
					31OCT85			7,770
					31OCT85	S	H	8,240
					13DEC85			6,580
					22JAN86			5,950
					25FEB86			5,760
					24MAR86			6,440
					25APR86			6,120
					28MAY86			5,970
				199-H4-3	19JUN85		H	9,090
					01AUG85		H	8,350
					27AUG85			3,950
					01OCT85			4,190
					01NOV85			8,410
					13DEC85			7,150
					22JAN86			9,970
					24FEB86			7,120
					24MAR86			12,200
					24APR86			11,800
					28MAY86			14,300
				199-H4-4	19JUN85		H	6,040
					01AUG85		H	6,930
					26AUG85			6,350
					01OCT85			5,590
					01NOV85			6,220
					12DEC85			3,770
					21JAN86			4,540
					24FEB86			4,120
					21MAR86			4,130
					24APR86			3,870
					28MAY86			4,430
				199-H4-5	24JUN85		H	3,870
					24JUN85	1	H	4,150
					24JUN85	2	H	4,180
					24JUN85	3	H	4,930
					25JUL85		H	3,550
					25JUL85	1	H	4,770
					25JUL85	2	H	4,740
					25JUL85	3	H	5,740
					26AUG85			4,000
					26AUG85	1		4,210
					26AUG85	2		4,120
					26AUG85	3		4,090
					01OCT85			3,920
					31OCT85			4,850
					31OCT85	S	H	5,370
					12DEC85			4,740
					21JAN86			3,990
					25FEB86			3,470
					25MAR86			4,290
					24APR86			4,180
					28MAY86			4,310
				199-H4-6	19JUN85		H	5,390
					25JUL85		H	5,580
					26AUG85			5,110
					03OCT85			4,880
					31OCT85			5,610
					12DEC85			6,000
					21JAN86			4,990
					25FEB86			5,250
					24MAR86			5,930
					25APR86			5,740
					28MAY86			5,490

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Site Specific

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A67	1,1,1-T	PPB	10	199-H3-1	24JUN85		H	<	M
					24JUN85	1	H	<	10.0
					24JUN85	2	H	<	10.0
					01AUG85		H	<	10.0
					01AUG85	1	H	<	10.0
					01AUG85	2	H	<	10.0
					27AUG85			<	10.0
					27AUG85	1		<	10.0
					27AUG85	2		<	10.0
					03OCT85			<	10.0
					31OCT85			<	10.0
					31OCT85	S	H	<	10.0
					13DEC85			<	10.0
					22JAN86				22.0
					25FEB86			<	10.0
					24MAR86			<	10.0
					25APR86			<	10.0
					26MAY86			<	10.0
				199-H4-3	19JUN85		H	<	10.0
					01AUG85		H	<	10.0
					27AUG85			<	10.0
					01OCT85			<	10.0
					01NOV85			<	10.0
					13DEC85			<	10.0
					22JAN86				11.0
					24FEB86			<	10.0
					24MAR86			<	10.0
					24APR86				24.4
					28MAY86			<	10.0
				199-H4-4	01OCT85			<	10.0
					01NOV85			<	10.0
					12DEC85			<	10.0
					21JAN86			<	10.0
					24FEB86			<	10.0
					21MAR86			<	10.0
					24APR86			<	10.0
					28MAY86			<	10.0
				199-H4-5	01OCT85			<	10.0
					31OCT85			<	10.0
					31OCT85	S	H	<	10.0
					12DEC85			<	10.0
					21JAN86				14.0
					25FEB86			<	10.0
					25MAR86			<	10.0
					24APR86			<	10.0
					28MAY86			<	10.0
				199-H4-6	03OCT85			<	10.0
					31OCT85			<	10.0
					12DEC85			<	10.0
					21JAN86			<	10.0
					25FEB86			<	10.0
					24MAR86			<	10.0
					25APR86				14.0
					28MAY86			<	10.0

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Site Specific

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A70	PERCENE	PPB	10	199-H3-1	24JUN85		H	<	M
					24JUN85	1	H	<	10.0
					24JUN85	2	H	<	10.0
					01AUG85		H	<	10.0
					01AUG85	1	H	<	10.0
					01AUG85	2	H	<	10.0
					27AUG85			<	10.0
					27AUG85	1		<	10.0
					27AUG85	2		<	10.0
					03OCT85			<	10.0
					31OCT85			<	10.0
					31OCT85	S	H	<	10.0
					13DEC85			<	10.0
					22JAN86			<	10.0
					25FEB86			<	10.0
					24MAR86			<	10.0
					25APR86			<	10.0
					28MAY86			<	10.0
				199-H4-3	19JUN85		H	<	10.0
					01AUG85		H		10.0
					27AUG85			<	10.0
					01OCT85				11.0
					01NOV85			<	10.0
					13DEC85			<	10.0
					22JAN86			<	10.0
					24FEB86			<	10.0
					24MAR86			<	10.0
					24APR86				11.4
					26MAY86			<	10.0
				199-H4-4	01OCT85			<	10.0
					01NOV85			<	10.0
					12DEC85			<	10.0
					21JAN86			<	10.0
					24FEB86			<	10.0
					21MAR86			<	10.0
					24APR86			<	10.0
					28MAY86			<	10.0
				199-H4-5	01OCT85			<	10.0
					31OCT85			<	10.0
					31OCT85	S	H	<	10.0
					12DEC85			<	10.0
					21JAN86			<	10.0
					25FEB86			<	10.0
					25MAR86			<	10.0
					24APR86			<	10.0
					28MAY86			<	10.0
				199-H4-6	03OCT85			<	10.0
					31OCT85			<	10.0
					12DEC85			<	10.0
					21JAN86			<	10.0
					25FEB86			<	10.0
					24MAR86			<	10.0
					25APR86				15.0
					28MAY86			<	10.0

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Site Specific

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A80	CHLFORM	PPB	10	199-H3-1	24JUN85		H	<	M
					24JUN85	1	H		10.0
					24JUN85	2	H		11.0
					01AUG85		H		10.0
					01AUG85	1	H	<	10.0
					01AUG85	2	H		14.0
					27AUG85			<	10.0
					27AUG85	1		<	10.0
					27AUG85	2			14.0
					03OCT85				11.0
					22JAN86			<	10.0
					25FEB86			<	10.0
					24MAR86			<	10.0
					25APR86			<	10.0
				199-H4-3	19JUN85		H		21.0
					01AUG85		H	<	10.0
					27AUG85				30.0
					01OCT85				28.0
					01NOV85				26.0
					13DEC85				26.0
					22JAN86				31.0
					24FEB86				29.0
					24MAR86				23.0
					24APR86				27.1
					28MAY86				32.0
				199-H4-4	01OCT85				27.0
					01NOV85				24.0
					21JAN86				22.0
					24FEB86				22.0
					21MAR86				16.0
					28MAY86				14.0
				199-H4-5	01OCT85				25.0
					31OCT85				25.0
					12DEC85				24.0
					21JAN86				27.0
					25FEB86				25.0
					25MAR86				27.0
					24APR86				27.0
					28MAY86				29.0
				199-H4-6	03OCT85				23.0
					31OCT85				24.0
					12DEC85				19.0
					21JAN86				18.0
					25FEB86				17.0
					24MAR86				14.0
					25APR86				15.0
					28MAY86				14.0

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Site Specific

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A93	METHYCH	PPB	10	199-H3-1	24JUN85		H	<	M
					24JUN85	1	H	<	10.0
					24JUN85	2	H	<	10.0
					01AUG85		H	<	10.0
					01AUG85	1	H	<	10.0
					01AUG85	2	H	<	10.0
					27AUG85			<	10.0
					27AUG85	1		<	10.0
					27AUG85	2		<	10.0
					03OCT85			<	10.0
					13DEC85				1,500
					22JAN86			<	10.0
					25FEB86				28.0
					24MAR86				36.0
					25APR86			<	10.0
				199-H4-3	19JUN85		H	<	10.0
					01AUG85		H	<	10.0
					27AUG85			<	10.0
					01OCT85			<	10.0
					13DEC85				110
					22JAN86			<	10.0
					24FEB86				34.0
					24MAR86				1,400
					24APR86				390
				199-H4-4	12DEC85				570
					21MAR86				340
				199-H4-5	12DEC85				600
					25FEB86			<	6.40
					25MAR86			<	2.80
				199-H4-6	12DEC85				140
					25FEB86				22.0
					24MAR86				470
					25APR86				56.0

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = Site Specific

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
C80	AMMONIU	PPB	50	199-H3-1	24JUN85			170
					24JUN85	1		175
					24JUN85	2		160
					01AUG85			230
					01AUG85	1		175
					01AUG85	2		180
					27AUG85			160
					27AUG85	1		130
					27AUG85	2		126
					03OCT85			138
					31OCT85			160
					13DEC85		<	48.0
					22JAN86		<	36.0
					25FEB86		<	50.0
					24MAR86		<	50.0
					25APR86		<	50.0
					28MAY86		<	50.0
				199-H4-3	19JUN85			220
					01AUG85			240
					27AUG85			130
					01OCT85			138
					01NOV85			175
					13DEC85			51.0
					22JAN86		<	42.0
					24FEB86		<	50.0
					24MAR86		<	50.0
					24APR86		<	50.0
					28MAY86		<	50.0
				199-H4-4	19JUN85			170
					01AUG85			230
					26AUG85			130
					01OCT85			118
					01NOV85			160
					12DEC85		<	48.0
					21JAN86		<	30.0
					24FEB86		<	50.0
					21MAR86		<	50.0
					24APR86		<	50.0
					28MAY86		<	50.0
				199-H4-5	24JUN85			180
					24JUN85	1		170
					24JUN85	2		190
					24JUN65	3		180
					25JUL85			220
					25JUL85	1		240
					25JUL85	2		250
					25JUL85	3		210
					26AUG85			190
					26AUG85	1		130
					26AUG85	2		130
					26AUG85	3		114
					01OCT85			130
					31OCT85			150
					12DEC85		<	45.0
					21JAN86		<	30.0
					25FEB86		<	50.0
					25MAR86		<	50.0
					24APR86		<	50.0
					28MAY86		<	50.0
				199-H4-6	19JUN85			170
					25JUL85			270
					26AUG85			155
					03OCT85			190
					31OCT85			220
					12DEC85			98.0
					21JAN86			74.0
					25FEB86		<	50.0
					24MAR86			103
					25APR86			89.0
					28MAY86			70.6

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = WAC 173-303-9905

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
A23	THALIUM	PPB	10	199-H3-1	24JUN85		H		18.0
					24JUN85	1	H		14.0
					24JUN85	2	H		12.0
					01AUG85		H	<	10.0
					01AUG85	1	H	<	10.0
					01AUG85	2	H	<	10.0
					27AUG85			<	10.0
					27AUG85	1		<	10.0
					27AUG85	2		<	10.0
					03OCT85			<	10.0
					22JAN86			<	10.0
					25APR86			<	10.0
				199-H4-3	19JUN85		H		21.0
					01AUG85		H	<	10.0
					27AUG85			<	10.0
					01OCT85			<	10.0
					22JAN86			<	10.0
					24APR86			<	10.0

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = WAC 173-303-9905

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab		Concentration
B40	BIS2EPH	PPB	10	199-H3-1	24JUN85		H	<	10.0
					24JUN85	1	H	<	10.0
					24JUN85	2	H	<	10.0
					01AUG85		H	<	10.0
					01AUG85	1	H	<	10.0
					01AUG85	2	H	<	10.0
					27AUG85			<	10.0
					27AUG85	1		<	10.0
					27AUG85	2		<	10.0
					03OCT85			<	10.0
					22JAN86			<	10.0
					25APR86			<	10.0
				199-H4-3	19JUN85		H	<	W
					01AUG85		H	<	10.0
					27AUG85			<	10.0
					01OCT85			<	10.0
					01NOV85				13.0
					22JAN86			<	10.0
					24APR86			<	10.0

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

TABLE G.3 Raw Data, Constituent List = WAC 173-303-9905

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
I99	UNKNOWN	PPB	0	199-H3-1	22JAN86			9.00

APPENDIX H

GRAPHS OF ANALYTICAL DATA

APPENDIX H

GRAPHS OF ANALYTICAL DATA

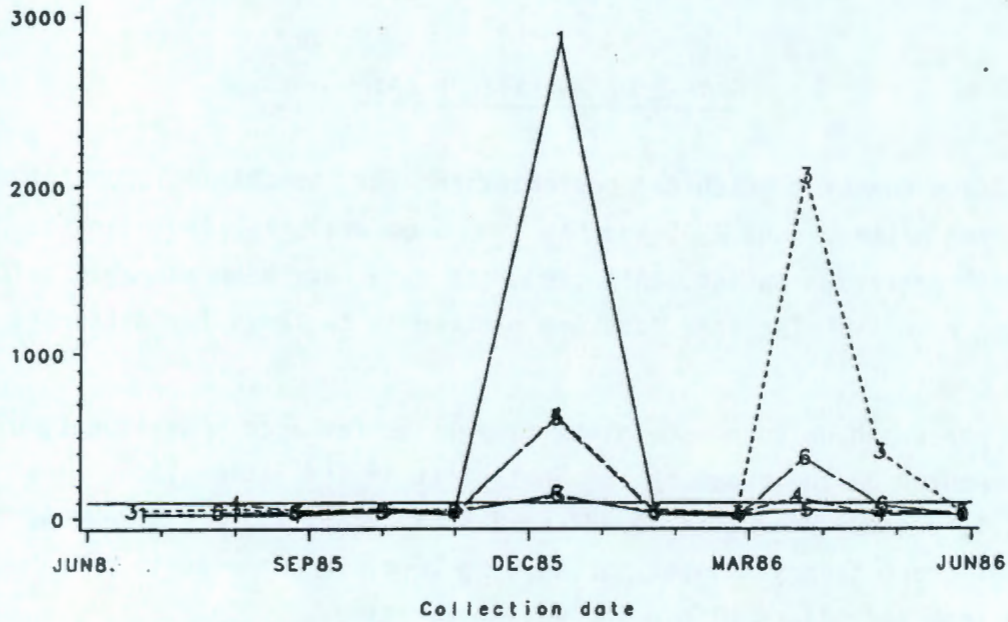
Appendix H contains graphical presentations for the chemical constituent data collected between June 1985 and May 1986 from wells located near the 183-H Solar Evaporation Basins. All replicate data have been averaged before plotting the results. The same data are plotted in two ways for different purposes.

The upper graph on each page gives time-lines for each constituent, with each well denoted on the graph by the last digit of its designation. That is, 1 = 199-H3-1, 3 = 199-H4-3, 4 = 199-H4-4, 5 = 199-H4-5, and 6 = 199-H4-6. This type of graph is mostly used for showing levels and trends in the constituent concentrations within the wells over time.

The lower graph on each page is used to allow comparisons of the levels and spread of concentrations between wells while ignoring the time effect. The order of the wells on the horizontal axis generally corresponds to their distance and hydraulic position relative to the basins, with upgradient wells first (199-H3-1 and 199-H4-6), followed by the source well (199-H4-3), and downgradient wells (199-H4-4 and 199-H4-5).

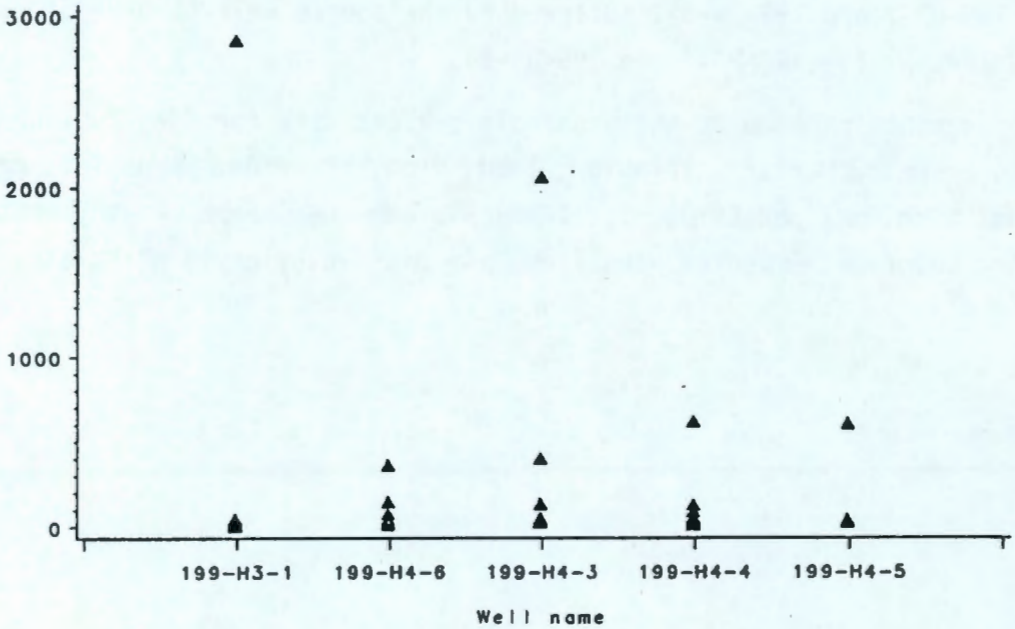
The graphs included in this appendix present data for TOX, TOC, coliform, cadmium, arsenic, mercury, selenium, lead, iron, fluoride, strontium, calcium, vanadium, aluminum, potassium, 1,1,1-trichloroethane, perchloroethylene, methylene chloride, ammonium, thallium, and bis(2-ethylexyl) phthalate.

RCRA Compliance Groundwater Monitoring Project
183-H Solar Evaporation Basins, June 1985 to May 1986
Constituent List=Contamination Indicators Constituent=C68 TOX PPB

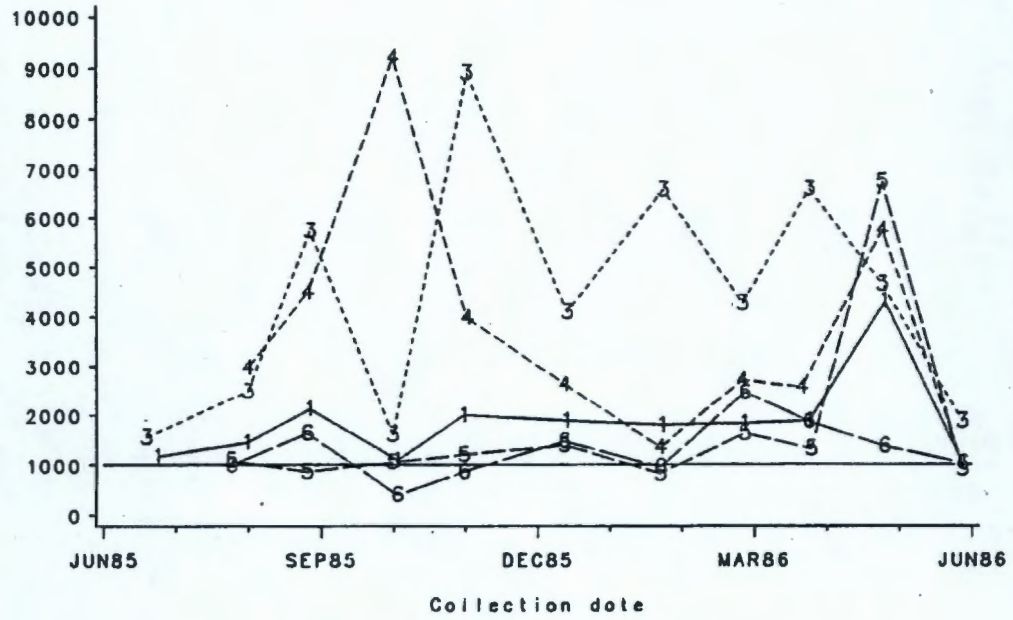


Horizontal solid line is detection limit

Constituent List=Contamination Indicators Constituent=C68 TOX PPB



RCRA Complionce Groundwater Monitoring Project
183-H Solar Evaporation Basins, June 1985 to May 1986
Constituent List=Contamination Indicators Constituent=C69 TOC PPB



Horizontal solid line is detection limit

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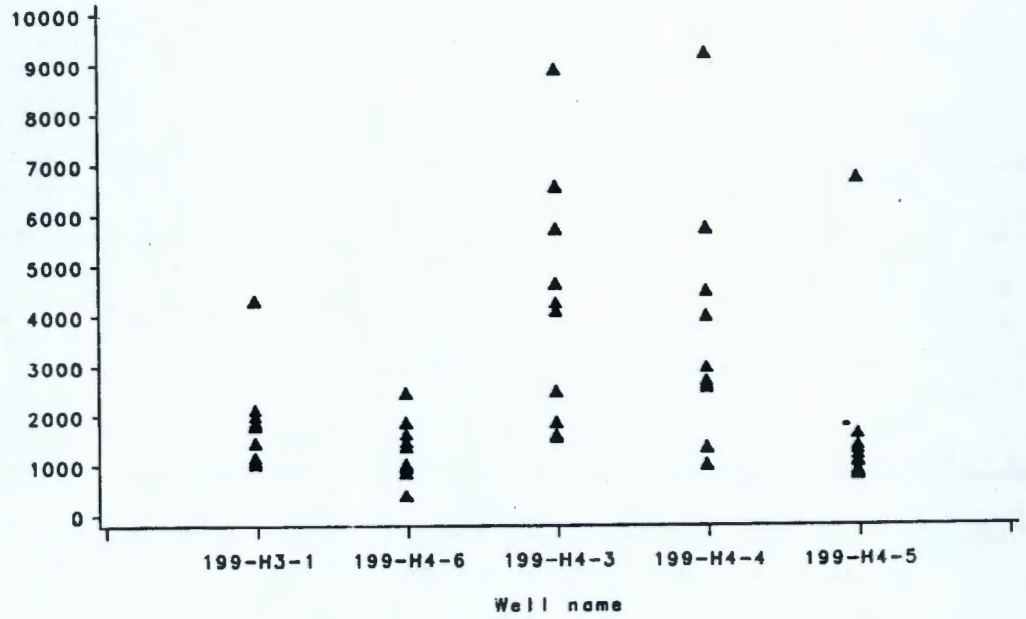

RCRA Compliance Groundwater Monitoring Project
183-H Solar Evaporation Basins, June 1985 to May 1986
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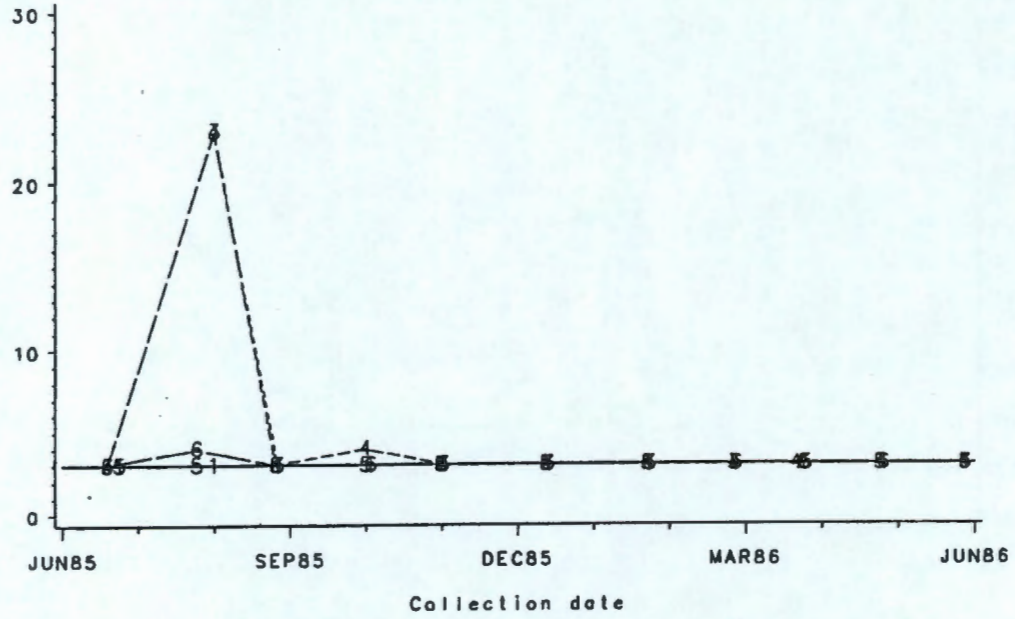

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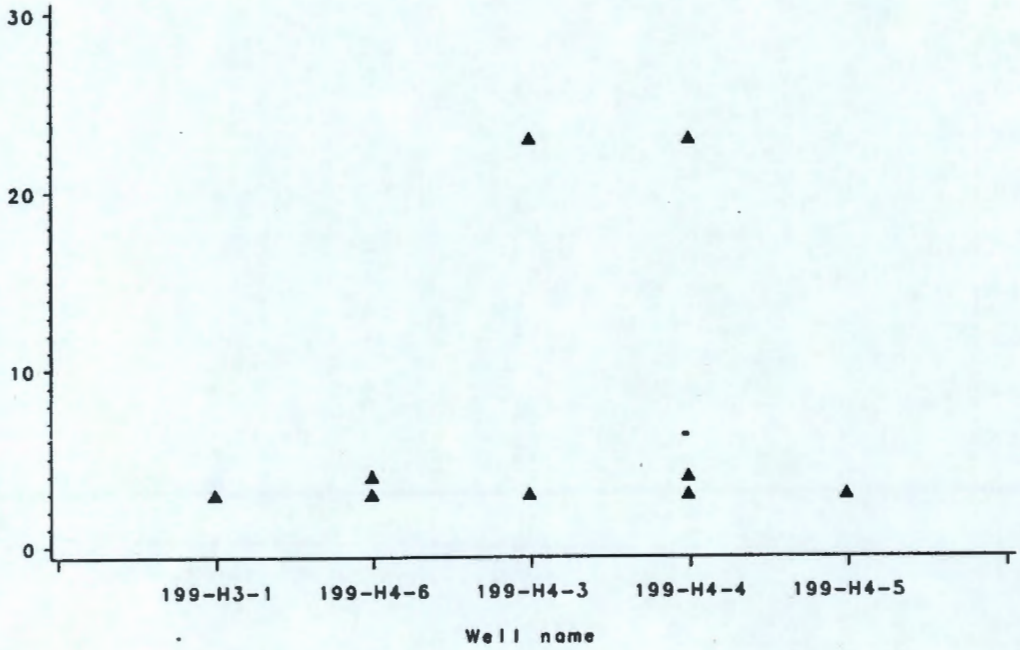

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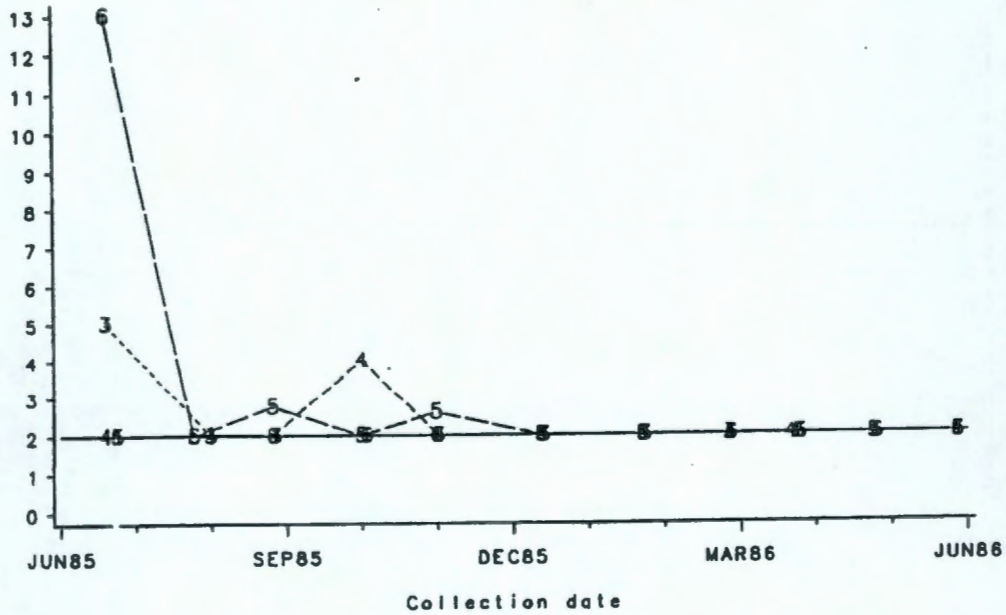

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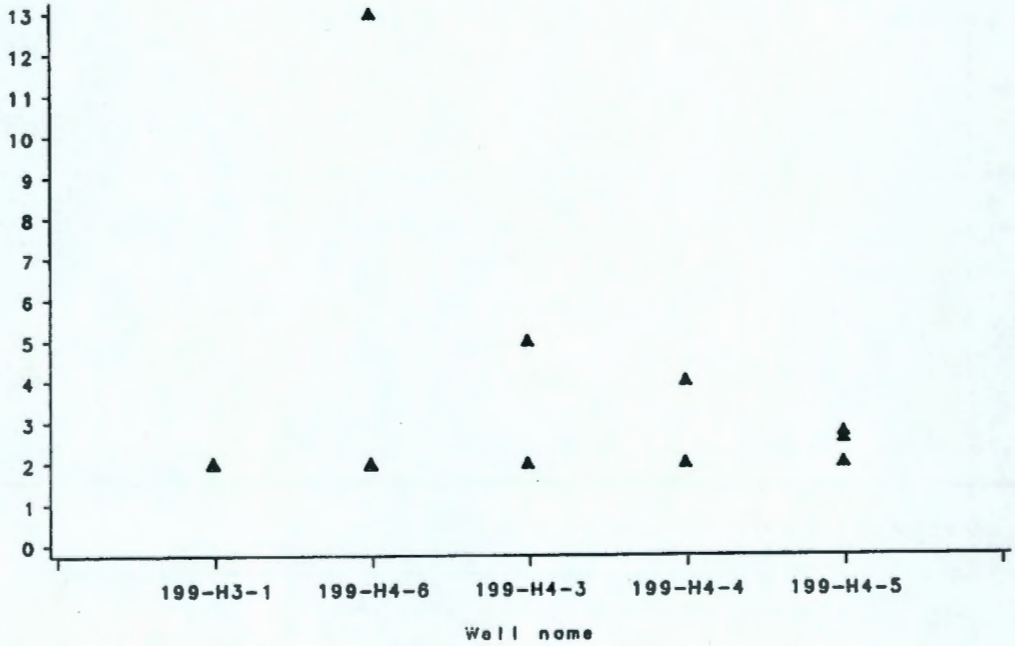

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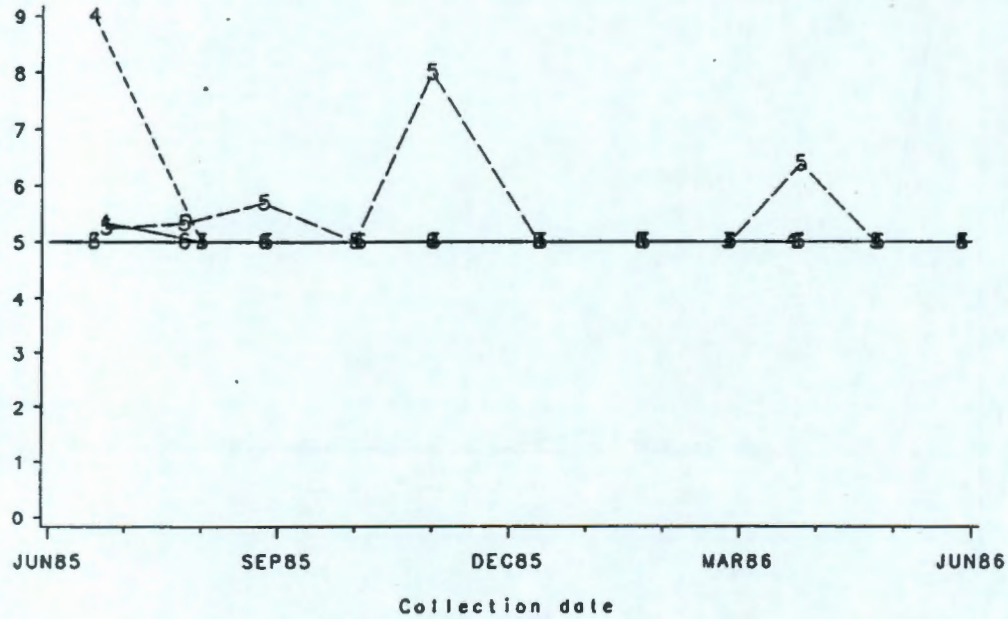

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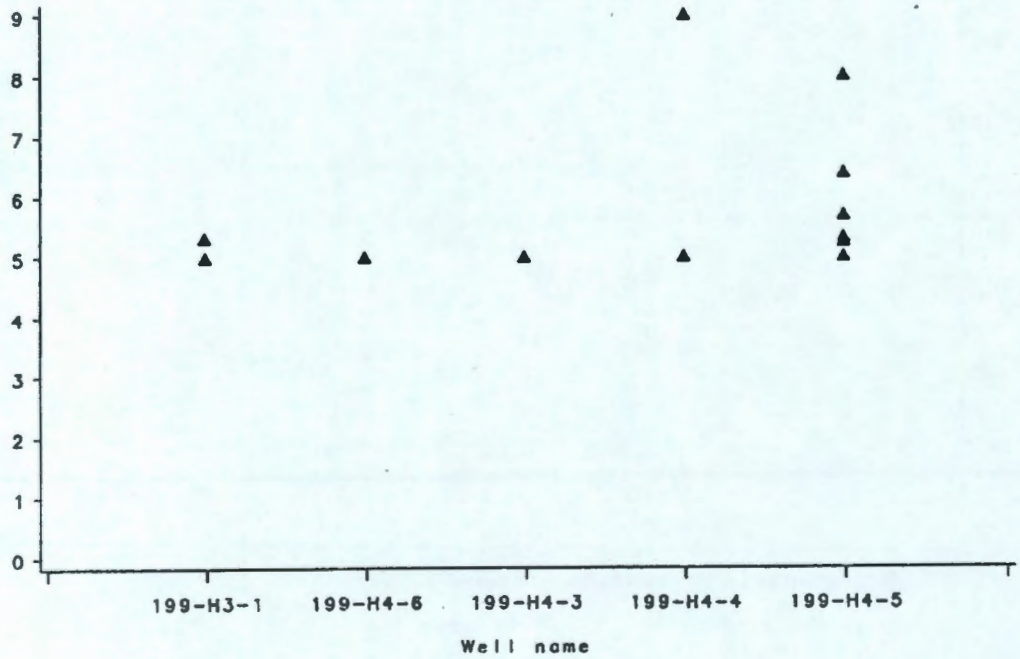

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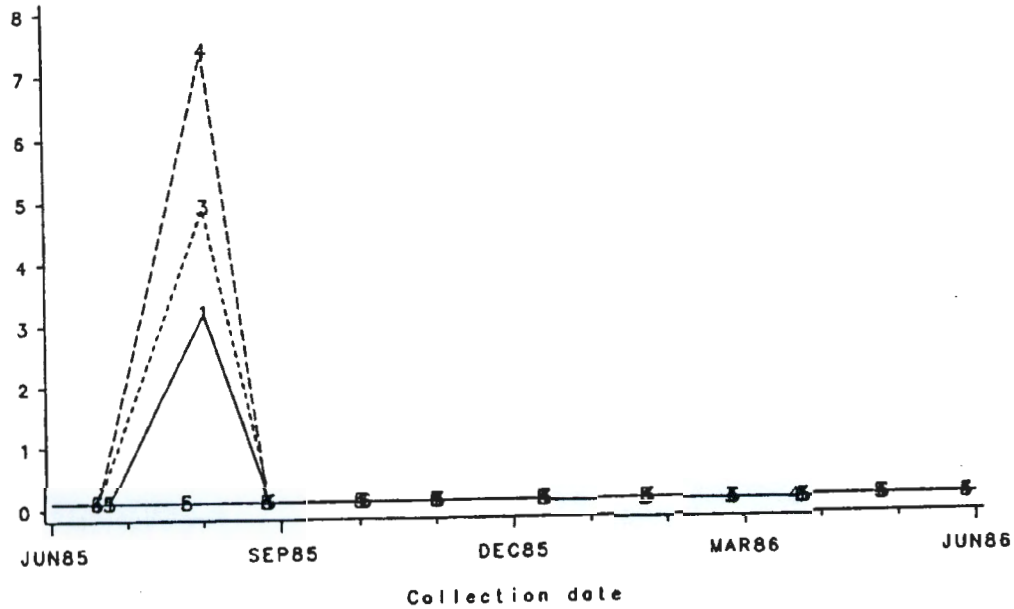

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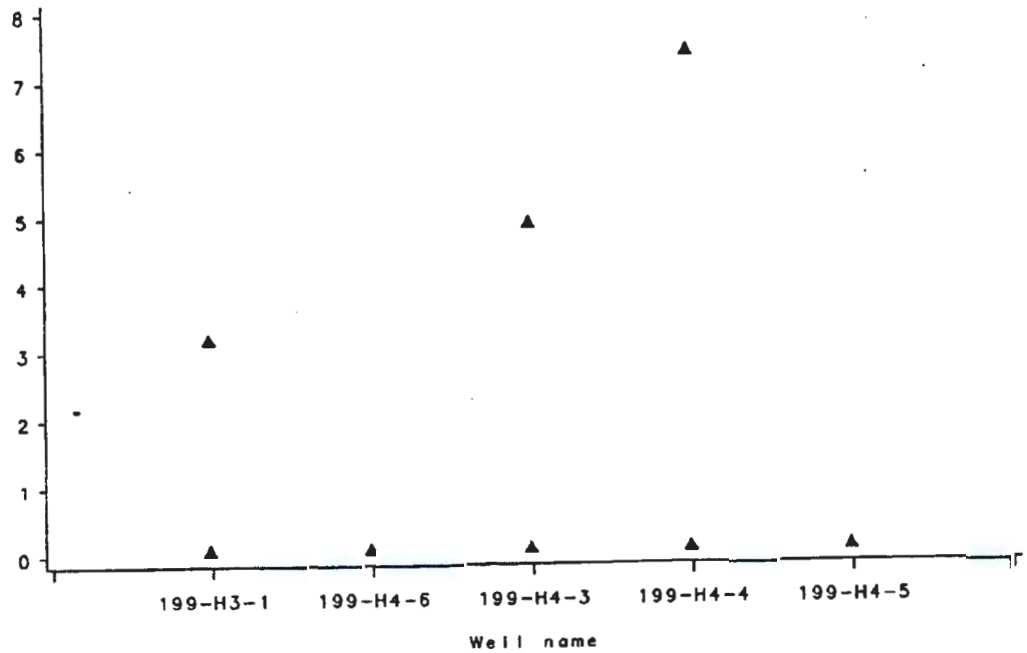

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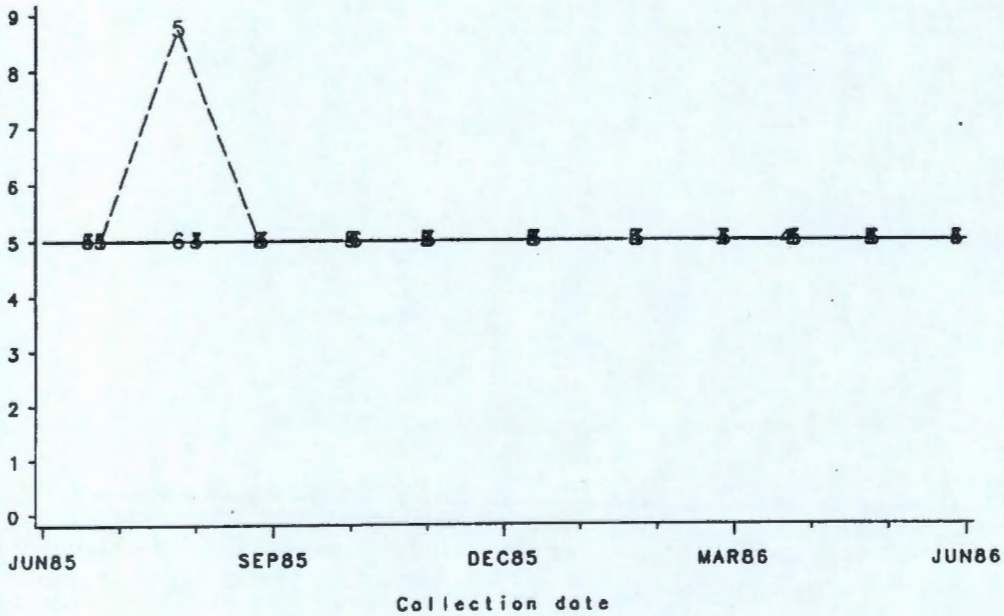

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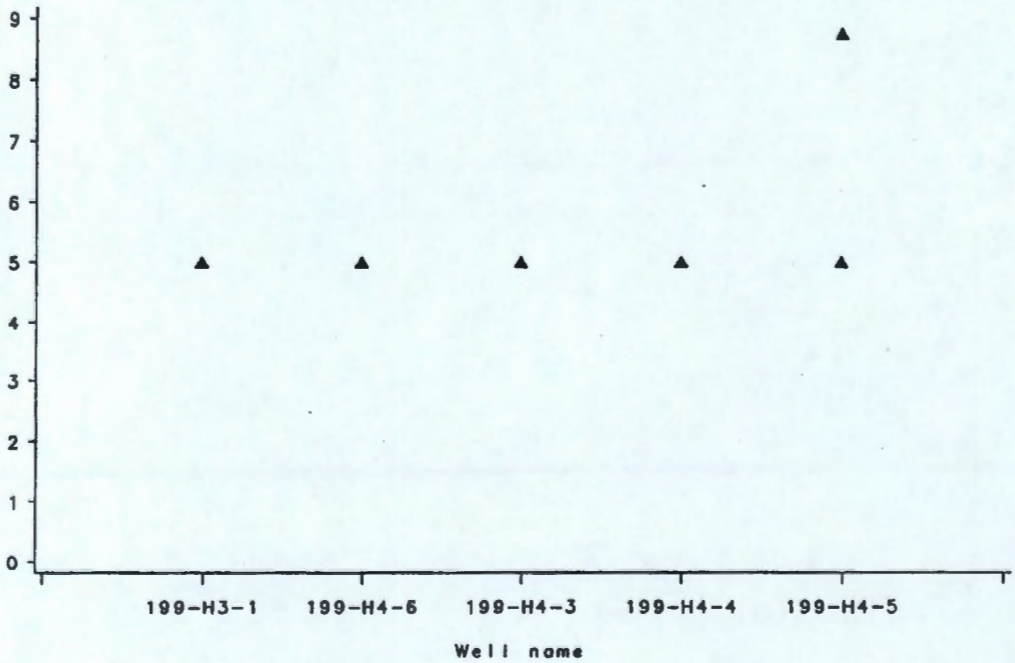

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183-H Solar Evaporation Basins, June 1985 to May 1986
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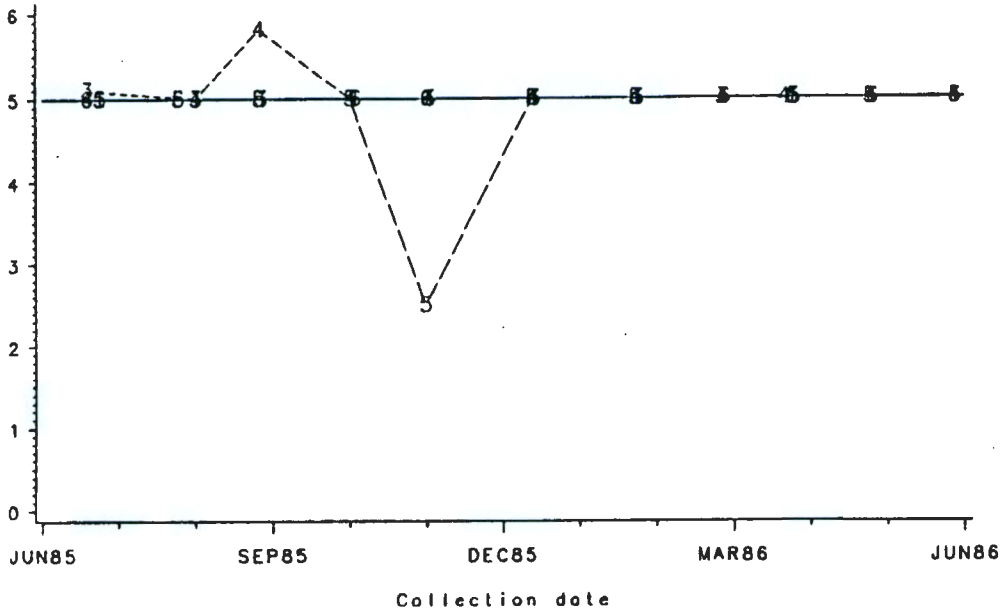

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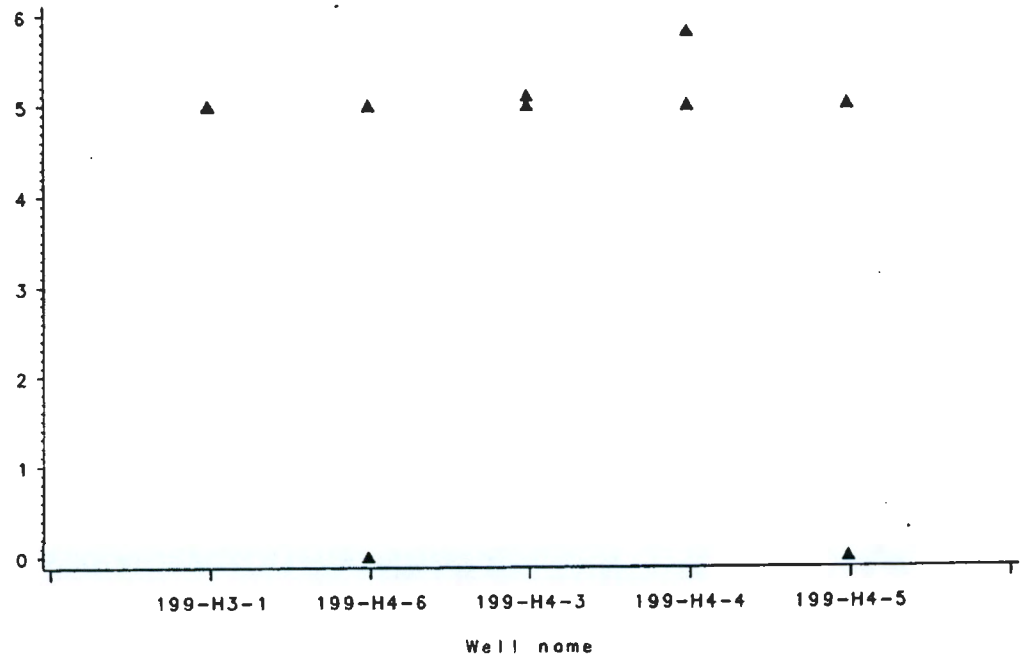
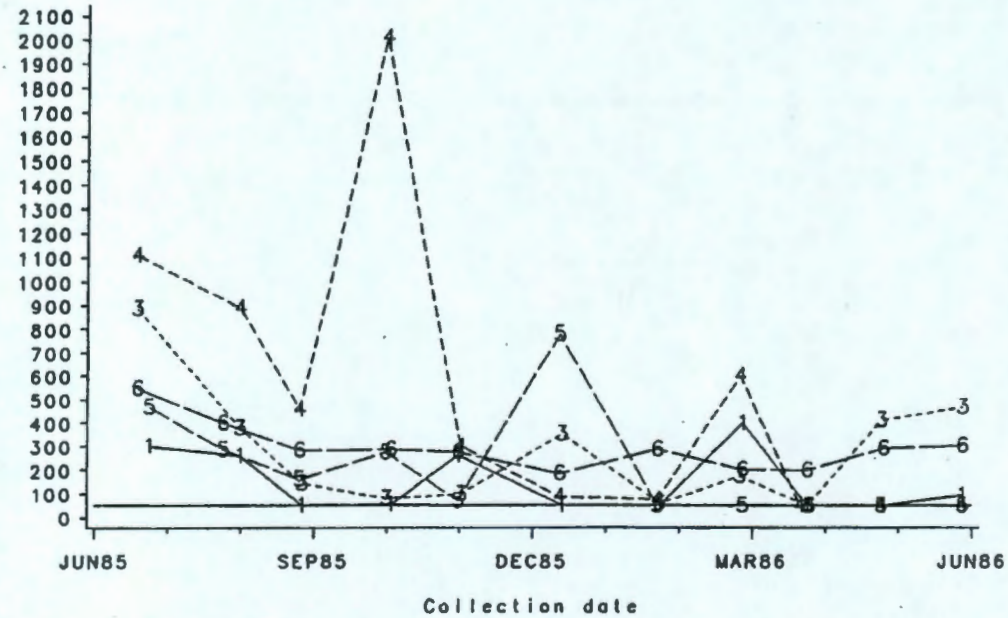


RCRA Compliance Groundwater Monitoring Project
183-H Solar Evaporation Basins, June 1985 to May 1986
Constituent List=Quality Characteristics Constituent=A19 IRON PPB



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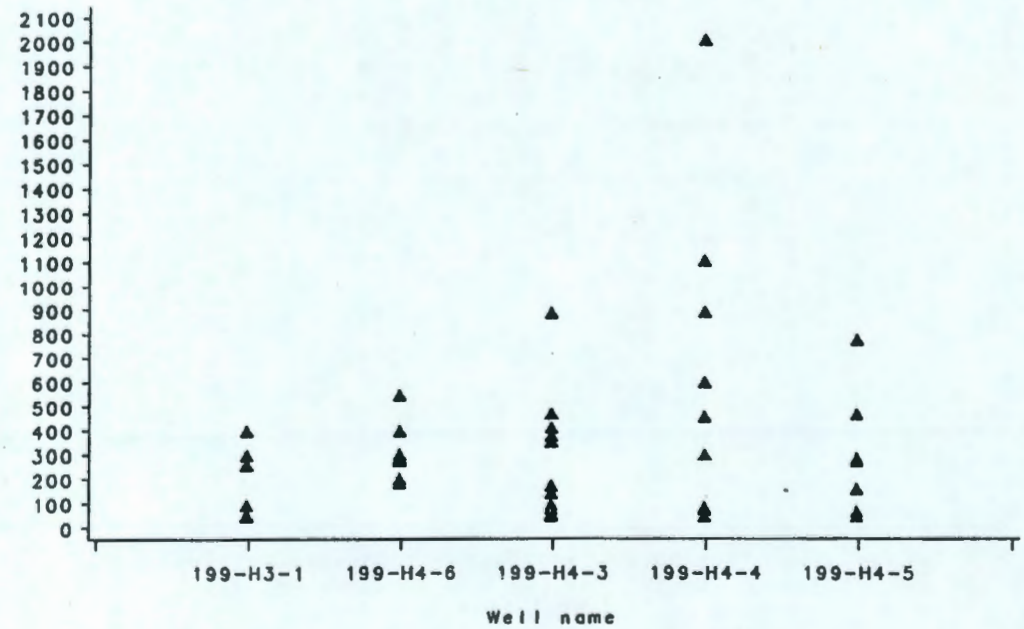

RCRA Compliance Groundwater Monitoring Project
183-H Solar Evaporation Basins, June 1985 to May 1986
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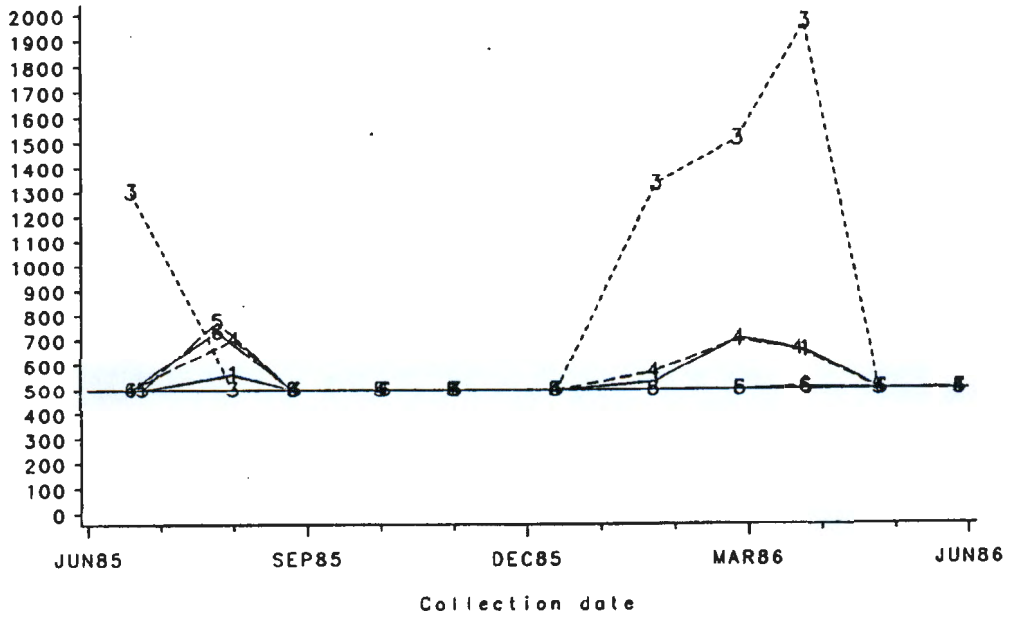

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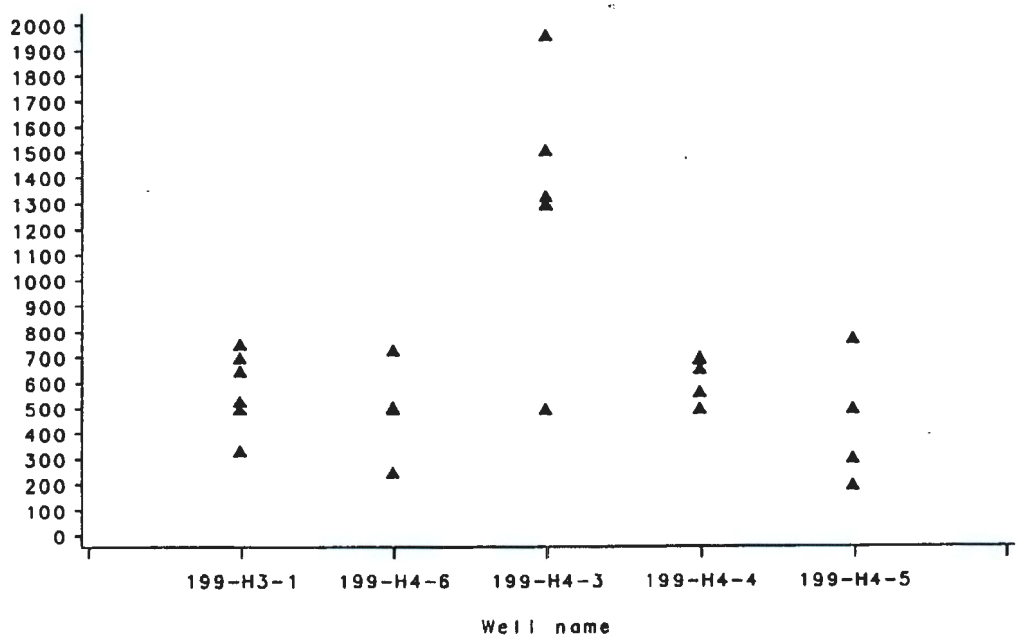

RCRA Compliance Groundwater Monitoring Project
183-H Solar Evaporation Basins, June 1985 to May 1986
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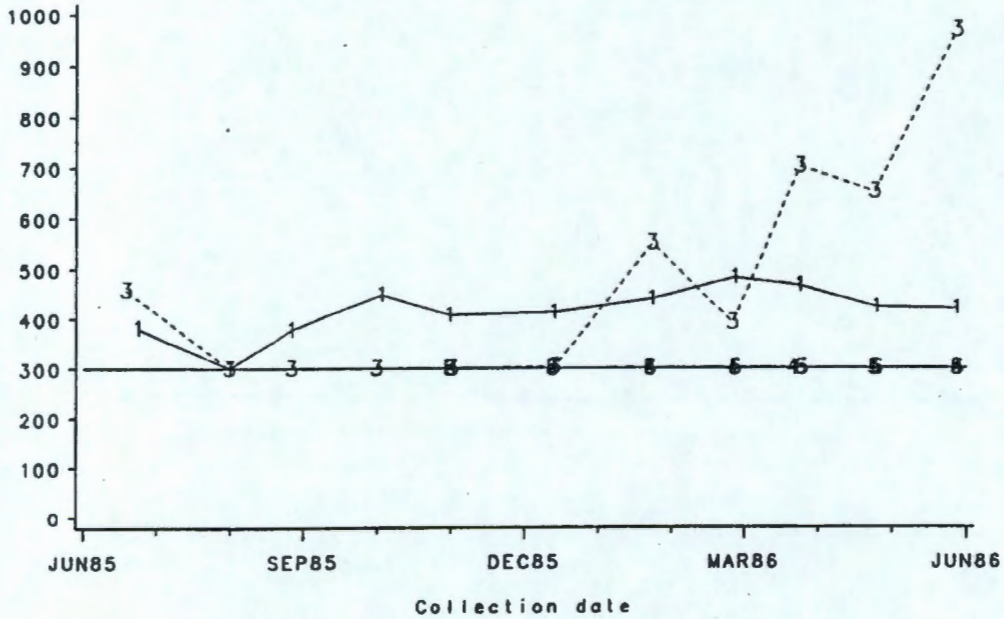

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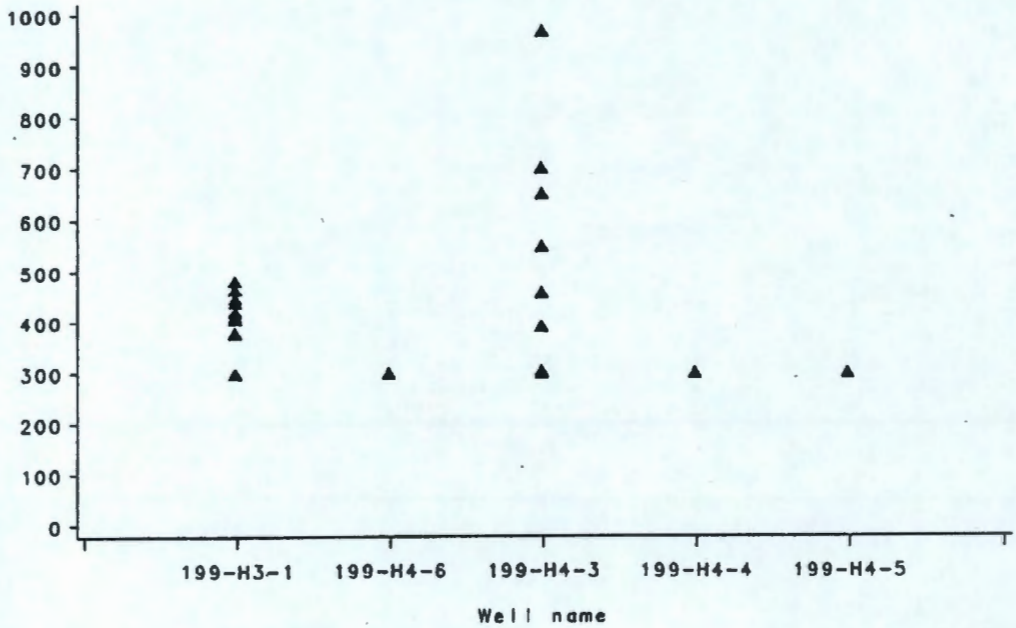

RCRA Compliance Groundwater Monitoring Project
183-H Solar Evaporation Basins, June 1985 to May 1986
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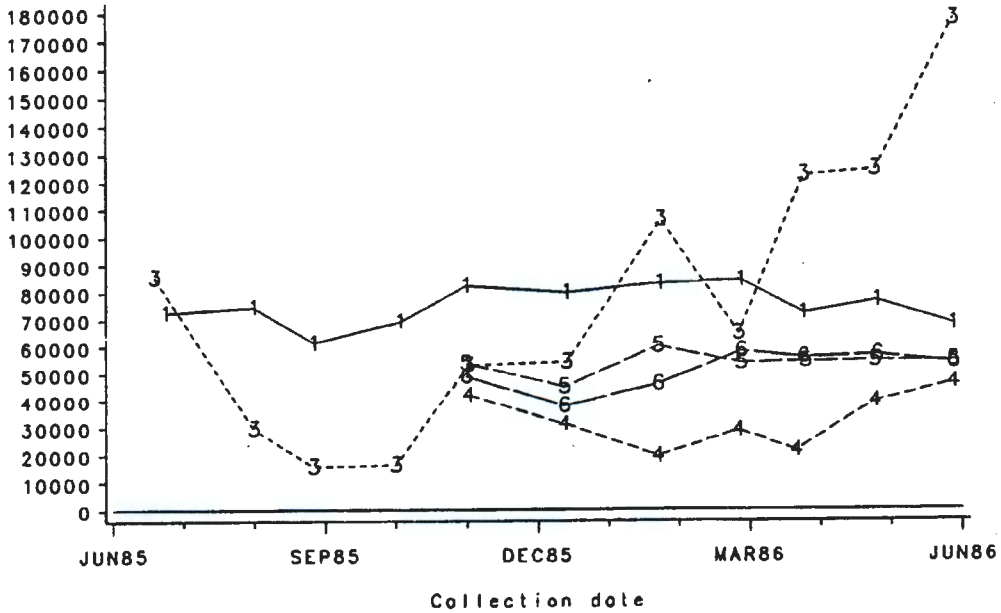

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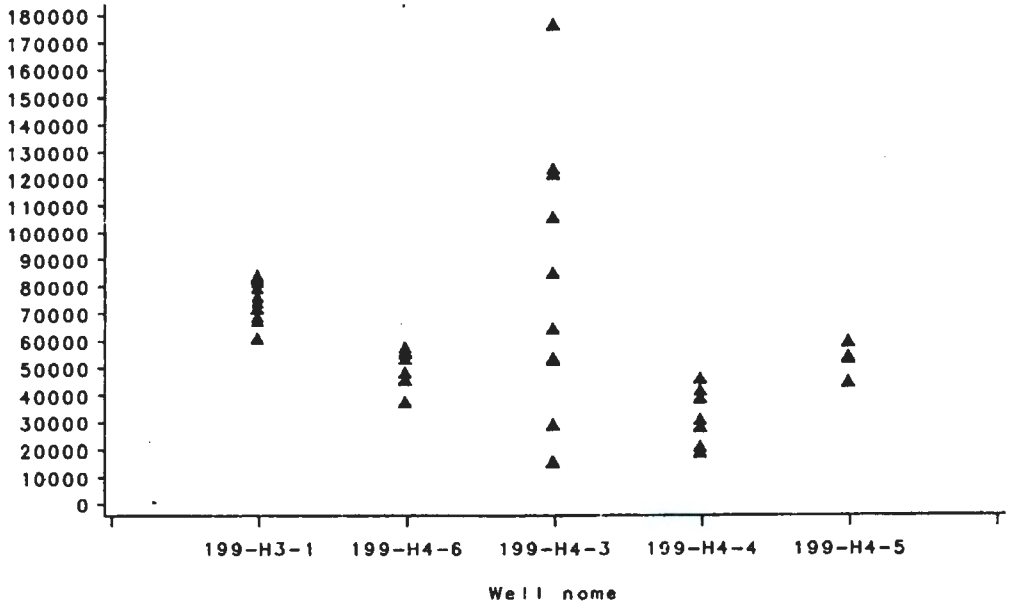

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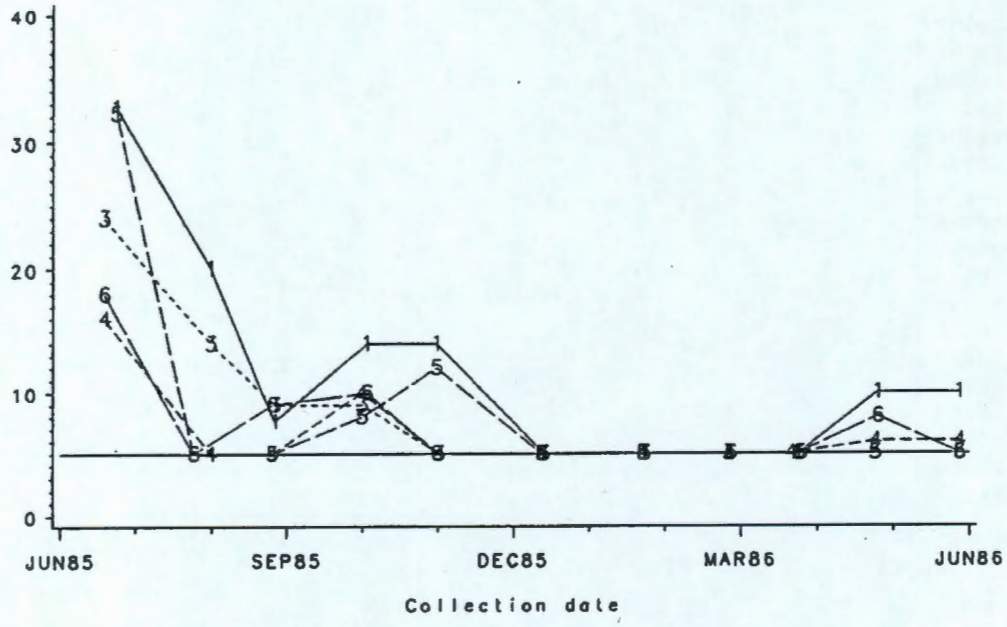

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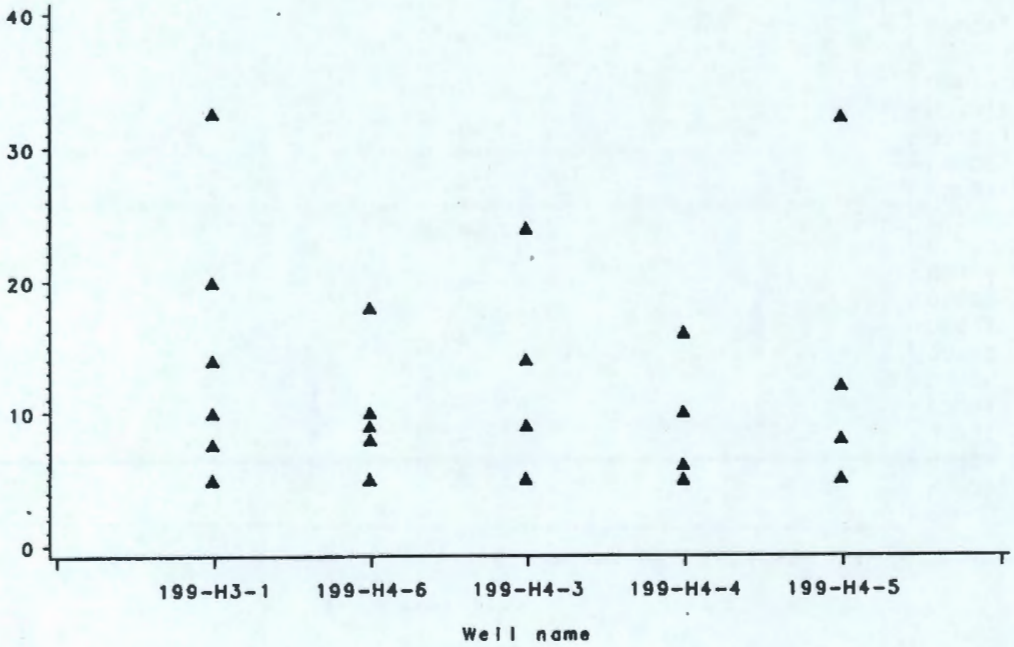

RCRA Compliance Groundwater Monitoring Project
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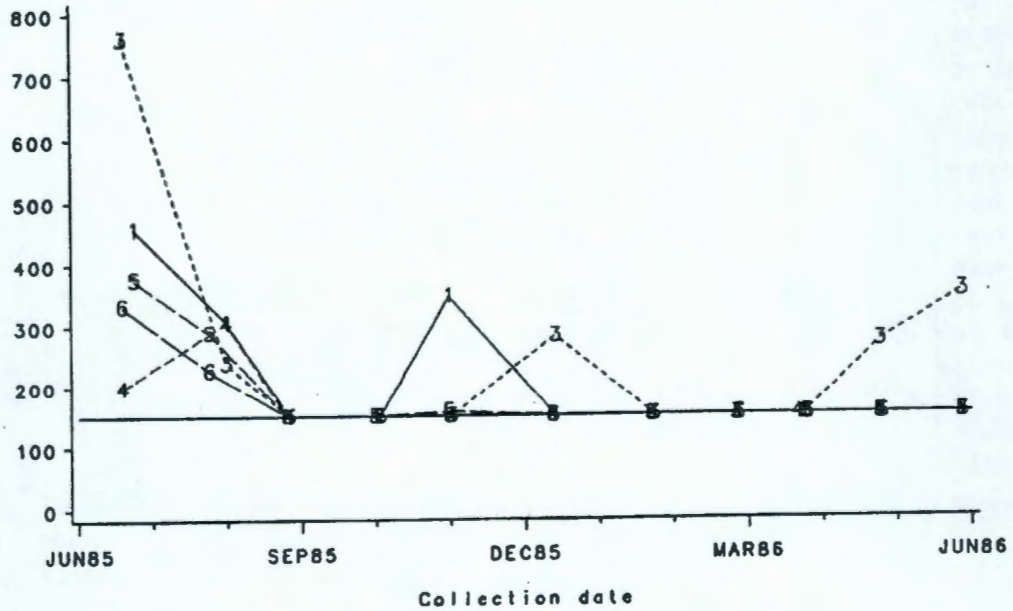

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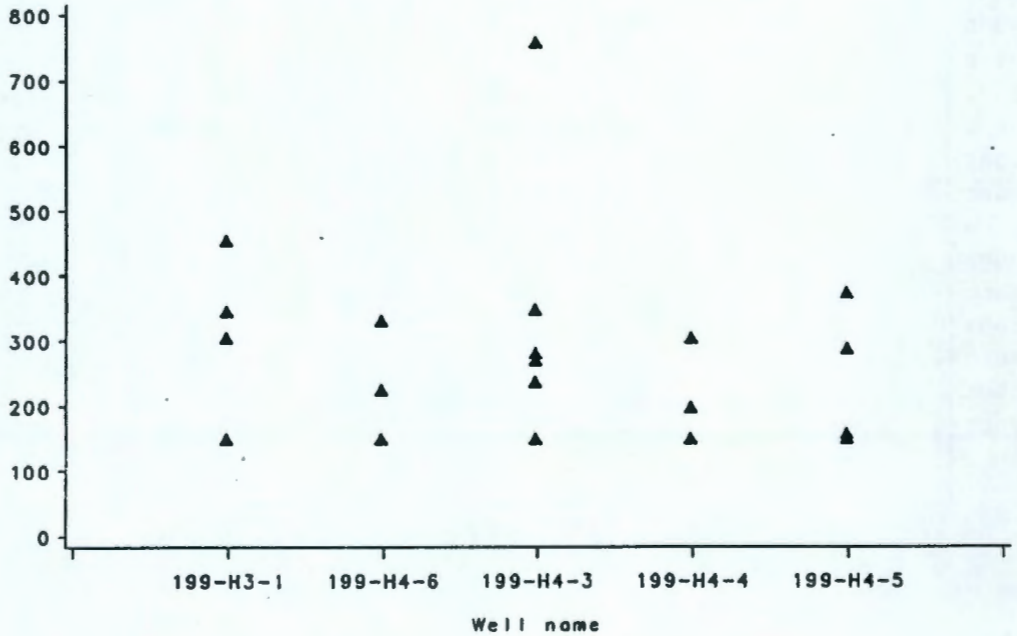

RCRA Compliance Groundwater Monitoring Project
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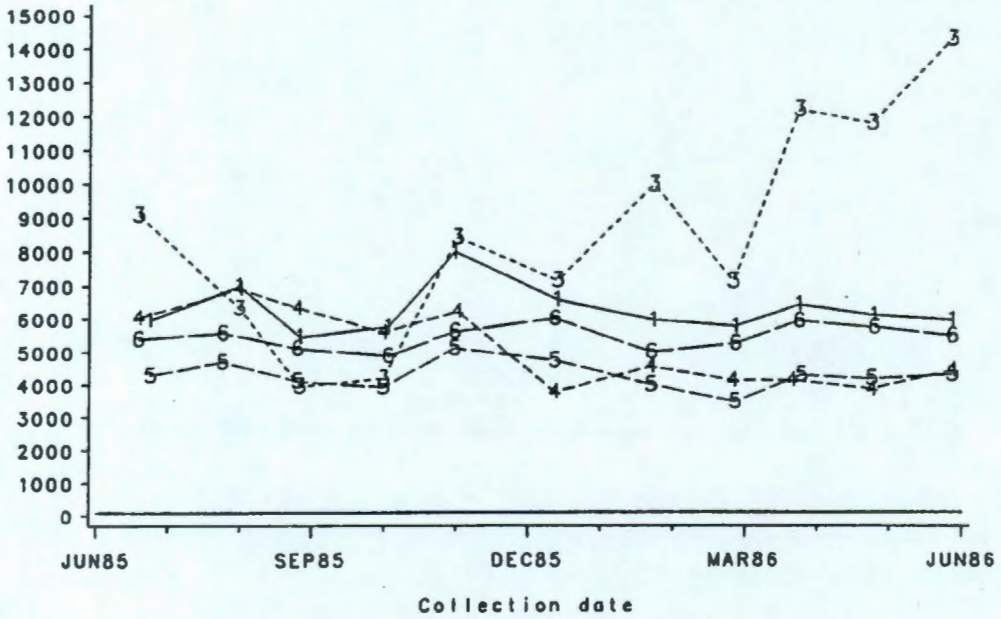

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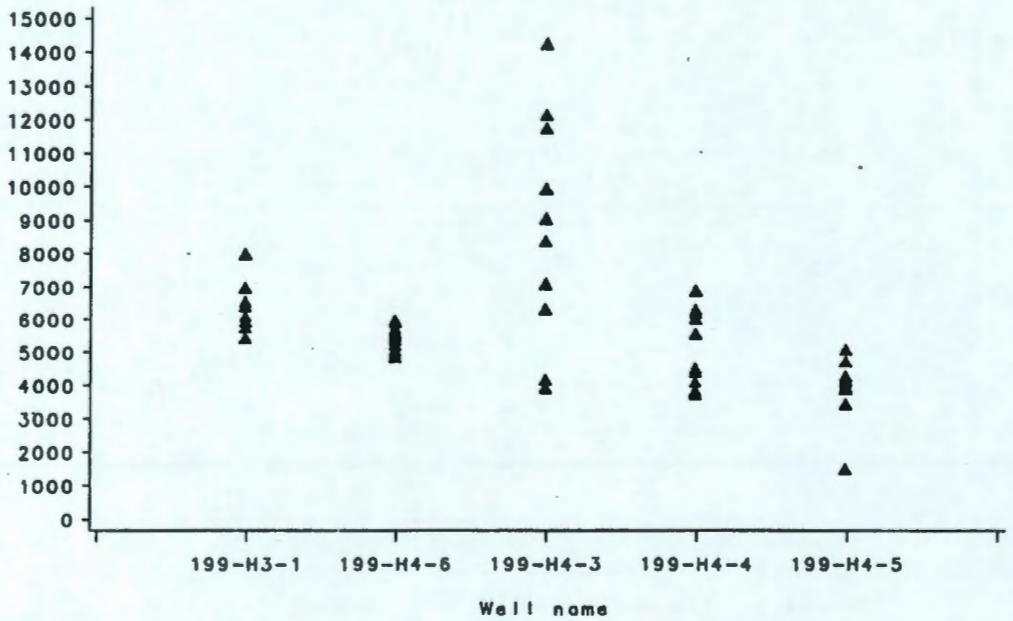

RCRA Compliance Groundwater Monitoring Project
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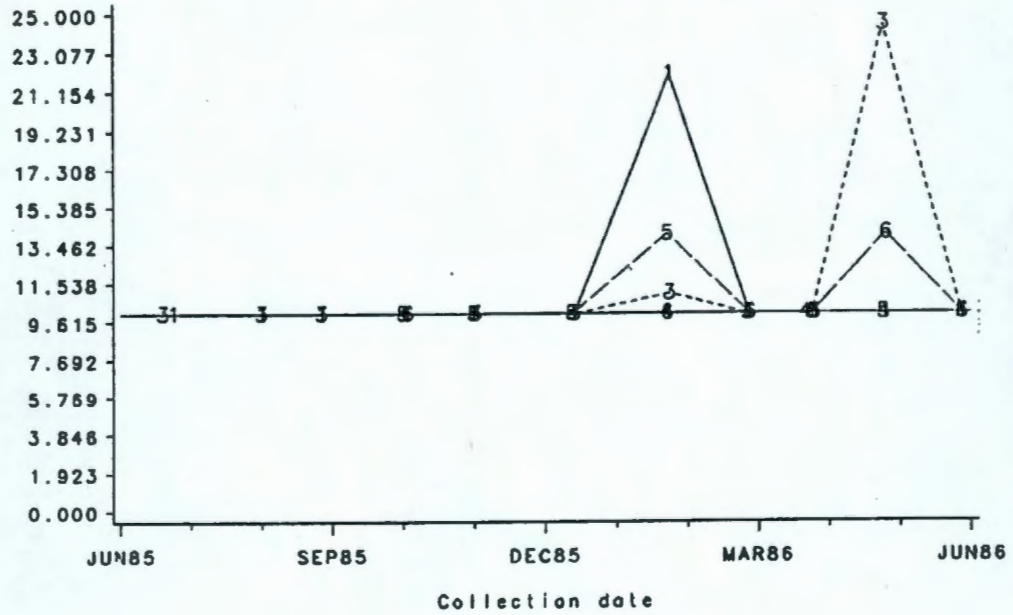

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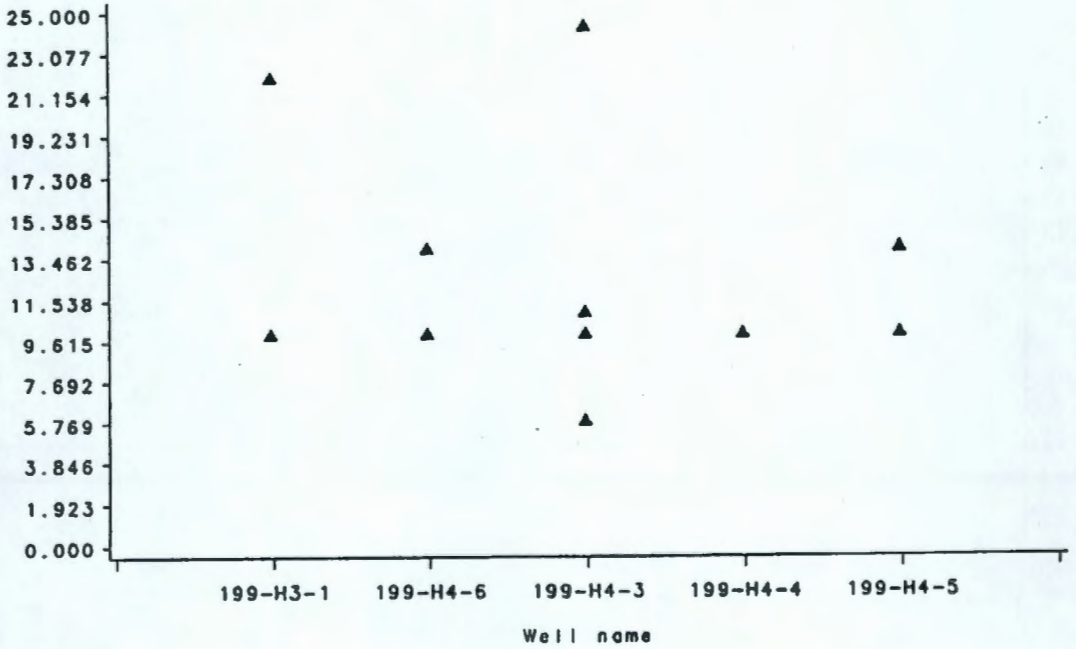

RCRA Compliance Groundwater Monitoring Project
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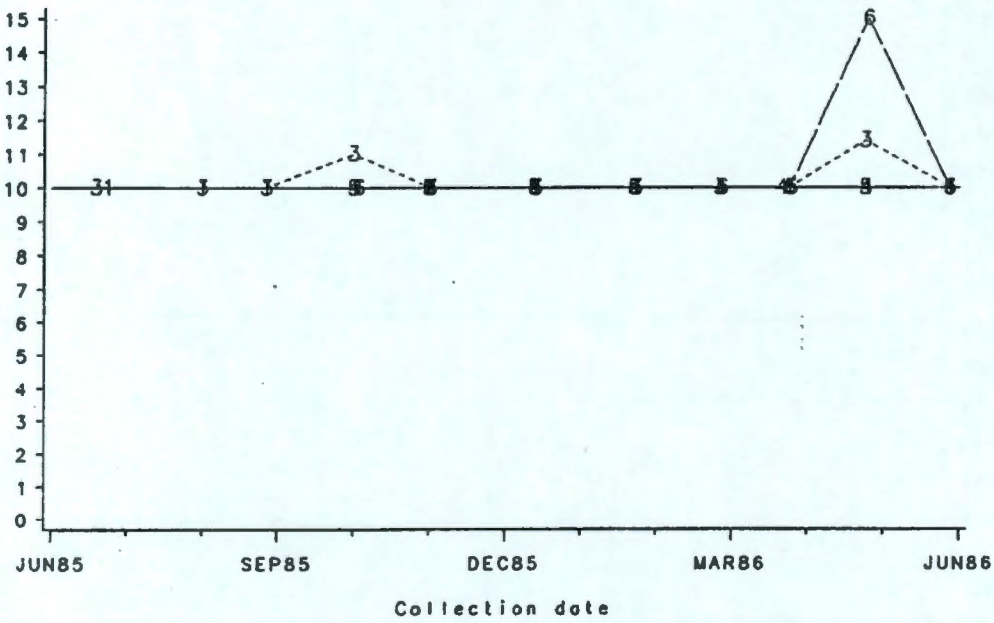

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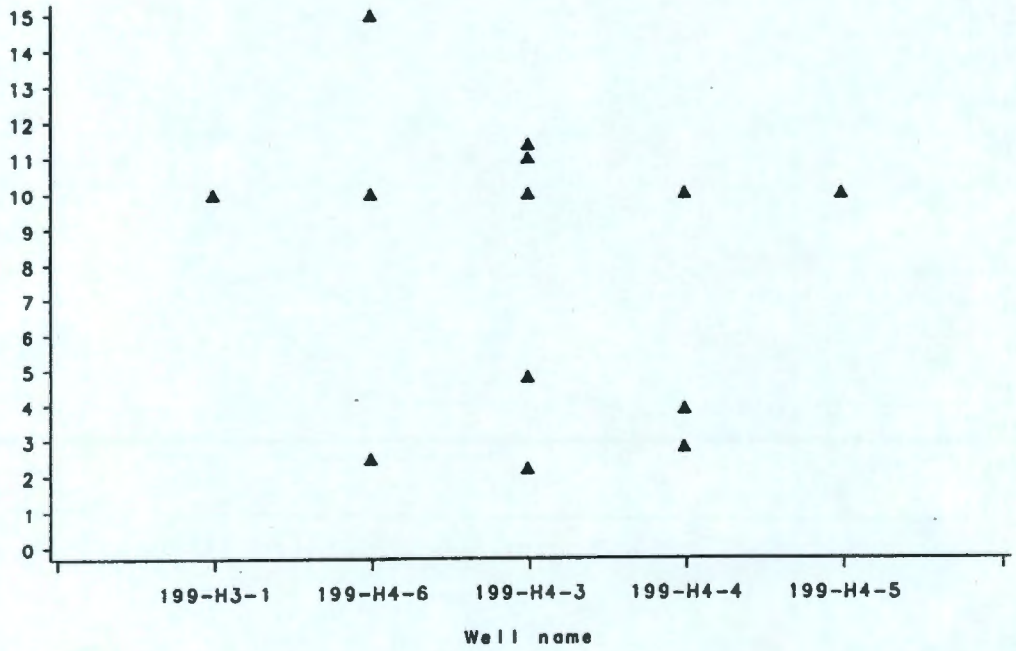

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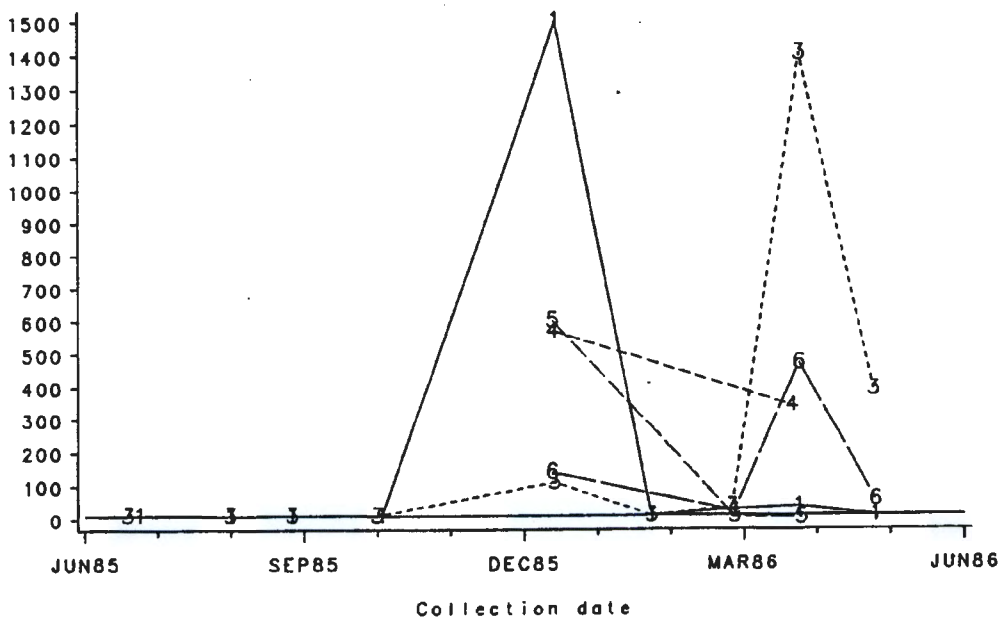

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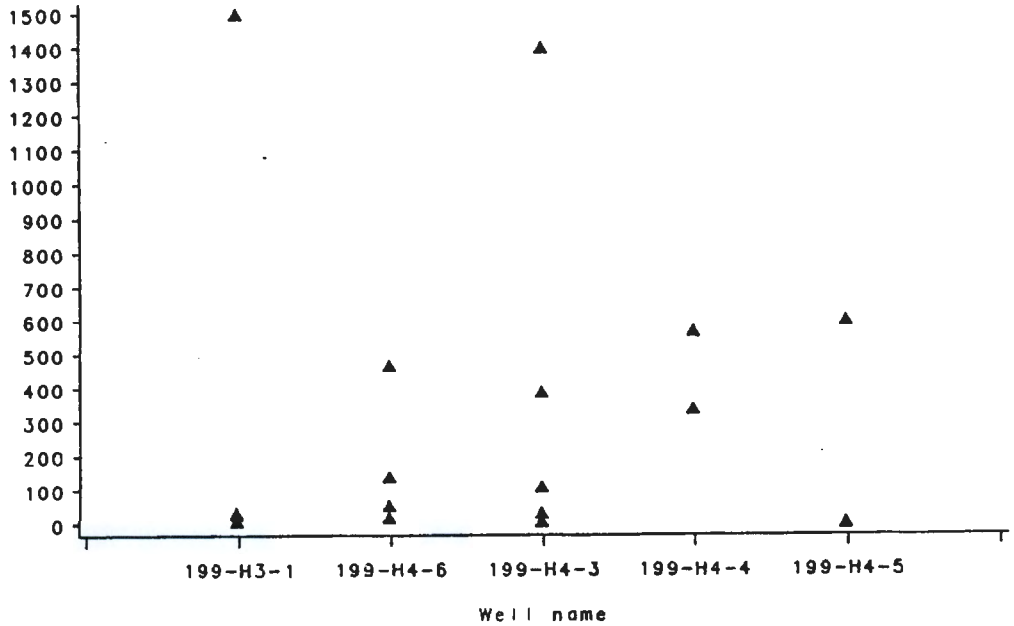

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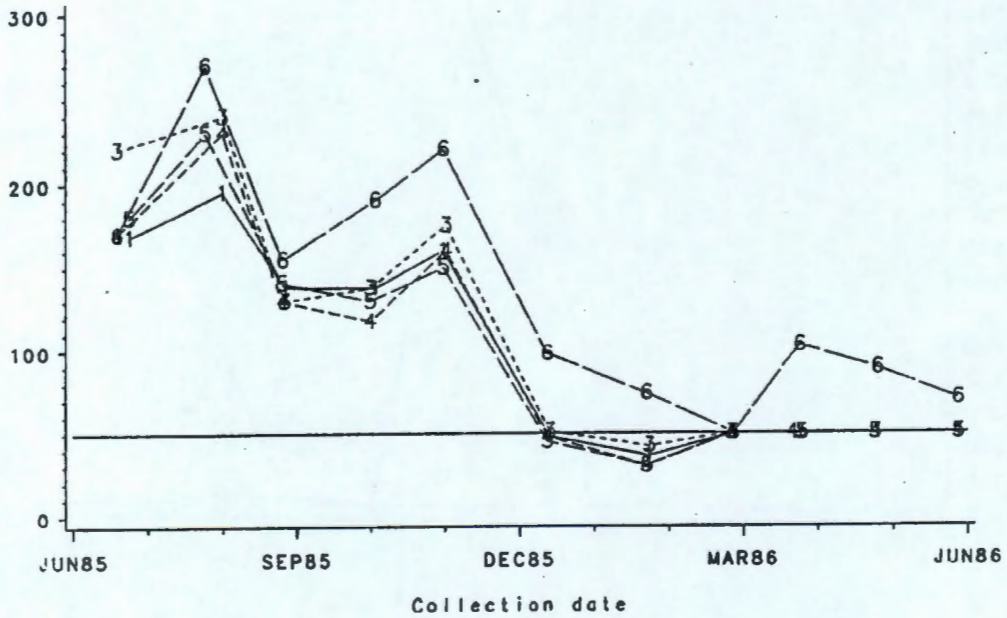

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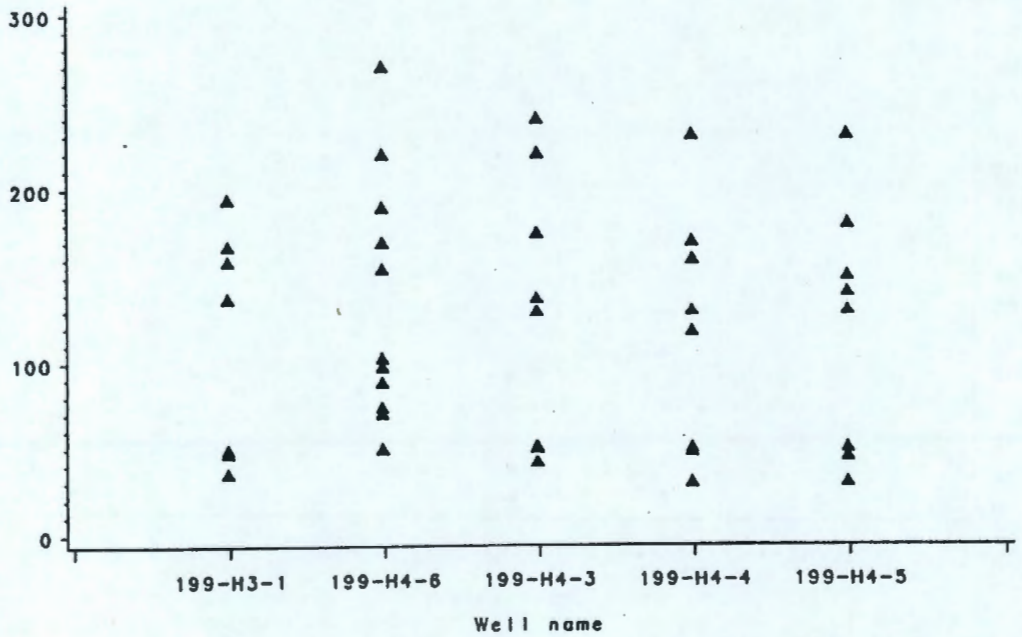

RCRA Compliance Groundwater Monitoring Project
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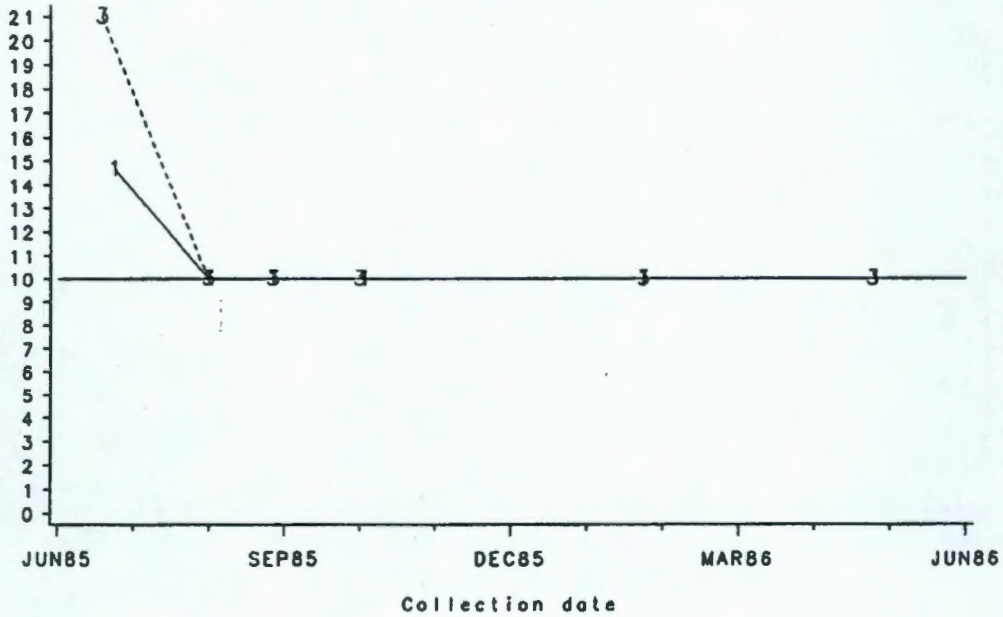

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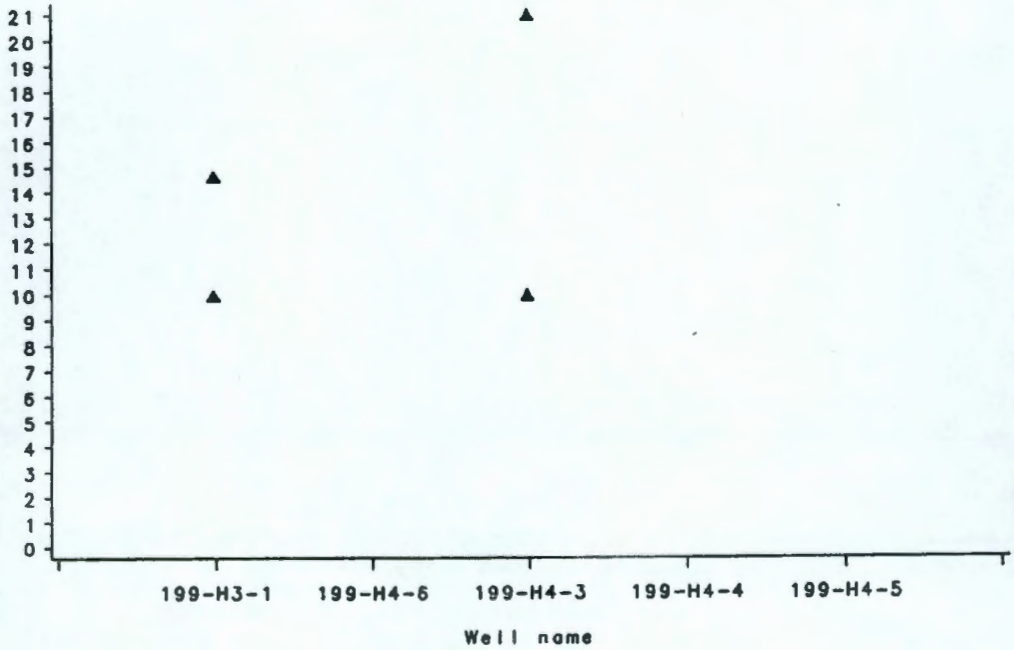

RCRA Compliance Groundwater Monitoring Project
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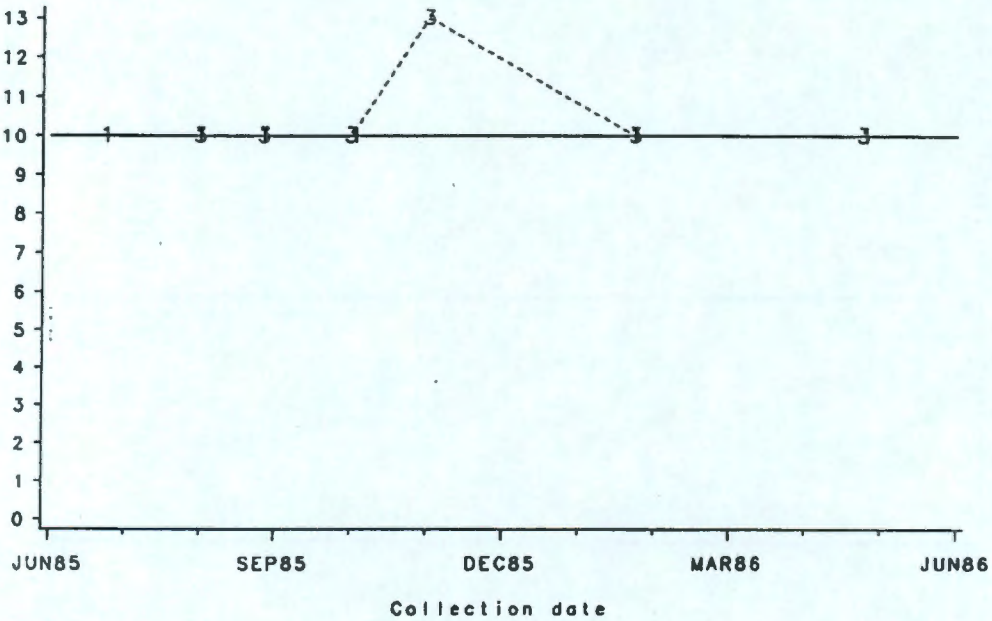

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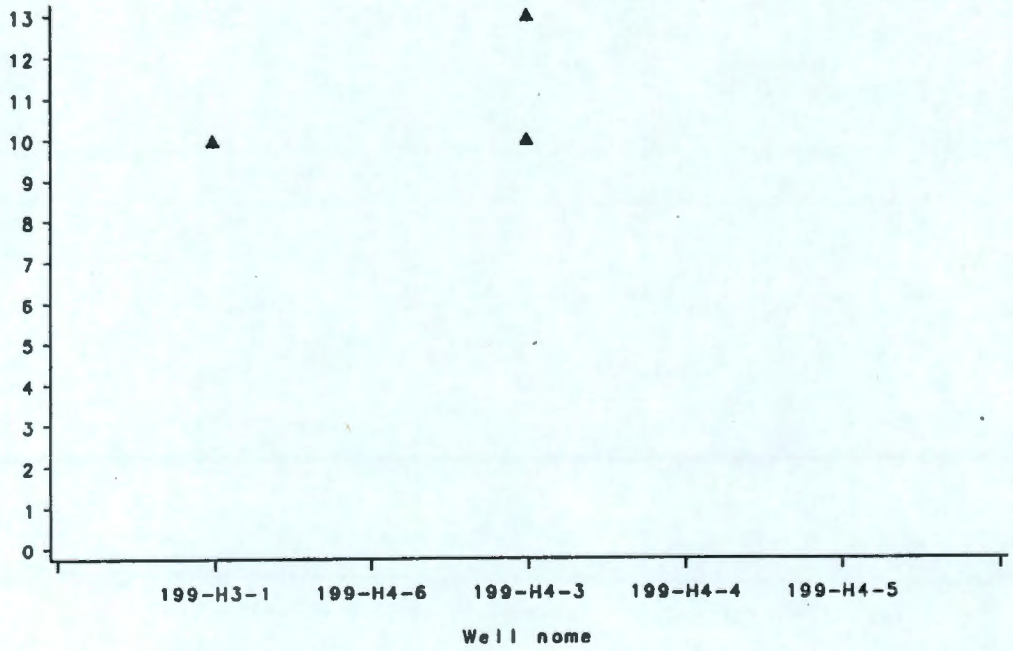

APPENDIX I

ADDITIONAL QUALITY CONTROL INFORMATION

APPENDIX I

ADDITIONAL QUALITY CONTROL INFORMATION

This appendix contains results of interlaboratory comparisons conducted with data from the RCRA Compliance Ground-Water Monitoring Project. These results are presented in three sections: results of comparison of anions (October 1985 through May 1986), metals (February through May 1986), and three selected volatile organic compounds (November/December 1985 through May 1986). Each section includes an introduction that names the laboratories involved in the comparison, describes the tables, and gives the regression formulas used to compare differences in analysis values determined by the laboratories.

This appendix also contains results of EPA's performance evaluation for Water Pollution Study Number WP016, the first such study in which UST participated. These results are presented in a copy of the evaluation form received from EPA.

ANALYSIS RESULTS FOR THE RCRA COMPLIANCE GROUND-WATER MONITORING PROJECT
ANALYSIS OF ANIONS BY WESTINGHOUSE HANFORD COMPANY (WHC), HANFORD ENVIRONMENTAL HEALTH FOUNDATION (HEHF), AND UNITED STATES TESTING COMPANY (UST)

The following tables show anion data from interlaboratory comparison from WHC, HEHF, and UST.

The comments column notes laboratory differences that may be significant. Differences greater than two standard deviations from the UST value, based on regression formulas from Environmenal Protection Agency (EPA) Performance Evaluation studies[a], are noted. Differences of 10% or greater are noted for concentrations that are outside the range of values to which the regression formulas apply. Other outlying values are also noted.

The number in parentheses in the comments column after the notation ">2s" is the magnitude of two standard deviations, according to the EPA regression formulas. This value is given to put relative differences into perspective. The "2s" criterion for significant differences may be slightly stringent because there is no "true value" involved. If one laboratory is on the high side of the "true concentration", and another is on the low side, the separation between two valid values could be ≅4s.

The comment "dilution" indicates the UST analysis was based on a dilution that was not optimal. A more appropriate dilution would bring the results closer to the values reported by the other laboratories. This problem has been addressed by the laboratory and in the future, optimum dilutions will be used to assess anion concentration.

Regression formulas are as follows:

Fluoride	$s = 0.0296T + 0.0184$	Range: 0.12 - 2.6 mg/ℓ
Chloride	$s = 0.0269T + 0.745$	Range: 14.6 - 235 mg/ℓ

(a) Personal communication from Paul W. Britton, Staff Statistician, Quality Assurance Branch, Environmental Monitoring and Support Laboraty (USEPA), Cincinnati, OH 45268, FTS 684-7325. Documents dated 10/84, received 3/30/86. "Estimation of Acceptance Limits for Drinking Water Laboratory Performance Evaluation" and "Estimation of Acceptance Limits for Water Pollution Laboratory Performance Evaluation."

Nitrate (as N)	s = 0.025T + 0.0209	Range:	0.15 - 9.1 mg/ℓ
(as Nitrate)			0.66 - 40.3 mg/ℓ
Phosphate	s = 0.0348T + 0.0046	Range:	0.018 - 3.69 mg/ℓ
Sulfate	s = 0.0469T + 0.774	Range:	6.31 - 98.3 mg/ℓ

Where T is the true concentration, in mg/ℓ.

In the tables, the following definitions apply:

WHC = Lab results from Westinghouse Hanford Company

HEHF = Lab results from Hanford Environmental Health Foundation

UST = Lab results from United States Testing Company.

TABLE I.1. Results of Anion Analysis (October 1985)

Well Code	Well Name	Fluoride (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	160	70	<500	All OK
1877	199-H4-3	220*	290	<500	
1878	199-H4-4	360	280	<500	
1890	199-H3-1	250	150	<500	
4402	399-2-1	430	430	<500	
4403	399-1-1	460	430	<500	
4407	399-1-4	440	420	<500	
4410	399-4-1	310	270	<500	
4802	699-S19-E13	300	250	<500	
0899	0899	<10	<100	<500	

* The amount of F by specific electrode is 0.22 ppm. An organic peak very close to F (superimposed) broadens the peak, so spike recovery appears very low.

Well Code	Well Name	Chloride (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	4,400	4,970	3,580	
1877	199-H4-3	5,100	4,510	5,160	
1878	199-H4-4	4,900	4,300	4,540	
1890	199-H3-1	8,900	7,700	7,760	
4402	399-2-1	13,600	13,300	11,700	
4403	399-1-1	10,200	7,800	8,320	
4407	399-1-4	5,500	5,100	4,880	
4410	399-4-1	8,900	7,850	7,790	
4802	699-S19-E13	17,900	18,500	14,800	>2s (1770 ppb)
0899	0899	10	<500	<500	

TABLE I.1. Results of Anion Analysis (October 1985) (cont)

Well Code	Well Name	Nitrate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	20,200	21,300	19,300	
1877	199-H4-3	890,000	1,960,000	1,040,000	
1878	199-H4-4	330,000	362,000	392,000	
1890	199-H3-1	67,000	83,800	72,500	
4402	399-2-1	23,400	25,900	22,300	
4403	399-1-1	22,600	23,100	21,500	
4407	399-1-4	25,400	28,500	25,300	
4410	399-4-1	10,600	12,200	9,420	>2s (655 ppb)
4802	699-S19-E13	17,600	22,500	16,100	>2s (990 ppb)
0899	0899	300	420	<500	

Well Code	Well Name	Phosphate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	<500	<500	<1,000	All OK
1877	199-H4-3	<500	<500	<1,000	
1878	199-H4-4	<500	<500	<1,000	
1890	199-H3-1	<500	<500	<1,000	
4402	399-2-1	<500	<650	<1,000	
4403	399-1-1	<500	<500	<1,000	
4407	399-1-4	<500	<500	<1,000	
4410	399-4-1	<500	<500	<1,000	
4802	699-S19-E13	<500	<500	<1,000	
0899	0899	<500	<500	<1,000	

TABLE I.1. Results of Anion Analysis (October 1985) (cont)

Well Code	Well Name	Sulfate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	39,000	37,500	43,900	
1877	199-H4-3	92,000	74,000	110,000	
1878	199-H4-4	65,000	62,000	83,900	>2s (9420 ppb)
1890	199-H3-1	70,000	67,000	86,200	>2s (9630 ppb)
4402	399-2-1	14,300	11,000	13,700	
4403	399-1-1	14,400	10,000	13,500	
4407	399-1-4	14,000	11,100	14,300	
4410	399-4-1	24,200	19,400	24,100	
4802	699-S19-E13	48,000	50,500	53,000	
0899	0899	<100	<400	<500	

TABLE I.2. Results of Anion Analysis (November/December 1985)

Well Code	Well Name	Fluoride (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	160	140	<500	All OK
1877	199-H4-3	70	360	<500	
1878	199-H4-4	180	160	<500	
1890	199-H3-1	260	230	<500	
4402	399-2-1	410	410	<500	
4403	399-1-1	450	440	<500	
4407	399-1-4	400	390	<500	
4410	399-4-1	320	320	<500	
4802	699-S19-E13	300	290	<500	
0899	0899	<2	<100	<500	

Well Code	Well Name	Chloride (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	4,200	4,100	3,550	All OK
1877	199-H4-3	5,000	6,800	5,490	
1878	199-H4-4	3,400	3,300	2,920	
1890	199-H3-1	9,800	8,600	8,360	
4402	399-2-1	14,800	15,000	15,100	
4403	399-1-1	6,700	6,500	5,950	
4407	399-1-4	17,000	17,200	15,200	
4410	399-4-1	8,400	7,800	7,580	
4802	699-S19-E13	16,600	15,400	15,000	
0899	0899	11	<500	<500	

TABLE I.2. Results of Anion Analysis (November/December 1985) (cont)

Well Code	Well Name	Nitrate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	20,000	22,000	19,600	
1877	199-H4-3	896,000	990,000	816,000	
1878	199-H4-4	23,200	25,000	23,300	
1890	199-H3-1	61,200	66,000	47,100	30% difference
4402	399-2-1	23,200	24,000	24,400	
4403	399-1-1	23,200	24,000	22,200	
4407	399-1-4	21,700	23,000	22,100	
4410	399-4-1	10,000	10,800	9,470	
4802	699-S19-E13	18,800	20,000	18,800	
0899	0899	<8	<200	<500	

Well Code	Well Name	Phosphate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	<500	<500	<1,000	All OK
1877	199-H4-3	---	<500	<1,000	
1878	199-H4-4	<500	<500	<1,000	
1890	199-H3-1	<500	<500	<1,000	
4402	399-2-1	600	520	<1,000	
4403	399-1-1	<500	<500	<1,000	
4407	399-1-4	<500	<500	<1,000	
4410	399-4-1	<500	<500	<1,000	
4802	699-S19-E13	<500	<500	<1,000	
0899	0899	<100	<500	<1,000	

TABLE I.2. Results of Anion Analysis (November/December 1985) (cont)

Well Code	Well Name	Sulfate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	37,200	37,000	37,300	
1877	199-H4-3	87,500	88,000	97,900	
1878	199-H4-4	30,600	31,000	28,900	
1890	199-H3-1	64,500	70,000	52,600	>2s (6480 ppb)
4402	399-2-1	14,200	14,500	15,800	
4403	399-1-1	13,800	14,100	13,200	
4407	399-1-4	14,000	14,300	14,400	
4410	399-4-1	23,800	24,000	23,600	
4802	699-S19-E13	91,500	47,000	48,100	WHC high
0899	0899	≅5	<1,000	<500	

TABLE I.3. Results of Anion Analysis (January 1986)

Well Code	Well Name	Fluoride (ppb) WHC	HEHF	UST	Comments
1874	199-H4-6	250	200	<500	All OK
1877	199-H4-3	180*	<500	1,330	
1878	199-H4-4	400	340	567	
1890	199-H3-1	280	210	531	
4402	399-2-1	330	290	<500	
4403	399-1-1	460	430	<500	
4407	399-1-4	410	390	<500	
4410	399-4-1	330	300	<500	
4802	699-S19-E13	310	260	521	
0899	0899	<2	<100	<500	

* F electrode/Organic interference

Well Code	Well Name	Chloride (ppb) WHC	HEHF	UST	Comments
1874	199-H4-6	7,200	6,800	6,930	All OK
1877	199-H4-3	5,700	6,800	6,990	
1878	199-H4-4	4,500	4,800	3,710	
1890	199-H3-1	9,500	9,500	9,090	
4402	399-2-1	25,000	24,900	22,200	
4403	399-1-1	11,100	10,500	11,000	
4407	399-1-4	11,300	12,100	10,700	
4410	399-4-1	9,500	9,000	7,840	
4802	699-S19-E13	17,100	15,600	14,900	
0899	0899	<5	<50	<500	

TABLE I.3. Results of Anion Analysis (January 1986) (cont)

Well Code	Well Name	Nitrate (ppb) WHC	HEHF	UST	Comments
1874	199-H4-6	26,000	27,400	27,100	
1877	199-H4-3	1,430,000	1,400,000	2,830,000	high (dilution)
1878	199-H4-4	235,000	248,000	225,000	
1890	199-H3-1	61,000	63,100	52,400	18% lower
4402	399-2-1	27,000	28,200	25,700	
4403	399-1-1	25,000	25,700	24,200	
4407	399-1-4	24,000	25,400	23,100	
4410	399-4-1	11,000	11,500	8,700	>2s (620 ppb)
4802	699-S19-E13	18,700	19,400	18,700	
0899	0899	<10	<200	<215	

Well Code	Well Name	Phosphate (ppb) WHC	HEHF	UST	Comments
1874	199-H4-6	<200	<500	<1,000	All OK
1877	199-H4-3	<200	<500	<1,000	
1878	199-H4-4	<200	<500	<1,000	
1890	199-H3-1	<200	<500	<1,000	
4402	399-2-1	680	540	<1,000	
4403	399-1-1	<200	<500	<1,000	
4407	399-1-4	<200	<500	<1,000	
4410	399-4-1	<200	<500	<1,000	
4802	699-S19-E13	<200	<500	<1,000	
0899	0899	<50	<500	<1,000	

TABLE I.3. Results of Anion Analysis (January 1986) (cont)

Well Code	Well Name	Sulfate (ppb) WHC	HEHF	UST	Comments
1874	199-H4-6	59,000	60,000	50,200	>2s (6260 ppb)
1877	199-H4-3	160,000	124,000	122,000	
1878	199-H4-4	60,000	62,000	60,200	
1890	199-H3-1	73,000	74,000	58,700	>2s
4402	399-2-1	13,400	16,400	15,300	
4403	399-1-1	13,500	14,600	14,100	
4407	399-1-4	13,300	14,200	12,100	
4410	399-4-1	25,000	26,300	20,700	>2s (3490 ppb)
4802	699-S19-E13	46,000	48,000	45,000	
0899	0899	<10	<1,000	<500	

TABLE I.4. Results of Anion Analysis (February 1986)

Well Code	Well Name	Fluoride (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	165	<100	<500	All OK
1877	199-H4-3	---*	≅300	1,510	
1878	199-H4-4	374	---	695	
1890	199-H3-1	260	190	702	
4402	399-2-1	310	260	<500	
4403	399-1-1	411	410	<500	
4407	399-1-4	423	420	<500	
4410	399-4-1	296	250	582	
4802	699-S19-E13	285	240	500	
0899	0899	<10	<100	<500	

* F electrode/Large interfering organic anion peak

Well Code	Well Name	Chloride (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	4,100	9,400	<4,240	HEHF high
1877	199-H4-3	5,390	5,800	6,620	
1878	199-H4-4	4,520	---	4,520	
1890	199-H3-1	9,570	9,400	8,880	
4402	399-2-1	24,300	25,000	23,400	
4403	399-1-1	10,400	10,800	7,140	46% low
4407	399-1-4	7,360	10,200	7,280	HEHF high
4410	399-4-1	10,100	11,200	10,400	
4802	699-S19-E13	16,100	16,300	15,200	
0899	0899	<20	<500	<500	

TABLE I.4. Results of Anion Analysis (February 1986) (cont)

Well Code	Well Name	Nitrate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	21,000	22,000	21,600	
1877	199-H4-3	1,180,000	1,570,000	1,000,000	18% difference
1878	199-H4-4	233,000	---	259,000	10% difference
1890	199-H3-1	60,000	65,000	71,600	
4402	399-2-1	32,400	36,000	32,600	
4403	399-1-1	20,900	23,000	19,000	>2s (1680 ppb)
4407	399-1-4	24,700	30,000	22,700	>2s (1320 ppb)
4410	399-4-1	11,400	12,100	11,900	
4802	699-S19-E13	17,900	19,400	17,800	
0899	0899	1,680	1,460	<500	high for blank

Well Code	Well Name	Phosphate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	<500	<500	<1,000	All OK
1877	199-H4-3	<500	<500	<1,000	
1878	199-H4-4	<500	---	<1,000	
1890	199-H3-1	<500	<500	<1,000	
4402	399-2-1	370	<500	<1,000	
4403	399-1-1	<500	<500	<1,000	
4407	399-1-4	<500	<500	<1,000	
4410	399-4-1	<500	<500	<1,000	
4802	699-S19-E13	<500	<500	<1,000	
0899	0899	<200	<500	<1,000	

TABLE I.4. Results of Anion Analysis (February 1986) (cont)

Well Code	Well Name	Sulfate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	37,000	37,000	39,400	All OK
1877	199-H4-3	100,000	104,000	113,000	
1878	199-H4-4	54,200	---	59,700	
1890	199-H3-1	70,700	73,000	76,300	
4402	399-2-1	36,400	37,000	35,600	
4403	399-1-1	13,400	14,300	11,800	
4407	399-1-4	13,600	14,300	12,700	
4410	399-4-1	25,800	27,000	26,800	
4802	699-S19-E13	46,400	44,000	46,300	
0899	0899	<50	<1,000	<500	

TABLE I.5. Results of Anion Analysis (March 1986)

Well Code	Well Name	Fluoride (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	180	<100	<500	All OK
1874	199-H4-6	260	110	507	
1877	199-H4-3	200*	1,200	1,960	
1878	199-H4-4	390	300	658	
1890	199-H3-1	280	130	652	
4402	399-2-1	360	290	<500	
4403	399-1-1	430	400	513	
4407	399-1-4	460	490	522	
4410	399-4-1	300	270	513	
4802	699-S19-E13	310	210	593	
0899	0899	<5	<100	<500	

* F electrode/IC masked by organic anion.

Well Code	Well Name	Chloride (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	4,040	5,100	4,270	All OK
1874	199-H4-6	9,300	10,000	8,980	
1877	199-H4-3	6,040	7,600	8,730	
1878	199-H4-4	4,480	6,000	4,760	
1890	199-H3-1	9,600	9,500	9,460	
4402	399-2-1	25,400	31,100	28,700	
4403	399-1-1	9,580	12,700	9,820	
4407	399-1-4	7,170	9,500	7,450	
4410	399-4-1	10,100	10,000	10,800	
4802	699-S19-E13	16,100	16,500	16,500	
0899	0899	<10	<500	<500	

TABLE I.5. Results of Anion Analysis (March 1986) (cont)

Well Code	Well Name	Nitrate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	21,200	22,000	22,300	
1874	199-H4-6	26,000	31,500	31,100	
1877	199-H4-3	1,650,000	1,690,000	1,940,000	13 % different
1878	199-H4-4	164,000	175,000	200,000	13 % different
1890	199-H3-1	63,000	64,000	74,200	14 % different
4402	399-2-1	25,100	27,000	29,300	>2s (1640 ppb)
4403	399-1-1	23,400	26,000	25,800	
4407	399-1-4	22,100	23,000	23,900	
4410	399-4-1	11,400	12,700	13,000	
4802	699-S19-E13	18,600	19,000	20,600	>2s (1220 ppb)
0899	0899	690	610	<500	

Well Code	Well Name	Phosphate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	<500	<500	<1,000	All OK
1874	199-H4-6	<500	<500	<1,000	
1877	199-H4-3	<300	<500	<1,000	
1878	199-H4-4	<500	<500	<1,000	
1890	199-H3-1	<500	<500	<1,000	
4402	399-2-1	<400	<500	<1,000	
4403	399-1-1	<500	<500	<1,000	
4407	399-1-4	<500	<500	<1,000	
4410	399-4-1	<500	<500	<1,000	
4802	699-S19-E13	<500	<500	<1,000	
0899	0899	<500	<500	<1,000	

TABLE I.5. Results of Anion Analysis (March 1986) (cont)

Well Code	Well Name	Sulfate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	37,900	36,000	39,500	
1874	199-H4-6	59,800	74,000	76,500	WHC low
1877	199-H4-3	136,000	145,000	153,000	
1878	199-H4-4	48,900	52,000	60,800	>2s (7250 ppb)
1890	199-H3-1	72,200	71,000	82,600	>2s (9300 ppb)
4402	399-2-1	22,800	24,000	26,800	
4403	399-1-1	14,200	14,900	15,300	
4407	399-1-4	14,600	15,500	15,300	
4410	399-4-1	26,200	27,000	29,900	
4802	699-S19-E13	47,700	46,000	53,000	
0899	0899	<50	<1,000	<500	

TABLE I.6. Results of Anion Analysis (April 1986)

Well Code	Well Name	Fluoride (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	170	<100	<500	
1877	199-H4-3	*	<100	<500	
1878	199-H4-4	170	<100	<500	
1890	199-H3-1	250	190	<500	
4402	399-2-1	380	320	<500	
4403	399-1-1	410	370	<500	
4407	399-1-4	520	490	677	>2s (77 ppb)
4410	399-4-1	310	260	<500	
4802	699-S19-E13	320	230	<500	
0899	0899	<5	<100	<500	

* F electrode/Large interfering organic anion peak

Well Code	Well Name	Chloride (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	4,040	3,800	3,930	
1877	199-H4-3	5,950	6,600	9,870	>2s (2020 ppb)
1878	199-H4-4	3,190	3,400	3,490	
1890	199-H3-1	9,910	9,000	9,040	
4402	399-2-1	19,500	16,500	19,000	
4403	399-1-1	11,000	11,600	10,500	
4407	399-1-4	7,740	7,200	8,410	
4410	399-4-1	9,720	9,000	9,520	
4802	699-S19-E13	15,900	14,400	17,000	
0899	0899	<7	<500		

TABLE I.6. Results of Anion Analysis (April 1986) (cont)

Well Code	Well Name	Nitrate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	20,600	22,000	22,400	
1877	199-H4-3	1,590,000	1,830,000	1,590,000	12%
1878	199-H4-4	37,800	43,000	38,700	
1890	199-H3-1	60,500	63,000	54,100	
4402	399-2-1	23,200	23,000	24,600	
4403	399-1-1	21,800	24,000	23,900	
4407	399-1-4	25,500	27,000	26,200	
4410	399-4-1	11,200	11,600	10,400	>2s (710 ppb)
4802	699-S19-E13			20,100	
0899	0899	<30	<200	<500	

Well Code	Well Name	Phosphate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	<500	<500	<1,000	All OK
1877	199-H4-3	<500	<500	<1,000	
1878	199-H4-4	<500	---	<1,000	
1890	199-H3-1	<500	<500	<1,000	
4402	399-2-1	<500	<500	<1,000	
4403	399-1-1	<500	<500	<1,000	
4407	399-1-4	<500	<500	<1,000	
4410	399-4-1	<500	<500	<1,000	
4802	699-S19-E13	<500	<500	<1,000	
0899	0899	<200	<500	<1,000	

TABLE I.6. Results of Anion Analysis (April 1986) (cont)

Well Code	Well Name	Sulfate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	38,400	37,000	38,000	
1877	199-H4-3	129,000	136,000	328,000	>2s
1878	199-H4-4	32,800	34,000	33,100	
1890	199-H3-1	69,500	70,000	65,800	
4402	399-2-1	17,200	16,300	18,500	
4403	399-1-1	15,600	15,700	17,200	
4407	399-1-4	17,500	17,400	18,400	
4410	399-4-1	26,100	26,000	27,500	
4802	699-S19-E13	23,900	47,000	53,600	
0899	0899	<30		<500	

TABLE I.7. Results of Anion Analysis (May 1986)

Well Code	Well Name	Fluoride (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	170	<100	<500	All OK
1877	199-H4-3	*	<100	<500	
1878	199-H4-4	220	110	<500	
1890	199-H3-1	300	230	<500	
4402	399-2-1	380	370	<500	
4403	399-1-1	420	390	<500	
4407	399-1-4	520	540	<500	
4410	399-4-1	300	310	<500	
4802	699-S19-E13	310	280	<500	
0899	0899	<4	<100	<500	

* Interference of F

Well Code	Well Name	Chloride (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	4,230	4,100	4,160	
1877	199-H4-3	6,330	8,600	8,960	
1878	199-H4-4	4,330	4,900	4,440	
1890	199-H3-1	8,530	8,500	8,700	
4402	399-2-1	18,500	19,600	18,000	
4403	399-1-1	12,700	13,000	14,300	
4407	399-1-4	7,260	7,500	7,890	
4410	399-4-1	11,300	11,200	11,600	
4802	699-S19-E13	16,500	18,200	16,600	
0899	0899	6	<500	<500	

TABLE I.7. Results of Anion Analysis (May 1986) (cont)

Well Code	Well Name	Nitrate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	25,300	25,000	26,000	
1877	199-H4-3	2,080,000	2,080,000	2,890,000	28% higher
1878	1-H4-4	135,000	143,000	125,000	
1890	199-H3-1	54,400	52,000	52,900	
4402	399-2-1	29,300	30,000	29,800	
4403	399-1-1	24,000	24,000	24,900	
4407	399-1-4	23,000	23,000	23,700	
4410	399-4-1	12,400	12,600	12,300	
4802	699-S19-E13	18,800	20,000	19,600	
0899	0899	<30		<500	

Well Code	Well Name	Phosphate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	<300	<500	<1,000	All OK
1877	199-H4-3	<600	<500	<1,000	
1878	199-H4-4	<300	<500	<1,000	
1890	199-H3-1	<300	<500	<1,000	
4402	399-2-1	370	<500	<1,000	
4403	399-1-1	<300	<500	<1,000	
4407	399-1-4	<300	<500	<1,000	
4410	399-4-1	<300	<500	<1,000	
4802	699-S19-E13	<300	<500	<1,000	
0899	0899	<200	<500	<1,000	

TABLE I.7. Results of Anion Analysis (May 1986) (cont)

Well Code	Well Name	Sulfate (ppb) WHC	HEHF	UST	Comments
1873	199-H4-5	42,400	44,000	42,500	UST OK
1877	199-H4-3	158,000	190,000	222,000	
1878	199-H4-4	23,600	47,000	47,400	WHC low
1890	199-H3-1	58,500	61,000	58,300	
4402	399-2-1	19,300	20,000	19,500	
4403	399-1-1	17,600	27,000	17,700	HEHF high
4407	399-1-4	18,000	18,000	18,100	
4410	399-4-1	27,600	28,000	28,600	
4802	699-S19-E13	48,500	46,500	47,700	
0899	0899	49	<1,000	<500	

ANALYSIS RESULTS FOR THE RCRA COMPLIANCE GROUND-WATER MONITORING PROJECT METALS ANALYSIS BY UST AND HEHF

Results of analyses of metals in ground-water samples are compared, based on EPA Performance Evaluations. Values that differ by more than two standard deviations (using the EPA regression formulas) are noted in the comments column. For values outside the range in which the regression formulas apply, a percentage difference is given.

Regression formulas are as follows:

Barium	s = 0.0679 T + 10.7	Range: 56 - 981 ppb
Cadmium	s = 0.0660 T + 0.315	Range: 1.3 - 325 ppb
Chromium	s = 0.0938 T + 0.795	Range: 5.1 - 1130 ppb
Copper	s = 0.0449 T + 1.71	Range: 5.2 - 892 ppb
Lead	s = 0.0724 T + 1.16	Range: 11.7 - 1570 ppb
Sodium	s = 0.0516 T + 0.102	Range: 1.1 - 68.5 ppm

Where T is the true concentration of the constituent.

Note that the range for sodium is in units of ppm, where those for the other metals are in ppb.

The results of analyses for barium have been inconsistent between the laboratories. Analyses of spiked QC samples from both laboratories have been acceptable, indicating that matrix interference is causing the discrepancies. The analysis method used by UST, ICP (EPA method 6010), is thought to be less likely to run into difficulty with interferences than AA spectroscopy, the analysis method used by HEHF. It is suspected that matrix interference could be causing the result reported by HEHF to be high.

(a) Personal communication from Paul W. Britton, Staff Statistician, Quality Assurance Branch, Environmental Monitoring and Support Laboratory (USEPA), Cincinnati, OH 47268, FTS 684-7325. Documents dated 10/84, received 3/30/86. "Estimation of Acceptance Limits for Drinking Water Laboratory Performance Evaluation" and "Estimation of Acceptance Limits for Water Pollution Laboratory Performance Evaluation."

TABLE I.8. Results of Metals Analysis (February 1986)

Well Code	Well Name	Barium (ppb) HEHF	Barium (ppb) UST	Comments
1873	199-H4-5	190	41	At 100 ppb, 2s = 35.8 ppb
1874	199-H4-6	290	37	ALL analyses, except
1877	199-H4-3	340	97	<detection limit,
1878	199-H4-4	140	41	differ by more than
1890	199-H3-1	320	51	this amount[a].
4402	399-2-1	160	63	
4568	399-4-7	170	36	
4806	399-1-5	100	22	
4837	399-1-6	<100	18	
0899	0899Q	<100	<6	

(a) Analyses by UST are assumed to be accurate.

Well Code	Well Name	Cadmium (ppb) HEHF	Cadmium (ppb) UST	Comments
1873	199-H4-5	<0.5	<2	All OK
1874	199-H4-6	<0.5	<2	
1877	199-H4-3	<0.5	<2	
1878	199-H4-4	<0.5	<2	
1890	199-H3-1	<0.5	<2	
4402	399-2-1	<0.5	<2	
4568	399-4-7	<0.5	<2	
4806	399-1-5	<0.5	<2	
4837	399-1-6	<0.5	<2	
0899	0899Q	<0.5	<2	

TABLE I.8. Results of Metals Analysis (February 1986) (cont)

Well Code	Well Name	Chromium (ppb) HEHF	Chromium (ppb) UST	Comments
1873	199-H4-5	530	492	All OK
1874	199-H4-6	39	40	
1877	199-H4-3	820	733	
1878	199-H4-4	610	571	
1890	199-H3-1	50	62	
4402	399-2-1	<5	<10	
4568	399-4-7	<5	<10	
4806	399-1-5	<5	<10	
4837	399-1-6	<5	<10	
0899	0899Q	<5	<10	

Well Code	Well Name	Copper (ppb) HEHF	Copper (ppb) UST	Comments
1873	199-H4-5	<50	<10	All OK
1874	199-H4-6	<50	<10	
1877	199-H4-3	60	53	
1878	199-H4-4	<50	<10	
1890	199-H3-1	<50	<10	
4402	399-2-1	<50	<13	
4568	399-4-7	<50	<10	
4806	399-1-5	100	107	
4837	399-1-6	100	98	
0899	0899Q	<50	<10	

TABLE I.8. Results of Metals Analysis (February 1986) (cont)

Well Code	Well Name	Lead (ppb) HEHF	Lead (ppb) UST	Comments
1873	199-H4-5	14	<5	2s (based on HEHF) = 4.3 ppb
1874	199-H4-6	<5	<5	
1877	199-H4-3	<5	<5	
1878	199-H4-4	<5	<5	
1890	199-H3-1	<5	<5	
4402	399-2-1	<5	<5	
4568	399-4-7	<5	<5	
4806	399-1-5	<5	<5	
4837	399-1-6	<5	<5	
0899	0899Q	<5	<5	

Well Code	Well Name	Sodium (ppm) HEHF	Sodium (ppm) UST	Comments
1873	199-H4-5	9,300	8,630	
1874	199-H4-6	20,600	22,300	
1877	199-H4-3	470,000	355,000	>30% difference
1878	199-H4-4	190,000	115,000	>40%
1890	199-H3-1	28,300	21,000	>2s (2370 ppb)
4402	399-2-1	17,700	14,700	>2s (1720 ppb)
4568	399-4-7	19,800	17,200	>2s (1980 ppb)
4806	399-1-5	19,800	19,700	
4837	399-1-6	7,800	7,400	
0899	0899Q	250	218	

TABLE I.9. Results of Metals Analysis (March 1986)

Well Code	Well Name	Barium (ppb) HEHF	Barium (ppb) UST	Comments
1873	199-H4-5	210	42	
1874	199-H4-6	260	40	
1877	199-H4-3	650	181	
1878	199-H4-4	130	32	
1890	199-H3-1	300	50	
4402	399-2-1	160	58	
4568	399-4-7	120	34	
4806	399-1-5	<100	19	
4837	399-1-6	120	19	
0899	0899Q	<100	<6	All >2s[a]

(a) Analyses by UST are assumed to be accurate.

Well Code	Well Name	Cadmium (ppb) HEHF	Cadmium (ppb) UST	Comments
1873	199-H4-5	<0.5	<2	All OK
1874	199-H4-6	<0.5	<2	
1877	199-H4-3	<0.5	<2	
1878	199-H4-4	<0.5	<2	
1890	199-H3-1	<0.5	<2	
4402	399-2-1	<0.5	<2	
4568	399-4-7	<0.5	<2	
4806	399-1-5	<0.5	<2	
4837	399-1-6	<0.5	<2	
0899	0899Q	<0.5	<2	

TABLE I.9. Results of Metals Analysis (March 1986) (cont)

Well Code	Well Name	Chromium (ppb) HEHF	Chromium (ppb) UST	Comments
1873	199-H4-5	525	469	All OK
1874	199-H4-6	50	41	
1877	199-H4-3	995	860	
1878	199-H4-4	383	361	
1890	199-H3-1	68	62	
4402	399-2-1	<5	<10	
4568	399-4-7	<5	<10	
4806	399-1-5	<5	<10	
4837	399-1-6	7	<10	
0899	0899Q	<5	<10	

Well Code	Well Name	Lead (ppb) HEHF	Lead (ppb) UST	Comments
1873	199-H4-5	<5	<5	All OK
1874	199-H4-6	<5	<5	
1877	199-H4-3	<5	<5	
1878	199-H4-4	<5	<5	
1890	199-H3-1	<5	<5	
4402	399-2-1	<5	<5	
4568	399-4-7	<5	<5	
4806	399-1-5	<5	<5	
4837	399-1-6	<5	<5	
0899	0899Q	<5	<5	

TABLE I.9. Results of Metals Analysis (March 1986) (cont)

Well Code	Well Name	Sodium (ppm) HEHF	Sodium (ppm) UST	Comments
1873	199-H4-5	8,600	8,730	All OK
1874	199-H4-6	21,000	22,500	
1877	199-H4-3	520,000	568,000	
1878	199-H4-4	103,000	101,000	
1890	199-H3-1	21,000	20,800	
4402	399-2-1	13,100	13,700	
4568	399-4-7	16,000	15,800	
4806	399-1-5	16,100	16,100	
4837	399-1-6	7,200	8,020	
0899	0899Q	<500	476	

TABLE I.10. Results of Metals Analysis (April 1986)

Well Code	Well Name	Barium (ppb) HEHF	Barium (ppb) UST	Comments
1873	199-H4-5	210	43	
1874	199-H4-6	280	40	
1877	199-H4-3	580	170	
1878	199-H4-4	150	31	
1890	199-H3-1	370	46	
4402	399-2-1	160	49	
4568	399-4-7	180	33	
4806	399-1-5	110	17	
4837	399-1-6	110	18	
0899	0899Q	<100	<6	All >2s[a]

(a) Analyses by UST are assumed to be accurate.

Well Code	Well Name	Cadmium (ppb) HEHF	Cadmium (ppb) UST	Comments
1873	199-H4-5	<0.5	<2	All OK
1874	199-H4-6	<0.5	<2	
1877	199-H4-3	<0.5	<2	
1878	199-H4-4	<0.5	<2	
1890	199-H3-1	<0.5	<2	
4402	399-2-1	<0.5	<2	
4568	399-4-7	<0.5	<2	
4806	399-1-5	<0.5	<2	
4837	399-1-6	<0.5	<2	
0899	0899Q	<0.5	<2	

TABLE I.10. Results of Metals Analysis (April 1986) (cont)

Well Code	Well Name	Chromium (ppb) HEHF	Chromium (ppb) UST	Comments
1873	199-H4-5	460	465	All OK
1874	199-H4-6	49	49	
1877	199-H4-3	840	832	
1878	199-H4-4	126	115	
1890	199-H3-1	51	47	
4402	399-2-1	<5	<10	
4568	399-4-7	<5	<10	
4806	399-1-5	<5	<10	
4837	399-1-6	<5	<10	
0899	0899Q	<5	<10	

Well Code	Well Name	Copper (ppb) HEHF	Copper (ppb) UST	Comments
1873	199-H4-5	<50	<10	All OK
1874	199-H4-6	<50	<10	
1877	199-H4-3	<50	48	
1878	199-H4-4	<50	<10	
1890	199-H3-1	<50	<10	
4402	399-2-1	<50	13	
4568	399-4-7	<50	<10	
4806	399-1-5	<50	15	
4837	399-1-6	<50	23	
0899	0899Q	<50	<10	

TABLE I.10. Results of Metals Analysis (April 1986) (cont)

Well Code	Well Name	Lead (ppb) HEHF	Lead (ppb) UST	Comments
1873	199-H4-5	<5	<5	All OK
1874	199-H4-6	<5	<5	
1877	199-H4-3	<5	<5	
1878	199-H4-4	<5	<5	
1890	199-H3-1	<5	<5	
4402	399-2-1	<5	<5	
4568	399-4-7	<5	<5	
4806	399-1-5	<5	<5	
4837	399-1-6	<5	<5	
0899	0899Q	<50	<10	

Well Code	Well Name	Sodium (ppm) HEHF	Sodium (ppm) UST	Comments
1873	199-H4-5	8,300	8,550	All OK
1874	199-H4-6	20,700	20,700	
1877	199-H4-3	500,000	542,000	
1878	199-H4-4	19,900	20,900	
1890	199-H3-1	20,900	19,500	
4402	399-2-1	11,700	13,100	
4568	399-4-7	15,600	15,900	
4806	399-1-5	12,500	13,200	
4837	399-1-6	7,900	8,400	
0899	0899Q	<500	237	

TABLE I.11. Results of Metals Analysis (May 1986)

Well Code	Well Name	Barium (ppb) HEHF	Barium (ppb) UST	Comments
1873	199-H4-5	220	48	
1874	199-H4-6	220	39	
1877	199-H4-3	820	248	
1878	199-H4-4	210	48	
1890	199-H3-1	230	44	
4402	399-2-1	140	52	
4568	399-4-7	150	36	
4806	399-1-5	110	21	
4837	399-1-6	140	18	
0899	0899Q	<100	<6	All >2s[a]

(a) Analyses by UST are assumed to be accurate.

Well Code	Well Name	Cadmium (ppb) HEHF	Cadmium (ppb) UST	Comments
1873	199-H4-5	<5	<2	
1874	199-H4-6	<5	<2	
1877	199-H4-3	<5	<2	
1878	199-H4-4	<5	<2	
1890	199-H3-1	<5	<2	
4402	399-2-1	<5	<2	
4568	399-4-7	<5	<2	
4806	399-1-5	<5	<2	
4837	399-1-6	<5	<2	
0899	0899Q	28	49	>2s (7.1 ppb)

TABLE I.11. Results of Metals Analysis (May 1986) (cont)

Well Code	Well Name	Chromium (ppb) HEHF	Chromium (ppb) UST	Comments
1873	199-H4-5	421	452	All OK
1874	199-H4-6	43	44	
1877	199-H4-3	980	916	
1878	199-H4-4	299	291	
1890	199-H3-1	40	40	
4402	399-2-1	<5	<10	
4568	399-4-7	<5	<10	
4806	399-1-5	<5	<10	
4837	399-1-6	<5	<10	
0899	0899Q	<5	<10	

Well Code	Well Name	Copper (ppb) HEHF	Copper (ppb) UST	Comments
1873	199-H4-5	<50	<10	All OK
1874	199-H4-6	<50	<10	
1877	199-H4-3	<50	46	
1878	199-H4-4	<50	<10	
1890	199-H3-1	<50	<10	
4402	399-2-1	<50	<10	
4568	399-4-7	<50	<10	
4806	399-1-5	<50	26	
4837	399-1-6	<50	19	
0899	0899Q	<50	<10	

TABLE I.11. Results of Metals Analysis (May 1986) (cont)

Well Code	Well Name	Lead (ppb) HEHF	Lead (ppb) UST	Comments
1873	199-H4-5	<5	5	All OK
1874	199-H4-6	<5	<5	
1877	199-H4-3	<5	<5	
1878	199-H4-4	<5	<5	
1890	199-H3-1	<5	<5	
4402	399-2-1	<5	<5	
4568	399-4-7	<5	<5	
4806	399-1-5	<5	<5	
4837	399-1-6	<5	<5	
0899	0899Q	<5	<5	

Well Code	Well Name	Sodium (ppm) HEHF	Sodium (ppm) UST	Comments
1873	199-H4-5	10,000	9,300	
1874	199-H4-6	21,300	20,000	
1877	199-H4-3	560,000	638,000	12% difference
1878	199-H4-4	46,000	48,000	
1890	199-H3-1	19,000	19,200	
4402	399-2-1	15,300	15,000	
4568	399-4-7	17,500	17,500	
4806	399-1-5	11,600	11,600	
4837	399-1-6	8,700	8,230	
0899	0899Q	<500	271	

ANALYSIS RESULTS FOR THE RCRA COMPLIANCE GROUND-WATER MONITORING PROJECT ANALYSIS OF VOLATILE ORGANIC COMPOUNDS BY PNL AND UST

Analyses of three volatile organic compounds in ground-water samples were performed by PNL and UST. These results are compared based on EPA Performance Evaluations[a]. Values that differ by more than two standard deviations using the EPA regression formulas are noted in the comments column.

Regression formulas are as follows:

1,1,1-Trichloroethane	$s = 0.130T + 0.337$	Range: 1.6 to 49.7 ppb
Chloroform	$s = 0.102T + 0.198$	Range: 5.9 to 102 ppb
Perchloroethylene	$s = 0.127T + 0.326$	Range: 6.0 to 92 ppb

Where T is the true concentration of the constituent (in ppb). Since T is not known, the value from UST is used to estimate the magnitude of s, the standard deviation.

(a) Personal communication from Paul W. Britton, Staff Statistician, Quality Assurance Branch, Environmental Monitoring and Support Laboratory (USEPA), Cincinnati, OH 45268, FTS 684-7325. Documents dated 10/84, received 3/30/86. "Estimation of Acceptance Limits for Drinking Water Laboratory Performance Evaluation" and "Estimation of Acceptance Limits for Water Pollution Laboratory Performance Evalution."

TABLE I.12. Organic Analyses from PNL and UST Labs (November/December 1985)

Well Code	Well Name	1,1,1-Trichloroethane PNL	1,1,1-Trichloroethane UST	Comments
1873	199-H4-5	0.28	<10	
1874	199-H4-6	2.26 ± 0.08	<10	
1877	199-H4-3	0.49	<10	
1878	199-H4-4	0.51	<10	
1890	199-H3-1	0.84	<10	
4400	399-T-1	0.87	<10	
4402	399-2-1	1.29	<10	
4403	399-1-1	1.21	<10	
4404	399-1-2	0.84	<10	
4406	399-1-3	----	<10	
4407	399-1-4	0.57	<10	
4408	399-8-2	17.87 ± 0.34	<10	>2s (3.0 ppb)
4410	399-4-1	0.87	<10	
4802	699-S19-E13	0.70	<10	
4804	699-S30-E15A	2.74 ± 0.12	<10	
4806	399-1-5	0.55	<10	
4837	399-1-6	0.63	<10	
4839	399-3-7	----	<10	
4896	399-T-2	0.38	<10	
0899	0899(B)	0.09	<10	

TABLE I.12. Organic Analyses from PNL and UST Labs (November/December 1985) (cont)

Well Code	Well Name	Chloroform (ppb) PNL	Chloroform (ppb) UST	Comments
1873	199-H4-5	33.06	24	>2s (5.3 ppb)
1874	199-H4-6	32.65 ± 0.97	19	>2s (4.3 ppb)
1877	199-H4-3	35.88	26	>2s (5.7 ppb)
1878	199-H4-4	8.68	----	
1890	199-H3-1	6.92	----	
4400	399-T-1	16.42	12	>2s (2.8 ppb)
4402	399-2-1	15.11	----	
4403	399-1-1	18.38	13	>2s (3.0 ppb)
4404	399-1-2	17.41	12	>2s (2.8 ppb)
4406	399-1-3	----	12	
4407	399-1-4	13.62	11	
4408	399-8-2	1.07 ± 0.13	----	
4410	399-4-1	9.83	----	
4802	699-S19-E13	0.09	----	
4804	699-S30-E15A	3.59 ± 0.20	----	
4806	399-1-5	12.92	11	
4837	399-1-6	13.39	----	
4896	399-T-2	9.27	----	
0899	0899(B)	7.79	----	

TABLE I.12. Organic Analyses from PNL and UST Labs (November/December 1985) (cont)

Well Code	Well Name	Perchloroethylene PNL	Perchloroethylene UST	Comments
1873	199-H4-5	0.75	<10	
1874	199-H4-6	10.96 ± 0.04	<10	
1877	199-H4-3	3.36	<10	
1878	199-H4-4	3.06	<10	
1890	199-H3-1	3.33	<10	
4400	399-T-1	8.58	<10	
4402	399-2-1	6.14	<10	
4403	399-1-1	4.14	<10	
4404	399-1-2	6.18	<10	
4406	399-1-3	----	<10	
4407	399-1-4	6.27	<10	
4408	399-8-2	13.65 ± 0.19	<10	
4410	399-4-1	7.67	<10	
4802	699-S19-E13	2.59	<10	
4804	699-S30-E15A	2.77 ± 0.05	<10	
4806	399-1-5	4.96	<10	
4837	399-1-6	4.12	<10	
4839	399-3-7	----	<10	
4896	399-T-2	3.91	<10	
0899	0899(B)	0.06	<10	

TABLE I.13. Organic Analyses from PNL and UST (January 1986)

Well Code	Well Name	1,1,1-Trichloroethane PNL	1,1,1-Trichloroethane UST	Comments
1873	199-H4-5	0.06 ± 0.02	14	>2s (4.3 ppb)
1877	199-H4-3	1.12	11	>2s (3.5 ppb)
1878	199-H4-4	1.41 ± 0.06	<10	
1890	199-H3-1	0.35	22	>2s (6.4 ppb)
4400	399-T-1	0.42	<10	
4402	399-2-1	0.78	<10	
4403	399-1-1	0.51	<10	
4404	399-1-2	0.54	<10	
4407	399-1-4	0.63	<10	
4408	399-8-2	10.62*	<10	
4410**	399-4-1	0.79	<10	
4802	699-S19-E13	0.68	<10	
4804	699-S30-E15A	0.17	<10	
4806	399-1-5	0.38	<10	
4837	399-1-6	0.42 ± 0.02	<10	
4896	399-T-2	0.15	<10	
0899	0899(B)	0.05,0.07[a]	<10	

* Slight shift of 1,1,1-TCE retention time in 4408. Impurities could be present.

** In most samples higher concentrations of trichloroethene than 1,1,1-TCE is observed but in 4410 much higher concentrations of trichloroethene are present.

TABLE I.13. Organic Analyses from PNL and UST Labs (January 1986) (cont)

Well Code	Well Name	Chloroform (ppb) PNL	Chloroform (ppb) UST	Comments
1873	199-H4-5	28.39 ± 1.46	27	All OK
1877	199-H4-3	28.66	31	
1878	199-H4-4	25.82 ± 0.02	22	
1890	199-H3-1	5.87	<10	
4400	399-T-1	11.92	12	
4402	399-2-1	10.43	----	
4403	399-1-1	12.51	11	
4404	399-1-2	9.6	12	
4407	399-1-4	10.59	11	
4408	399-8-2	0.68	----	
4410	399-4-1	6.17	----	
4802	699-S19-E13	2.26	<10	
4804	699-S30-E15A	3.01	----	
4806	399-1-5	10.90	14	
4837	399-1-6	9.90 ± 0.25	----	
4896	399-T-2	4.86	----	
0899	0899(B)	8.55,7.55[a]	11	

TABLE I.13. Organic Analyses from PNL and UST Labs (January 1986) (cont)

Well Code	Well Name	Perchloroethylene PNL	Perchloroethylene UST	Comments
1873	199-H4-5	0.03 ± 0.0	<10	All OK
1877	199-H4-3	4.81	<10	
1878	199-H4-4	5.26 ± 0.19	<10	
1890	199-H3-1	1.74	<10	
4400	399-T-1	7.66	<10	
4402	399-2-1	4.32	<10	
4403	399-1-1	3.25	<10	
4404	399-1-2	4.17	<10	
4407	399-1-4	4.55	<10	
4408	399-8-2	6.64	<10	
4410	399-4-1	6.14	<10	
4802	699-S19-E13	3.11	<10	
4804	699-S30-E15A	0.26	<10	
4806	399-1-5	1.94	<10	
4837	399-1-6	2.27 ± 0.11	<10	
4896	399-T-2	1.77	<10	
0899	0899(B)	0.03	<10	

TABLE I.14. Organic Analyses from PNL and UST Labs (February 1986)

Well Code	Well Name	1,1,1-Trichloroethane PNL	1,1,1-Trichloroethane UST	Comments
1873	199-H4-5	0.02	<10	All OK
1874	199-H4-6	0.42 ± 0.01	<10	
1877	199-H4-3	0.81 ± 0.02	<10	
1878	199-H4-4	0.82	<10	
1890	199-H3-1	0.73	<10	
4400	399-T-1	1.26	<10	
4402	399-2-1	0.59	<10	
4403	399-1-1	1.60	<10	
4404	399-1-2	1.34	<10	
4406	399-1-3	1.06	<10	
4407	399-1-4	1.33	<10	
4408	399-8-2	<9.5 (≅2.5)*	<10	
4410	399-4-1	----	<10	
4802	699-S19-E13	<0.72 (≅0.2)*	<10	
4804	699-S30-E15A	0.20	<10	
4806	399-1-5	1.10 ± 0.27	<10	
4837	399-1-6	1.38	<10	
4839	399-3-7	0.17	<10	
4896	399-T-2	0.65	<10	
0899	0899(B)	0.30	<10	

TABLE I.14. Organic Analyses from PNL and UST Labs (February 1986) (cont)

Well Code	Well Name	Chloroform (ppb) PNL	Chloroform (ppb) UST	Comments
1873	199-H4-5	24.54	25	All OK
1874	199-H4-6	15.91 ± 0.01	17	
1877	199-H4-3	25.96 ± 0.58	29	
1878	199-H4-4	18.61	22	
1890	199-H3-1	5.47	<4.6	
4400	399-T-1	10.31	11	
4402	399-2-1	8.13	<7.8	
4403	399-1-1	11.03	11	
4404	399-1-2	11.25	11	
4406	399-1-3	11.54	12	
4407	399-1-4	10.42	10	
4408	399-8-2	0.85		
4410	399-4-1	----		
4802	699-S19-E13	0.31		
4804	699-S30-E15A	2.97		
4806	399-1-5	10.64 ± 0.22	10	
4837	399-1-6	10.78	10	
4839	399-3-7	3.45		
4896	399-T-2	6.70	6.8	
0899	0899(B)	1.01		

TABLE I.14. Organic Analyses from PNL and UST Labs (February 1986) (cont)

Well Code	Well Name	Perchloroethylene PNL	Perchloroethylene UST	Comments
1873	199-H4-5	0.03	<10	All OK
1874	199-H4-6	2.33 ± 0.05	<2.5	
1877	199-H4-3	3.00 ± 0.12	<2.2	
1878	199-H4-4	3.08	<3.9	
1890	199-H3-1	0.66	<10	
4400	399-T-1	2.96	<3.7	
4402	399-2-1	2.29	<10	
4403	399-1-1	1.98	<10	
4404	399-1-2	2.22	<3	
4406	399-1-3	4.08	<4.1	
4407	399-1-4	2.74	<4	
4408	399-8-2	3.98	<3.1	
4410	399-4-1	----	<10	
4802	699-S19-E13	2.40	<10	
4804	699-S30-E15A	0.26	<10	
4806	399-1-5	2.32 ± 0.07	<2.6	
4837	399-1-6	2.18	<3	
4839	399-3-7	0.81	<10	
4896	399-T-2	1.31	<10	
0899	0899(B)	0.13	<10	

* Values in parenthesis (1,1,1-TCE) are estimated concentration of carbon tetrachloride. 1,1,1,-TCE and CCl_4 are poorly resolved and when CCl_4 is present in samples, determination of 1,1,1- TCE is difficult.

TABLE I.15. Organic Analyses from PNL and UST Labs (March 1986)

Well Code	Well Name	1,1,1-Trichloroethane PNL	1,1,1-Trichloroethane UST	Comments
1873	199-H4-5	0.02	<10	All OK
1874	199-H4-6	0.47 ± 0.01	<10	
1877	199-H4-3	7.50 ± 0.27	<5.9	
1878	199-H4-4	1.12	<10	
1890	199-H3-1	0.85	<10	
4400	399-T-1	---- ***	<10	
4402	399-2-1	0.84 *	<10	
4403	399-1-1	1.06	<10	
4404	399-1-2	0.89	<10	
4406	399-1-3	0.84	<10	
4407	399-1-4	0.83 ± 0.03	<10	
4408	399-8-2	<7.89 (≅2.0)**	<10	
4410	399-4-1	<0.39 (≅0.2) *,**	<10	
4802	699-S19-E13	<0.58 (≅0.2)**	<10	
4804	699-S30-E15A	0.15	<10	
4806	399-1-5	0.86	<10	
4837	399-1-6	0.57	<10	
4839	399-3-7	0.32	<10	
4896	399-T-2	---- ***	<10	
0899	0899(B)	0.24	<10	

TABLE I.15. Organic Analyses from PNL and UST Labs (March 1986) (cont)

Well Code	Well Name	Chloroform (ppb) PNL	Chloroform (ppb) UST	Comments
1873	199-H4-5	22.24	27	All OK
1874	199-H4-6	13.56 ± 0.02	14	
1877	199-H4-3	23.65 ± 1.67	23	
1878	199-H4-4	15.07	16	
1890	199-H3-1	3.33	<2.9	
4400	399-T-1	---- ***	<9	
4402	399-2-1	8.19	<7.9	
4403	399-1-1	9.54	<9.1	
4404	399-1-2	9.12	<9.6	
4406	399-1-3	9.41	10	
4407	399-1-4	10.17 ± 0.17	11	
4408	399-8-2	0.73	----	
4410	399-4-1	6.26	<6.2	
4802	699-S19-E13	0.91	----	
4804	699-S30-E15A	2.34	----	
4806	399-1-5	10.94	12	
4837	399-1-6	7.43	<7.3	
4839	399-3-7	4.35	<4.1	
4896	399-T-2	---- ***	<4.3	
0899	0899(B)	0.76	----	

TABLE I.15. Organic Analyses from PNL and UST Labs (March 1986) (cont)

Well Code	Well Name	Perchloroethylene PNL	Perchloroethylene UST	Comments
1873	199-H4-5	0.02	<10	All OK
1874	199-H4-6	2.23 ± 0.05	<10	
1877	199-H4-3	5.45 ± 0.23	<4.8	
1878	199-H4-4	3.31	<2.8	
1890	199-H3-1	0.82	<10	
4400	399-T-1	---- ***	<2.3	
4402	399-2-1	2.34	<10	
4403	399-1-1	2.07	<10	
4404	399-1-2	2.48	<2.3	
4406	399-1-3	3.42	<2.8	
4407	399-1-4	2.57 ± 0.08	<2	
4408	399-8-2	4.25	<4.4	
4410	399-4-1	2.13	<2	
4802	699-S19-E13	1.71	<10	
4804	699-S30-E15A	0.25	<10	
4806	399-1-5	1.95	<10	
4837	399-1-6	1.86	<10	
4839	399-3-7	1.26	<10	
4896	399-T-2	---- ***	<10	
0899	0899(B)	0.12	<10	

* Sample 4402 has ≅5 ppb and 4410 has ≅7 ppb trichloroethylene.
** Carbon tetrachloride (estimated concentration given in parenthesis) causes poor analysis of 1,1,1-TCE.
*** Samples 4400 and 4896 broken before arrival at PNL laboratory.

TABLE I.16. Organic Analyses from PNL and UST Labs (April 1986)

Well Code	Well Name	1,1,1-Trichloroethane PNL	1,1,1-Trichloroethane UST	Comments
1873	199-H4-5	14.81 ± 0.90	<10	All OK
1874	199-H4-6	16.32*	14	
1877	199-H4-3	18.52 ± 0.32	24.4	
1878	199-H4-4	0.92	<10	
1890	199-H3-1	2.92	<10	
4400	399-T-1	1.03	<10	
4402	399-2-1	0.46	<10	
4403	399-1-1	0.75	<10	
4404	399-1-2	1.32	<10	
4406	399-1-3	1.17	<10	
4407	399-1-4	1.25 ± 0.00	<10	
4408	399-8-2	<6.61 (≅2.0)**	<10	
4410	399-4-1	---- **	<10	
4802	699-S19-E13	0.46	<10	
4804	699-S30-E15A	---- **	<10	
4806	399-1-5	0.44	<10	
4837	399-1-6	0.47	<10	
4839	399-3-7	0.54	<10	
4896	399-T-2	---- **	<10	
0899	0899(B)	0.13	<10	

TABLE I.16. Organic Analyses from PNL and UST Labs (April 1986) (cont)

Well Code	Well Name	Chloroform (ppb) PNL	Chloroform (ppb) UST	Comments
1873	199-H4-5	26.39 ± 1.82	27	
1874	199-H4-6	18.22*	15	
1877	199-H4-3	12.70 ± 0.64	27.1	>2s (5.9 ppb)
1878	199-H4-4	6.92	----	
1890	199-H3-1	3.62	<10	
4400	399-T-1	8.95	<9.2	
4402	399-2-1	9.12	<8.9	
4403	399-1-1	9.52	<8.9	
4404	399-1-2	11.60	12	
4406	399-1-3	9.94	11	
4407	399-1-4	11.41 ± 0.17	11	
4408	399-8-2	0.72	----	
4410	399-4-1	---- **	<8	
4802	699-S19-E13	0.07	<10	
4804	699-S30-E15A	---- **	----	
4806	399-1-5	11.74	12	
4837	399-1-6	11.49	12	
4839	399-3-7	7.62	<8.3	
4896	399-T-2	---- **	<7.2	
0899	0899(B)	0.36	<10	

* Observed broken cap, possible poor seal on 1874.
** 4410, 4804, and 4896 broken before arrival to PNL laboratory.

TABLE I.16. Organic Analyses from PNL and UST Labs (April 1986) (cont)

Well Code	Well Name	Perchloroethylene PNL	Perchloroethylene UST	Comments
1873	199-H4-5	9.66 ± 0.42	<10	All OK
1874	199-H4-6	14.94 *	15	
1877	199-H4-3	12.32 ± 0.15	11.4	
1878	199-H4-4	2.98	<10	
1890	199-H3-1	1.61	<10	
4400	399-T-1	1.80	<10	
4402	399-2-1	1.75	<10	
4403	399-1-1	1.89	<10	
4404	399-1-2	2.73	<10	
4406	399-1-3	3.03	<3.5	
4407	399-1-4	3.36 ± 0.11	<10	
4408	399-8-2	4.26	<4.6	
4410	399-4-1	---- **	<10	
4802	699-S19-E13	2.47	<10	
4804	699-S30-E15A	---- **	<10	
4806	399-1-5	1.71	<10	
4837	399-1-6	1.74	<10	
4839	399-3-7	1.58	<10	
4896	399-T-2	---- **	<10	
0899	0899(B)	0.07	<10	

* Observed broken cap, possible poor seal on 1874.
** 4410, 4804, and 4896 broken before arrival to PNL laboratory.

TABLE I.17. Organic Analyses from PNL and UST Labs (May 1986)

Well Code	Well Name	1,1,1-Trichloroethane PNL	1,1,1-Trichloroethane UST	Comments
1873	199-H4-5	0.27 ± 0.01	<10	All OK
1874	199-H4-6	0.24	<10	
1877	199-H4-3	0.56	<10	
1878	199-H4-4	0.41	<10	
1890	199-H3-1	5.80 ± 0.14	<10	
4400	399-1-7	3.24	<10	
4402	399-2-1	1.14	<10	
4403	399-1-1	2.21	<10	
4404	399-1-2	2.82	<10	
4406	399-1-3	3.55	<10	
4407	399-1-4	2.24	<10	
4408	399-8-2	<3.0 *	<10	
4410	399-4-1	≅0.2 *	<10	
4802	699-S19-E13	0.49	<10	
4804	699-S30-E15A	0.27	<10	
4806	399-1-5	9.23	<10	
4837	399-1-6	1.69 ± 0.20	<10	
4839	399-3-7	0.54	<10	
4896	399-1-8	7.80	<10	
0899	0899	0.09	<10	

* 1,1,1 TCE results are approximate because carbon tetrachloride is present in these well locations.

TABLE I.17. Organic Analyses from PNL and UST Labs (May 1986) (cont)

Well Code	Well Name	Chloroform (ppb) PNL	Chloroform (ppb) UST	Comments
1873	199-H4-5	20.97 ± 0.82	29	>2s (6.3 ppb)
1874	199-H4-6	11.18	14	
1877	199-H4-3	18.13	32	>2s (6.9 ppb)
1878	199-H4-4	11.65	14	
1890	199-H3-1	7.75 ± 0.19	----	
4400	399-1-7	12.47	12	
4402	399-2-1	6.9	----	
4403	399-1-1	10.74	11	
4404	399-1-2	12.74	13	
4406	399-1-3	14.48	13	
4407	399-1-4	14.51	13	
4408	399-8-2	0.97	----	
4410	399-4-1	8.46	----	
4802	699-S19-E13	0.30	----	
4804	699-S30-E15A	2.38	----	
4806	399-1-5	17.97	17	
4837	399-1-6	14.14 ± 0.45	13	
4839	399-3-7	6.45	----	
4896	399-1-8	6.95	----	
0899	0899	0.32	----	

TABLE I.17. Organic Analyses from PNL and UST Labs (May 1986) (cont)

Well Code	Well Name	Perchloroethylene PNL	Perchloroethylene UST	Comments
1873	199-H4-5	1.27	<10	All OK
1874	199-H4-6	1.46	<10	
1877	199-H4-3	2.29	<10	
1878	199-H4-4	2.01	<10	
1890	199-H3-1	2.15 ± 0.06	<10	
4400	399-1-7	3.27	<10	
4402	399-2-1	2.57	<10	
4403	399-1-1	2.71	<10	
4404	399-1-2	3.12	<10	
4406	399-1-3	3.85	<10	
4407	399-1-4	3.61	<10	
4408	399-8-2	4.14	<10	
4410	399-4-1	2.74	<10	
4802	699-S19-E13	3.22	<10	
4804	699-S30-E15A	1.15	<10	
4806	399-1-5	2.56	<10	
4837	399-1-6	2.59	<10	
4839	399-3-7	2.61	<10	
4896	399-1-8	2.00	<10	
0899	0899	0.82	<10	

TABLE I.18. Organic Analyses from PNL and UST Labs (June 1986)

Well Code	Well Name	1,1,1-Trichloroethane PNL	1,1,1-Trichloroethane UST	Comments
1873	199-H4-5	0.78 ± 0.04	<10	All OK
1874	199-H4-6	1.76	<10	
1877	199-H4-3	1.10	<10	
1878	199-H4-4	0.56	<10	
1890	199-H3-1	3.27 ± 0.10	<10	
4400	399-1-7	1.22	<10	
4402	399-2-1	1.90	<10	
4403	399-1-1	1.36	<10	
4404	399-1-2	1.36	<10	
4406	399-1-3	1.07	<10	
4407	399-1-4	1.21	<10	
4408	399-8-2	<3 *	<10	
4410	399-4-1	<1	<10	
4802	699-S19-E13	0.75	<10	
4804	699-S30-E15A	0.99	<10	
4806	399-1-5	0.88	<10	
4837	399-1-6	0.98	<10	
4839	399-3-7	1.34	<10	
4896	399-1-8	0.54 ± 0.03	<10	
0899	0899Q	0.08	<10	

TABLE I.18. Organic Analyses from PNL and UST Labs (June 1986) (cont)

Well Code	Well Name	Chloroform (ppb) PNL	Chloroform (ppb) UST	Comments
1873	199-H4-5	23.29 ± 0.84	22	All OK
1874	199-H4-6	13.50	12	
1877	199-H4-3	28.34	25	
1878	199-H4-4	19.44	17	
1890	199-H3-1	10.66 ± 0.22	----	
4400	399-1-7	21.74	19	
4402	399-2-1	11.53	11	
4403	399-1-1	16.56	17.9	
4404	399-1-2	19.31	18	
4406	399-1-3	20.05	18	
4407	399-1-4	20.5	19	
4408	399-8-2	0.93	----	
4410	399-4-1	5.64	----	
4802	699-S19-E13	0.20	----	
4804	699-S30=E15A	4.18	----	
4806	399-1-5	18.04	18	
4837	399-1-6	17.87	18	
4839	399-3-7	5.73	----	
4896	399-1-8	10.53 ± 0.09	----	

TABLE I.18. Organic Analyses from PNL and UST Labs (June 1986) (cont)

Well Code	Well Name	Perchloroethylene PNL	Perchloroethylene UST	Comments
1873	199-H4-5	1.91 ± 0.20	<10	All OK
1874	199-H4-6	2.48	<10	
1877	199-H4-3	2.86	<10	
1878	199-H4-4	2.52	<10	
1890	199-H3-1	2.14 ± 0.16	<10	
4400	399-1-7	3.40	<10	
4402	399-2-1	3.79	<10	
4403	399-1-1	3.08	<10	
4404	399-1-2	3.12	<10	
4406	399-1-3	3.14	<10	
4407	399-1-4	2.69	<10	
4408	399-8-2	3.84	<10	
4410	399-4-1	2.59	<10	
4802	699-S19-E13	2.34	<10	
4804	699-S30-E15A	1.41	<10	
4806	399-1-5	2.15	<10	
4837	399-1-6	2.09	<10	
4839	399-3-7	1.78	<10	
4896	399-1-8	1.56 ± 0.10	<10	
0899	0899Q	0.96	<10	

WATER POLLUTION STUDIES

PERFORMANCE EVALUATION REPORT

DATE: 06/03/86

WATER POLLUTION STUDY NUMBER WP016

LABORATORY: WA023

PARAMETERS	SAMPLE NUMBER	REPORT VALUE	TRUE VALUE*	ACCEPTANCE LIMITS	WARNING LIMITS	PERFORMANCE EVALUATION
TRACE METALS IN MICROGRAMS PER LITER:						
ALUMINUM	1	1972	2129	1780.-2430.	1860.-2350.	ACCEPTABLE
	2	676	700	557.- 850.	594.- 813.	ACCEPTABLE
ARSENIC	1	312	342	244.- 419.	266.- 397.	ACCEPTABLE
	2	160	191	131.- 244.	145.- 230.	ACCEPTABLE
BERYLLIUM	1	272	291	246.- 326.	256.- 316.	ACCEPTABLE
	2	626	661	564.- 749.	588.- 725.	ACCEPTABLE
CADMIUM	1	286	307	269.- 348.	279.- 338.	ACCEPTABLE
	2	114	119.3	105.- 134.	108.- 131.	ACCEPTABLE
COBALT	1	892	953	783.-1090.	822.-1050.	ACCEPTABLE
	2	200	210	176.- 244.	184.- 235.	ACCEPTABLE
CHROMIUM	1	269	274	213.- 331.	227.- 316.	ACCEPTABLE
	2	689	688	534.- 826.	571.- 790.	ACCEPTABLE
COPPER	1	358	380	332.- 422.	344.- 411.	ACCEPTABLE
	2	710	749	657.- 830.	679.- 809.	ACCEPTABLE
IRON	1	1233	1311	1120.-1480.	1170.-1440.	ACCEPTABLE
	2	608	633	538.- 722.	581.- 699.	ACCEPTABLE
MERCURY	1	48.8	50.0	34.4- 65.9	38.3- 61.9	ACCEPTABLE
	2	15.9	15.0	10.1- 20.7	11.4- 19.4	ACCEPTABLE
MANGANESE	1	505	510	448.- 564.	463.- 550.	ACCEPTABLE
	2	145	150	129.- 169.	134.- 164.	ACCEPTABLE
NICKEL	1	514	532	460.- 605.	479.- 587.	ACCEPTABLE
	2	897	911	791.-1030.	821.-1000.	ACCEPTABLE
LEAD	1	102	118.8	89.0- 146.	98.1- 139.	ACCEPTABLE
	2	755	851	706.- 984.	740.- 949.	ACCEPTABLE

* BASED UPON THEORETICAL CALCULATIONS, OR A REFERENCE VALUE WHEN NECESSARY.

PERFORMANCE EVALUATION REPORT DATE: 06/03/86

WATER POLLUTION STUDY NUMBER WP016

LABORATORY: WA023

PARAMETERS	SAMPLE NUMBER	REPORT VALUE	TRUE VALUE*	ACCEPTANCE LIMITS	WARNING LIMITS	PERFORMANCE EVALUATION
TRACE METALS IN MICROGRAMS PER LITER:						
SELENIUM	1	47.9	54.9	32.6- 66.9	36.9- 62.6	ACCEPTABLE
	2	65.4	90.8	54.1- 109.	61.1- 102.	ACCEPTABLE
VANADIUM	1	1652	1660	1370.-1930.	1440.-1860.	ACCEPTABLE
	2	656	650	511.- 778.	545.- 744.	ACCEPTABLE
ZINC	1	350	383	333.- 429.	345.- 417.	ACCEPTABLE
	2	850	893	782.- 994.	809.- 967.	ACCEPTABLE
ANTIMONY	3	58.5	64.8	41.8- 92.9	48.3- 86.5	ACCEPTABLE
	4	68.8	75.6	52.7- 106.	59.5- 99.7	ACCEPTABLE
SILVER	3	2.60	2.60	1.50- 3.62	1.76- 3.35	ACCEPTABLE
	4	18.0	18.2	13.9- 23.2	15.1- 22.0	ACCEPTABLE
THALLIUM	3	24.5	20.0	14.6- 26.8	16.1- 25.2	ACCEPTABLE
	4	66.4	60.8	38.5- 84.0	44.3- 78.2	ACCEPTABLE
MOLYBDENUM	3	11.0	11.6	4.25- 18.6	6.11- 16.8	ACCEPTABLE
	4	57.5	58.1	36.1- 79.0	42.2- 72.9	ACCEPTABLE
STRONTIUM	3	11.6	11.8	8.60- 15.4	9.61- 14.4	ACCEPTABLE
	4	34.5	33.8	25.6- 42.2	28.1- 39.9	ACCEPTABLE
TITANIUM	3	50.0	55.8	32.7- 79.5	39.3- 72.9	ACCEPTABLE
	4	114	125.6	90.0- 166.	101.- 155.	ACCEPTABLE
MINERALS IN MILLIGRAMS PER LITER: (EXCEPT AS NOTED)						
PH-UNITS	3	6.64	6.70	6.54- 6.83	6.58- 6.80	ACCEPTABLE
	4	4.42	4.50	4.30- 4.59	4.41- 4.56	ACCEPTABLE
SPEC. COND. (UMMOS/CM AT 25 C)	1	510	568	516.- 637.	531.- 622.	NOT ACCEPTABLE
	2	124	135	125.- 153.	129.- 150.	NOT ACCEPTABLE

* BASED UPON THEORETICAL CALCULATIONS, OR A REFERENCE VALUE WHEN NECESSARY.

PERFORMANCE EVALUATION REPORT DATE: 06/03/96

WATER POLLUTION STUDY NUMBER WP016

LABORATORY: WA023

PARAMETERS	SAMPLE NUMBER	REPORT VALUE	TRUE VALUE*	ACCEPTANCE LIMITS	WARNING LIMITS	PERFORMANCE EVALUATION
MINERALS IN MILLIGRAMS PER LITER (EXCEPT AS NOTED)						
TOTAL HARDNESS (AS CACO3)	1	161	168	153.- 180.	157.- 177.	ACCEPTABLE
	2	25.2	26.1	21.9- 30.1	22.9- 29.0	ACCEPTABLE
CALCIUM	1	34.61	36.0	31.0- 40.4	32.1- 39.2	ACCEPTABLE
	2	9.45	9.80	8.20- 11.3	8.59- 10.9	ACCEPTABLE
MAGNESIUM	1	18.04	19.8	15.8- 21.8	16.5- 21.0	ACCEPTABLE
	2	0.378	0.400	.289- .497	.315- .471	ACCEPTABLE
SODIUM	1	23.40	25.1	21.9- 28.7	22.7- 27.8	ACCEPTABLE
	2	9.27	9.90	8.29- 11.5	8.69- 11.1	ACCEPTABLE
POTASSIUM	1	22.40	25.0	20.8- 28.7	21.1- 27.6	ACCEPTABLE
	2	7.12	8.00	6.34- 9.39	6.72- 9.00	ACCEPTABLE
CHLORIDE	1	116	119	109.- 128.	111.- 126.	ACCEPTABLE
	2	18.8	18.5	15.4- 21.5	16.1- 20.8	ACCEPTABLE
FLUORIDE	1	1.53	1.30	1.08- 1.49	1.13- 1.44	NOT ACCEPTABLE
	2	0.474	0.397	.319- .449	.341- .468	CHECK FOR ERROR
SULFATE	1	54.0	55.0	43.7- 65.3	46.4- 62.6	ACCEPTABLE
	2	18.6	18.0	13.9- 21.6	14.9- 20.6	ACCEPTABLE
NUTRIENTS IN MILLIGRAMS PER LITER:						
AMMONIA-NITROGEN	1	4.36	4.60	3.68- 5.49	3.90- 5.28	ACCEPTABLE
	2	6.69	7.22	5.87- 8.55	6.19- 8.23	ACCEPTABLE
NITRATE-NITROGEN	1	2.68	2.50	2.05- 2.95	2.16- 2.84	ACCEPTABLE
	2	1.48	1.50	1.19- 1.79	1.26- 1.72	ACCEPTABLE
ORTHOPHOSPHATE	1	1.39	1.31	1.09- 1.51	1.14- 1.46	ACCEPTABLE
	2	3.25	3.21	2.74- 3.66	2.85- 3.55	ACCEPTABLE

* BASED UPON THEORETICAL CALCULATIONS, OR A REFERENCE VALUE WHEN NECESSARY.

PERFORMANCE EVALUATION REPORT DATE: 06/03/86

WATER POLLUTION STUDY NUMBER WP016

LABORATORY: WA023

PARAMETERS	SAMPLE NUMBER	REPORT VALUE	TRUE VALUE*	ACCEPTANCE LIMITS	WARNING LIMITS	PERFORMANCE EVALUATION
DEMANDS IN MILLIGRAMS PER LITER:						
TOC	1	32.2	38.6	28.9- 47.7	31.4- 45.3	ACCEPTABLE
	2	23.1	26.7	19.9- 33.3	21.6- 31.5	ACCEPTABLE
PCB'S IN MICROGRAMS PER LITER:						
PCB-AROCLOR 1232	1	4.02	4.98	2.23- 6.43	2.77- 5.90	ACCEPTABLE
PCB-AROCLOR 1248	2	1.98	2.39	1.15- 3.17	1.41- 2.92	ACCEPTABLE
PESTICIDES IN MICROGRAMS PER LITER:						
ALDRIN	1	0.113	0.161	.0403- .220	.0632- .197	ACCEPTABLE
	2	0.428	0.626	.175- .817	.257- .735	ACCEPTABLE
DIELDRIN	1	0.130	0.136	.0645- .198	.0815- .181	ACCEPTABLE
	2	0.536	0.484	.261- .658	.311- .608	ACCEPTABLE
DDD	1	0.227	0.240	.107- .351	.138- .320	ACCEPTABLE
	2	0.901	0.646	.335- .901	.407- .829	CHECK FOR ERROR
DDE	1	0.152	0.128	.0641- .214	.0832- .195	ACCEPTABLE
	2	0.408	0.369	.191- .525	.225- .481	ACCEPTABLE
DDT	1	0.259	0.319	.134- .456	.174- .415	ACCEPTABLE
	2	0.877	0.957	.498- 1.39	.610- 1.28	ACCEPTABLE
HEPTACHLOR	1	0.123	0.127	.0361- .194	.0562- .174	ACCEPTABLE
	2	0.446	0.476	.224- .645	.277- .592	ACCEPTABLE
HEPTACHLOR EPOXIDE	1	0.075	0.075	.0396- .111	.0487- .102	ACCEPTABLE
	2	0.341	0.380	.196- .484	.233- .448	ACCEPTABLE

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PERFORMANCE EVALUATION REPORT DATE: 06/03/86

WATER POLLUTION STUDY NUMBER WP016

LABORATORY: WA023

PARAMETERS	SAMPLE NUMBER	REPORT VALUE	TRUE VALUE*	ACCEPTANCE LIMITS	WARNING LIMITS	PERFORMANCE EVALUATION
PESTICIDES IN MICROGRAMS PER LITER:						
CHLORDANE	3	1.16	1.57	.689- 2.19	.880- 2.00	ACCEPTABLE
	4	4.58	5.89	2.62- 7.70	3.26- 7.06	ACCEPTABLE
VOLATILE HALOCARBONS IN MICROGRAMS PER LITER:						
1,2 DICHLOROETHANE	1	29.4	25.8	17.7- 32.8	19.6- 30.9	ACCEPTABLE
	2	89.0	77.3	46.6- 100.	54.2- 100.	ACCEPTABLE
CHLOROFORM	1	7.08	6.04	3.27- 8.55	3.95- 7.87	ACCEPTABLE
	2	93.0	84.5	57.1- 110.	63.8- 103.	ACCEPTABLE
1,1,1 TRICHLOROETHANE	1	16.2	14.8	10.2- 20.7	11.5- 19.4	ACCEPTABLE
	2	46.1	44.3	28.0- 62.5	32.3- 58.2	ACCEPTABLE
TRICHLOROETHENE	1	22.1	22.5	14.0- 30.0	16.0- 27.9	ACCEPTABLE
	2	97.4	100.2	58.8- 137.	68.5- 127.	ACCEPTABLE
CARBONTETRACHLORIDE	1	17.5	18.5	11.1- 26.0	13.0- 24.1	ACCEPTABLE
	2	52.9	52.9	33.0- 76.2	38.4- 70.8	ACCEPTABLE
TETRACHLOROETHENE	1	14.8	16.9	10.6- 22.5	12.1- 21.0	ACCEPTABLE
	2	71.3	84.7	51.3- 189.	58.5- 102.	ACCEPTABLE
BROMODICHLOROMETHANE	1	16.2	15.6	10.8- 21.2	12.1- 19.8	ACCEPTABLE
	2	72.3	65.7	44.4- 92.9	50.5- 86.8	ACCEPTABLE
DIBROMOCHLOROMETHANE	1	19.3	19.1	11.5- 28.9	13.7- 26.7	ACCEPTABLE
	2	107	95.6	64.7- 142.	74.6- 132.	ACCEPTABLE
BROMOFORM	1	48.2	50.6	28.1- 75.1	34.0- 69.2	ACCEPTABLE
	2	31.9	30.6	14.5- 49.0	18.8- 44.7	ACCEPTABLE
METHYLENE CHLORIDE	1	24.5	20.5	10.8- 38.0	13.2- 27.6	ACCEPTABLE
	2	73.4	63.8	30.6- 93.0	38.4- 85.2	ACCEPTABLE

* BASED UPON THEORETICAL CALCULATIONS, OR A REFERENCE VALUE WHEN NECESSARY.

PERFORMANCE EVALUATION REPORT DATE: 06/03/86

WATER POLLUTION STUDY NUMBER WP016

LABORATORY: WA023

PARAMETERS	SAMPLE NUMBER	REPORT VALUE	TRUE VALUE*	ACCEPTANCE LIMITS	WARNING LIMITS	PERFORMANCE EVALUATION
VOLATILE HALOCARBONS IN MICROGRAMS PER LITER:						
CHLOROBENZENE	1	25.9	29.4	20.2- 38.1	22.9- 35.8	ACCEPTABLE
	2	57.9	67.8	46.1- 91.6	51.8- 85.9	ACCEPTABLE
VOLATILE AROMATICS IN MICROGRAMS PER LITER:						
BENZENE	1	85.9	83.0	46.5- 119.	55.6- 110.	ACCEPTABLE
	2	26.6	25.9	17.3- 34.7	19.5- 32.4	ACCEPTABLE
ETHYLBENZENE	1	56.1	62.9	39.8- 85.2	45.7- 79.3	ACCEPTABLE
	2	12.7	15.7	9.72- 21.7	11.3- 20.1	ACCEPTABLE
TOLUENE	1	74.7	78.2	50.2- 106.	57.4- 98.4	ACCEPTABLE
	2	7.70	7.82	5.21- 10.8	5.91- 10.1	ACCEPTABLE
MISCELLANEOUS PARAMETERS:						
TOTAL CYANIDE	1	0.783	1.05	.609- 1.36	.706- 1.27	ACCEPTABLE
(IN MG/L)	2	0.522	0.608	.343- .807	.401- .748	ACCEPTABLE
NON-FILTERABLE RESIDUE	1	31.0	35.6	26.6- 37.5	28.0- 36.1	ACCEPTABLE
(IN MG/L)	2	56.7	65.2	50.8- 69.2	53.1- 66.9	ACCEPTABLE
OIL AND GREASE	1	7.35	16.0	7.40- 22.1	9.24- 20.3	NOT ACCEPTABLE
(IN MG/L)	2	5.40	11.0	3.88- 16.5	5.46- 14.9	CHECK FOR ERROR

* BASED UPON THEORETICAL CALCULATIONS, OR A REFERENCE VALUE WHEN NECESSARY.

APPENDIX J

STATEMENT OF WORK: WELL DRILLING SPECIFICATIONS, 183-H SOLAR EVAPORATION BASINS

APPENDIX J

STATEMENT OF WORK: WELL DRILLING SPECIFICATIONS, 183-H SOLAR EVAPORATION BASINS

The Statement of Work presented in this appendix contains drilling specifications for wells to be installed near the 183-H Basins 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.

PNL-SOW.183-H

STATEMENT OF WORK

WELL DRILLING SPECIFICATIONS
183-H SOLAR EVAPORATION BASINS

July 15, 1986

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

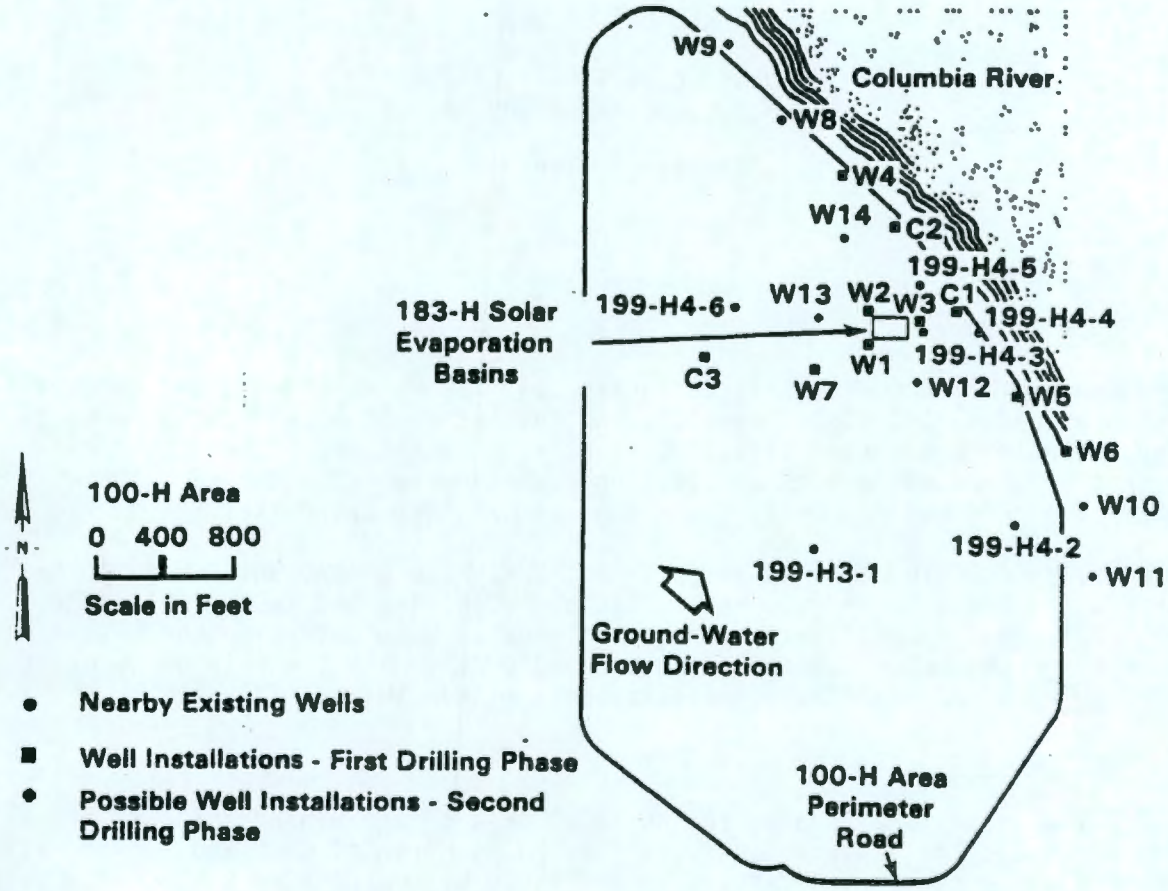

FIGURE 1. Well Location Map of the 100-H Area

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

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 (5 85)

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.

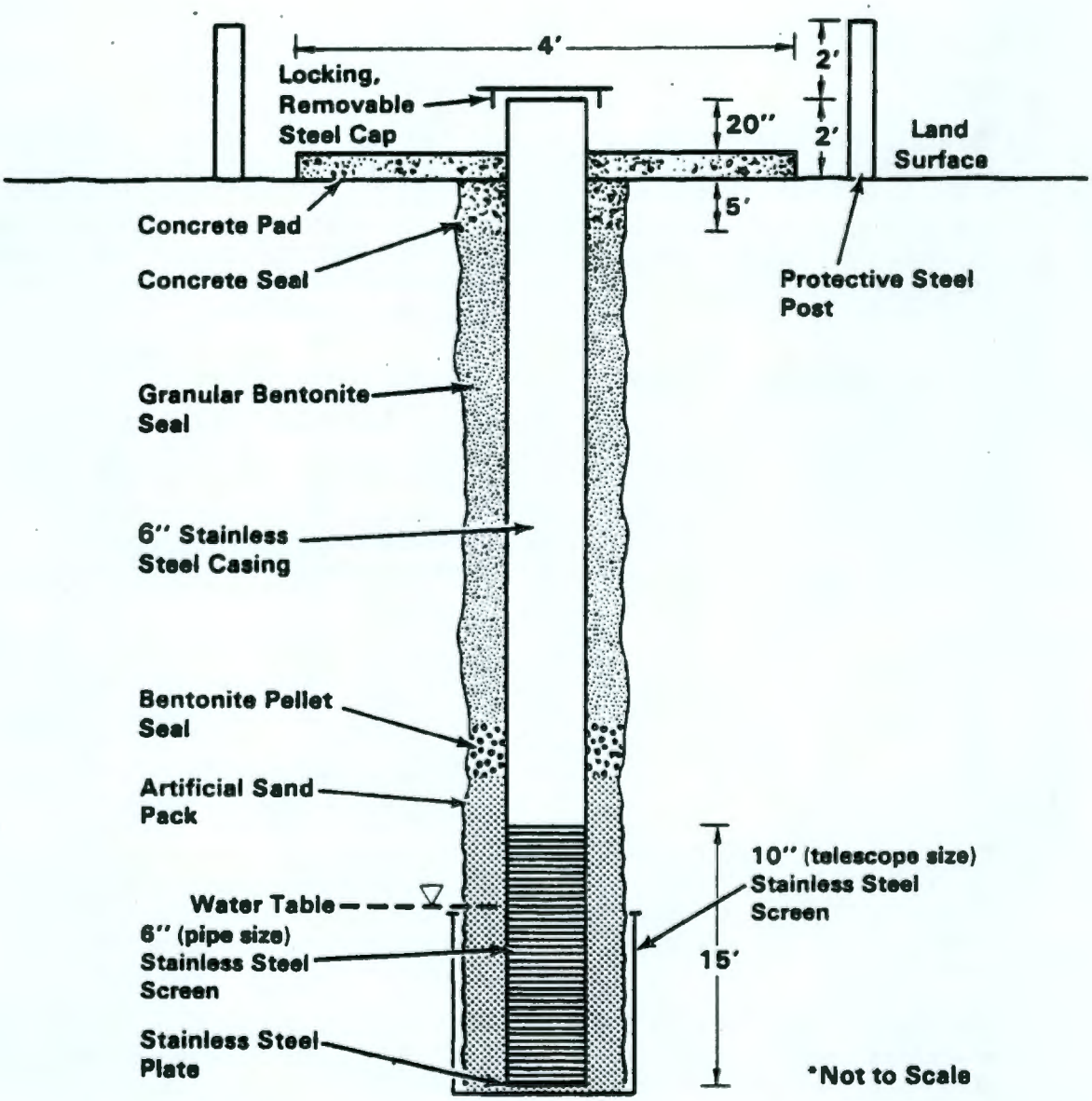

FIGURE 3. Single Shallow Wells Completed in Hanford Gravels

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.

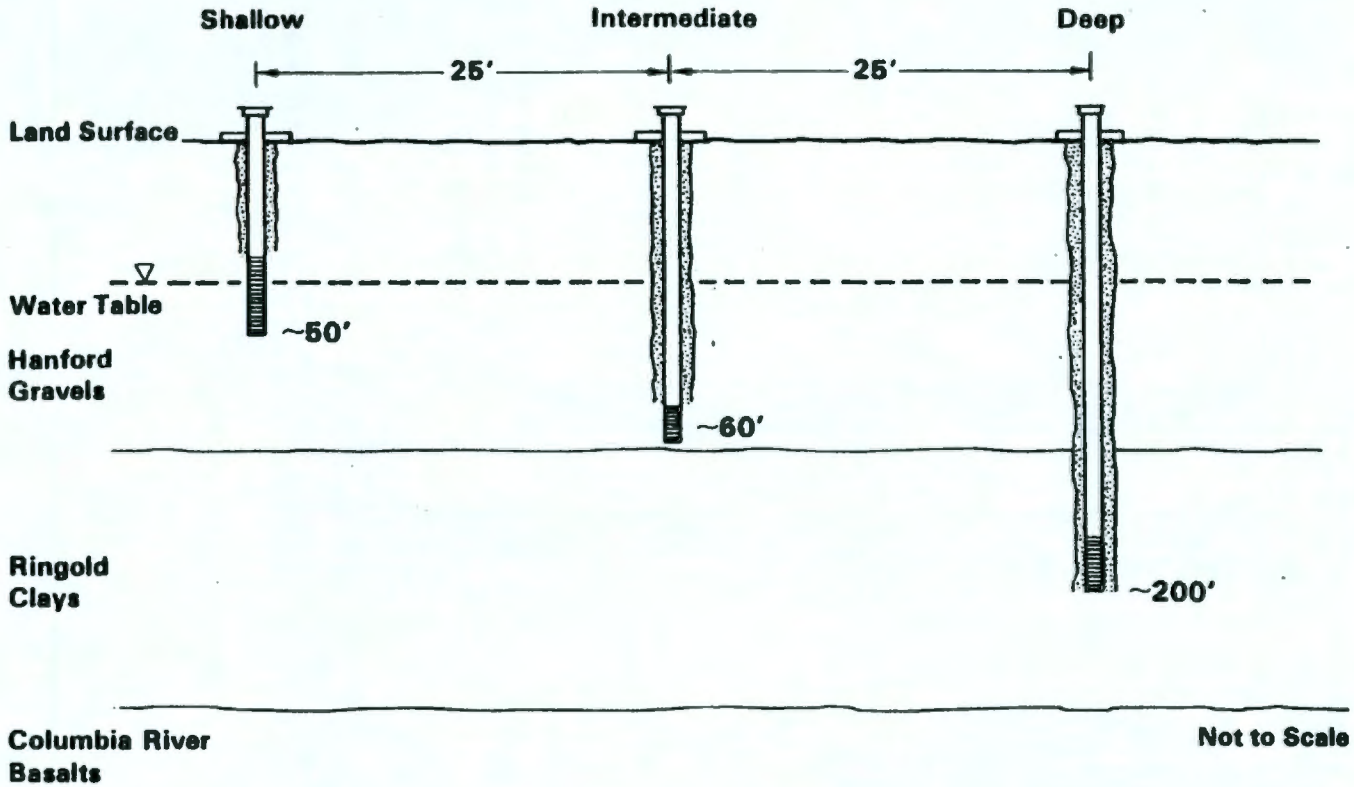

FIGURE 4. Cross Sectional View of Well Cluster Completion

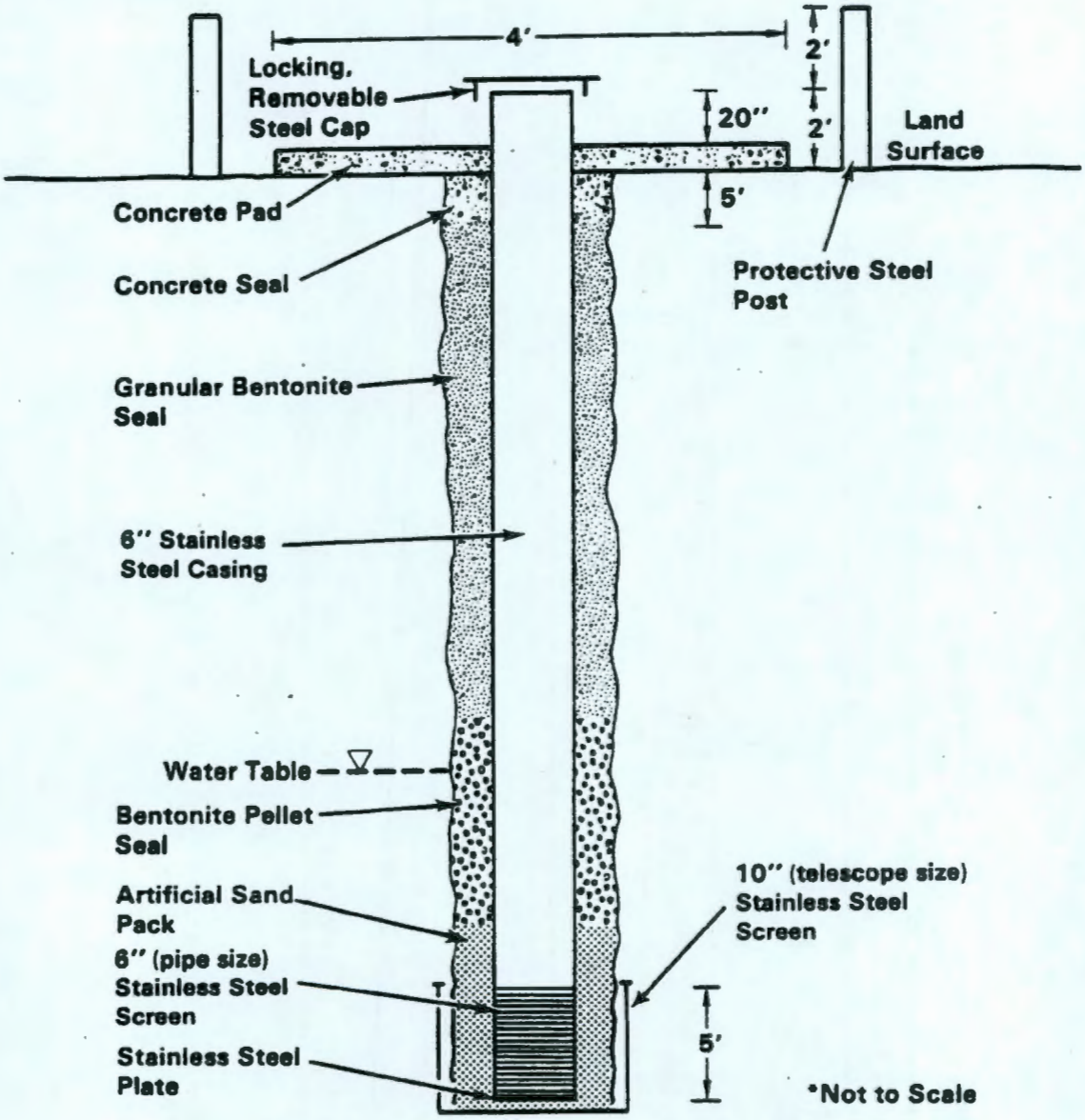

FIGURE 5. Intermediate Wells Completed at Top of Ringold Clays

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.

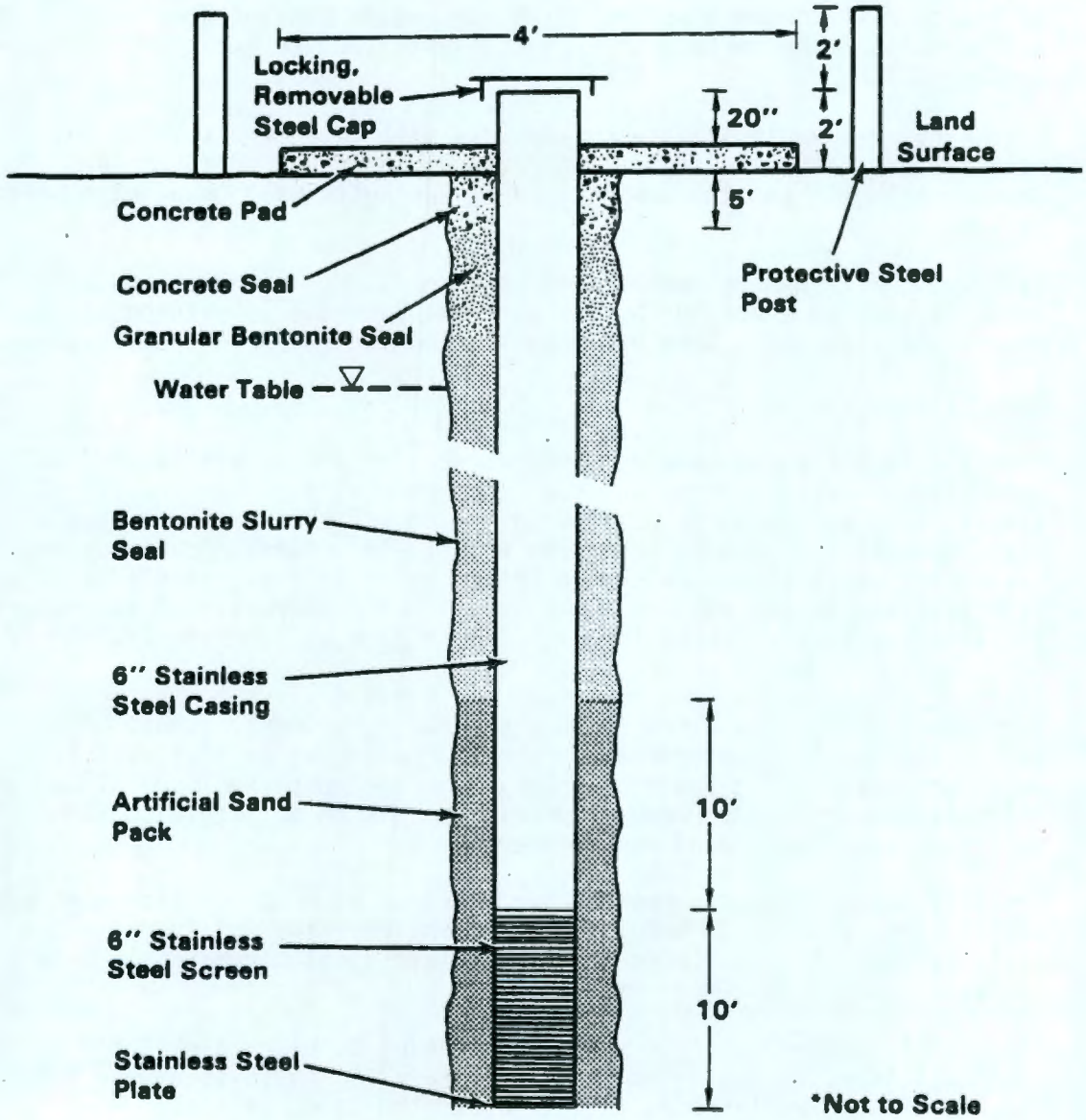

FIGURE 6. Deep Wells Completed Within Ringold Clays

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.