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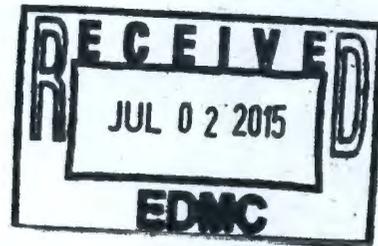


Revised Ground-Water Monitoring Compliance Plan for the 183-H Solar Evaporation Basins

September 1986

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

Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
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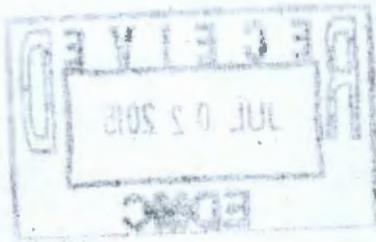
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COMPLIANCE PLAN FOR THE 183-H
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September 1986

Prepared by
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Richland Operations Office
Richland, Washington 99352

CONTENTS

INTRODUCTION	1
BACKGROUND INFORMATION	3
FACILITY DESCRIPTION	3
Physical Structure of the 183-H Basins	3
Operational History of the 183-H Basins	6
Nature of the Stored Wastes	7
GEOLOGY AND HYDROLOGY OF THE 100-H AREA	8
Geology	9
Hydrology	13
HISTORICAL DATA OBTAINED BY THE HANFORD GROUND-WATER MONITORING PROJECT	14
INTERIM STATUS WORK CONDUCTED TO DATE	23
SCOPE AND DESCRIPTION	23
Well Network	23
Sample Collection	24
Water-Level Measurements	31
Sample Analysis	32
Analytical Parameters	32
Analytical Methods	40
Data Handling and Verification	41
UST's Data Handling Procedures	41
PNL's Data Handling Procedures	43
Data Evaluation	44
Quality Assurance	44

Quality Control	44
UST's Internal QC Effort	45
External QC Effort	45
RESULTS	47
Types of Constituents Detected	47
Data Listings and Summaries	48
Graphs of the Data	60
Observations Regarding the Data	64
QC Program Results	72
Results of UST's Internal QC Effort	72
Blanks	72
Matrix Spikes	72
Surrogate Recovery	73
Radioactivity	73
Interlaboratory Comparisons Conducted Using Field Samples	74
Anions	74
Metals	74
Volatile Organic Chemicals	77
Spiked Samples Prepared by PNL	77
Metals	78
Ions	79
Pesticides and Herbicides	79
Volatile Organic Compounds	82
Spiked Samples Submitted Under EPA-Sponsored Studies	83

Factors Potentially Affecting the Data	84
Contamination of the Bladder Pumps	84
Preservation of Samples to be Analyzed for Metals	85
Alterations to Analytical Methods	85
Ammonium Ion	85
Gross Beta	86
Lead	86
Antimony	86
Mercury	86
Osmium	86
Silver	86
Radium	87
Presence of Methylene Chloride in Blanks and Field Samples	87
Potential Laboratory Differences	87
DESCRIPTION AND RESULTS OF GROUND-WATER MODELING FOR THE 100-H AREA	89
Data Collection	90
Development of a Conceptual Flow Model	96
Model Calibration	96
Simulations	98
Assessment of the Potential for a Reversed Gradient	98
Future Modeling Work	101
PLANNED EXPANSION OF THE GROUND-WATER MONITORING PROGRAM	103
APPROACH TO BE TAKEN	103
Well Installations	103

First Drilling Phase	104
Second Drilling Phase	108
Well Construction Details	108
Hydrogeologic Testing and Characterization	111
Geologic Core Analysis	112
Geophysical Well Logging	112
Soil Moisture in the Unsaturated Zone	113
Permeameter Tests	113
Hydraulic Gradient Determinations	113
Aquifer Testing	114
Objectives	114
Test Strategy for the Hanford Formation	114
Test Strategy for the Middle Ringold Formation	115
Monitoring of the Columbia River	115
Analysis of the Aquifer Testing Data	116
Sampling and Analysis	116
Data Evaluation	118
Method of Determining the Rate and Extent of Contaminant Movement	119
Estimating the Rate of Contaminant Movement	119
Estimating the Extent of Contamination	119
Ground-Water Flow and Transport Modeling	119
SCHEDULE OF IMPLEMENTATION	120
REPORTS TO BE PRODUCED	121
REFERENCES	123

APPENDIX A: DRILLING LOGS	A.1
APPENDIX B: PROCEDURES FOR SAMPLE COLLECTION, CHAIN-OF-CUSTODY, AND FIELD MEASUREMENTS	B.1
APPENDIX C: ADDITIONAL VOLATILE AND SEMIVOLATILE COMPOUNDS	C.1
APPENDIX D: ANALYTICAL METHODS AND QUALITY CONTROL PROCEDURES	D.1
APPENDIX E: DANGEROUS WASTE CONSTITUENTS LIST BY CATEGORY	E.1
APPENDIX F: QUALITY ASSURANCE (QA) PLAN	F.1
APPENDIX G: DATA LISTINGS AND SUMMARIES	G.1
APPENDIX H: GRAPHS OF ANALYTICAL DATA	H.1
APPENDIX I: ADDITIONAL QUALITY CONTROL INFORMATION	I.1
APPENDIX J: STATEMENT OF WORK: WELL DRILLING SPECIFICATIONS, 183-H SOLAR EVAPORATION BASINS	J.1

FIGURES

1	The Hanford Site	2
2	100-H Area Map	4
3	Schematic Cross Section of the 183-H Basins	5
4	Plan View of the 183-H Basins	6
5	Generalized Geologic Column for the 100-H Area	10
6	Geologic Cross Sections of the 100-H Area	11
7	Location Map for Geologic Cross Sections	12
8	100-H Area Water-Table Map (July 1, 1985)	15
9	100-H Area Water-Table Map (September 24, 1985)	16
10	100-H Area Water-Table Map (January 6, 1986)	17
11	100-H Area Water-Table Map (April 1, 1986)	18
12	100-H Area Well-Location Map	20
13	Annual Average Concentrations of Nitrate in Well 199-H4-3	21
14	Annual Average Concentrations of Chromium in Well 199-H4-3	21
15	Annual Average Concentrations of Nitrate in Well 199-H3-1	22
16	Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H4-4	26
17	Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H4-5	27
18	Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H4-6	28
19	Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H3-1	29
20	Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H4-3	30

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	63
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	63
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	65
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	65
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	66
26	Barium 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	66
27	Chromium 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	67
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	67
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	68
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	68
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	69
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	69

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	70
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	70
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	71
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	71
37	Interlaboratory Comparison Results for Chloride, October 1985	75
38	Interlaboratory Comparison Results for Nitrate, October 1985	75
39	Interlaboratory Comparison Results for Sulfate, October 1985	76
40	Interlaboratory Comparison Results for Chromium, February 1986	76
41	Interlaboratory Comparison Results for Chloroform, February 1986	78
42	Water-Level Measurements for Well 199-H4-4 Plotted with Columbia River Stage During Days 30-60 of 1985	91
43	Water-Level Measurements for Well 199-H4-5 Plotted with Columbia River Stage During Days 30-60 of 1985	92
44	Water-Level Measurements for Well 199-H4-6 Plotted with Columbia River Stage During Days 30-60 of 1985	93
45	Hydrographs of Continuously Monitored Wells in the 100-H Area	94
46	Maximum Water-Level Change (ft) Due to Columbia River Stage Fluctuations	95
47	Grid Used for the Modeling Project, Including Locations of 183-H Basins and Monitoring Wells	97

48	Simulated Pathlines from the 183-H Basins for January 22-30, 1985	99
49	Simulated Pathlines from the 183-H Basins During March 1985	100
50	Pathline During a Period of Simulated Southerly Gradient	102
51	Location Map for Planned Well Installations	105
52	Planned Design for Shallow Wells Completed in the Hanford Gravels	106
53	Cross-Sectional View of a Well Cluster Completion	107
54	Planned Design for Intermediate-Depth Wells Completed Just Above the Ringold Clays	109
55	Planned Design for Deep Wells Completed Within the Ringold Clays	110

TABLES

1	Quantities of Materials Discharged to the 183-H Basins in 1985 (Rokkan 1986)	8
2	Standard List of Analyses for the 100-H Area Network	34
3	Additional Analytical Parameters	37
4	Summary of Analyses Conducted from June 1985 through May 1986	50
5	Analytical Data, June 1985 through May 1986, Summarized by Constituent	57
6	Analytical Data, June 1985 through May 1986, Summarized by Constituent Ranks - Maximum	61
7	Analytical Data, June 1985 through May 1986, Summarized by Constituent Ranks - Median	62
8	Analytical Results of Spiked Samples Containing Metals, January and April 1986	80
9	Analytical Results of Spiked Samples Containing Anions, January 1986	80
10	Analytical Results of Spiked Samples Containing Anions, April 1986	81
11	Analytical Results of Spiked Samples Containing Pesticides and Herbicides, January 1986	81
12	Analytical Results of Spiked Samples Containing Pesticides and Herbicides, April 1986	82
13	Analytical Results of Spiked Samples Containing Volatile Organic Compounds (Halomethanes), January 1986	82
14	Analytical Results of Spiked Samples Containing Volatile Organic Compounds (Halomethanes), April 1986	83

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.

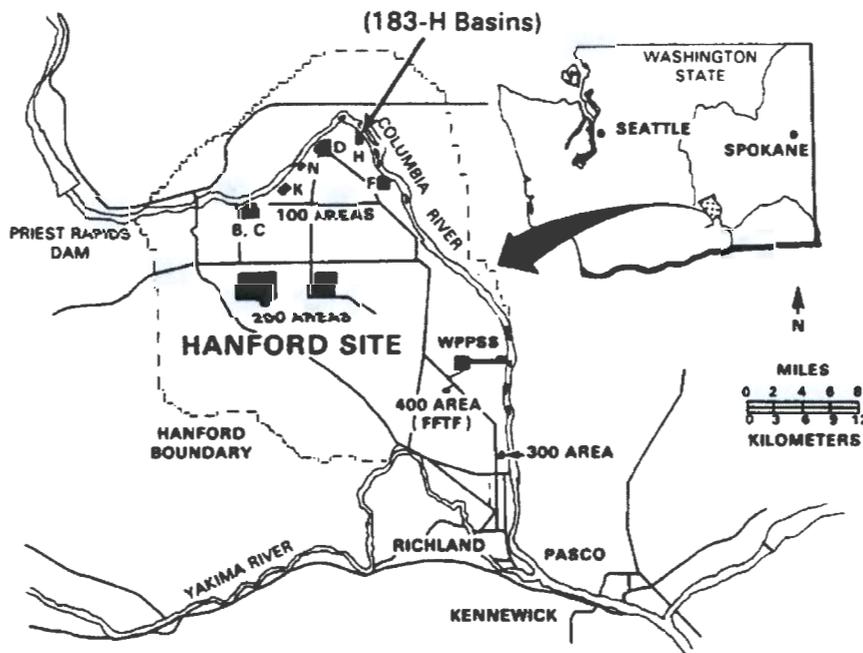


FIGURE 1. The Hanford Site

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.

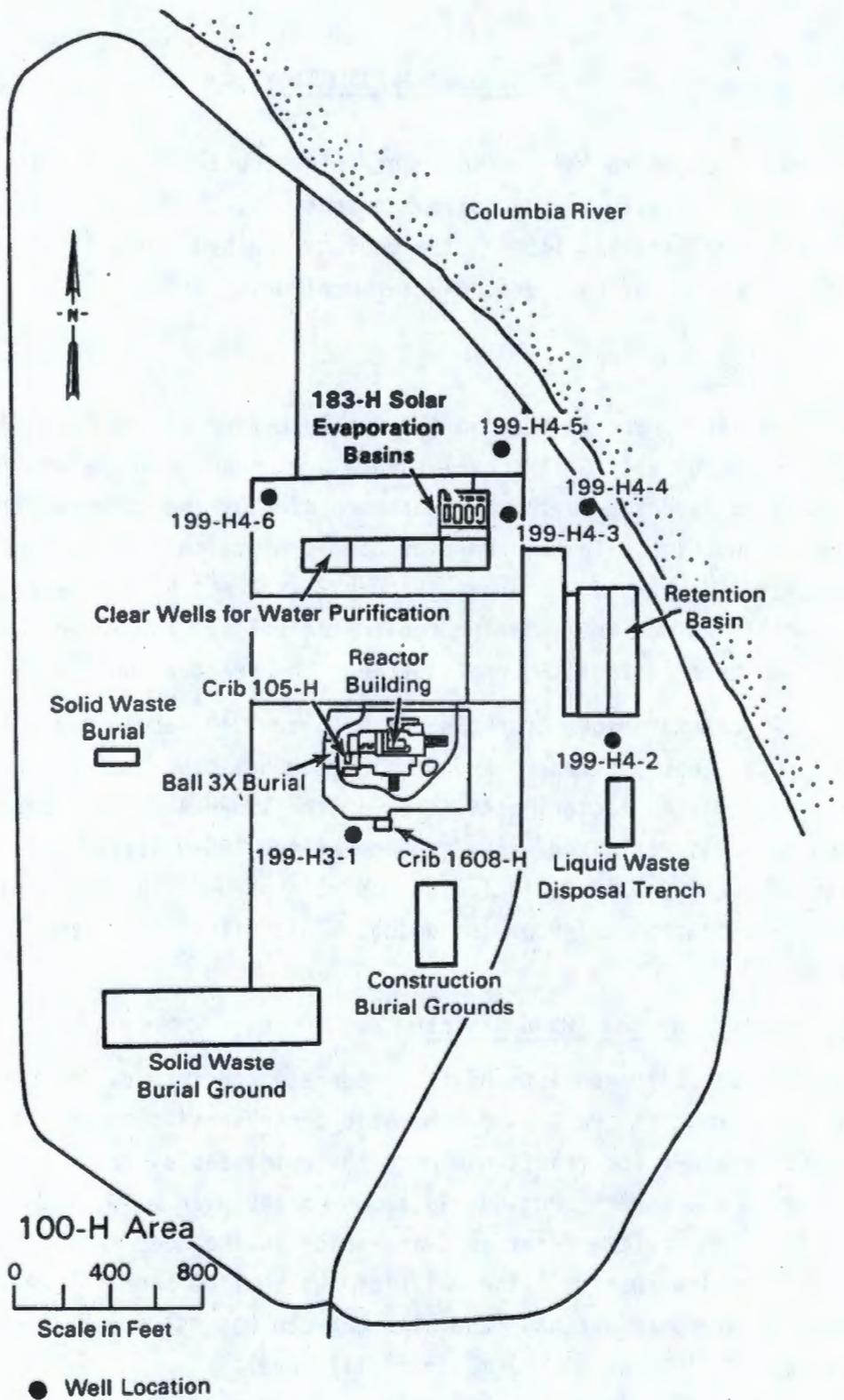


FIGURE 2. 100-H Area Map

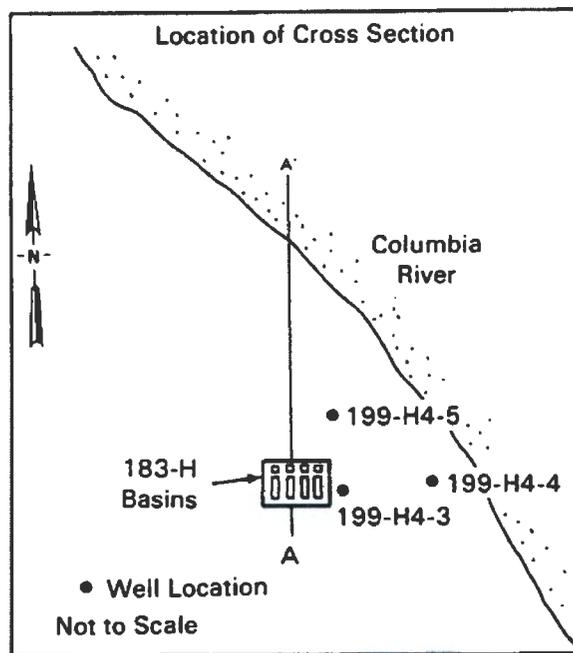
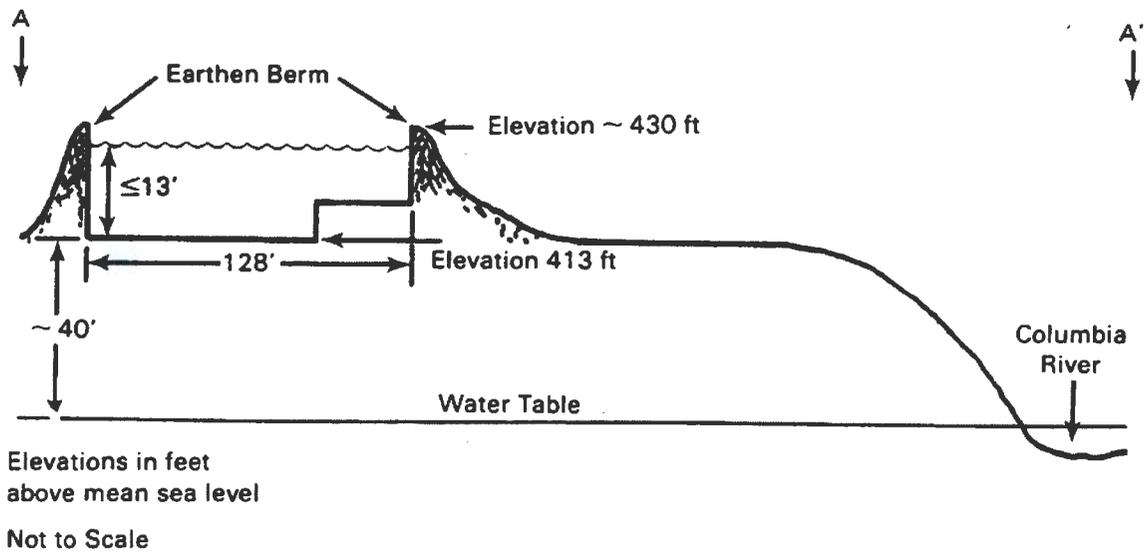


FIGURE 3. Schematic Cross Section of the 183-H Basins

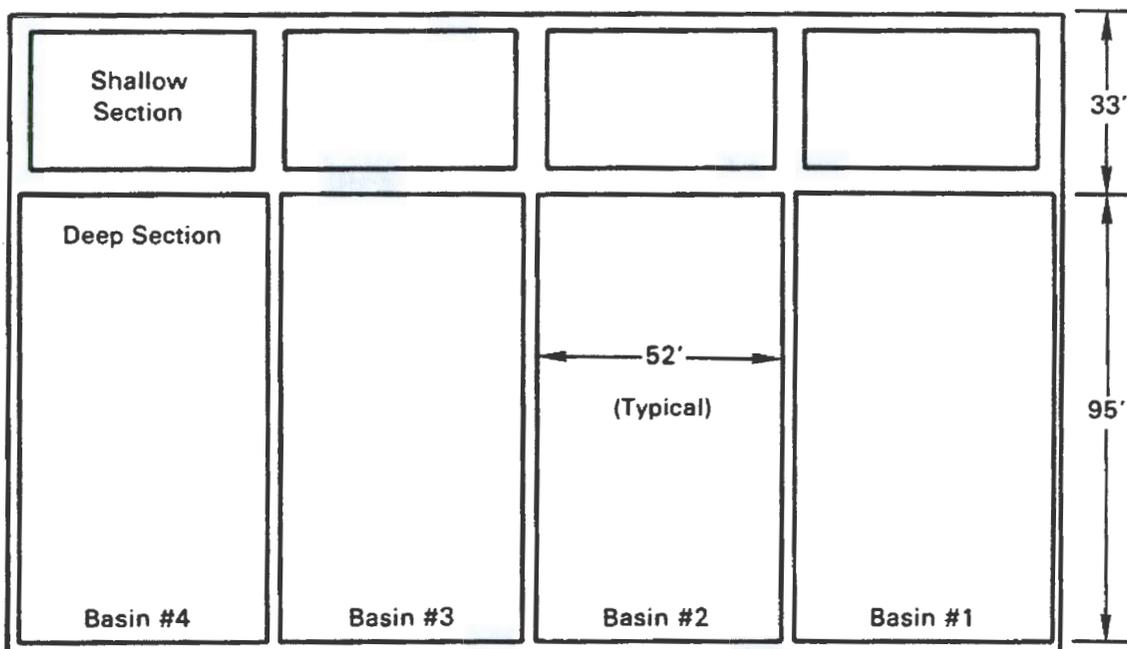


FIGURE 4. Plan View of the 183-H Basins

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 ft³ 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)

<u>Material</u>	<u>Pounds</u>
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

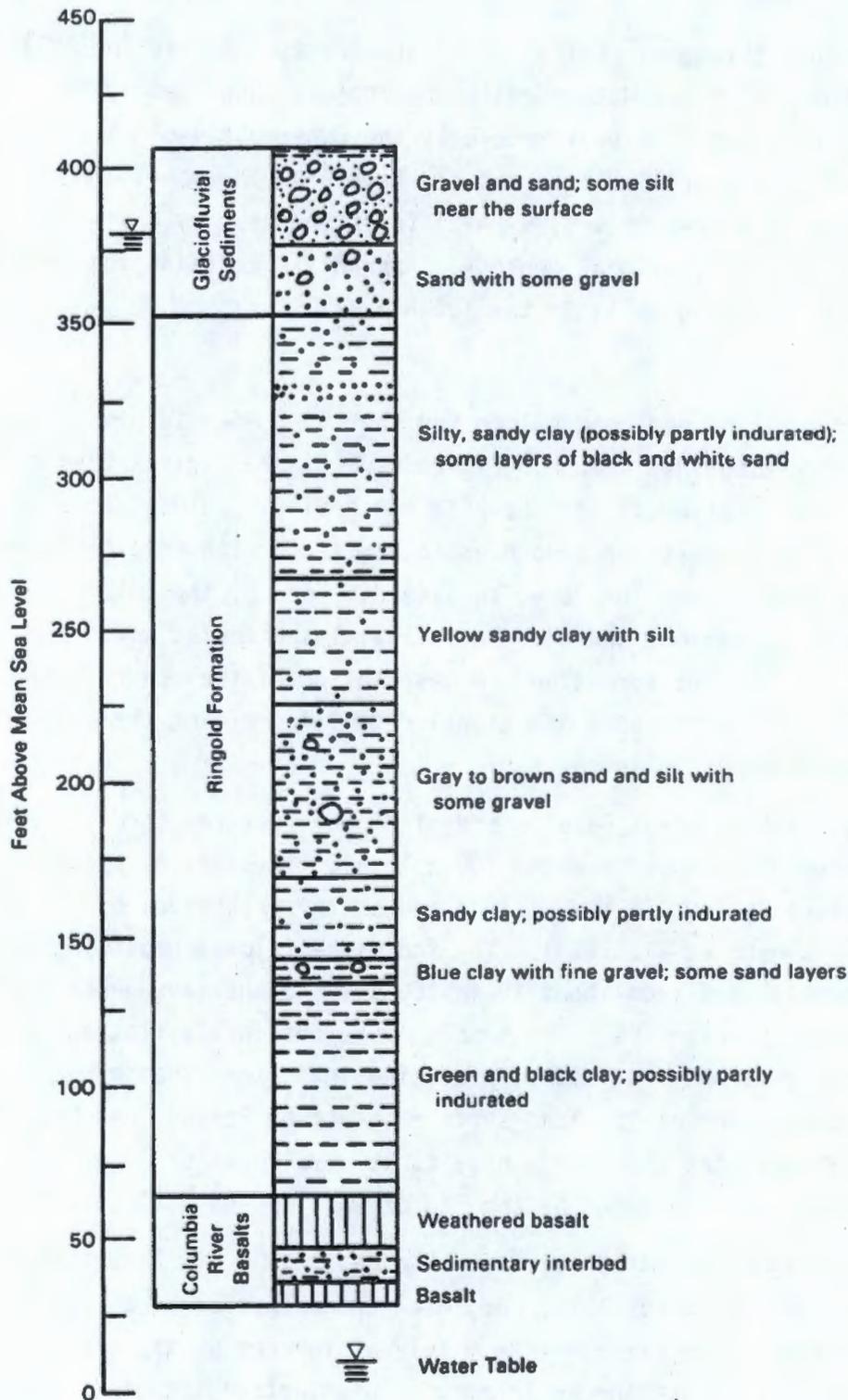


FIGURE 5. Generalized Geologic Column for the 100-H Area

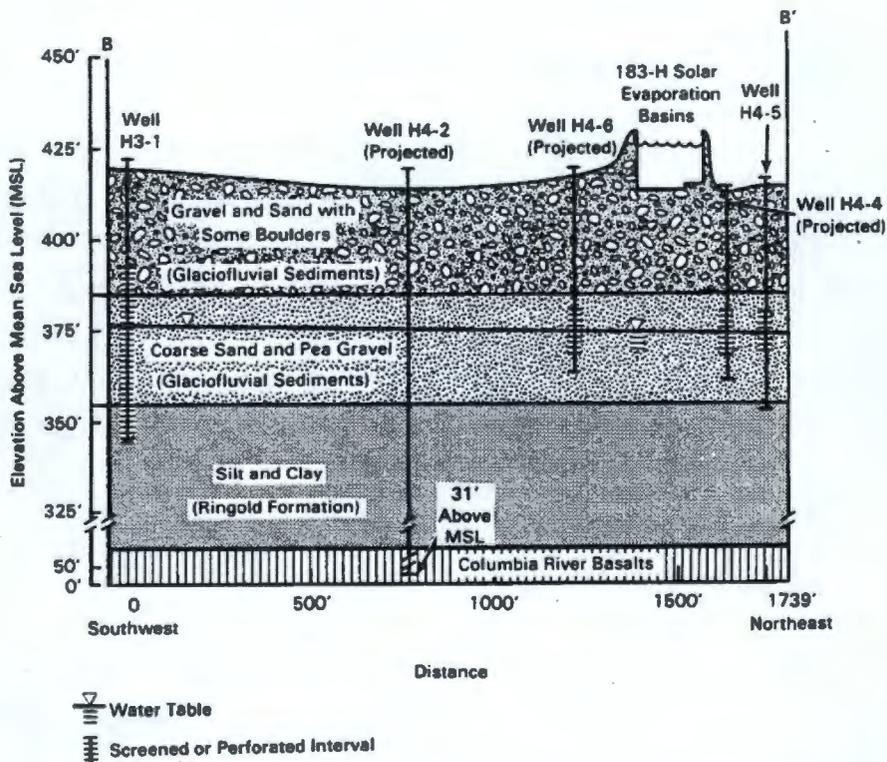
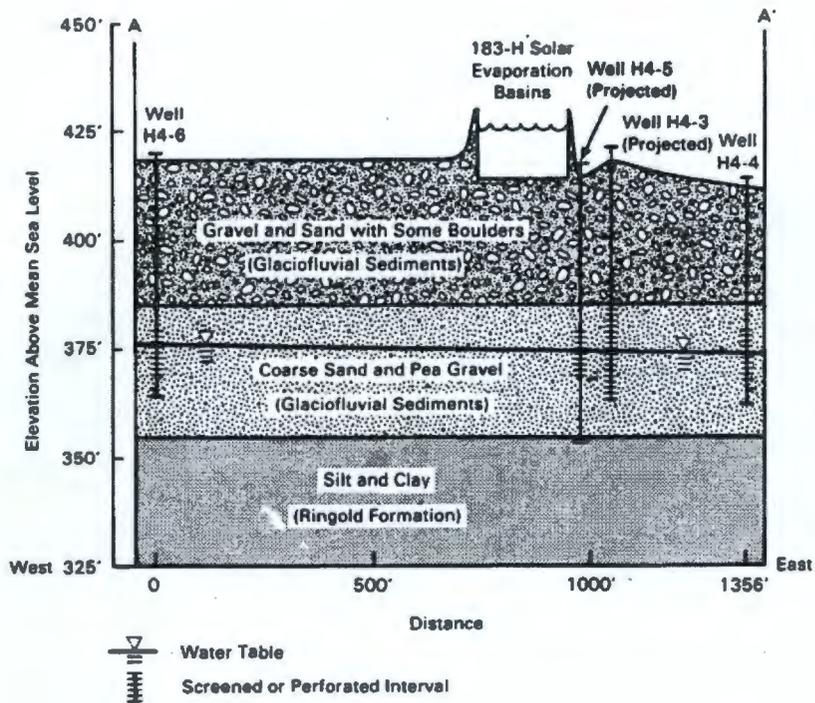


FIGURE 6. Geologic Cross Sections of the 100-H Area

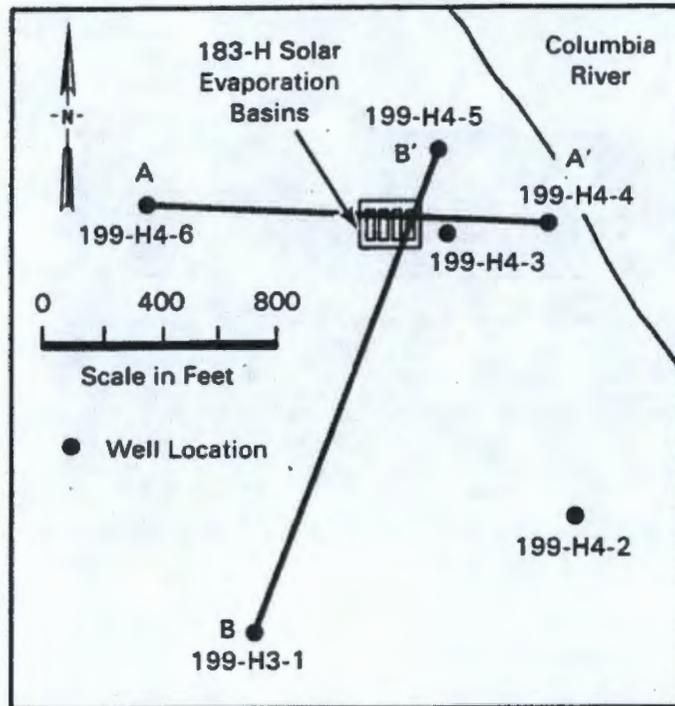


FIGURE 7. Location Map for Geologic Cross Sections

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 ft² 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

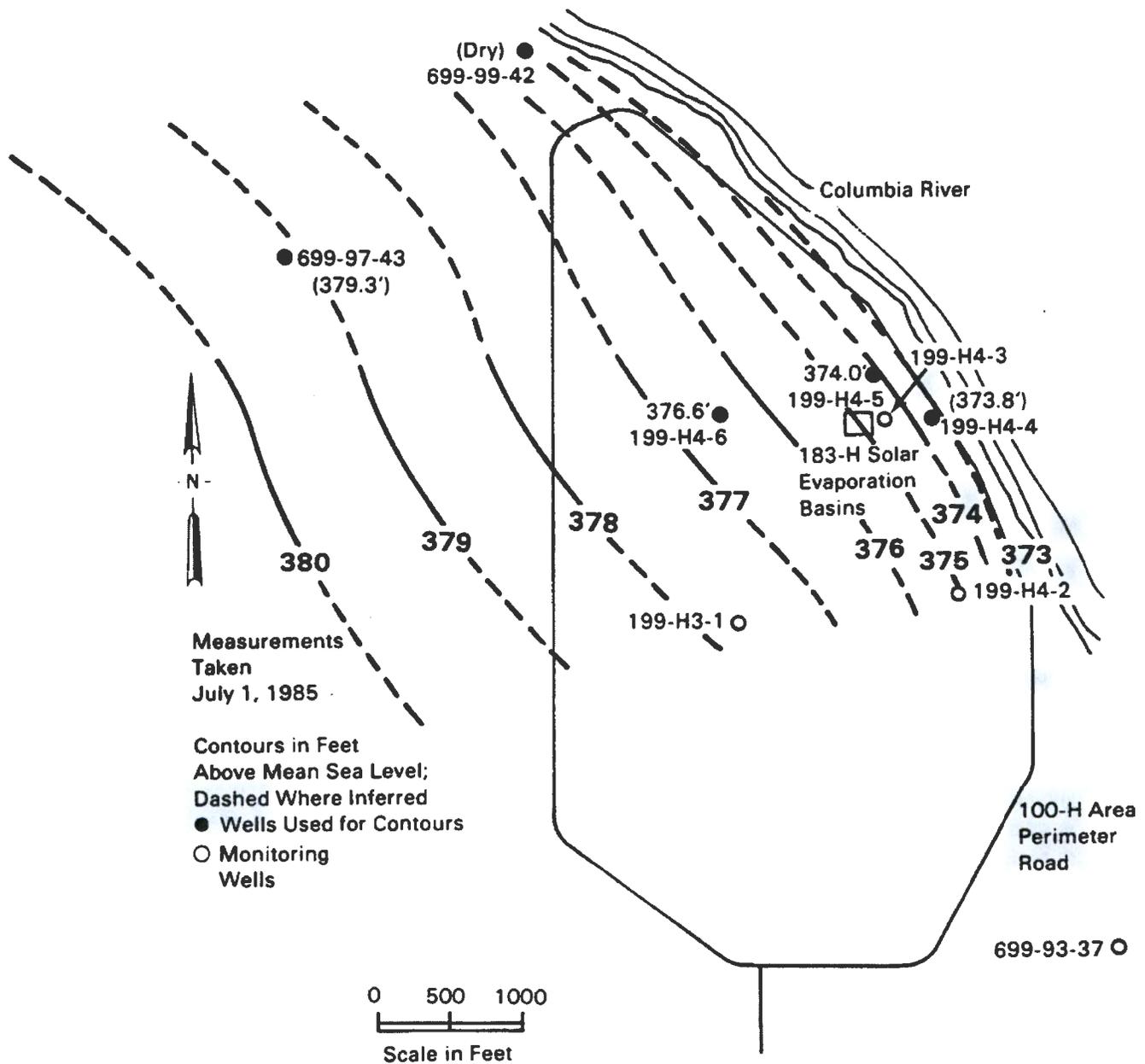


FIGURE 8. 100-H Area Water-Table Map (July 1, 1985)

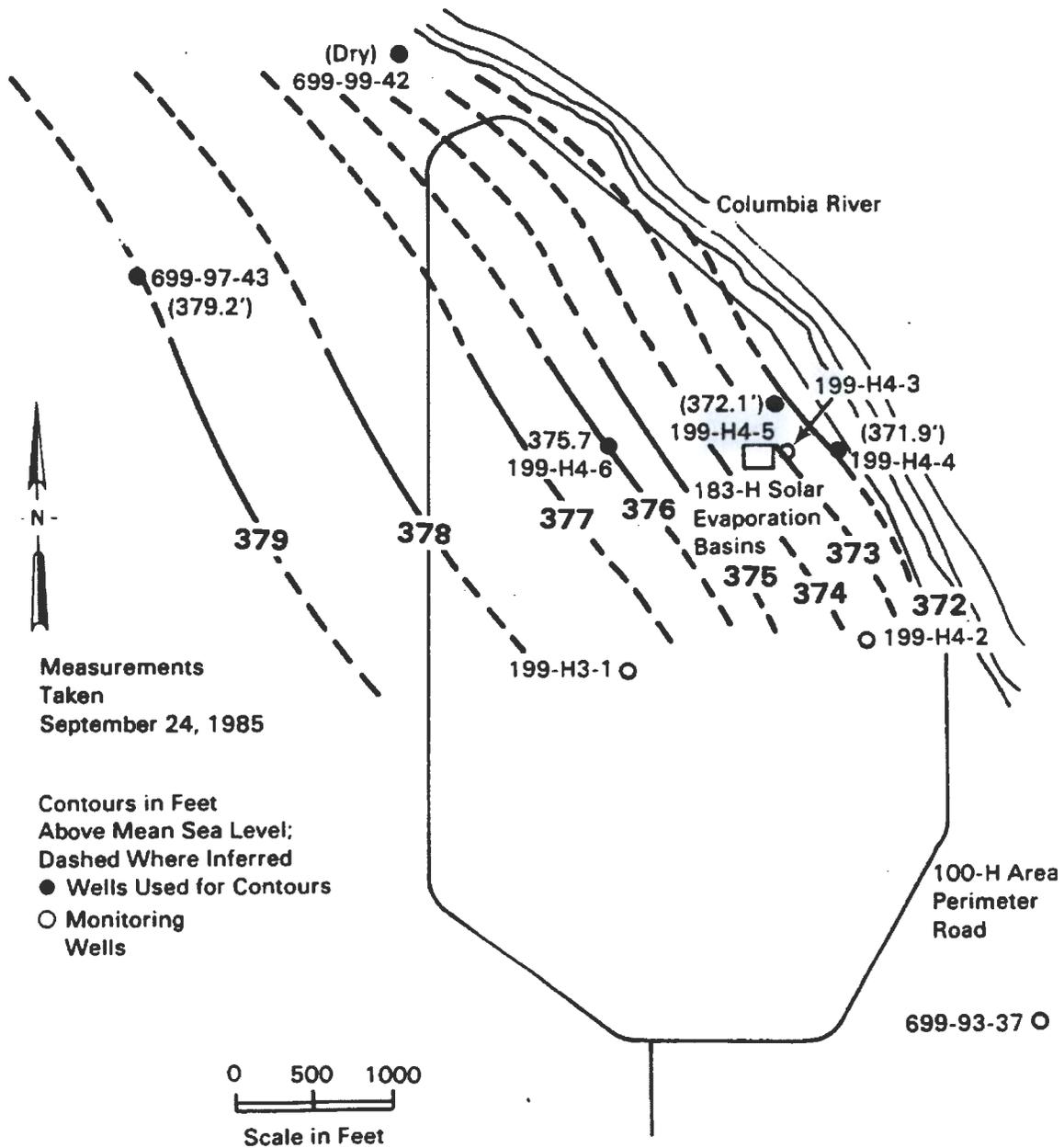


FIGURE 9. 100-H Area Water-Table Map (September 24, 1985)

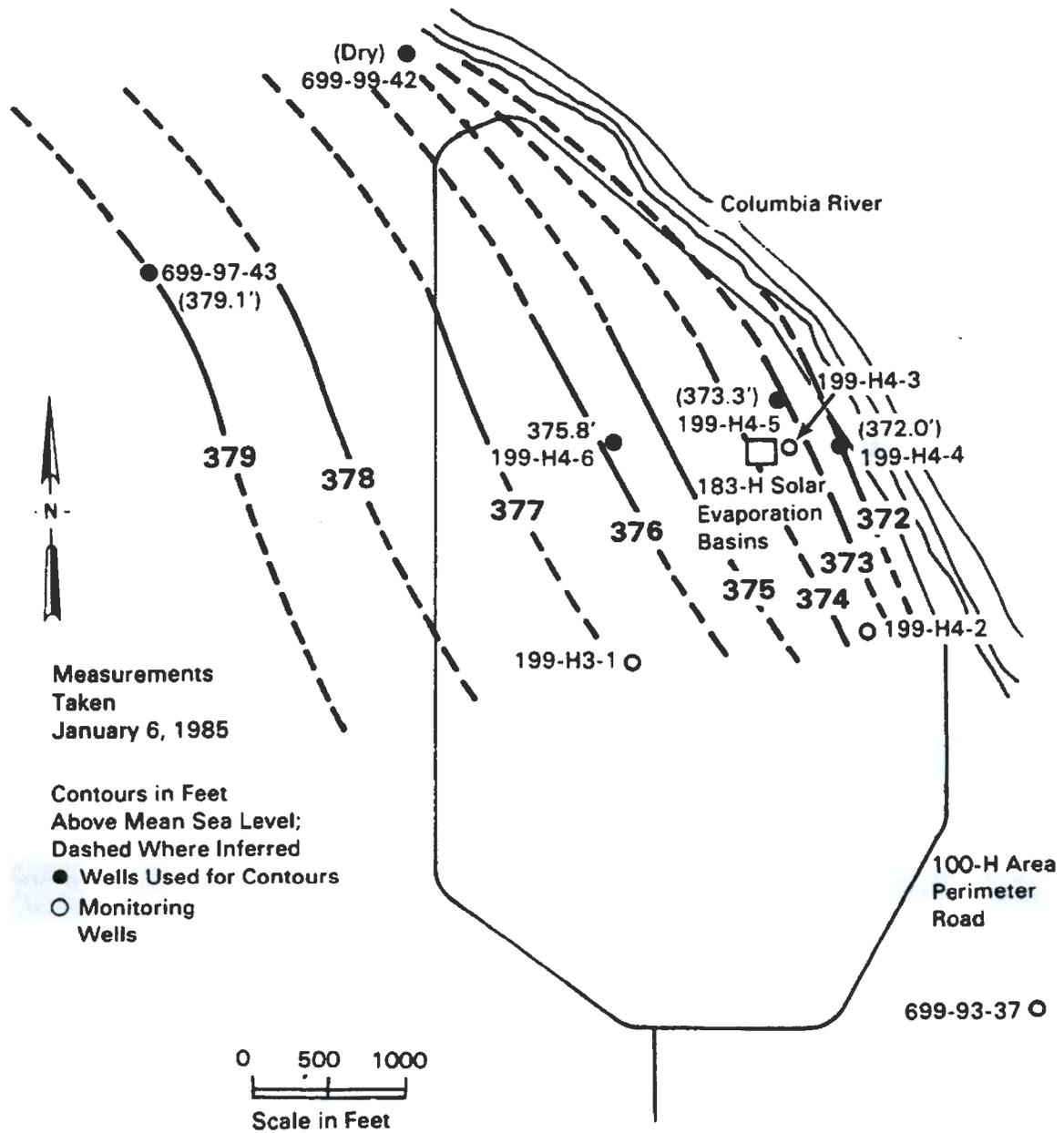


FIGURE 10. 100-H Area Water-Table Map (January 6, 1986)

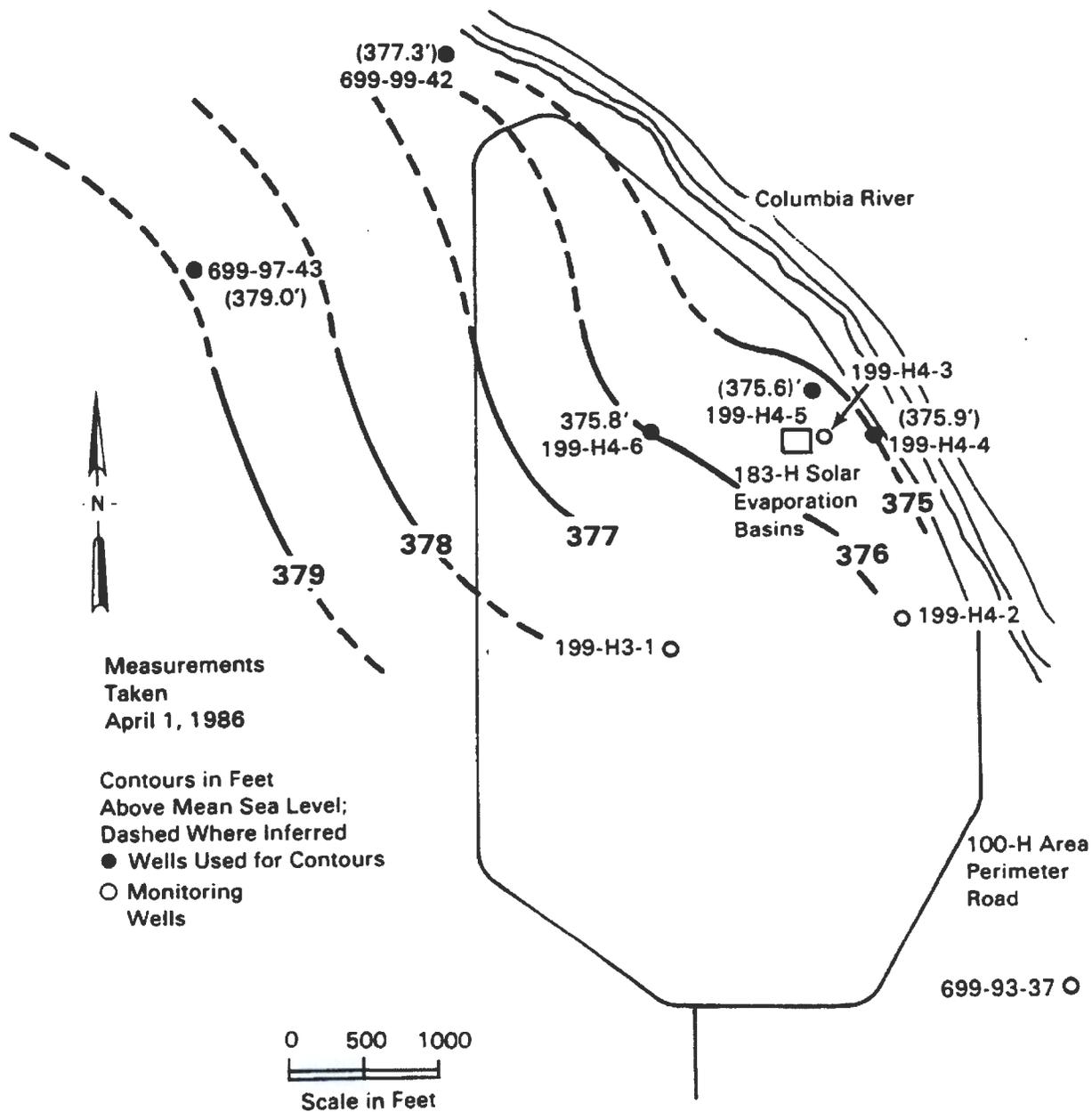


FIGURE 11. 100-H Area Water-Table Map (April 1, 1986)

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.

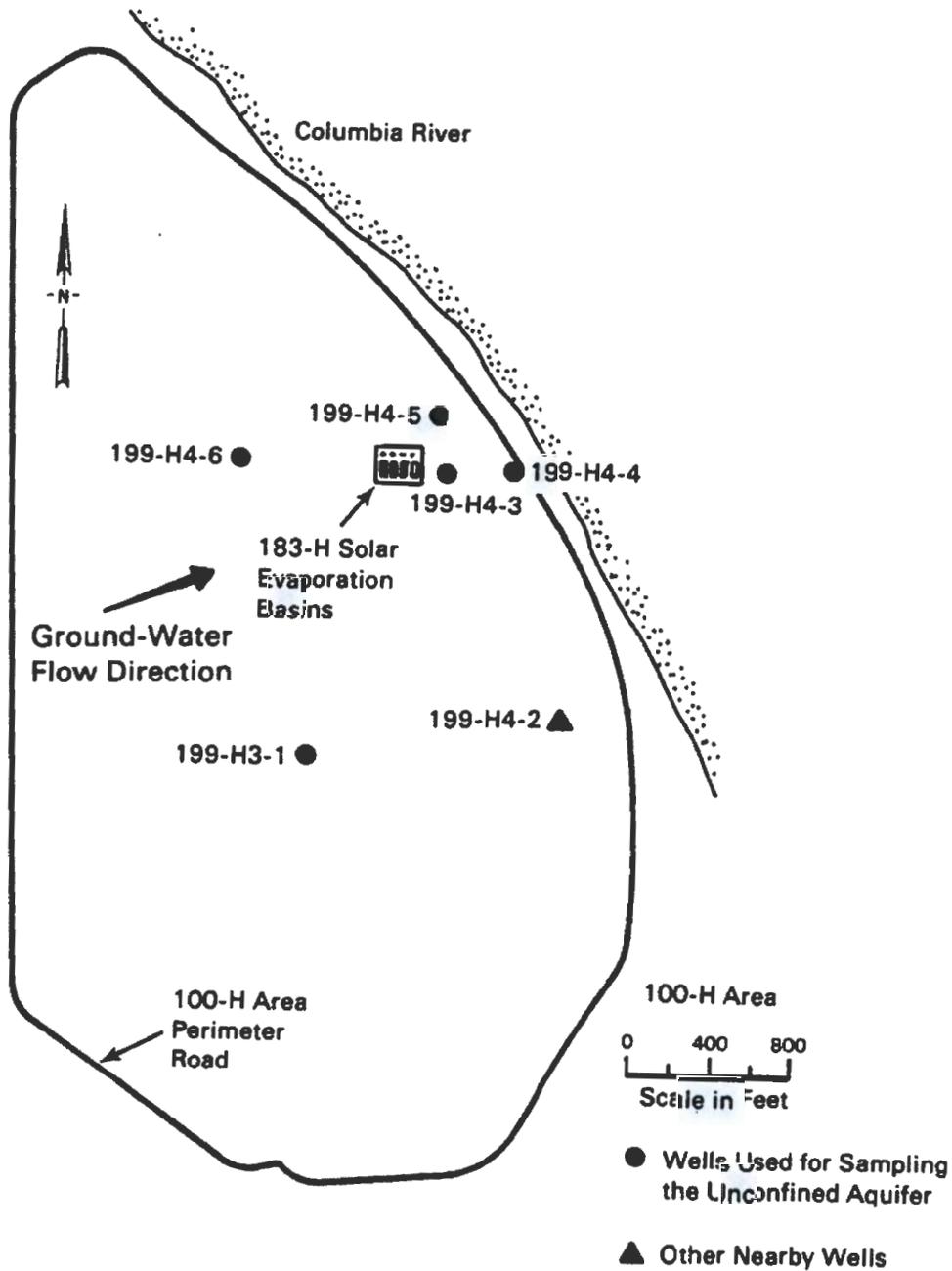


FIGURE 12. 100-H Area Well-Location Map

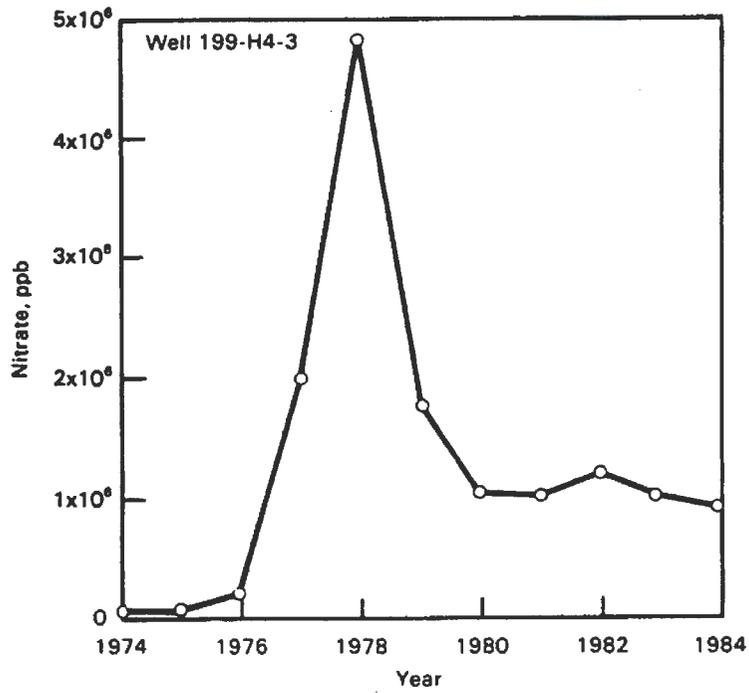


FIGURE 13. Annual Average Concentrations of Nitrate in Well 199-H4-3

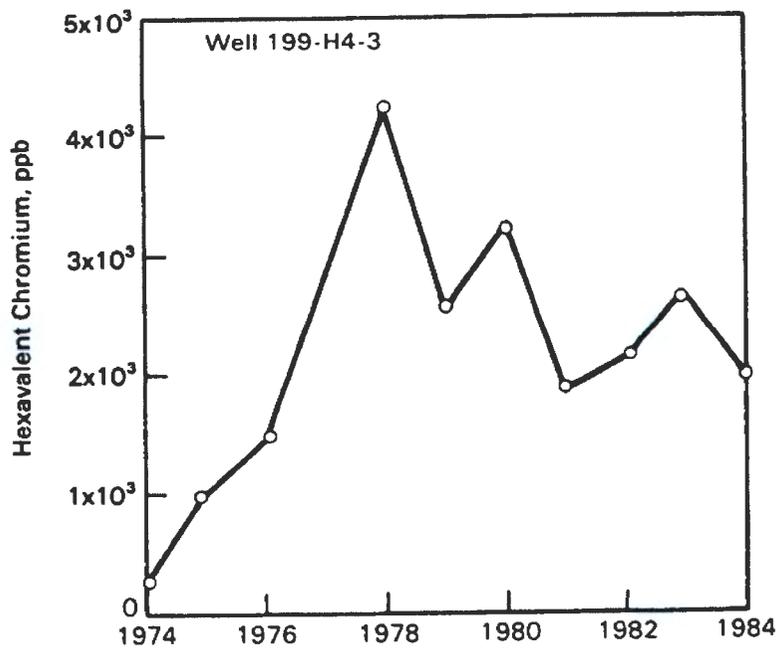


FIGURE 14. Annual Average Concentrations of Chromium in Well 199-H4-3

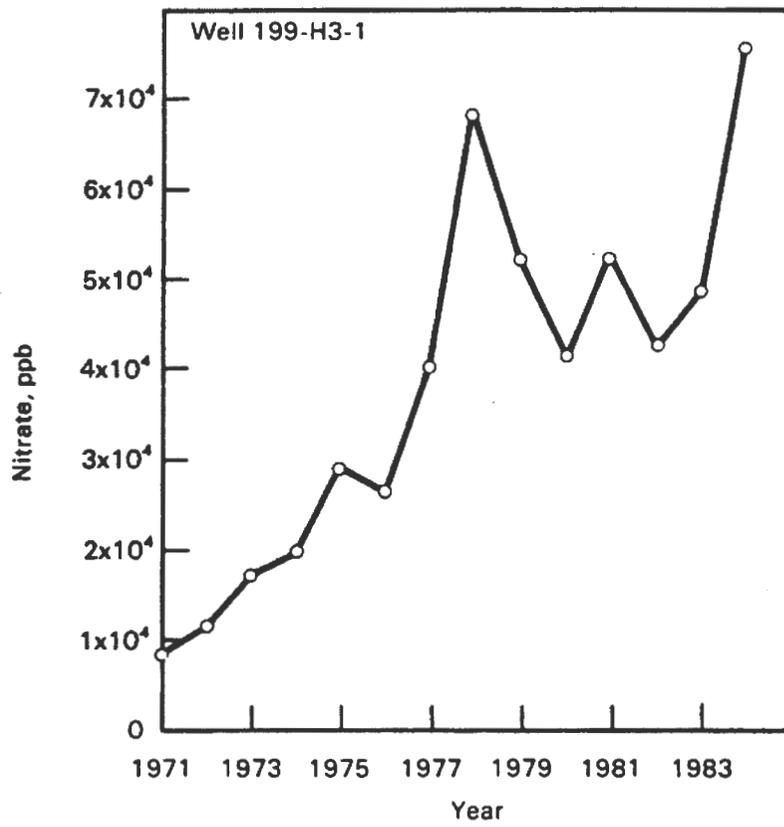


FIGURE 15. Annual Average Concentrations of Nitrate in Well 199-H3-1

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

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

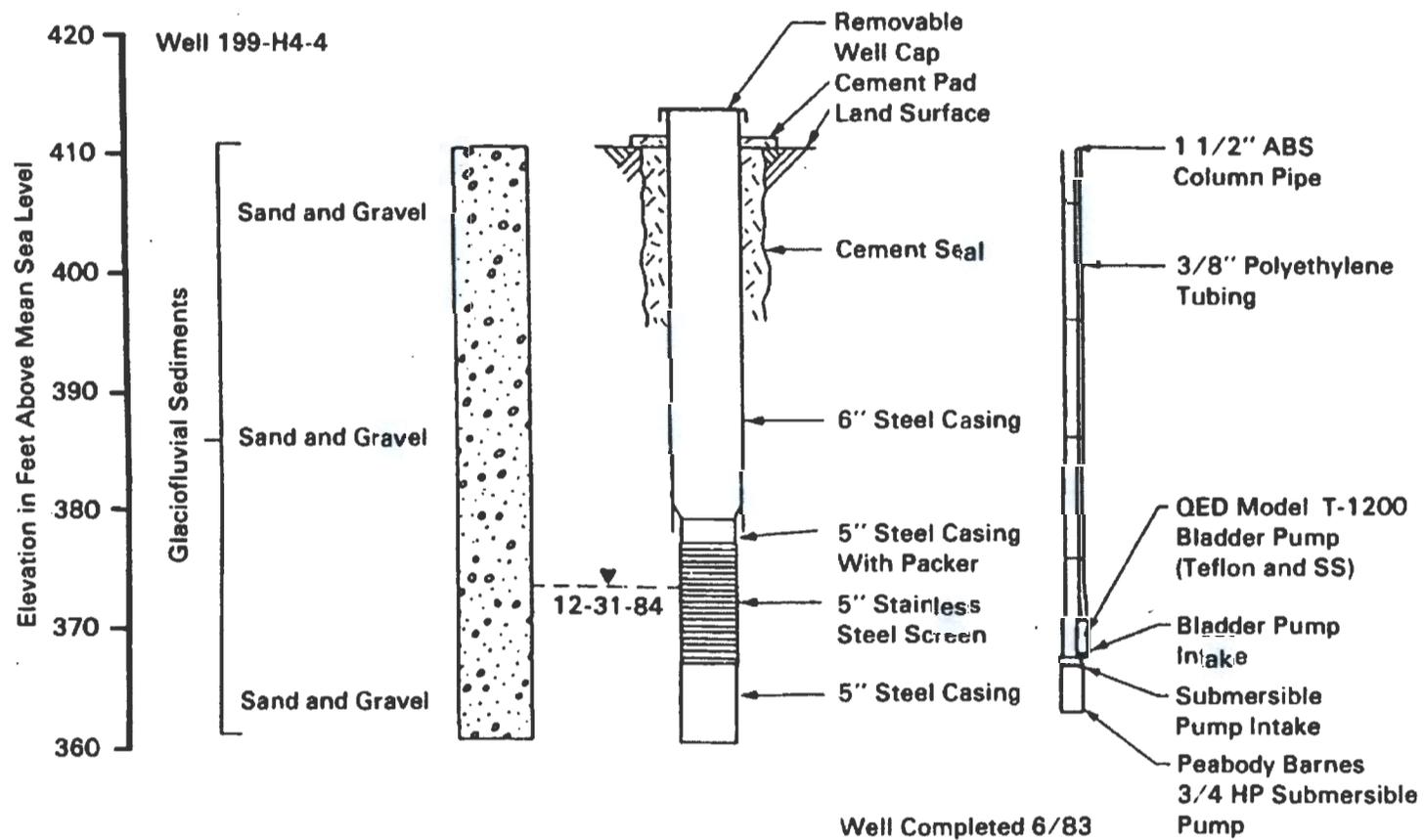


FIGURE 16. Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H4-4

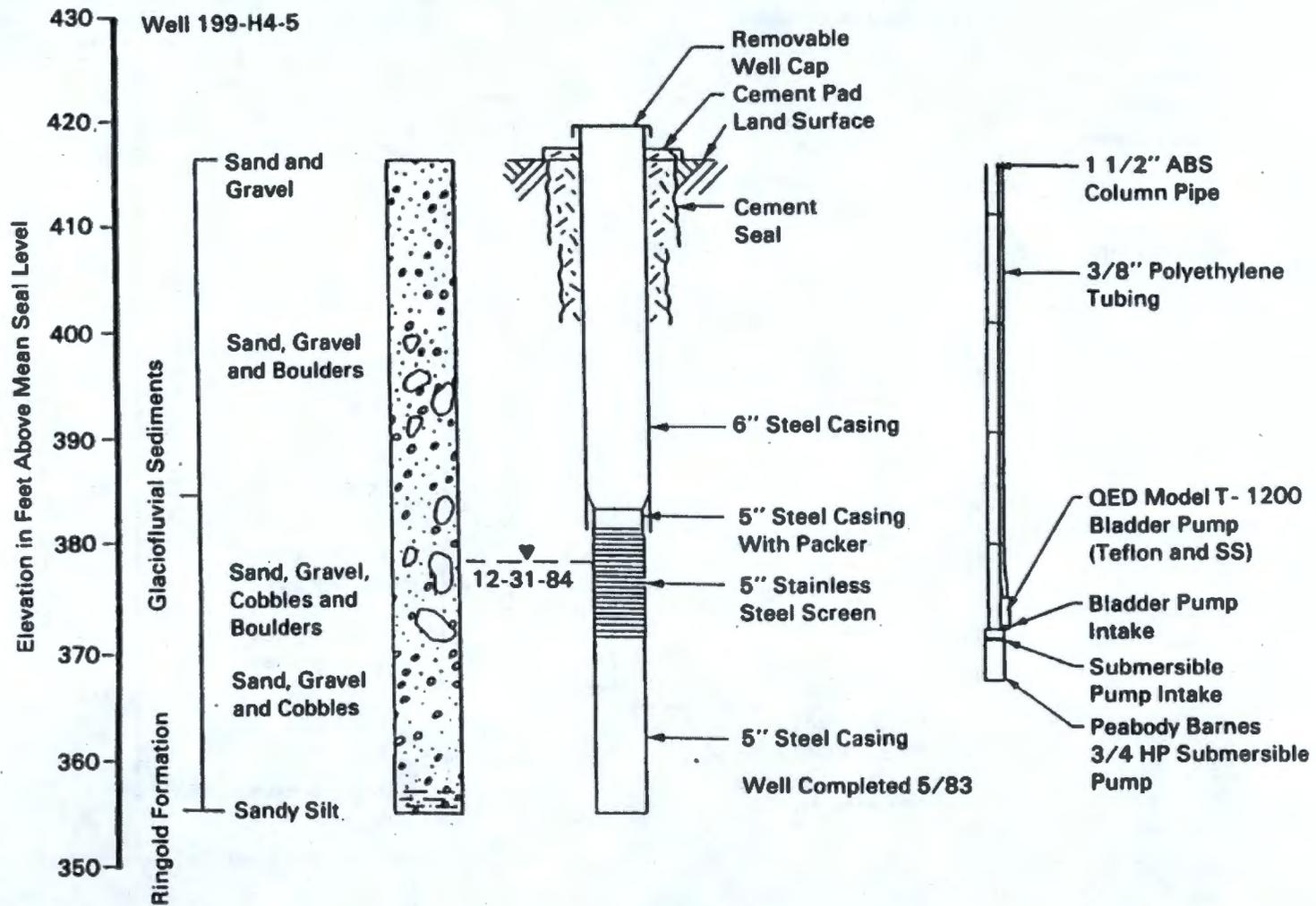


FIGURE 17. Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H4-5

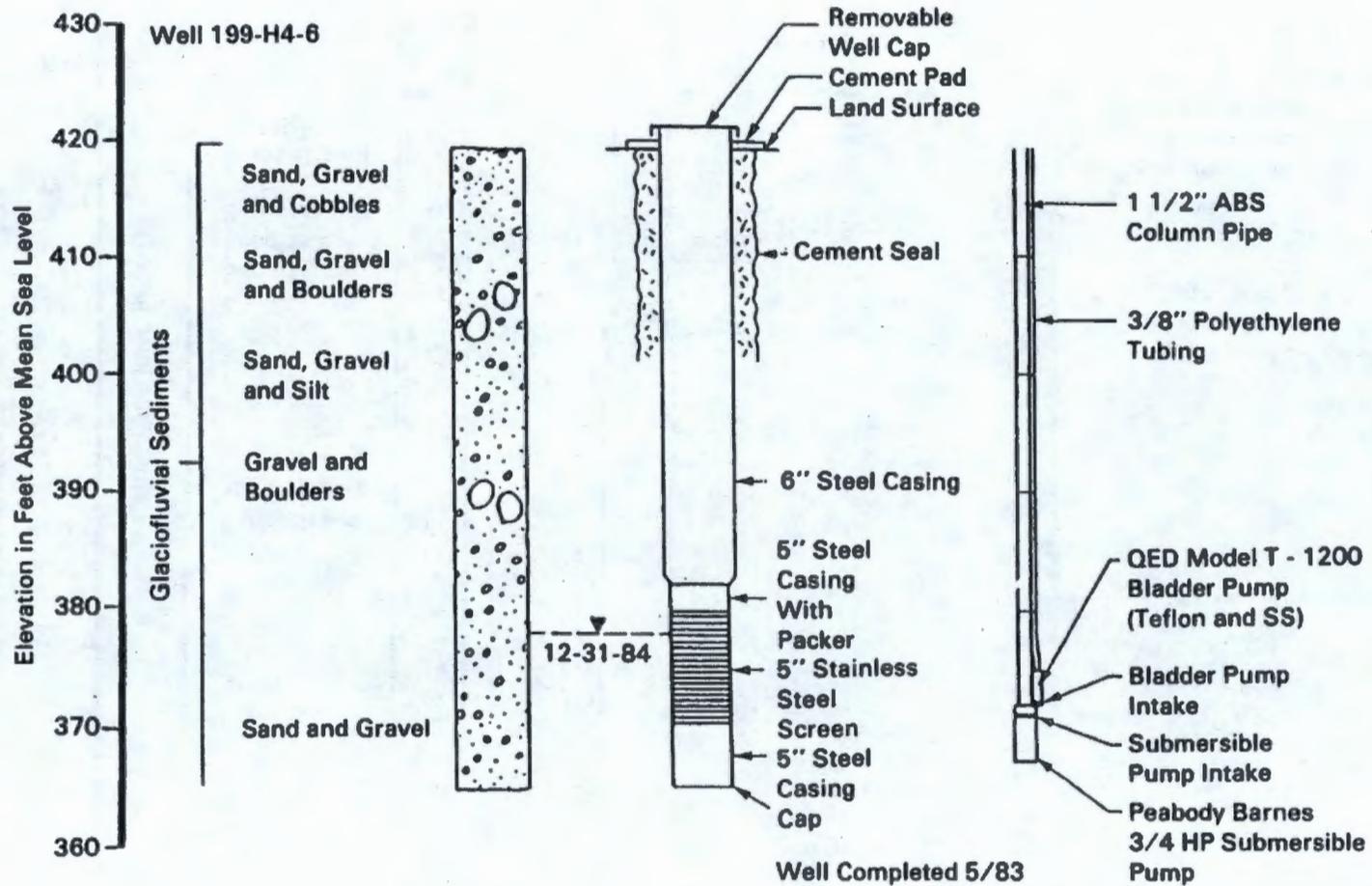


FIGURE 18. Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H4-6

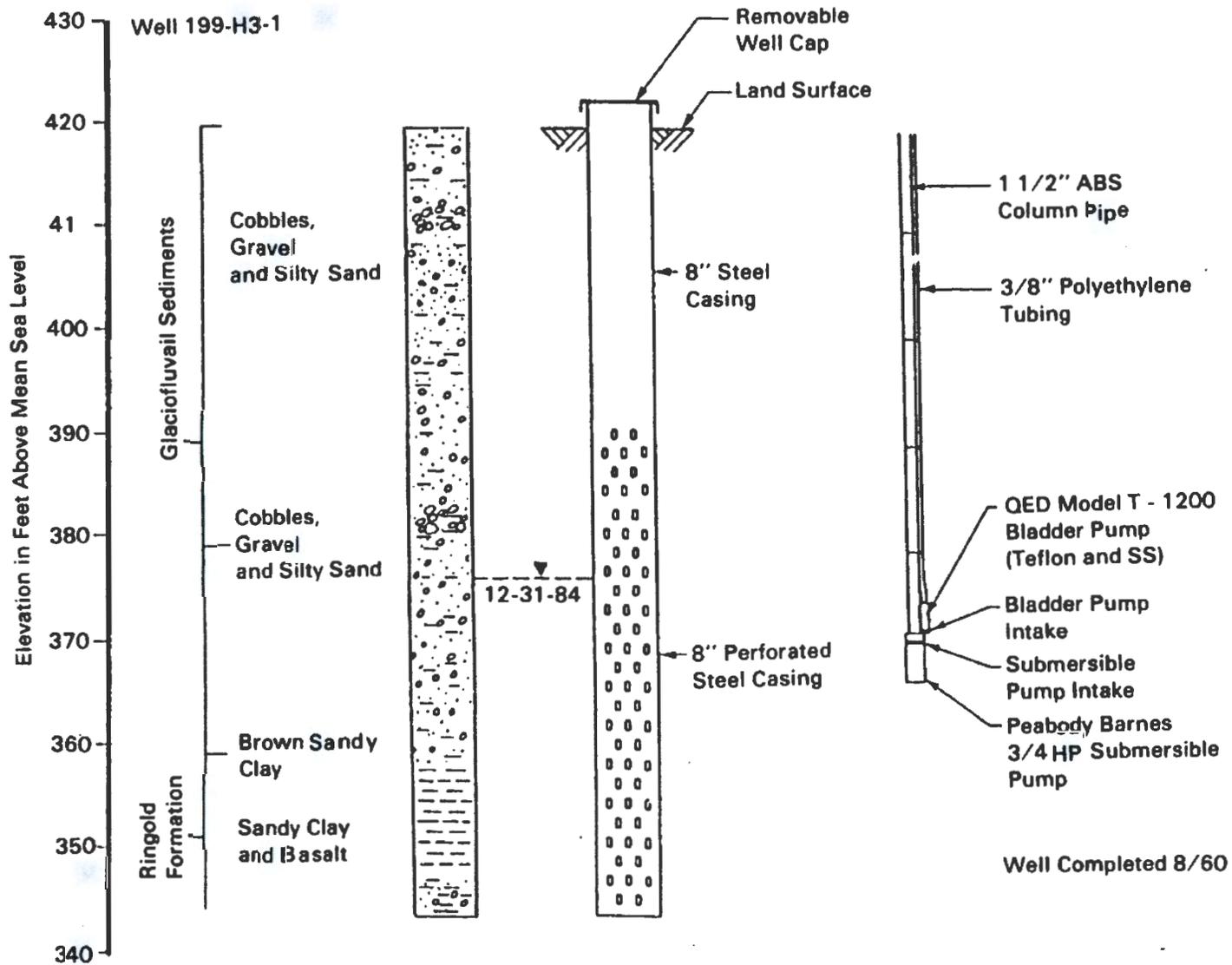


FIGURE 19. Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H3-1

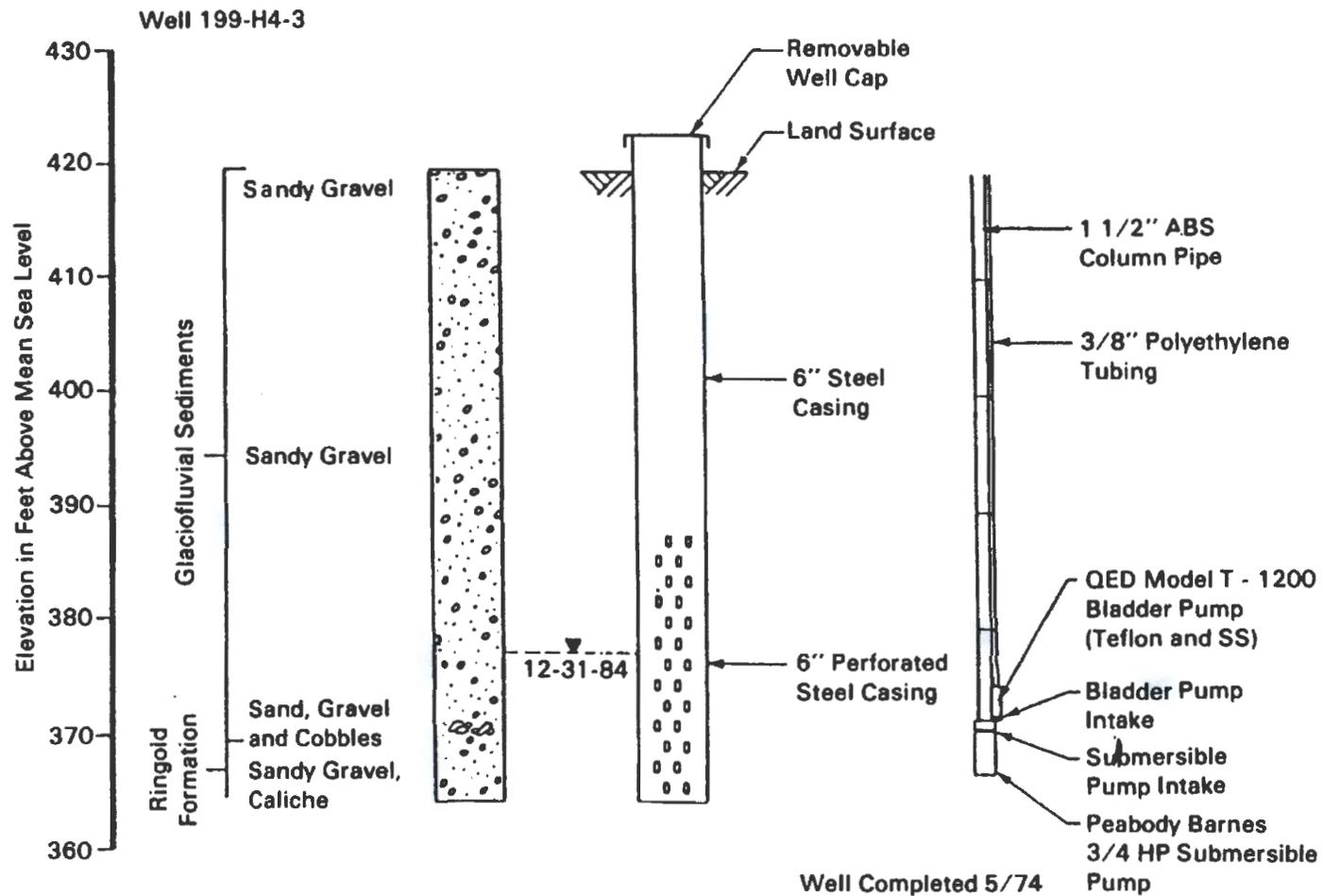


FIGURE 20. Geologic Log, Well Construction Diagram, and Pump Setting Diagram for Well 199-H4-3

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
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 ₂ SO ₄ to pH<2	Std. Methods #505	1000
Ammonium ion	G, H ₂ SO 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)

<u>Constituent</u>	<u>Collection & Preservation^(a,b)</u>	<u>Method^(c)</u>	<u>Detection Limit, ppb^(d)</u>
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 ⁽ⁱ⁾			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 micro-coulometric 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 $\pm 10\%$), 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 [$100 (\text{STDDEV}/\text{MEAN})$] 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
C88	TOX	PPB	100	64	55	.	.	.	Total organic halogen
C89	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	8	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	LDALPHA	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	CHROMIUM	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	SELENIUM	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
C67	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	61	31	.	.	.	Strontium
A04	ZINC	PPB	5	61	17	.	.	.	Zinc
A06	CALCIUM	PPB	50	61	0	.	.	.	Calcium
A12	NICKEL	PPB	10	72	68	.	.	.	Nickel
A13	COPPER	PPB	10	72	63	.	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	61	51	***	.	.	Beryllium
A02	OSMIUM	PPB	300	61	51	***	.	.	Osmium
A15	ANTIMONY	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	HEXC BEN	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
C69	1234TE	PPB	10	72	72	***	.	.	1,2,3,4-tetrachlorobenzene
C80	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		Heptachlor 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	DICDIFW	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 ***	8	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-tetrachloroethane
B06	1122-tc	PPB	10	18	18 ***				1,1,2,2-tetrachloroethane

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	BROMDRM	PPB		10	18	18	***	.	Bromoform
B09	TRCMEOL	PPB		10	18	18	***	.	Trichloromethanethiol
B10	TRCMFLW	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	10	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-aminobiphenyl
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	BENDICH	PPB		10	18	18	***	.	Benzene, dichloromethyl
B32	BENTHOL	PPB		10	18	18	***	.	Benzenethiol
B33	BENZINE	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	BIS2CHW	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	CHLAWIL	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,k]anthracene
B56	DIBCACA	PPB		10	18	18	***	.	7H-dibenzo[c,g]carbazole
B57	DIBAEPY	PPB		10	18	18	***	.	Dibenzo[a,i]pyrene
B58	DIBAHPY	PPB		10	18	18	***	.	Dibenzo[a,h]pyrene
B59	DIBAIKY	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
B66	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-diethylbenz[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	DIMPHEM	PPB	10	18	18	***	.	.	2,4-dimethylphenol
B76	DIMPPTH	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	DIPHNYD	PPB	10	18	18	***	.	.	1,2-diphenylhydrazine
B85	DIPRNT	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	HEXCXYC	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	***	.	.	Meth:pyrilene
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	METAUTO	PPB	10	18	18	***	.	.	2-methylacetonitrile
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	***	.	.	Nitrobenzene
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-nitrosoethylethylamine
C19	NNIURET	PPB	10	18	18	***			N-nitroso-N-methylurethane
C20	NNIVIMY	PPB	10	18	18	***			N-nitrosomethylvinylamine
C21	NNIMORP	PPB	10	18	18	***			N-nitrosomorpholine
C22	NNINICO	PPB	10	18	18	***			N-nitrosornicotine
C23	NNIPIPE	PPB	10	18	18	***			N-nitrosopiperidine
C24	NITRPYR	PPB	10	18	18	***			Nitrosopyrrolidine
C26	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	SAFRDL	PPB	10	18	18	***			Safrol
C39	TETRCHP	PPB	10	18	18	***			2,3,4,8-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	***			2,4,6-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	CARBPHI	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
C98	PARALDE	PPB	3000	18	18	***			Paraldehyde
C91	STRYCHN	PPB	50	39	39	***			Strychnine
C92	MALHYDR	PPB	500	39	39	***			Malic hydrazide
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
H06	ETHOXID	PPB	3000	18	18	***	.	.	Ethylene oxide
H06	ETHMETH	PPB	3000	18	18	***	.	.	Ethyl methacrylate
H07	FLUROA	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	2,4,6-T	PPB	1	17	17	***	.	.	2,4,6-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	56.6	46	40.4	69.0	15	248
A07 CADMIUM PPB	72	2	65	10	2.28	2	1.38	60.4	2	13
A08 CHROMIUM 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 SELENIUM 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	638000	
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	16700	177000	
A12 NICKEL PPB	72	10	58	.	18.6	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	7.88	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	55.6	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 constituent, 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
C88 TOX PPB	1	3	4	5	2
C89 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 CHROMIUM 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 SELENIUM 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

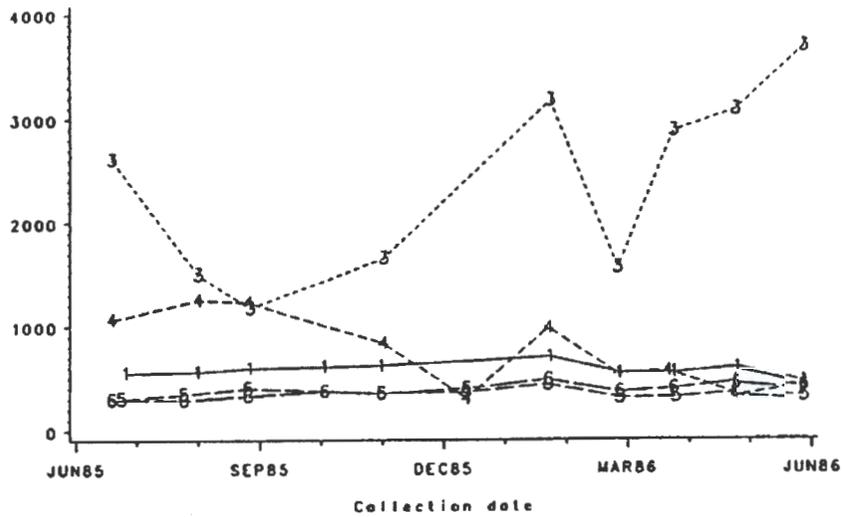


FIGURE 21. Conductivity Measurements (μmho) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

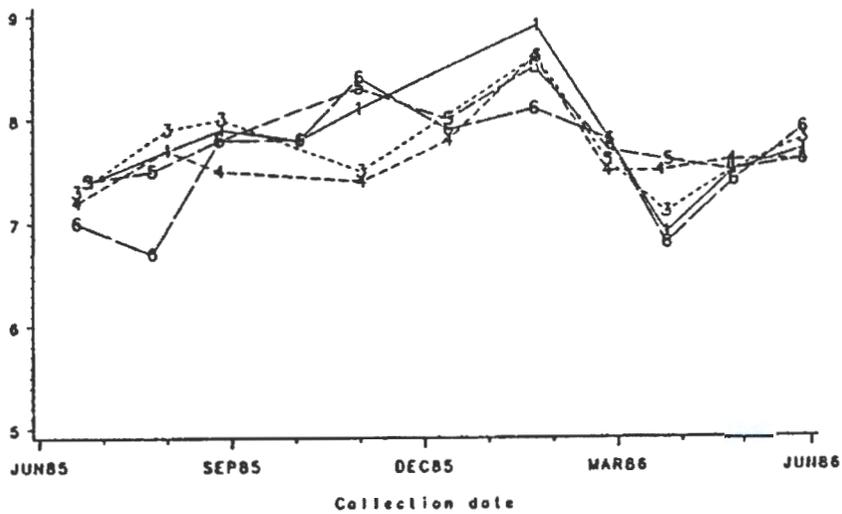


FIGURE 22. pH Measurements (pH units) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

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.

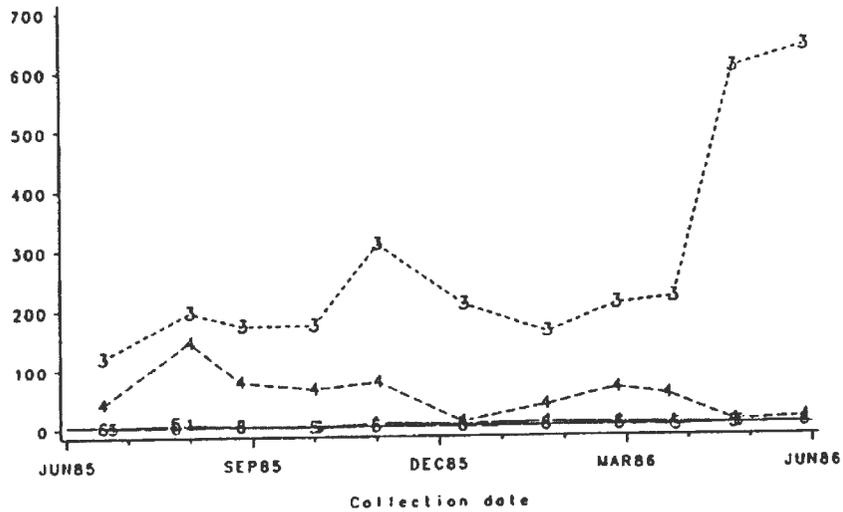
For the anions nitrate and sulfate, the values for well 199-H4-3 are notably higher than the values for the other wells (Figures 33 and 34); however, well 199-H3-1 has generally higher values for chloride (Figure 35).

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

Observations Regarding the Data

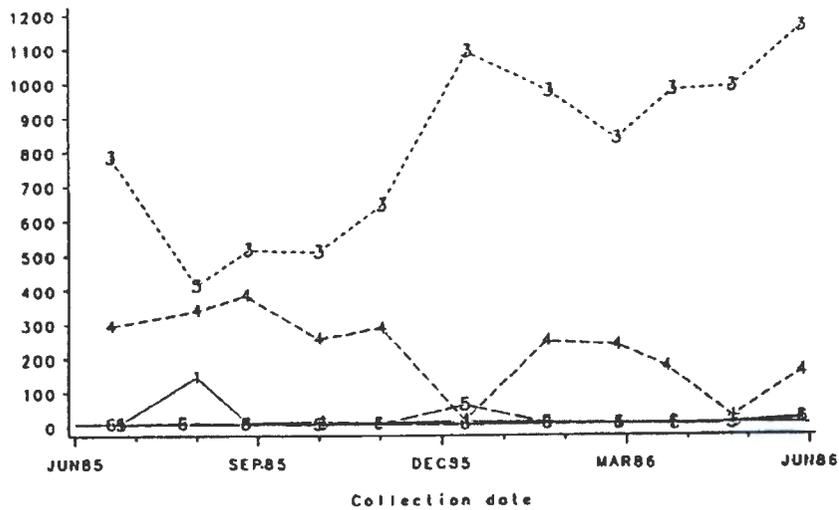
A few general observations can be made concerning the data collected during the first year of sampling. Examination of the data shows that the concentrations of a few constituents, i.e., nickel and copper, are consistently high in well 199-H4-3 but are virtually undetected elsewhere (Figures 29 and 30). 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.



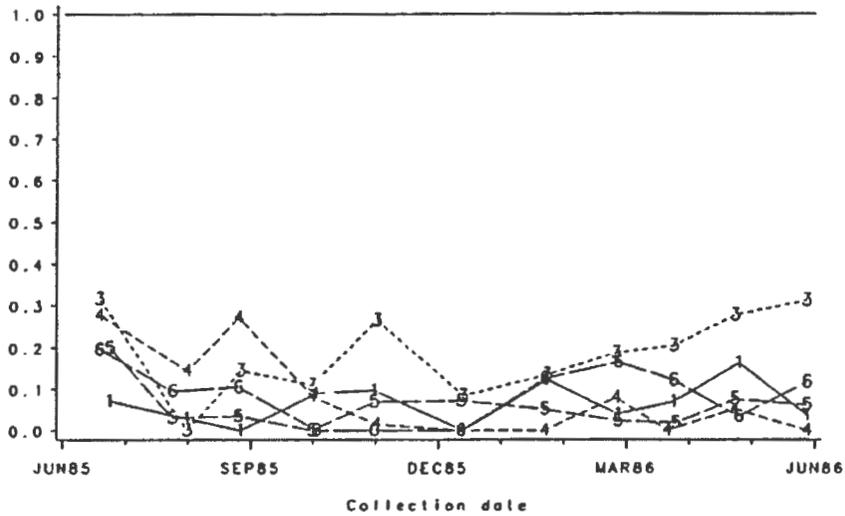
Horizontal solid line is detection limit

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



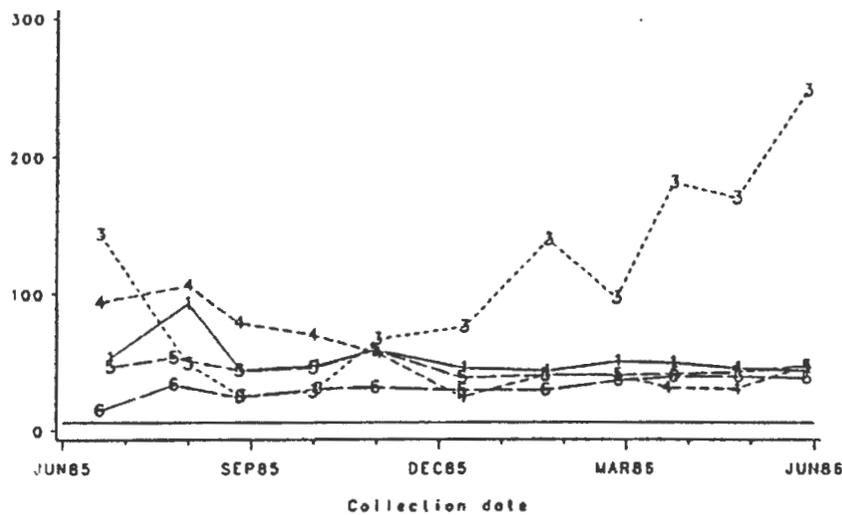
Horizontal solid line is detection limit

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



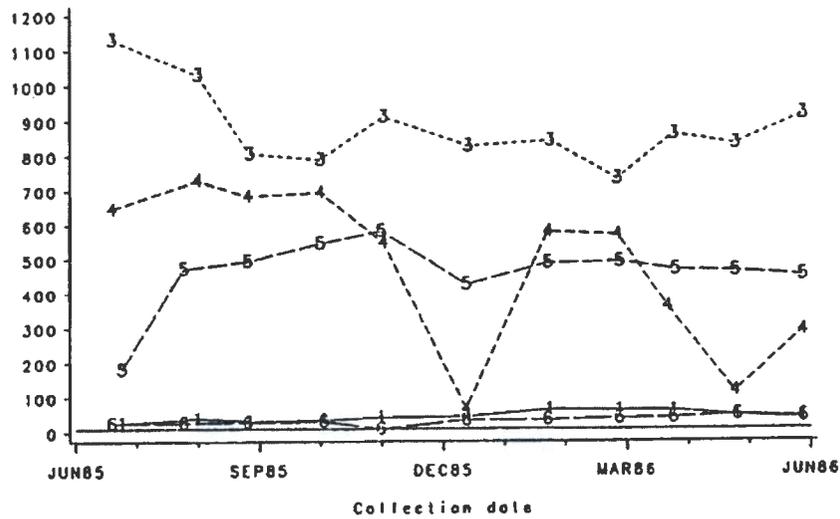
Horizontal solid line is detection limit

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



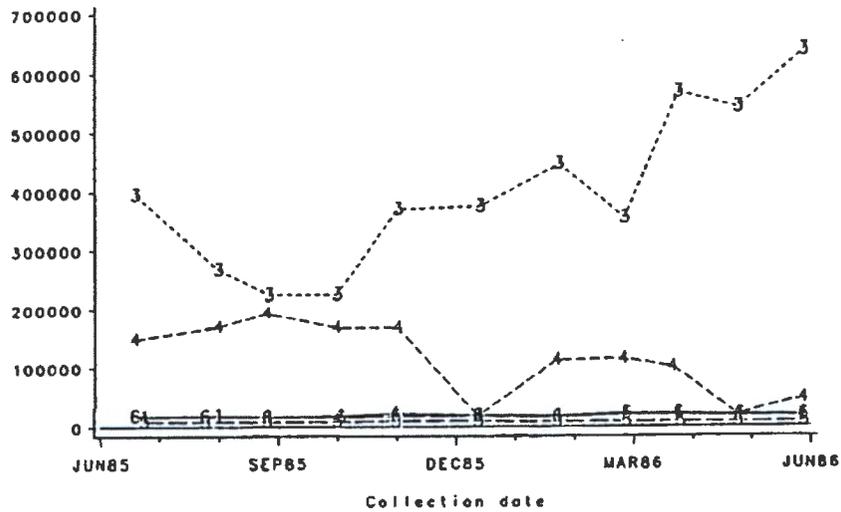
Horizontal solid line is detection limit

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



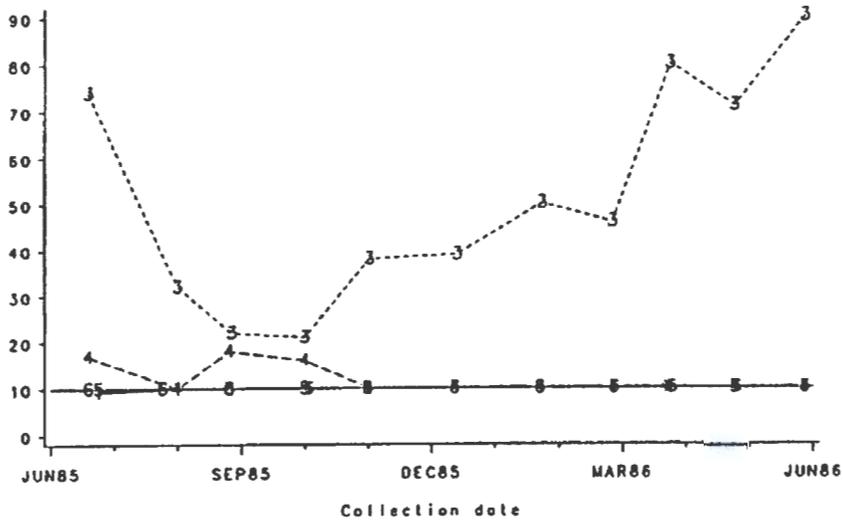
Horizontal solid line is detection limit

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



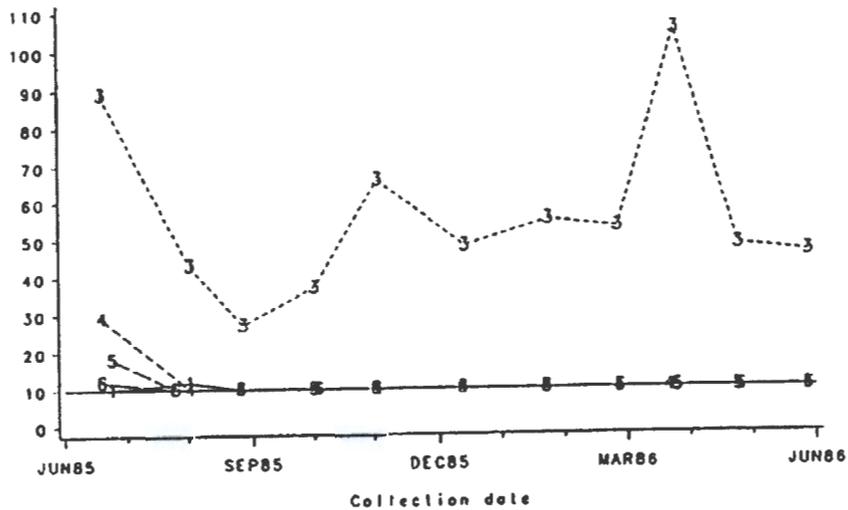
Horizontal solid line is detection limit

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



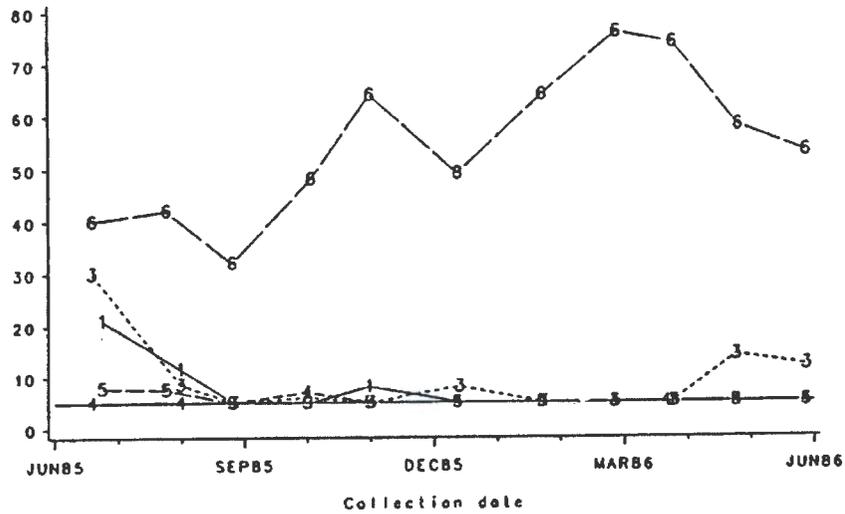
Horizontal solid line is detection limit

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



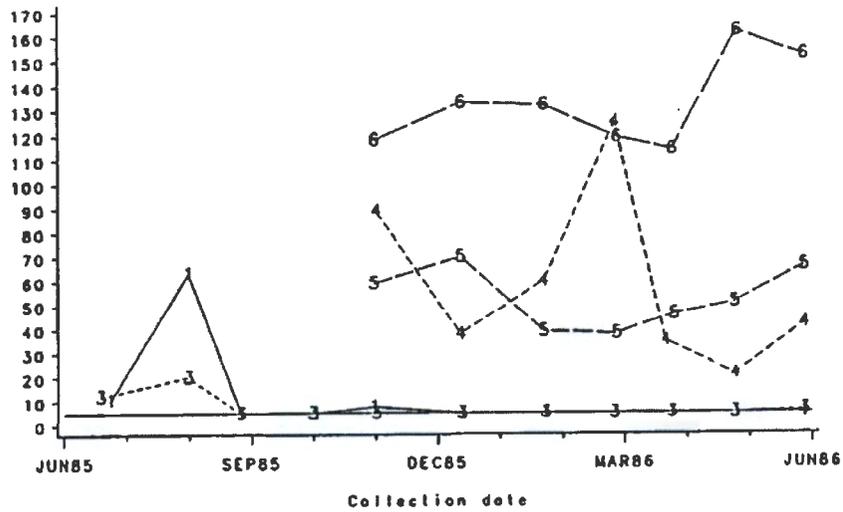
Horizontal solid line is detection limit

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



Horizontal solid line is detection limit

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



Horizontal solid line is detection limit

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

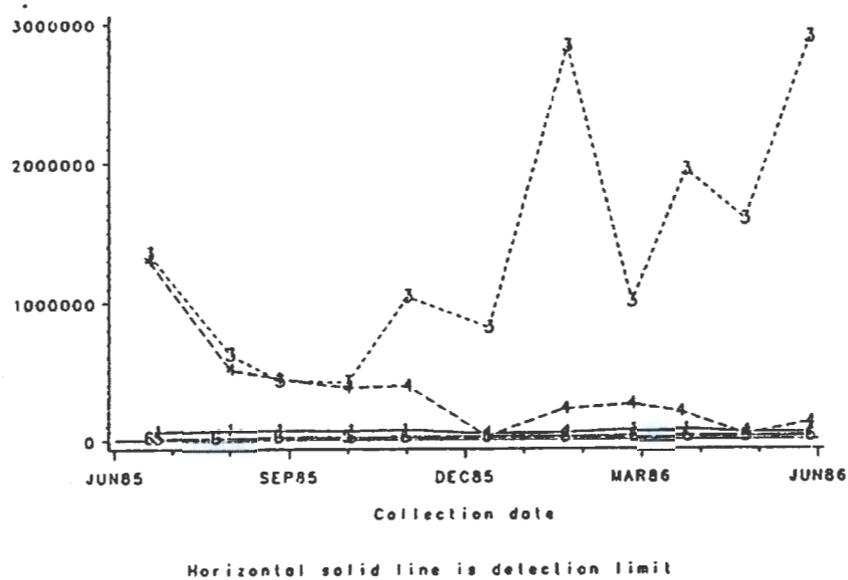


FIGURE 33. Nitrate Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

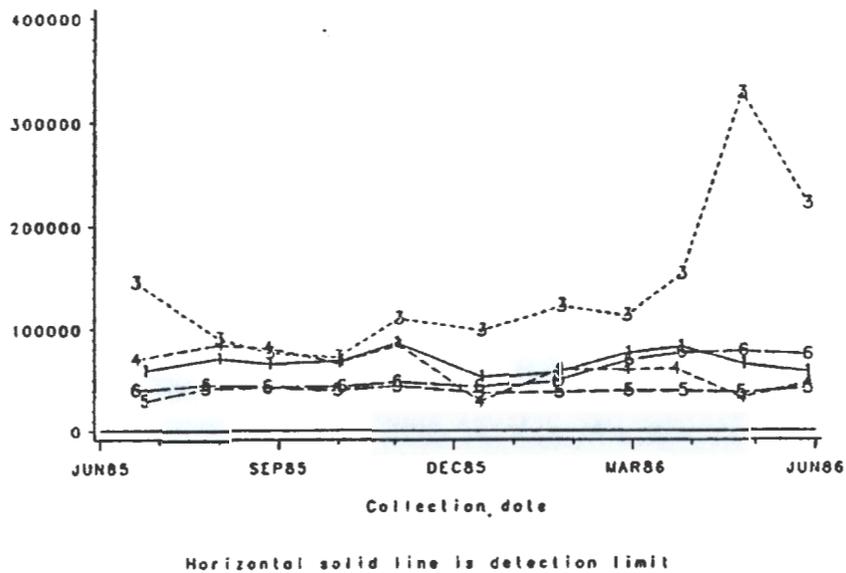


FIGURE 34. Sulfate Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

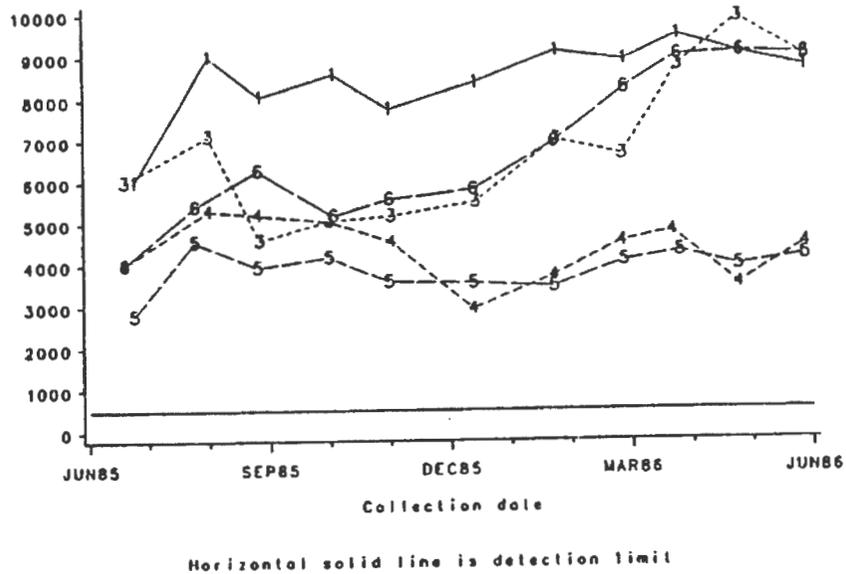


FIGURE 35. Chloride Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

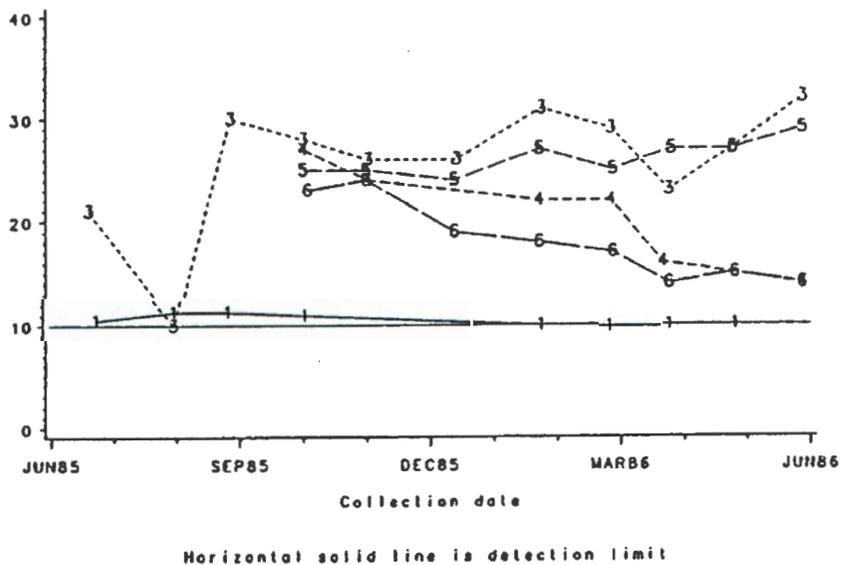


FIGURE 36. Chloroform Concentrations (ppb) for Wells 199-H3-1 (1), 199-H4-3 (3), 199-H4-4 (4), 199-H4-5 (5), and 199-H4-6 (6), June 1985 through May 1986

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 concentrations 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 intermittent 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 extractor 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

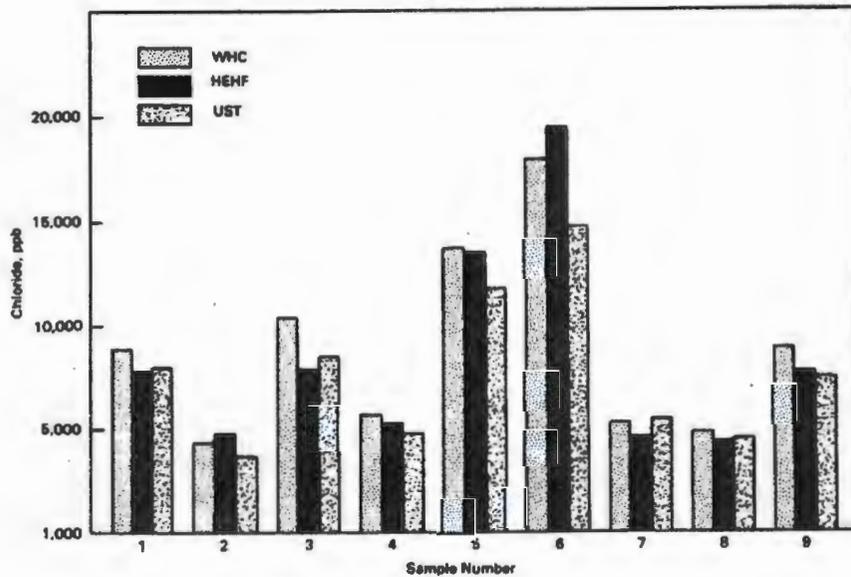


FIGURE 37. Interlaboratory Comparison Results for Chloride, October 1985

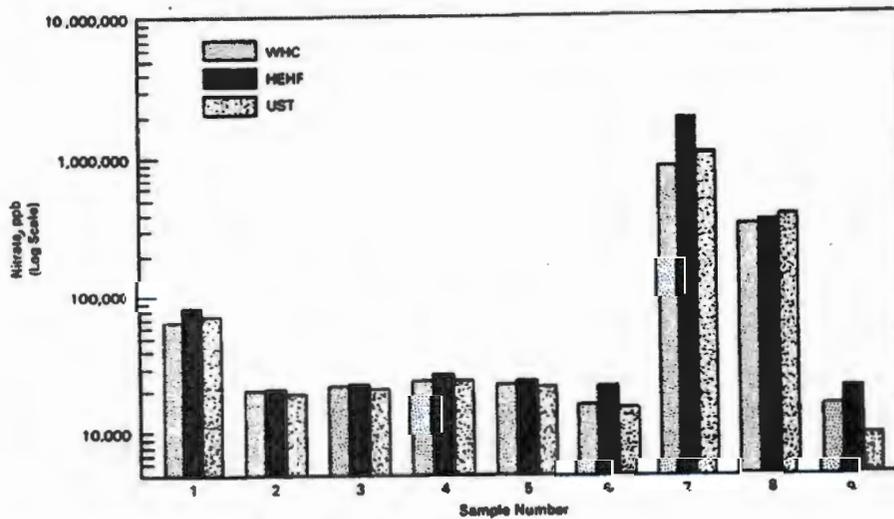


FIGURE 38. Interlaboratory Comparison Results for Nitrate, October 1985

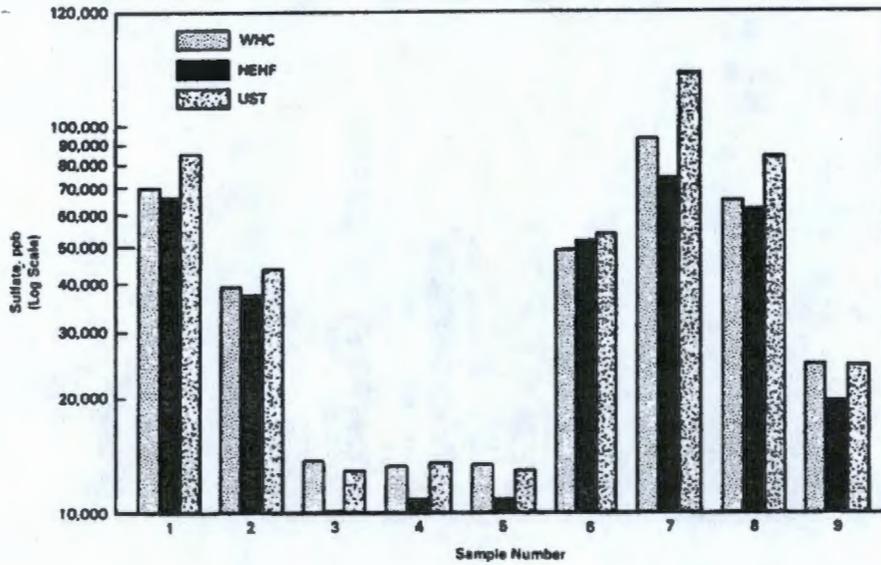


FIGURE 39. Interlaboratory Comparison Results for Sulfate, October 1985

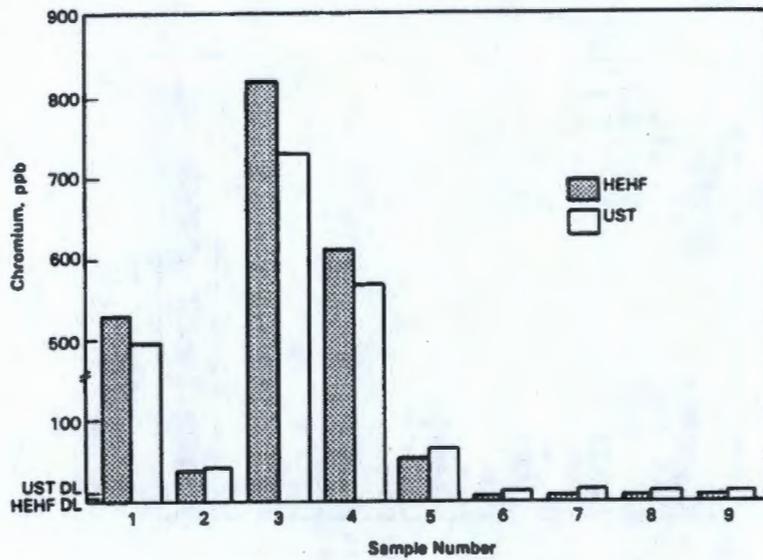


FIGURE 40. Interlaboratory Comparison Results for Chromium, February 1986

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.

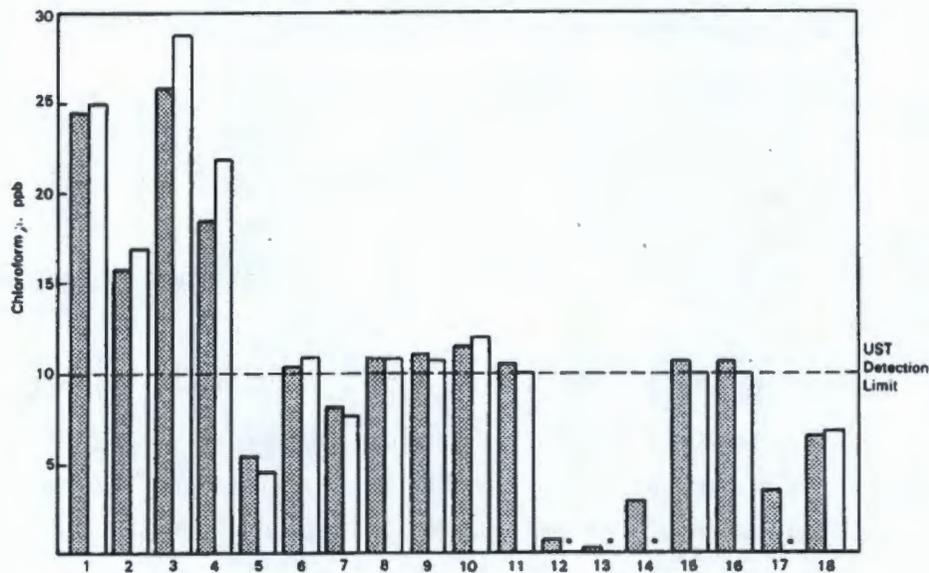


FIGURE 41. Interlaboratory Comparison Results for Chloroform, February 1986

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

Metals	January 1986		April 1986	
	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

<u>Ions</u>	<u>UST Analysis</u>	<u>WHC Analysis</u>	<u>Target Range</u>
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

<u>Pesticides</u>	<u>UST Analysis</u>	<u>Target Range</u>
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

<u>Pesticides</u>	<u>UST Analysis</u>	<u>Target Range</u>
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

<u>Volatile Organics</u>	<u>UST Analysis</u>	<u>PNL Analysis</u>	<u>Target Range</u>
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

<u>Volatile Organics</u>	<u>UST Analysis^(a)</u>	<u>PNL Analysis^(a)</u>	<u>Target Range</u>
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, tetrachloroethylene, 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).

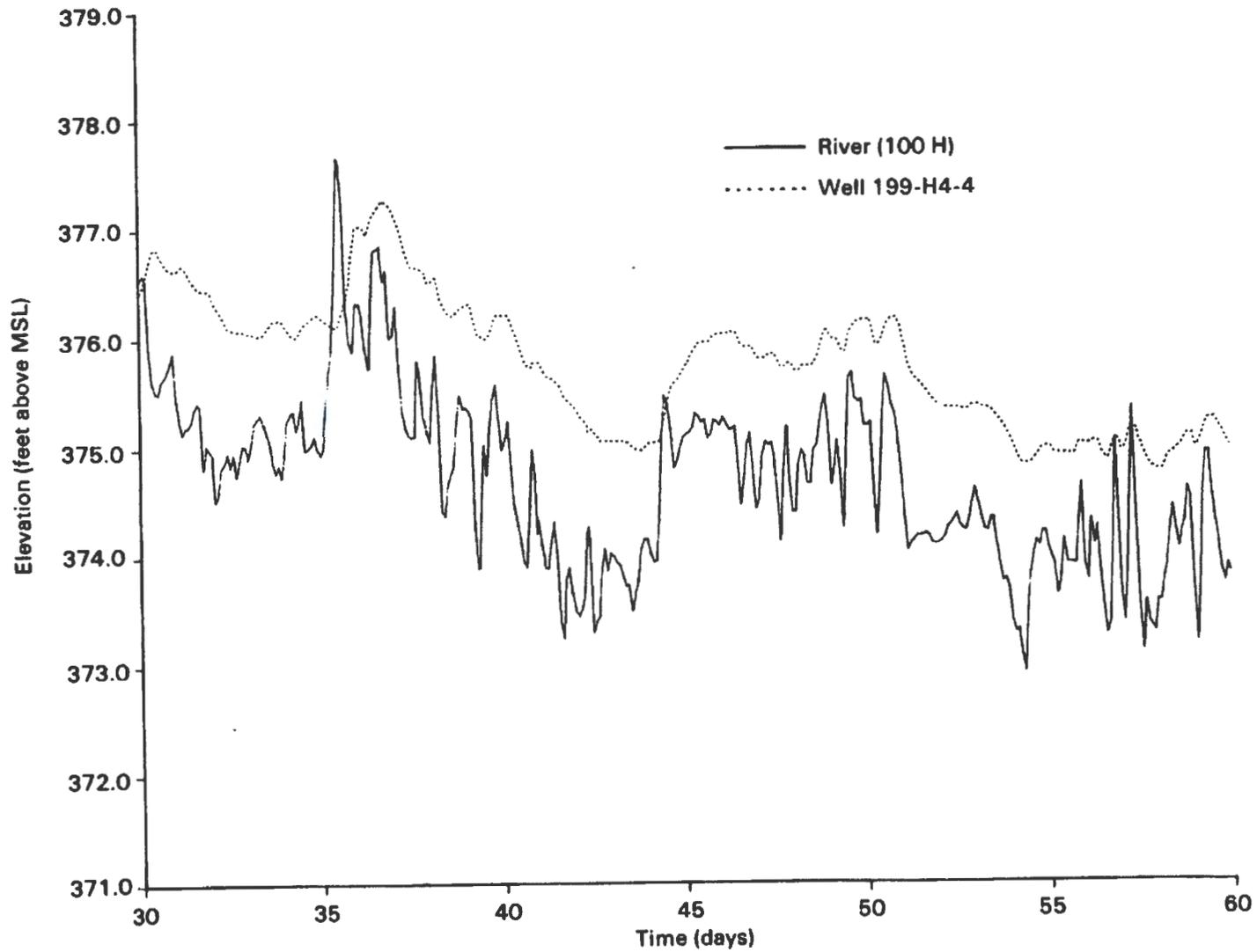


FIGURE 42. Water-Level Measurements for Well 199-H4-4 Plotted with Columbia River Stage During Days 30-60 of 1985

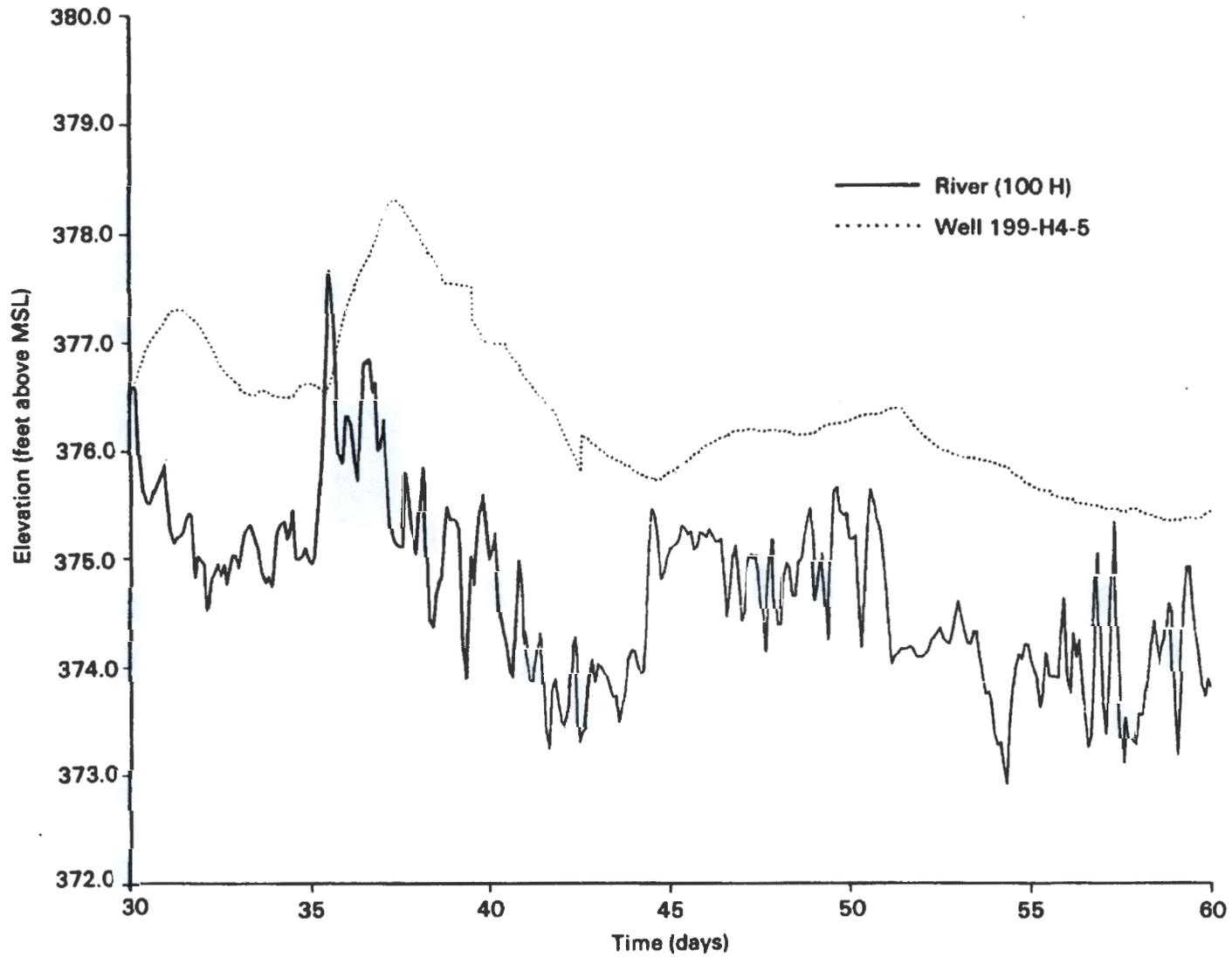


FIGURE 43. Water-Level Measurements for Well 199-H4-5 Plotted with Columbia River Stage During Days 30-60 of 1985

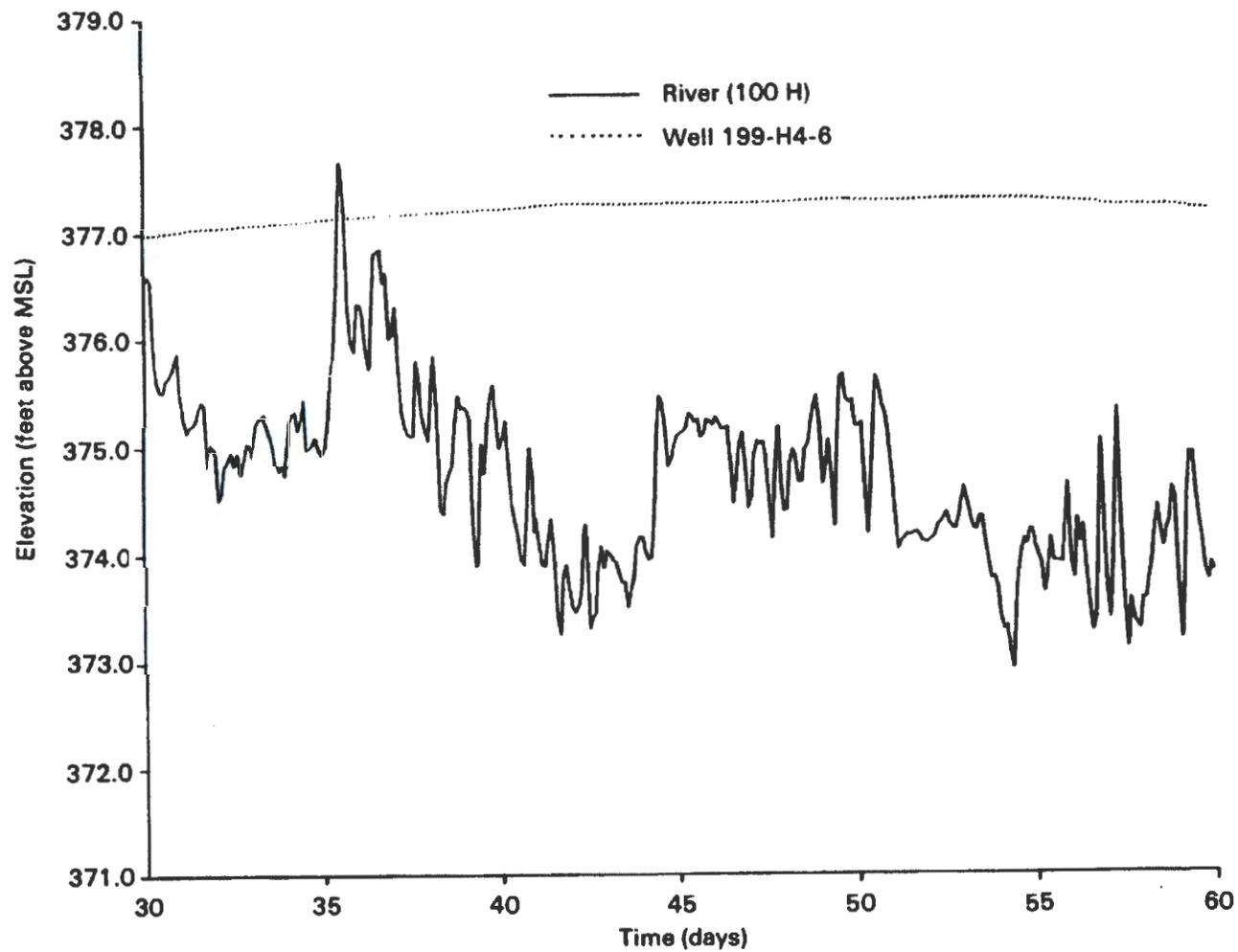


FIGURE 44. Water-Level Measurements for Well 199-H4-6 Plotted with Columbia River Stage During Days 30-60 of 1985

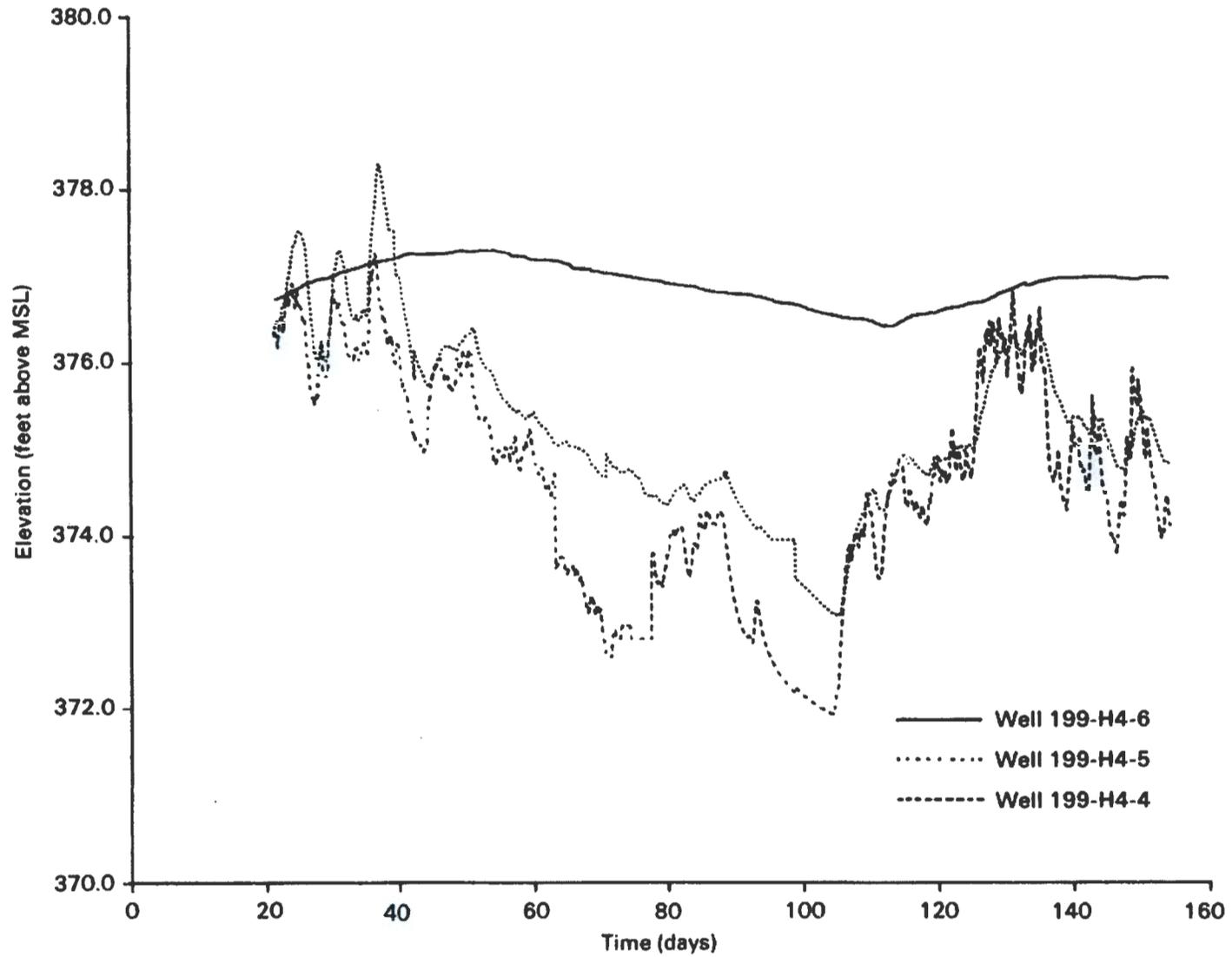


FIGURE 45. Hydrographs of Continuously Monitored Wells in the 100-H Area

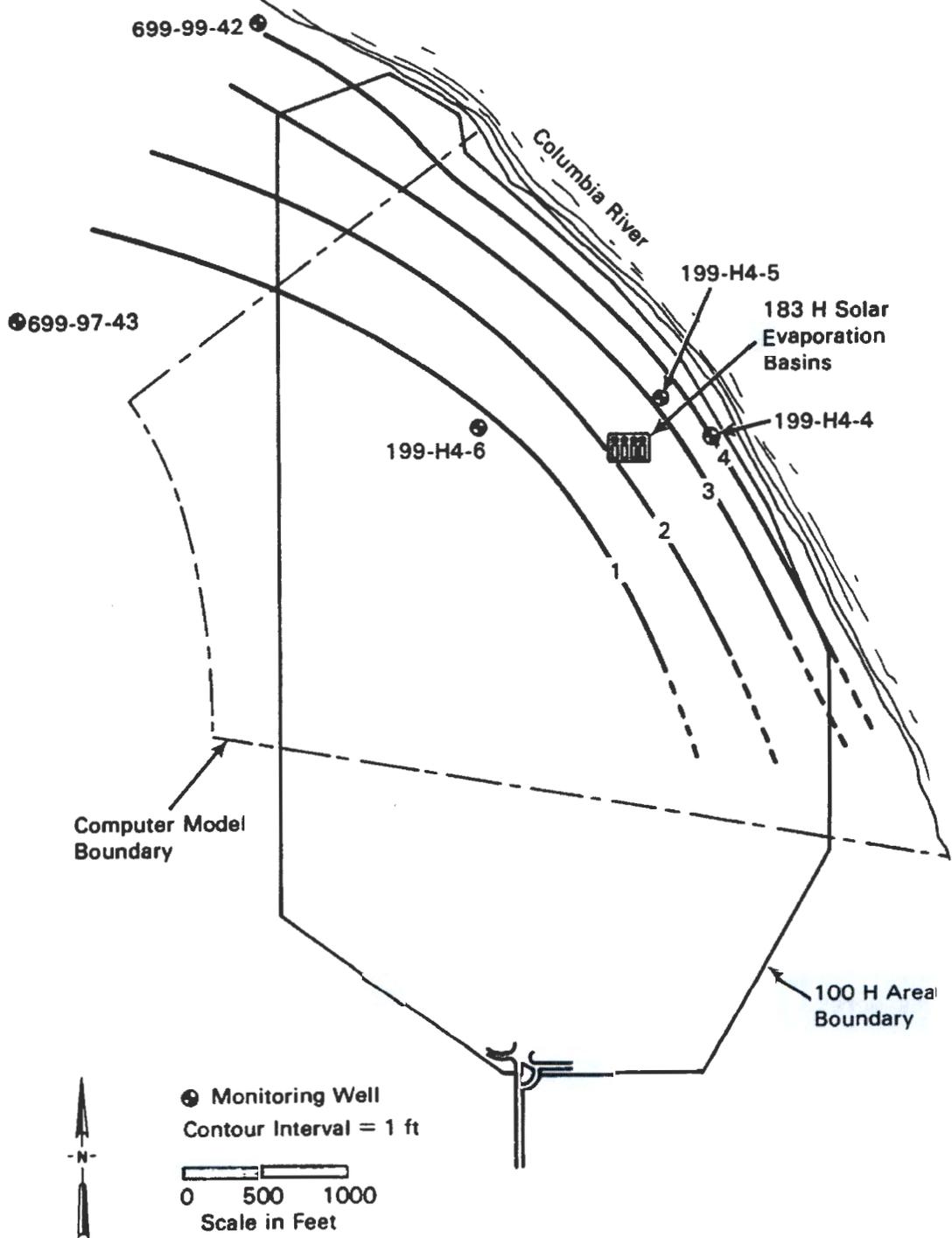


FIGURE 46. Maximum Water-Level Change (ft) Due to Columbia River Stage Fluctuations

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.

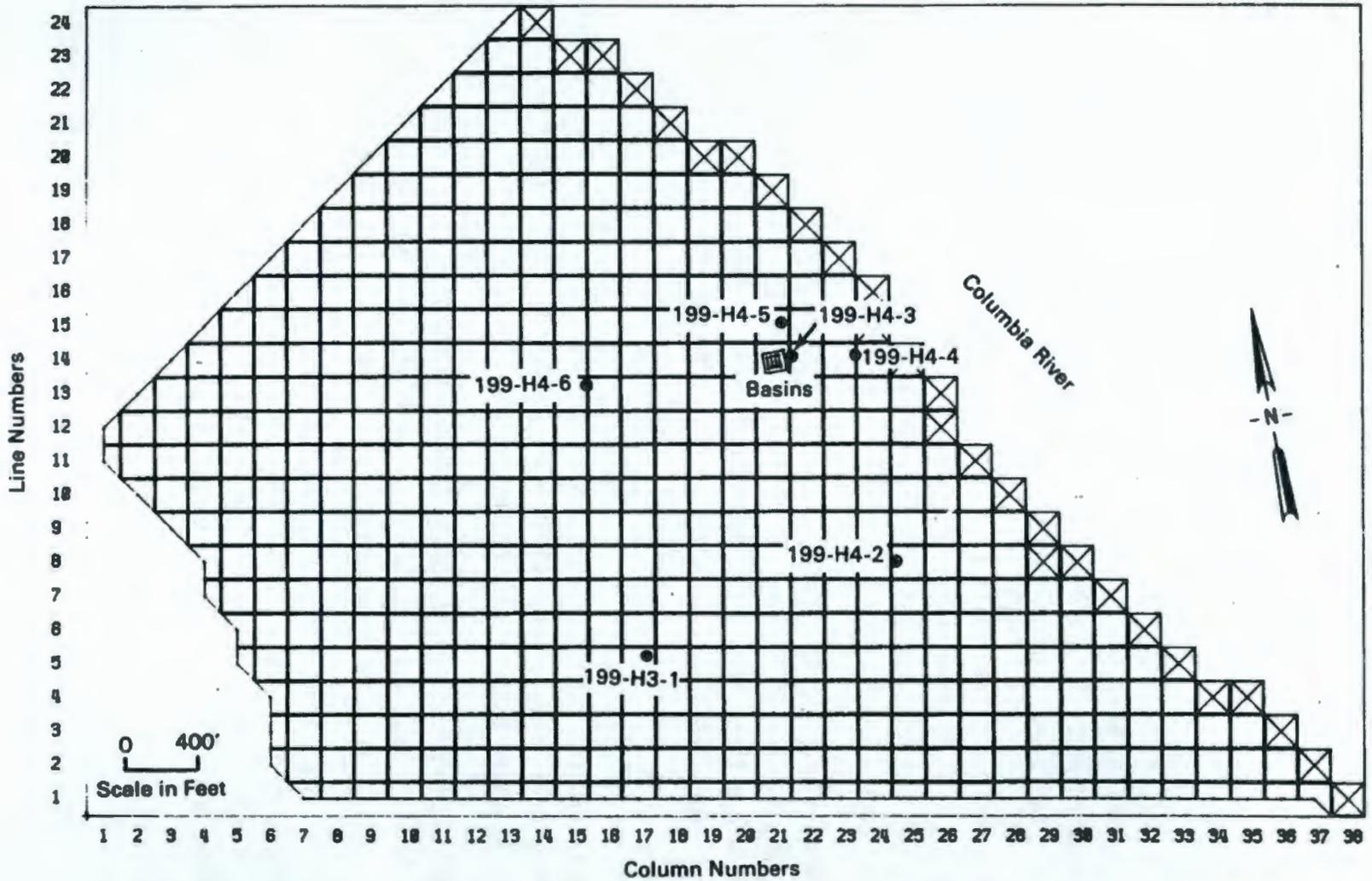


FIGURE 47. Grid Used for the Modeling Project, Including Locations of 183-H Basins and Monitoring Wells.

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

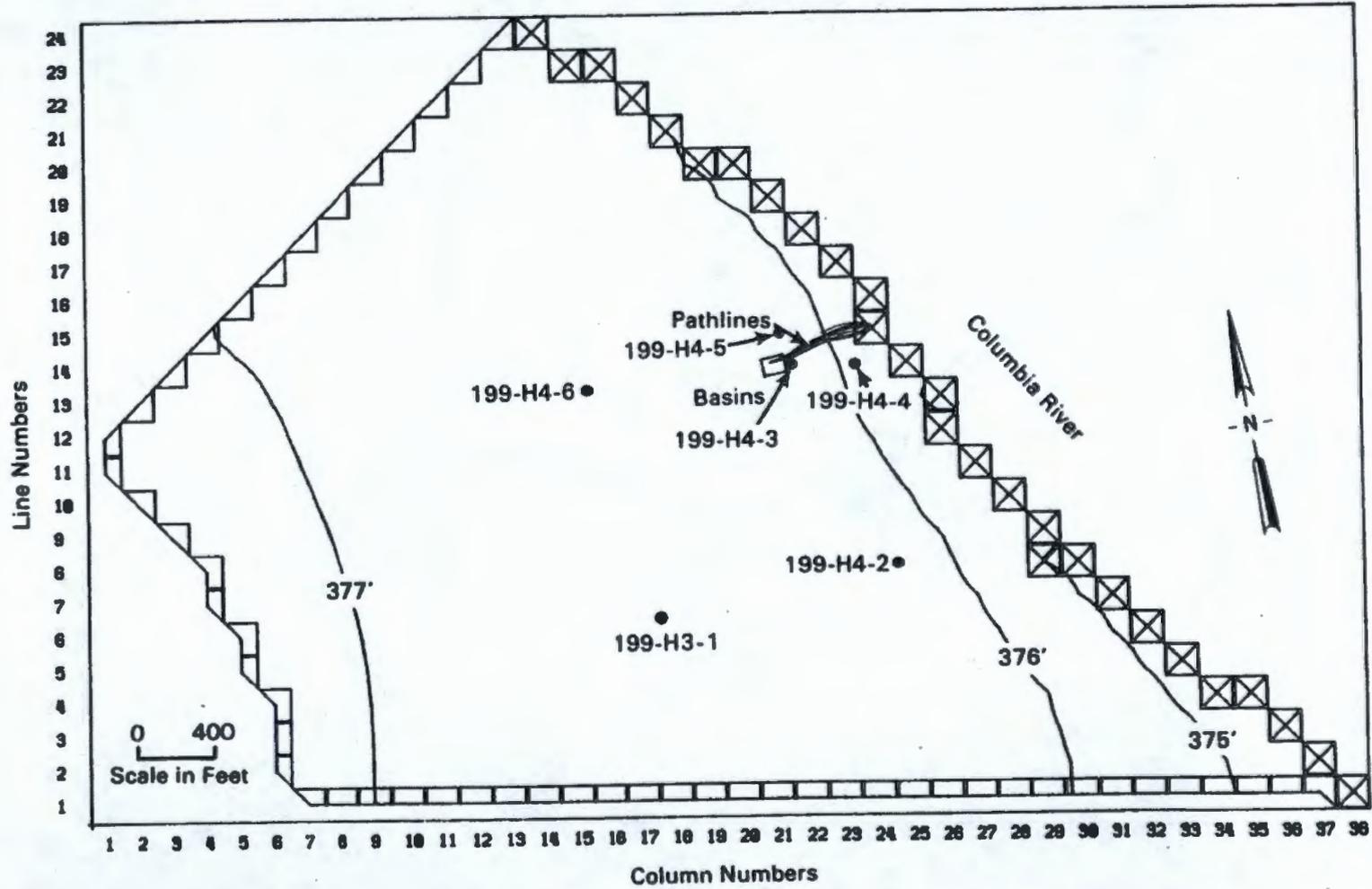


FIGURE 48. Simulated Pathlines from the 183-H Basins for January 22-30, 1985

100

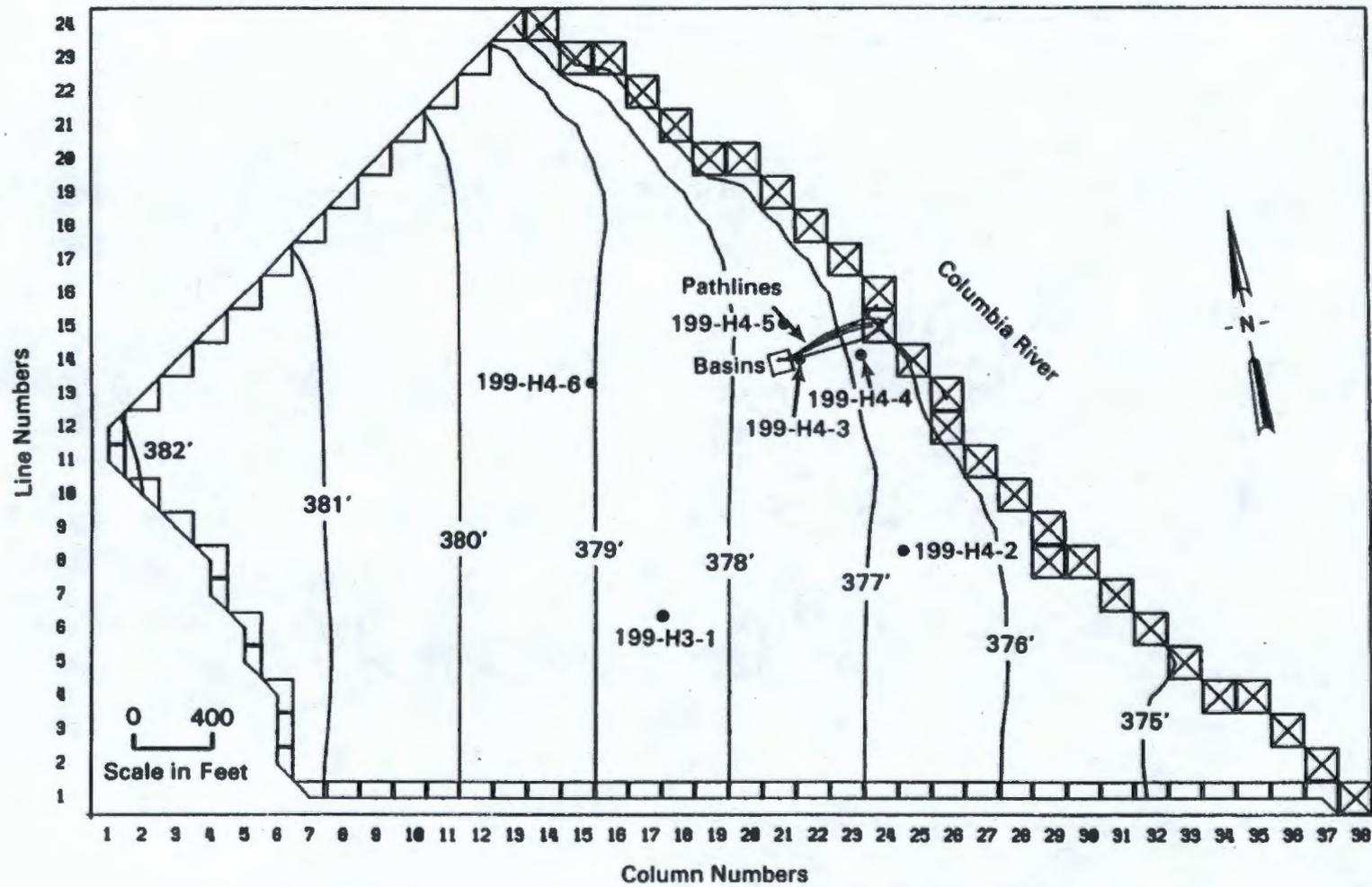


FIGURE 49. Simulated Pathlines from the 183-H Basins During March 1985

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."

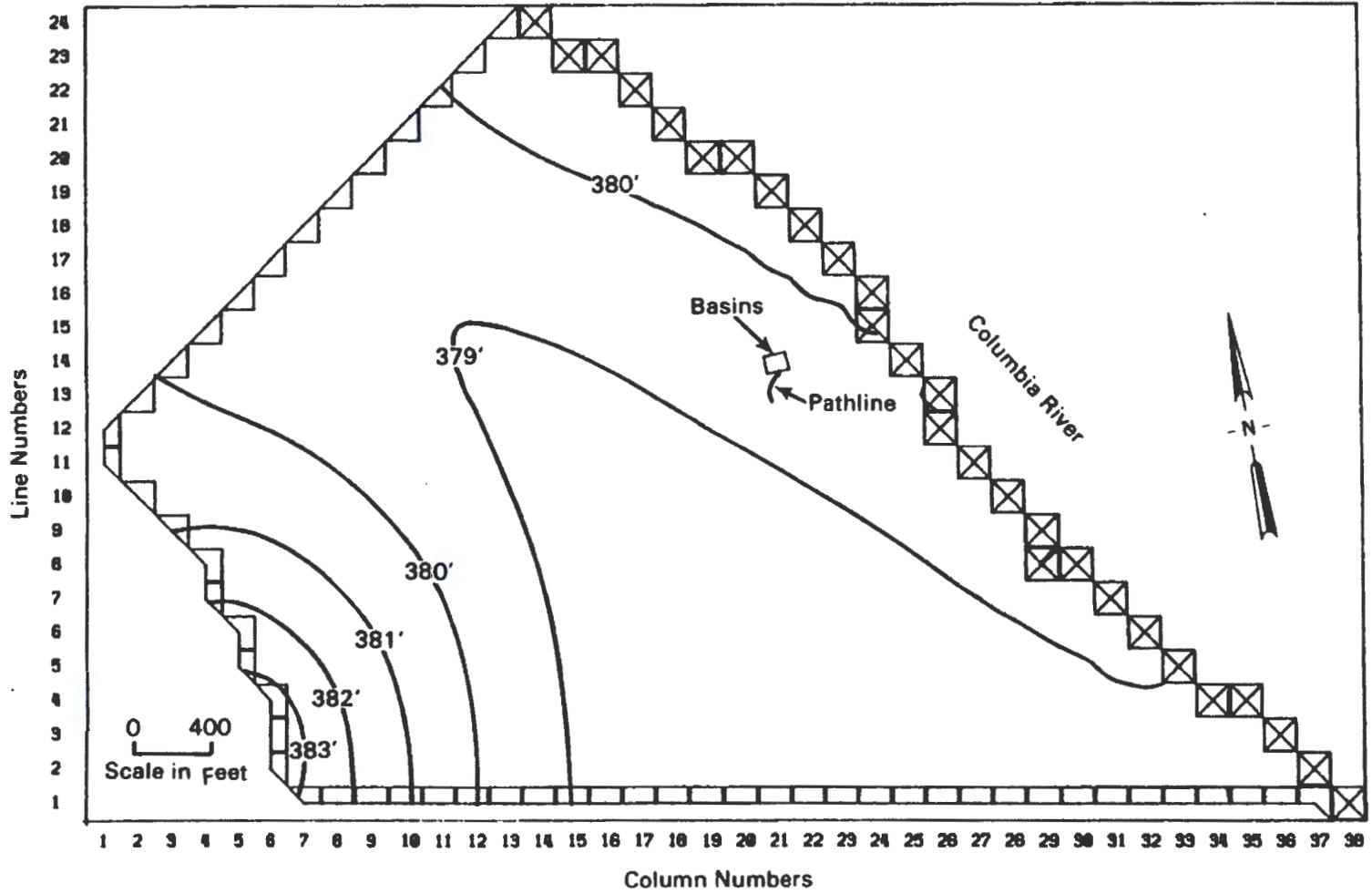


FIGURE 50. Pathline During a Period of Simulated Southerly Gradient

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

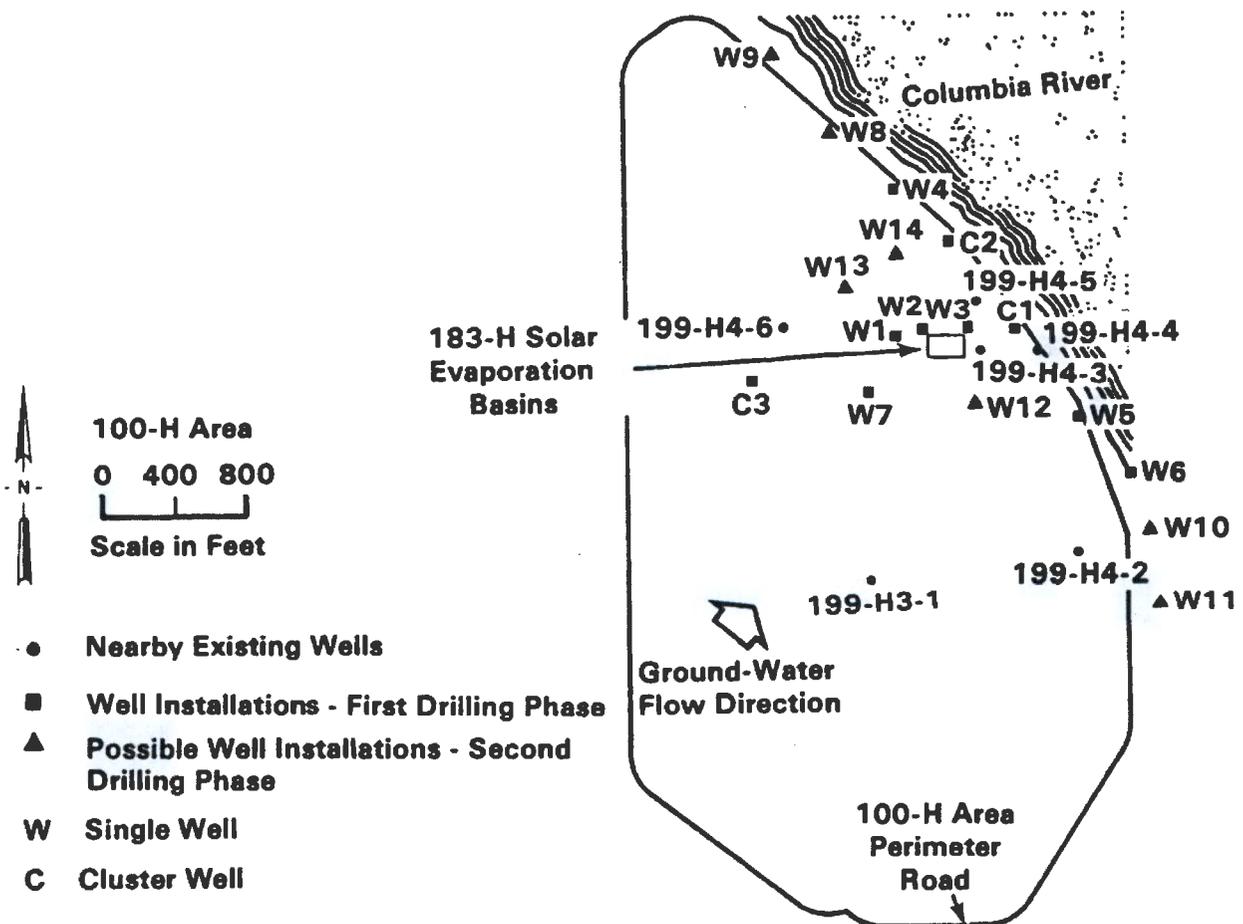


FIGURE 51. Location Map for Planned Well Installations

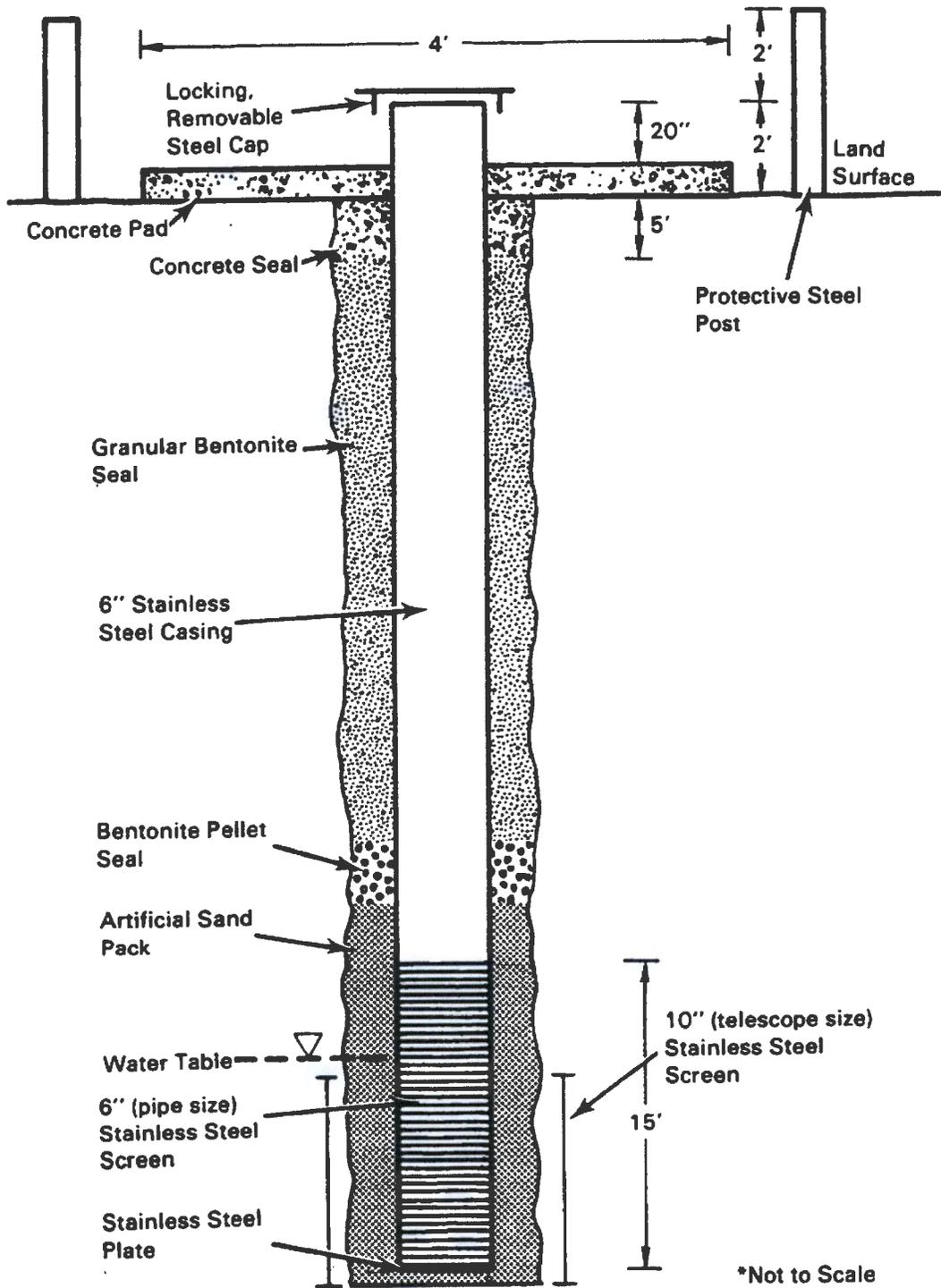


FIGURE 52. Planned Design for Shallow Wells Completed in the Hanford Gravels

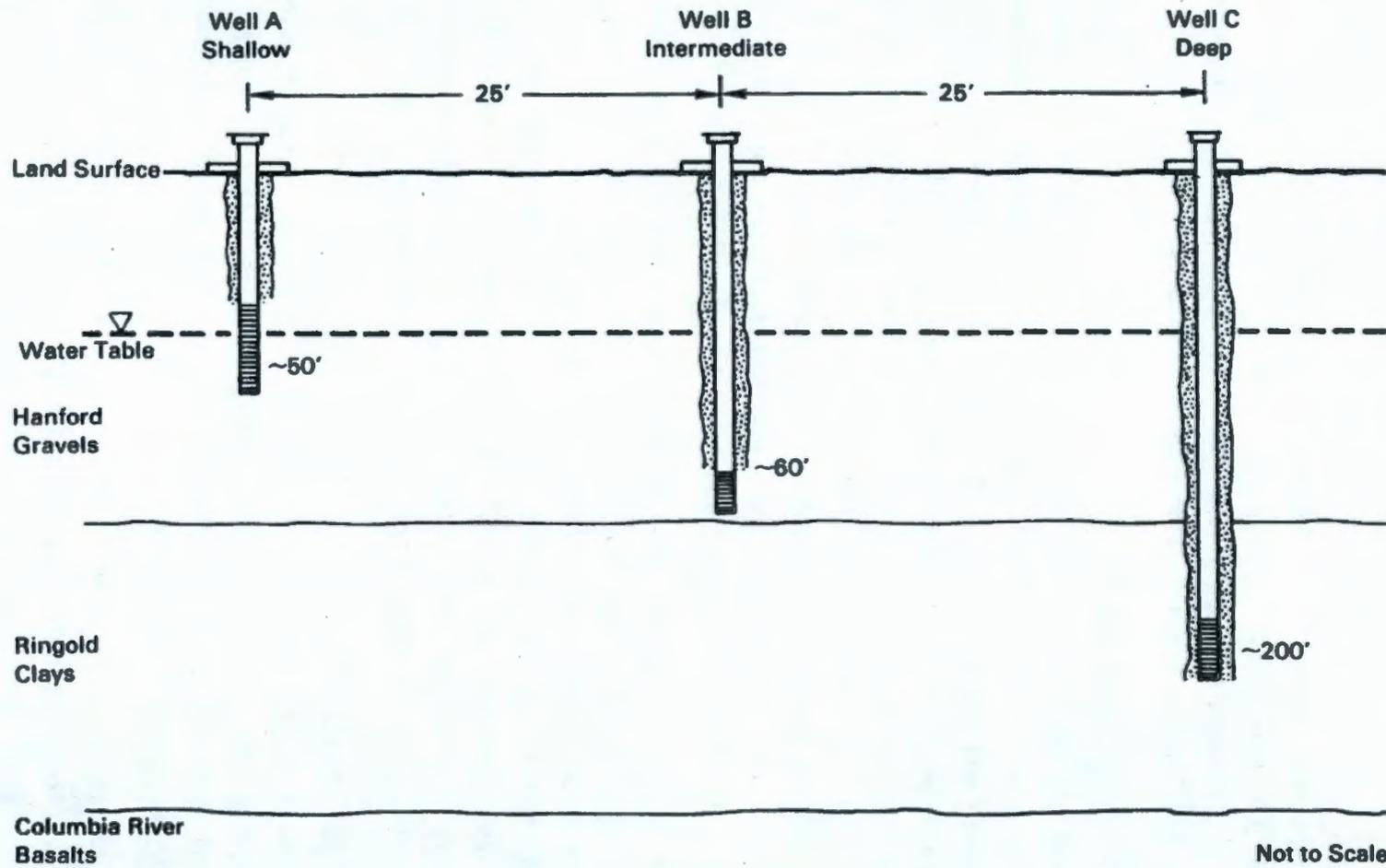


FIGURE 53. Cross Sectional View of a Well Cluster Completion

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

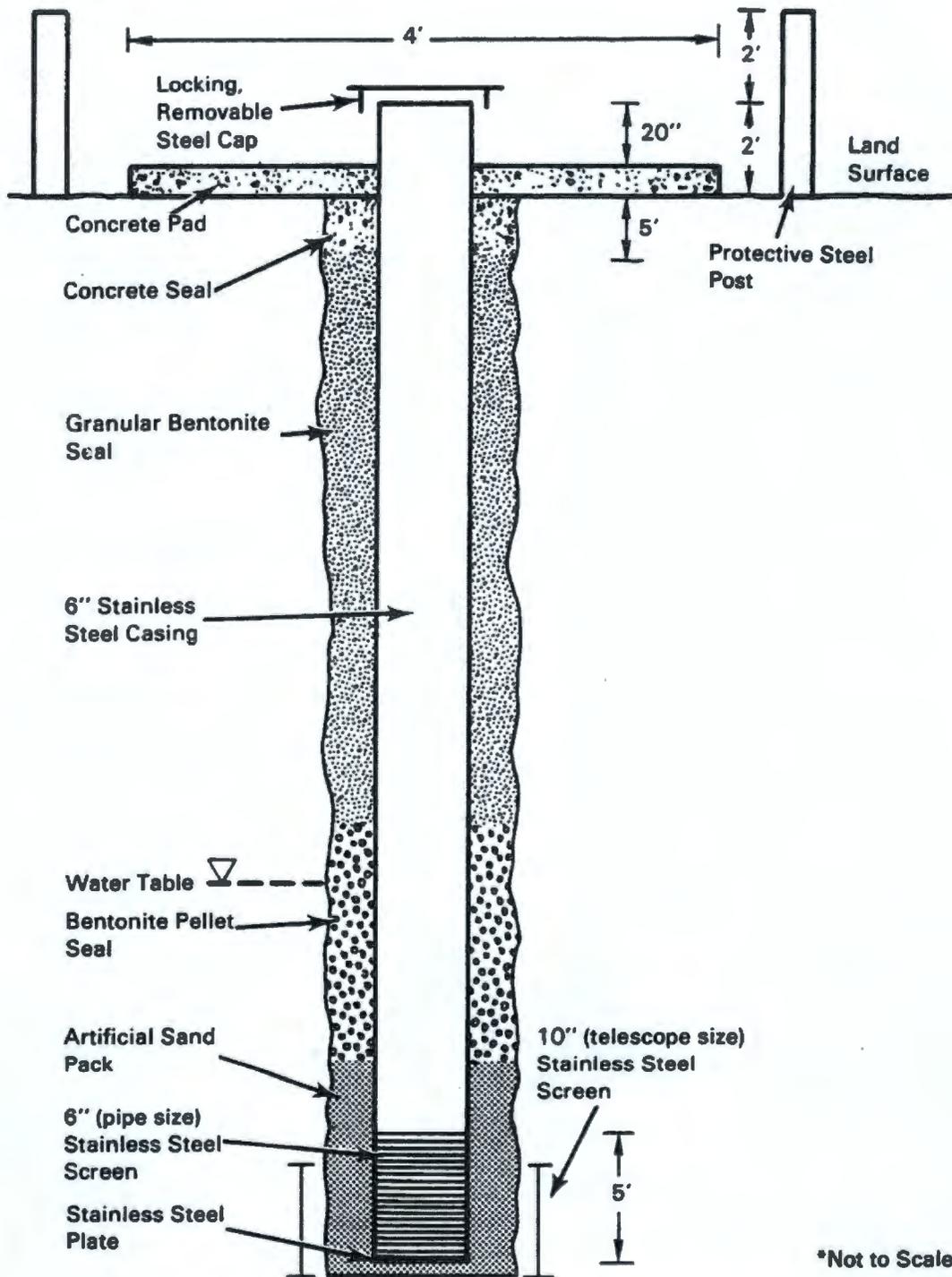


FIGURE 54. Planned Design for Intermediate-Depth Wells Completed just Above the Ringold Clays

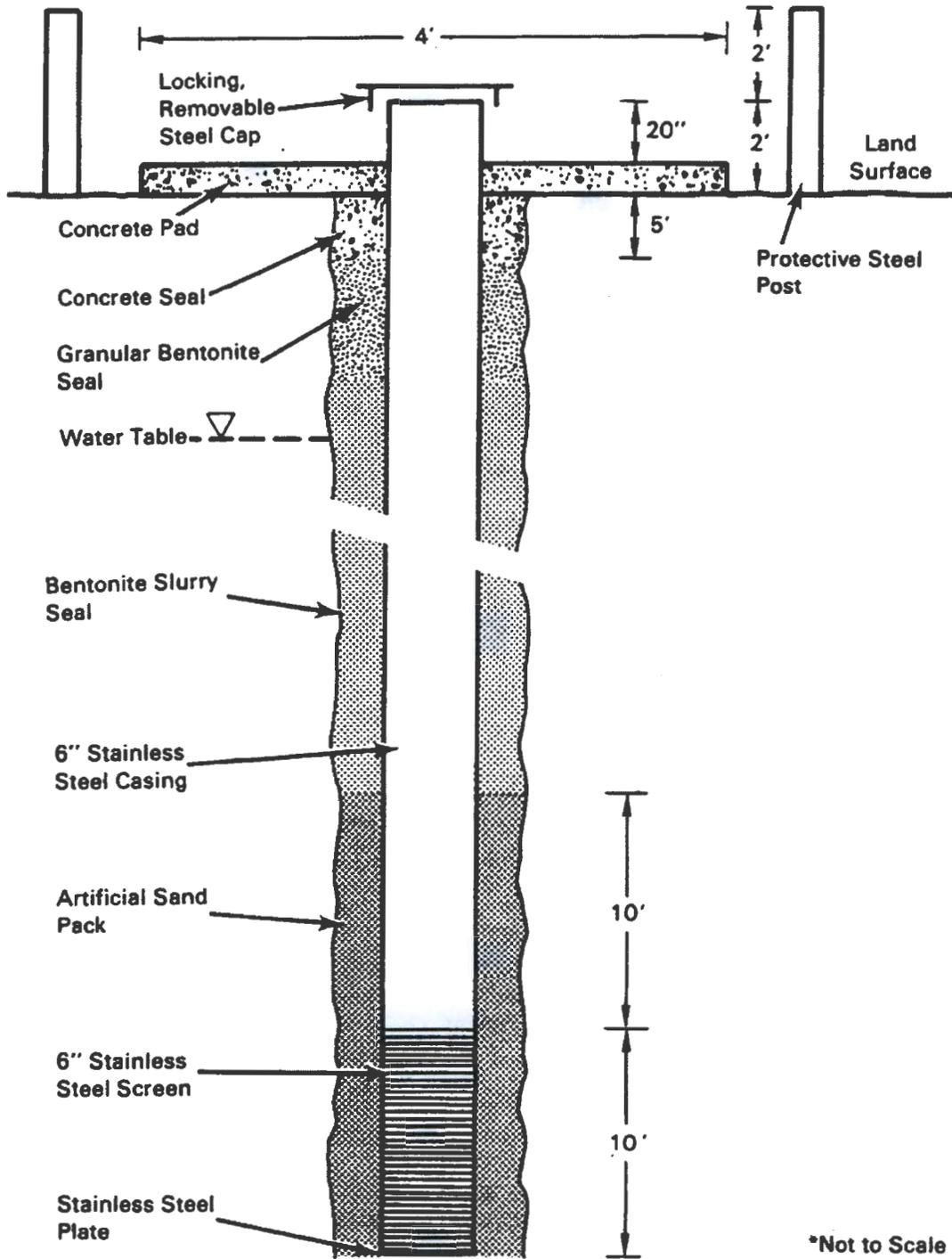


FIGURE 55. Planned Design for Deep Wells Completed Within the Ringold Clays

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 hydro-logic 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. 4		WELL NO. 199-H3-1		DATE 8-24-60	DEPTH BEGINNING OF SHIFT 0	
DRILLER J. D. St. George		FOREMAN		SHIFT 6:30AM-5:30	DEPTH COMPLETION OF SHIFT 520' 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.2

DRILLING LOG

199-H4-2

PROJECT NO. _____

Rig No. AEC 22-3132

Date 3/28/52

Well No. 107-H-2

Shift _____

Driller Row

Depth beginning of Shift 0'

Foreman _____

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" PIA
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.

A.8

177-44-2

DRILLING LOG

PROJECT NO. _____

Rig No. AEC 22-3152
 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.

A.9

DRILLING LOG

199-44-2

PROJECT NO. _____

Rig No. AEC-22-3132

Date 4/1/52

Well No. 107-H-2

Shift _____

Driller Row

Depth beginning of shift 20'

Foreman _____

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 1/2" 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. Hange up 18 pipe.

Have to drive pipe every 6" to make any hole. Bails hard

A.10

HW-6.207

DRILLING LOG

199-44-2

PROJECT NO. _____

Rig No. AEC- 22-3132

Date 4/2/1952

Well No. 107-H-2

Shift _____

Driller Row

Depth beginning of shift 30'

Foreman _____

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, Gyps			
					3:00-3:30	Welding 6'11" pipe (43'7" OH)

A.11

REMARKS

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. ABC 22-3152
 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 36'. 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.

A.12

DRILLING LOG

PROJECT NO. _____

199-44-2

Rig No. AEC 22-3152
 Well No. 107-II-2
 Driller Rov
 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

A.13

DRILLING LOG

PROJECT NO. _____

199-44-2

Rig No. AEC 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.

A.14

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 68'.
 Hit more water at 68'.

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. AEG-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)
1:30-2:00	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 that lets the upper water come in.

A.15

DRILLING LOG

PROJECT NO. _____

199-44-2

Rig No. AEC-22-3132
 Well No. 107-II-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.		

A.16

REMARKS

From 135' to 160' 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.

DRILLING LOG

PROJECT NO. _____

149-44-2

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

A.17

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.	

A.18

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.

DRILLING LOG

PROJECT NO. _____

199-44-2

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.

A.19

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.

DRILLING LOG

PROJECT NO. _____

199-44-2

Rig No. AEC 22-3132
 Well No. 107-II-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	206'			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 bottom.
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.

NW-6.207

DRILLING LOG

PROJECT NO. _____

199-44-2

Rig No. AEC 22-3132

Date 4/14/52

Well No. 107-II-2

Shift _____

Driller Row

Depth beginning of Shift 230'

Foreman _____

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	Holding 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.

A.21

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. ASC 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.

A.22

DRILLING LOG

PROJECT NO. _____

199-44-2

Rig No. AEG 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.

A.23

DRILLING LOG

PROJECT NO. _____

199-44-2

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	Holding 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 80' from land surface at 10:45 A.M.
 AT 270' to 272' layer of blue clay with gravel imbeded in it. Between 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 formation. 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.

A.24

DRILLING LOG

PROJECT NO. _____

199-44-2

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

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.
12:30-1:50	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.

A.25

DRILLING LOG

PROJECT NO. _____

199-44-2
199-44-2

Rig No. AEC 22-3132

Date 4/21/52

Well No. 107-H-2

Shift _____

Driller Row

Depth beginning of Shift 310'

Foreman _____

Depth completion of Shift 320'

DRILLING		CORING		TYPE SOIL	OTHER DELAYS	
Time	Depth	Time	Depth		Time	Explanation
					7:45-10:00	Waiting 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.

A.26

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.

DRILLING LOG

PROJECT NO. _____

199-44-2

Rig No. AEC 22-5182
 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. Get pieces of hard gray shale when dry, black when wet.
 Bails good, comes out of hole slick and slimy.
 Blower to drill past 330'. Pipe moves very slow and hard. Takes about 6 minutes to get a foot driven.
 Water is completely shut off.

A.27

199-44-2

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 $\frac{1}{4}$ ". Drove pipe after making 1' and it is still moving very slow.
 At 2:30 P.M. Knocked off box on stem.

A.28

DRILLING LOG

PROJECT NO. _____

199-44-2

Rig No. AEC 22-3132

Date 4/24&25/52

Well No. 107-H-2

Shift _____

Driller Row

Depth beginning of Shift 340'

Foreman _____

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.

A.29

DRILLING LOG

PROJECT NO. _____

199-144-2

Rig No. AEC 22-3132
 Well No. 107-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.

A.30

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.

DRILLING LOG

PROJECT NO. _____

199-H4-2

Rig No. ABC 22-3132

Date 4/29/52

Well No. 107-H-2

Shift _____

Driller How

Depth beginning of Shift 365'

Foreman _____

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 1/2' above ground surface.

A.31

DRILLING LOG

PROJECT NO. _____

199-44-2

Rig No. AEC 22-3132

Date 4/30/52

Well No. 107-H-2

Shift _____

Driller Row

Depth beginning of Shift 380'

Foreman _____

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 level 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.

A.32

MS-6.28'

DRILLING LOG

177-H4-2

199-H4-2

PROJECT NO. _____

Rig No. AEC 22-3132

Date 5/2/52

Well No. 107-H-2

Shift _____

Driller Row

Depth beginning of Shift 386' Hole complete

Foreman _____

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" & 7'11" & 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.

OK 5/2/52 PERF
29-50 5 CU. / RMD/RT-3

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 rotten basalt before it stopped.

A.33

DRILL LOG		BY	NIG	WELL NUMBER	COMPUTER NUMBER	PROJECT OR WORK ORDER NO
		1001	White	45 H4-4		5-30-46
		DATE		DEPTH		SUBCONTRACT NO
		12/8/53		45 to 54"		JAT 1541
TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION <small>% EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.</small>	TIME	DRILLING COMMENTS
5 1/2"	36'	Hard Tool		Stained rig - could (approx) water to indicate	7:00	
	50-55'	--	WET	Sand & Gravel mix Fine - extensive	12:30	
				Welded outside casing at 54 1/2" (6")		
				Have some cement - sand mix - Bad - had		
				To get out bottom of casing - some sand		
				gravel still inside drilled out bottom		
				of casing but sand keeps filling in to		
				50' - batted hole for three hours		
				Hauled cement and barrel to mix		
				To #3 well from #2 well ready for		
				tomorrow		
				Pat in sigs gas		5:45
				Left for home	3:20	
				Total 8 hours		Sigs gas

REMARKS:

A-6000-021 74) B-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VV-VERY FINE STANDING WATER

A.43

DRILL LOG		BY Troy	RIG W.H.T.	WELL NUMBER 3 H4-4	COMPUTER NUMBER	PROJECT OR WORK ORDER NO N-30716
		DATE 6/9/83		DEPTH 4' TO 54'		SUBCONTRACT NO. JW 1121
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) bags gas in well and (2) bags in rig		5 bags gas
5' Blank 10'		Screen	7' Bags including Parker		7:10 am	
			Ran Screen Pulled Pipe Back 15'			
			Cut off 24" above Ground - Boiled water			
			for cement - mixed (2) five sacks cement			
			Poured in hole - pulled surface down mixed (3)			
			Three more sacks poured in - mixed (6) more			
			To fill total of (4) five more sacks - Boiled			1 1/2 sacks cement
			hole for (4) bags down Total			4 hours development
			lowered rig down - stand up when (2) bags in			
			started digging outside test hole - soil that			
			Painted then seal well head with (2) bags of			
			Primer - went to well #1 and started digging			
			Post holes - cleaned up yard and			
			hauled to dumpster set 2500' away			
			To town - left for home		3:20	
				Total 8 hours		5 bags gas

REMARKS:

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

A.44

A.45

DRILL LOG		BY Troy	RIG White	WELL NUMBER "1" "2" "3" H4-4	COMPUTER NUMBER 178-H1-1	PROJECT OR WORK ORDER NO. 13-30416
		DATE 3/16/83		DEPTH 5 to 0		SUBCONTRACT NO. JAT 1541
TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
				Finished Dying Diviside Post on well #1	7:00 AM	See the work
				Dug Post Holes and set Post on well #2		
				Painted well Head and Diviside Post on	7:30	12:00 pm 4/6/83
				Well #1 & 2 with 2 coats Primer - Painted		Teach
				all three with two coats finish yellow		
				Cleaned up well sites. Trimed 6" casing		
				with Teak - finished lining Mast Boxes		
				pins and welded X-braces - Bleed Brakes		
				- Fixed Genetic Bracket - checked oil water		
				and gas in rig meter and Teak meter,		
				cleared off well samples from wells #1, 2, 3		
				at Brads office with copies 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 pickup		
				up white Teak -	3:42	
REMARKS: Total 40 hrs Dugals Cas Total 132 hrs in Rig 8 months 11 hours						

A-6000-021 (1- B-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 0428	WHITE	H4-5		B-30416
		DATE		DEPTH		SUBCONTRACT NO.
		4/29/83		10' " 13'		JAJ-1541
TOTAL CASING	DEPTH	DRILL METHOD	WEIGHTY SAMPLE	LITHOLOGIC DESCRIPTION	TIME	DRILLING COMMENTS
8'	8'	Hard Tool		(L) Gravel to medium (S) Gravel and sand (F) Bailed Hole at 90%	8:00 AM 8:27 AM	Started work added 5gals of Water/Started Drilling Hole is coming back outting slow.
15' 6" 10"	12'			Surface liner to hold hole open - free pit in hole Extra Large Gravel 8" to 15" approximately 50% Bailed Hole	11:04 1:05	added 2gals water Stopped Drilling at 3:30 PM Headtop pull liner back (2) Times Left Job at 4:38 PM
REMARKS: Stopped Drilling at 3:30 PM - Hand to put voltage regulator on rig motor, checked oil added (1 quart) Put (5) gal gas in rig - put water in Batterys on rig as welder - was low. \$1:05						
8.545 Total Hours for Today is (8 hours) (30 minutes)						

A-8000-021 (1-74) D-DRIFT BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE _____ STANDING WATER

A.48

DRILL LOG

BY TROY #0438
 DATE 5/2/83

WELL NUMBER 44-5
 DATE 13' 12' 17'

PROJECT OR WORK ORDER NO. B-30416
 SUBCONTRACT NO. JAS-1541

TOTAL LACING	DEPTH	DRILL METHOD	WEY/DRY SAMPLE	LITHOLOGIC DESCRIPTION <small>3 EACH GRAIN SIZE, COLOR, ROUNDNESS, FLAKES, ETC.</small>	TIME	DRILLING COMMENTS
8' / 12"	8'	—	—	Started Late - Motor Went out of Pickup on Way Here.	9:35 AM	Started Drilling at 1:00 AM
15' 6" / 10"	15' 6"	Hard Tool	NET #10P3	Got Casing Down To Bottom of Hole Finally Bailed Hole at 15' Got Samples #15	1:30 PM	Still Drilling Hard
	15'				12:58 PM	
	20'		LIFT #120P3	Light Grs, Larger To Medium River Gravel Bailed Hole at 20'	5:15 PM	Stopped Drilling
19' 6" / 6"	20'			Set in Hole and filled with 6" Hard Tool	5:45 PM	Left Job for Home

REMARKS:



Total Hours



8 hours

A-6000-021

741

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.49

DRILL LOG		BY Singham	RIG white	WELL NUMBER H4-5	EDUCATION NUMBER	PROJECT OR WORK ORDER NO. B-30416
		DATE 5/5/83	DEPTH 27	TO 35		SUBCONTRACT NO. JAT-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		
				Extremely hard drilling GOES FROM ONE BOULDER to ANOTHER		
REMARKS:						

A.52

A-6006-021 (1-74) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE TANDING WATER

DRILL LOG

WELL NUMBER
 Bigham white
 DAY
 5/9/83

DEPTH
 48

114-5
 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 <small>& EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.</small>	TIME	DRILLING COMMENTS
54 1/2"						
	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) B-DRIVE BARREL H HARD TOOL I-LARGE M-MEDIUM S-SMALL VC-VERY COARSE C-COARSE F-FINE VF-VERY FINE _____STANDING WATER

A.54

DRILL LOG

BY
5/10/73
DATE
B. Giam

DRY
white

WELL IDENTIFICATION
H4-5

WELL NO. / STATE DESIGN SYMBOL NO. DATA
B-30416
SUBCONTRACT NO.
JAT-1541

TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION <small>% EACH GRAIN SIZE, COLOR, ADHESION, CALICHE, ETC.</small>	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

41

D-DRIVE BARREL

H-HARD TOOL

L-LARGE

M-MEDIUM

S-SMALL

VC-VERY COARSE

C-COARSE

F-FINE

VF-VERY FINE

TANDING WATER

A.55

DRILL LOG		BY	RIG	WELL NUMBER	COMPUTER NUMBER	PROJECT OR WORK ORDER NO
		Troj	white	2		B-30416
		DATE		DEPTH		SUBCONTRACT NO
		5/16/83		15		JAT 1541
TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION & EACH GRAIN SIZE, COLOR, BOUNDRIES, CALICHE, ETC.	TIME	DRILLING COMMENTS
		Hard Tool		Started at 100 - Picked up whites at 200 and Gears - Greased rig - oil (W.K.) - Gas (W.K.) Checked Drill string for joints right or loose (26)		
	15'		WET	Will have to fix sept. section. Looks like medium to small gravel with a little sand - (coarse) mixed in.	9:00	Started Drilling at 7:30 Took Sept 7:30
(20'3")	With Drive Shoe			Drilling pretty good until 20' and have casing in the hole with drive shoe	10:04	Will stop in 20' 3"
	20'		WET	small - medium - large gravel - with fine sand and medium sand	20:0	Down
				8 hours Rig Time - (12 minutes welding)	30:6	Shot down Headed for home
				Total 8 hours		
REMARKS:						

A-6000-021 (

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 46.70	WELL NUMBER 14-111	COMPLETION NUMBER	PROJECT OR WORK ORDER NO. B-30416
		DATE 5/17/83	DEPTH 20' to 27'			SUBCONTRACT NO. JNT 1541
TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION § EACH GRAIN SIZE, COLOR, ROUNDNESS, CALICHE, ETC.	TIME	DRILLING COMMENTS
		Hard Tool		700 - Geared rig - checked oil - water fixed choke -		
	25'		WT	Same as yesterday no change - 11 one large Gulder - Had to run off 7000' casing Down.	12:10	Welder broke Down - will use dry welder 7.1' Date correct his Fixed -
26'3"	27'			Welded on 6' of casing Dumped Down with drive clamps - went in very good. added 2 gal. Water	12:30 3:10	Left for Home
						Put in logs of Gas in Rig Meter \$12.00
REMARKS: Total 8 hours						

A.60

A-6000-021 (. 4)

B-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	DATE	NIC	WELL NUMBER	COMPUTER NUMBER	PROJECT OR WORKORDER NO
TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION % SAND GRAIN SIZE, COLOR, ROUNDNESS, CALCIM, ETC.		TIME	DRILLING COMMENTS
				White	2		B-50416
					31' to 36'		SUBCONTRACT NO. JAT 1541
35' 7"	35'	Hand Tool	UcT	700 Start - Hung brace on rig - can't get pin in - put welding rods in temporary medium Gravel and large Gravel and Boulders			Had to jump rods to start
39' 7"	36'			welded on 4' of casing for temporary Drilling Head and slow large Gravel and Rocks - a little coarse sand.		2000	Drilling Head Put in 10 gals Gas \$12.00
							2000 2000 Co. Home
8 hours Total							
REMARKS:							

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

A.62

DRILL LOG		BY Troy DATE 5/24	RIG White	WELL NUMBER 54	DEPTH 55'	COMPUTER NUMBER	PROJECT OR WORK ORDER NO. B-3046
TOTAL CASING	DEPTH	DRILL METHOD	WET/DRY SAMPLE	LITHOLOGIC DESCRIPTION (EACH STRAIN SIZE, COLOR, BOUNDS, etc.)		TIME	DRILLING COMMENTS
54'	54'	Hard Tool	---	7:00 AM - static 13' or (41' from well head) Crossed Rig - (Pat in 109's Gas) Drilled and bolted Bottom of hole Will stand open only to bottom of casing (54' to 39')			812.00
48' of 6" casing				5' of 5" casing with Bottom end welded 10' of screen and 1' 6" of 5" casing with Parker - installed in the Bottom Have 2' of screen above water static Pulled 14' of bit - cut off 24" above ground level - grouted - (14 jacks according to mix - pulled surface liner - installed Parker cap with Hasp & lock Hinge - cleaned up area, Dailed Hole for (3) more Hours - Layed down rig Returned Tools and pipe - loaded air bottles + gauges in rig - checked oil' Water' Gas' (OK) - Secured leads - - also Brake drive barrel and Jaws - Broken			126 96¢/sack 269
REMARKS: Waited for Dale so He could Follow me To Exxon area Drove Rig To Exxon + Park - Went To pickup my pickup 7 Hours							

A.65

A-6000 (1-76) D-DRIVE BARREL H-HARD TOOL L-LARGE M-MEDIUM S-SMALL SC-VERY COARSE C-COARSE F-FINE V-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 trailer
- 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.

Sample Collection
Using Submersible
Pump

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.

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

<u>Well Number</u>	<u>Calculated Time (min)</u>
(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.

Teflon Bailer
Cleaning
Procedure

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 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. _____		1	2	3	4	5	6	7	8	9	10	11	12	13
SAMPLE ID _____														
UST SAMPLE ID _____														
COMMENTS														
CODE	CONSTITUENT													
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	797	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 μ mhos. 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	N,N-diethylhydrazine
acrylonitrile	hydrogen sulfide
bis(chloromethyl) ether	iodomethane
bromoacetone	methacrylonitrile
methyl bromide	methanethiol
carbon disulfide	pentachloroethane
chlorobenzene	1,1,1,2-tetrachlorethane
2-chloroethyl vinyl ether	1,1,2,2-tetrachlorethane
methyl chloride	bromoform
chloromethyl methyl ether	trichloromethanethiol
crotonaldehyde	trichloromonofluoromethane
1,2-dibromo-3-chloropropane	trichloropropane
1,2-dibromoethane	1,2,3-trichloropropane
dibromomethane	vinyl chloride
1,4-dichloro-2-butene	diethylarsine
dichlorodifluoromethane	methyl methacrylate
1,1-dichloroethane	ethyl methacrylate
1,2-dichloroethane	benzene
trans-1,2-dichloroethene	dioxane
1,1-dichloroethylene	pyridine
1,2-dichloropropane	toluene
1,3-dichloropropene	

Table C.2. Additional Semi-Volatile Organics

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

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-nitrosornicotine
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
hexachloropropene

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 CO₂. The CO₂ 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 ¹³⁷Cs and ⁶⁰Co. 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 ($\pm 10\%$ 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 ($\pm 10\%$) -Matrix spike after every 10th sample
Herbicides	GC/Electron Capture Detector (ECD)	-3-point calibration curve daily -Mid-range standard after every 10th sample ($\pm 10\%$) -Verification standard at end of batch -Matrix spikes after every 10 samples (no surrogate)
Organochlorine Pesticides	GC/ECD	-Dibutylchloroendate (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 ($\pm 10\%$) -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 ($\pm 20\%$) -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 ($\pm 20\%$) -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 ($\pm 10\%$) -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	<ul style="list-style-type: none"> -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	<ul style="list-style-type: none"> -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)	<ul style="list-style-type: none"> -Electrode slope determined -Calibration standards, blank plus 7-point curve -Matrix spike after every 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)	<ul style="list-style-type: none"> -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)	<ul style="list-style-type: none"> -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)	<ul style="list-style-type: none"> -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)	<ul style="list-style-type: none"> -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 $\pm 10\%$ 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)

<u>Constituent or Group</u>	<u>Analysis Method</u>	<u>QC Procedures</u>
Mercury	Cold Vapor Atomic Absorption (Method 7470)	<ul style="list-style-type: none"> -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)	<ul style="list-style-type: none"> -Calibration involves: <ul style="list-style-type: none"> -Two titration cell standards (to $\pm 5\%$) -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)	<ul style="list-style-type: none"> -Calibration involves: <ul style="list-style-type: none"> -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 $\pm 10\%$) -Calibration blanks, 10% -Run standard after batch (check drift)
Coliform Bacteria	Presumptive Test, Confirmation Test	<ul style="list-style-type: none"> -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

PNL-6470, 1988

Appendices E through J cont. on disk

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 Diallylate	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 alcohol	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 Hexachlorocyclopentadiene	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-Methylactonitrile	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 hydro- chloride 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-Nitrosornicotine	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 Octamethylpyrophosphoramidate	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	168	Dioxane
9	Acrylonitrile	182	Ethylmethacrylate
31	Benzene	188	Formaldehyde
47	Bis(chloromethyl)ether	206	Hydrogen sulfide
49	Bromoacetone	209	Iodomethane
50	Methyl bromide	226	Methacrylonitrile
59	Carbon disulfide	227	Methanethiol
72	Chlorobenzene	235	Methyl ethyl ketone
76	2-Chloroethyl vinyl ether	238	Methyl methacrylate
77	Chloroform	285	Pentachloroethane
78	Methyl chloride	308	Pyridine
79	Chloromethyl methyl ether	325	Tetrachloroethane
91	Crotonaldehyde	326	1,1,1,2-Tetrachlorethane
111	1,2-Dibromo-3-chloropropane	327	1,1,2,2-Tetrachlorethane
112	1,2-Dibromoethane	328	Tetrachlorethylene
113	Dibromomethane	329	Tetrachloromethane
120	1,4-Dichloro-2-butene	347	Toluene
121	Dichlorodifluoromethane	352	Bromoform
122	1,1-Dichloroethane	354	1,1,1-Trichloroethane
123	1,2-Dichloroethane	355	1,1,2-Trichloroethane
124	trans-1,2-Dichloroethene	356	Trichloroethane
126	1,1-Dichloroethylene	357	Trichloromethanethiol
127	Methylene chloride	358	Trichloromonofluoromethane
133	1,2-Dichloropropane	363	Trichloropropane
136	1,3-Dichloropropene	364	1,2,3-Trichloropropane
139	Diethylarsine	373	Vinyl chloride
140	N,N-Diethylhydrazine		

TABLE E.3. Semi-Volatile Organics

2	Acetophenone	119	3,3'-Dichlorobenzidine
3	Warfarin	128	2,4-Dichlorophenol
4	2-Acetylaminofluorene	129	2,6-Dichlorophenol
14	4-Aminobiphenyl	143	Diethyl phthalate
16	5-(Aminomethyl)-3-oxazolol	146	Dihydrosafrole
17	Amitrole	150	3,3'-Dimethoxybenzidine
18	Aniline	151	p-Dimethylaminoazobenzene
20	Aramite	152	7,12-Dimethylbenz[a]anthracene
25	Auramine	153	3,3'-Dimethylbenzidine
29	Benz[c]acridine	157	Thiofanox
30	Benz[a]anthracene	158	Alpha, alpha-Dimethylphenethylamine
33	Benzene, dichloromethyl	159	2,4-Dimethylphenol
34	Benzenethiol	160	Dimethyl phthalate
35	Benzidine	162	Dinitrobenzene
36	Benzo[b]fluoranthene	163	4,6-Dinitro-o-cresol and salts
37	Benzo[j]fluoranthene	164	2,4-Dinitrophenol
38	Benzo[a]pyrene	165	2,4-Dinitrotoluene
39	p Benzoquinone	166	2,6-Dinitrotoluene
41	Benzyl chloride	167	Di-n-octyl phthalate
43	Bis(2-chloroethoxy)methane	169	Diphenylamine
44	Bis(2-chloroethyl) ether	170	1,2-Diphenylhydrazine
45	Chloronaphazine	171	Di-n-propylnitrosamine
46	Bis(2-chloroisopropyl)ether	179	Ethyleneimine
48	Bis(2-ethylhexyl) phthalate	183	Ethyl methanesulfonate
51	4-Bromophenyl phenyl ether	184	Fluoranthene
54	Butyl benzyl phthalate	194	Hexachlorobenzene
55	2-sec-Butyl-4,6-dinitrophenol	195	Hexachlorobutadiene
64	Chlorinated benzenes	197	Hexachlorocyclopentadiene
70	Chloroalkyl ethers	198	Hexachloroethane
71	p-chloroaniline	200	Hexachlorophene
74	p-Chloro-m-cresol	201	Hexachloropropene
75	1-Chloro-2,3-epoxypropane	203	Hydrazine
80	2-Chloronaphthalene	208	Indeno(1,2,3-cd)pyrene
81	2-Chlorophenol	213	Isosafrole
85	Chrysene	221	Maleic hydrazide
90	Cresols	222	Malononitrile
97	2-Cyclohexyl-4,6-dinitrophenol	223	Melphalan
104	Dibenz[a,h]acridine	228	Methapyrilene
105	Dibenz[a,j] acridine	229	Metholonyl
106	Dibenz[a,h]anthracene	231	2-Methylaziridine
107	7H-Dibenzo[c,g]carbazole	232	3-Methylcholanthrene
108	Dibenzo[a,e]pyrene	234	4,4'-Methylenebis(2-chloroaniline)
109	Dibenzo[a,h]pyrene	237	2-Methylactonitrile
110	Dibenzo[a,e]pyrene	239	Methyl methanesulfonate
114	Di-n-butyl phthalate	240	2-Methyl-2-(methylthio) propionaldehyde-o- (methylcarbonyl)oxime
115	1,2-Dichlorobenzene	243	Methylthiouracil
116	1,3-Dichlorobenzene		
117	1,4-Dichlorobenzene		

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-Nitrosornicotine
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	176	Ethyl carbamate
8	Acrylamide	177	Ethyl cyanide
12	Allyl alcohol	180	Ethylene oxide
61	Chloral	187	Fluoroacetic acid
69	Chloroacetaldehyde	190	Glycidylaldehyde
83	3-Chloropropionitrile	203	Hydrazine
93	Cyanogen	212	Isobutyl alcohol
94	Cyanogen bromide	236	Methyl hydrazine
95	Cyanogen chloride	282	Paraldehyde
134	Dichloropropanol	305	n-Propylamine
155	1,1-Dimethyl hydrazine	307	2-Propyn-1-ol
156	1,2-Dimethyl hydrazine		

TABLE E.5. Constituents that Only Require Analysis for Metal Species

19	Antimony, NOS	302	Potassium silver cyanide
21	Arsenic and compounds, NOS	313	Selenious acid
22	Arsenic acid	314	Selenium and compounds, NOS
23	Arsenic pentoxide	315	Selenium sulfide
24	Arsenic trioxide	317	Silver and compounds, NOS
27	Barium and compounds	318	Silver cyanide
28	Barium cyanide	321	Strontium sulfide
42	Beryllium and compounds, NOS	335	Thallium and compounds, NOS
56	Cadmium and compounds, NOS	336	Thallic oxide
57	Calcium chromate	337	Thallium acetate
84	Chromium and compounds, NOS	338	Thallium carbonate
88	Copper cyanide	339	Thallium chloride
216	Lead and compounds, NOS	340	Thallium nitrate
217	Lead acetate	341	Thallium selenite
218	Lead phosphate	342	Thallium sulfate
225	Mercury and compounds, NOS	371	Vanadic acid, ammonium salt
250	Nickel and compounds, NOS	372	Vanadium pentoxide
252	Nickel cyanide	374	Zinc cyanide
280	Osmium tetroxide	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:	TOC:
65 Chlorinated ethane	87 Coal tars
66 Chlorinated fluorocarbons	89 Creosote
67 Chlorinated naphthalene	
68 Chlorinated phenol	Ammonium:
118 Dichlorobenzene	
125 Dichloroethylene	263 Nitrosamine
132 Dichloropropane	
135 Dichloropropene	
191 Halomethane	

TABLE E.8. Miscellaneous Organics and Inorganics

86	Citrus red No. 2	345	Thiourea
92	Cyanide	6	1-Acetyl-2-thiourea
58	Calcium cyanide	82	1-(o-Chlorophenyl)thiourea
204	Hydrocyanic acid	145	Diethylstilbesterol
301	Potassium cyanide	181	Ethylenethiourea
319	Sodium cyanide	249	1-Naphthyl-2-thiourea
		292	N-Phenylthiourea

TABLE E.9. Constituents Unstable in Water

5	Acetyl chloride	211	Methyl isocyanate
13	Aluminum phosphide	220	Maleic anhydride
40	Benzotrichloride	233	Methyl chlorocarbonate
53	2-butanone peroxide	257	Nitrogen dioxide
60	Carbon oxyfluoride	293	Phosgene
142	O,O Diethylphosphoric acid, O-p-nitrophenyl ester	295	Phorate
148	Diisopropylfluorophosphate	296	Famphur
154	Dimethylcarbamoyl chloride	298	Phthalic anhydride
161	Dimethyl sulfate	331	Tetraethyldithiopyrophosphate
185	Fluorine	350	Toluene diisocyanate
205	Hydrofluoric acid	367	Tris (1-aziridiny) phosphine sulfide

TABLE E.10. Constituents For Which Adequate Analysis Is Unavailable

10	Aflatoxins	241	N-methyl-N'-nitro-N-nitrosoguanidine
15	Mitomycin C	244	Mustard gas
26	Azaserine	251	Nickel carbonyl
32	Benzeneearsonic acid	254	Nitric oxide
52	Brucine	258	Nitrogen mustard - HCl salt
62	Chlorambucil	259	Nitrogen mustard N-oxide and HCl salt
96	Cycasin	260	Nitroglycerin
98	Cyclophosphamide	262	4-nitroquinoline
99	Daunomycin	268	N-Nitroso-N-ethylurea
103	Diallate	270	N-Nitroso-N-methylurea
131	Dichlorophenylarsine	277	N-nitrososacrosine
138	1,2:3,4 Diepoxybutane	279	Octamethylpyrophosphoramide
144	Thionazin	281	Endothol
147	3,4-dihydroxy-alpha-(methylamino) methyl benzyl alcohol	291	Phenylmercury acetate
173	2,4-dithiobiuret	294	Phosphine
178	Ethylenebisdithiocarbamic acid	304	1,3-propanesultone
186	2-fluoroacetamide	306	Propylthiouracil
189	Formic acid	311	Saccharin and salts
199	Hexachlorohyxahydro-endo, endo-dimethanonaphthalene	316	Selenourea
202	Hexaethyl tetraphosphate	320	Streptozotocin
207	Hydroxydimethylarsine oxide	332	Tetraethyl lead
214	Kepone	334	Tetranitromethane
210	Iron dextran	343	Thioacetamide
215	Lasiocarpine	344	Thiosemicarbazide
219	Lead subacetate	369	Trypan blue
224	Mercury fulminate	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.

QA PLAN

Project Service Activity

Page 1 of 19

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 <u>7-24-86</u>	SIGNATURE (QUALITY ENGINEER) <u>D. R. Dahl</u>
DATE APPROVED <u>7/25/86</u>	SIGNATURE (Q.E. MANAGER) <u>D. E. Ryder</u>
DATE APPROVED <u>7-24-86</u>	SIGNATURE (PROJECT/ACTIVITY MANAGER) <u>L. S. Prater/R. Schalla</u>
DATE APPROVED <u>7/23/86</u>	SIGNATURE (LINE MANAGER) (a) <u>P. E. Bramson</u>
Date Approved <u>7/31/86</u>	Signature (UNC) <u>L. W. Vance</u>

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.

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	
2.3.3 Revisions		0	
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)

	<u>Applies</u>	<u>W/C</u>	<u>REV</u>
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	●	0	
7.1.2 Traceability	●	0	
8.1 Control of Special Processes	0	0	
8.1.1 Process Controls	0	0	
8.1.2 Process Selection	0	0	
9.1 Performance of Inspections and Tests	●	●	1
9.1.1 Receiving Inspection	●	0	
9.1.2 Other Inspections (Nonreceiving)	●	0	
9.1.3 Content of ITI	●	0	
9.1.4 Records, Tagging and Nonconformances	●	0	
10.1 Control of Measuring and Test Equipment	●	●	
10.1.1 Basic Responsibilities	●	0	
10.1.2 Performance Checks	●	0	
10.1.3 Calibration of M&TE	●	0	
10.1.4 Calibration Discrepancy	●	0	
10.1.5 New Equipment	●	0	
10.1.6 Records	●	0	
11.1 Handling, Storage and Shipping	●	0	
11.1.1 General Guidance	●	0	
11.1.2 Special Instructions	●	0	
12.1 Status of Inspection, Test & Operating Condition	●	●	
12.1.1 Status Indication Authorities	●	0	
12.1.2 Status Indication Requirements	●	0	
13.1 Nonconformance & Corrective Action	●	●	
13.1.1 Occurrences	●	0	
13.1.2 Control of Nonconforming Item	●	0	
13.1.3 Corrective Action	●	0	
14.1 QA Records	●	●	1
14.1.1 General Guidance	●	0	
14.1.2 QA Record Requirement	●	0	
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

Projects: Hazardous Material Monitoring Project/RCRA
Compliance Ground-Water Monitoring Project

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.

Projects: Hazardous Material Monitoring Project/RCRA
Compliance Ground-Water Monitoring Project

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.

Projects: Hazardous Material Monitoring Project/RCRA
Compliance Ground-Water Monitoring Project

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 initialed 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.

Projects: Hazardous Material Monitoring Project/RCRA
Compliance Ground-Water Monitoring Project

- 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. Data Base Contents and Use

- 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.

Projects: Hazardous Material Monitoring Project/RCRA
Compliance Ground-Water Monitoring Project

- 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

Projects: Hazardous Material Monitoring Project/RCRA
Compliance Ground-Water Monitoring Project

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, and 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

Projects: Hazardous Material Monitoring Project/RCRA
Compliance Ground-Water Monitoring Project

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,

Projects: Hazardous Material Monitoring Project/RCRA
Compliance Ground-Water Monitoring Project

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.

Projects: Hazardous Material Monitoring Project/RCRA
Compliance Ground-Water Monitoring Project

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

Projects: Hazardous Material Monitoring Project/RCRA
Compliance Ground-Water Monitoring Project

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

Projects: Hazardous Material Monitoring Project/RCRA
Compliance Ground-Water Monitoring Project

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.

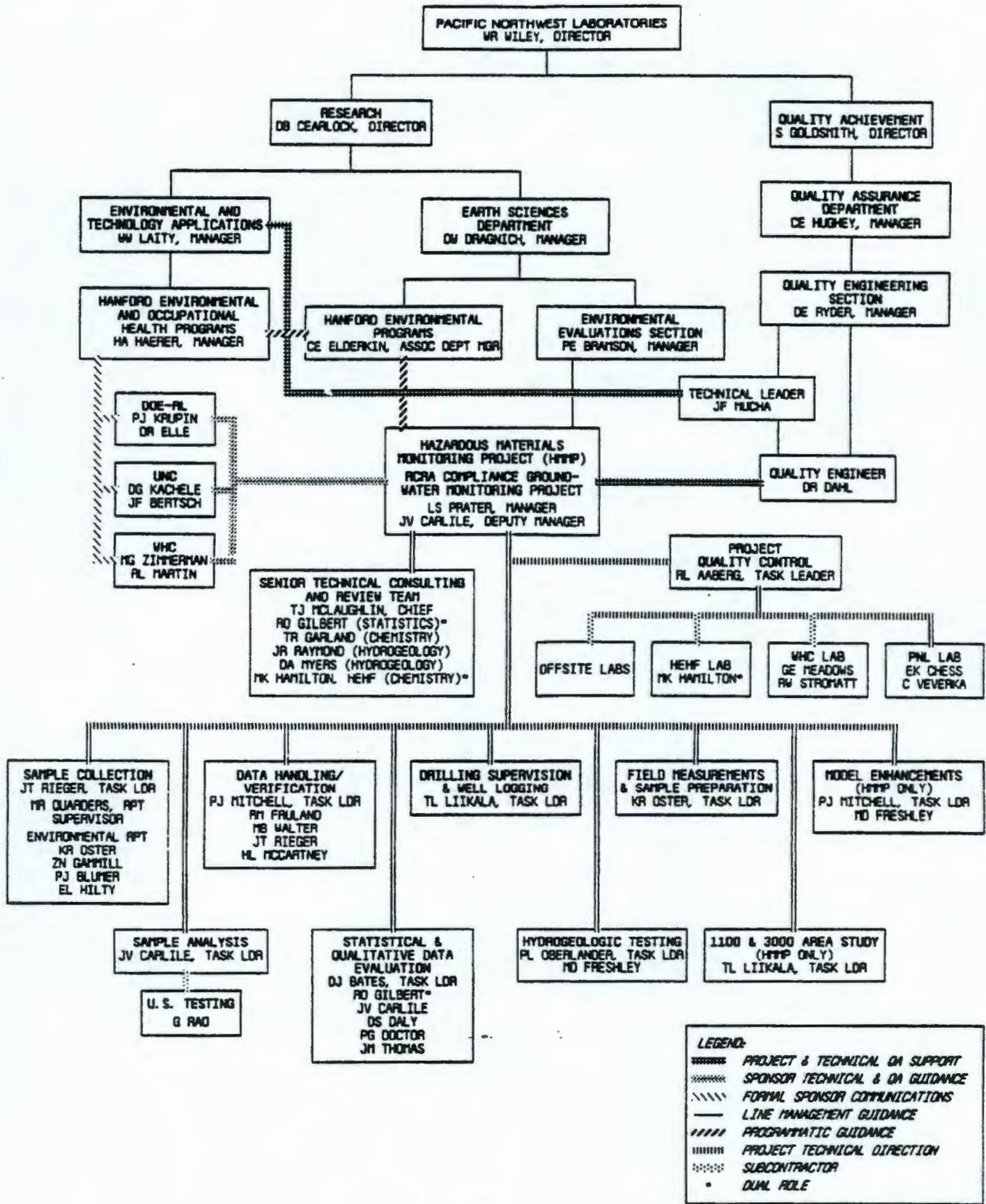
15. AUDITS

- 15.1 Annual audits shall be performed by the PNL QA Systems and Audits Section to determine conformance with QA requirements.

Projects: Hazardous Material Monitoring Project/RCRA
Compliance Ground-Water Monitoring Project

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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 ($100 \times \text{STDDEV} / \text{MEAN}$) 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 1988

15:43 TUESDAY, AUGUST 26, 1988

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	7.65	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	6	.	.	80.6	33.3	107	133.1	16	364
199-H4-4	10	100	6	.	.	110	48	183	165.9	15	622
199-H3-1	17	100	16	.	.	188	18.4	689	366.2	8.2	2660
199-H4-3	11	100	6	.	.	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	588	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

G.3

RCRA Compliance Ground-Water Monitoring Data
103-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=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	8	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	0.0589	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	8		5	0.182	0.167	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

G.4

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=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	47.6	45	8.67	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			CHROMIUM	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	189	591		
199-H4-4	11	10	0		50	480	571	235	49.0	66	729		
199-H4-3	11	10	0		50	879	642	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	5.06	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		

G.5

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

15:43 TUESDAY, AUGUST 26, 1986

TABLE Q.1 Summarized by Constituent-Well, sorted by Mean

-----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	0.538	0.1	1.45	269.8	0.1	4.9
199-H3-1	18	0.1	18		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	286.2	0.1	7.4

-----Constituent List=Drinking Water Standards Constituent Code, Name, Units=A22 SELENIUM 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	4.78	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	22480	3780	17.7	14500	26000
199-H4-6	11	500	1		45000	24700	27100	5800	22.7	15000	81100
199-H3-1	17	500	1		45000	84100	86600	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

G.6

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1986 to May 1986

15:43 TUESDAY, AUGUST 26, 1986

TABLE G.1 Summarized by Constituent-Well, sorted by Mean

-----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	89.2	13.3	500	730
199-H3-1	17	500	12		1400	535	500	85.5	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	0.803	11.6	5	7
199-H4-5	21	5	19			6	5	3.16	52.7	5	16
199-H3-1	18	5	13			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	1480
199-H4-3	11	50	1			281	173	253	89.9	50	887
199-H4-6	11	50	0			296	286	103	34.7	184	547
199-H4-4	11	50	3			516	300	617	119.5	50	2010

G.7

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

15:44 TUESDAY, AUGUST 26, 1986

TABLE G.1 Summarized by Constituent-Well, sorted by Mean

-----Constituent List=Quality Characteristics Constituent Code, Name, Units=C73 SULFATE PPB-----											
WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-6	20	600	0	.	.	38700	39700	6140	19.3	29000	45300
199-H4-6	11	600	0	.	.	55700	47900	15400	27.7	40000	78300
199-H4-4	11	600	0	.	.	61500	60800	18900	30.7	28900	84100
199-H3-1	17	600	1	.	.	67400	68800	9330	19.8	52800	86200
199-H4-3	11	600	0	.	.	139000	119000	75600	54.8	72400	328000

-----Constituent List=Quality Characteristics Constituent Code, Name, Units=C75 CHLORID PPB-----											
WELLNAME	SAMPLES	DETLIMIT	BELOWDL	ALLBELOW	MAXLIMIT	MEAN	MEDIAN	STDDEV	COEFFVAR	MINIMUM	MAXIMUM
199-H4-6	20	600	0	.	.	3810	3910	685	18.0	2600	5500
199-H4-4	11	600	0	.	.	4350	4520	750	17.2	2920	5300
199-H4-8	11	600	0	.	.	6780	6280	1790	26.5	4000	9080
199-H4-3	11	600	0	.	.	6780	6620	1780	26.0	4570	9870
199-H3-1	17	600	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-H4-6	8	300	8	***	.	300	300	0	0.0	300	300
199-H4-8	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-H4-6	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-H4-8	7	5	0	.	.	133	132	18.2	13.7	114	162

G.8

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

16:44 TUESDAY, AUGUST 28, 1986

TABLE G.1 Summarized by Constituent-Well, sorted by Mean

-----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	61000
199-H3-1	18	50	0		.	73500	74400	7830	10.6	50300	82700
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	8		.	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	6		.	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

G.9

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1986 to May 1986

16:44 TUESDAY, AUGUST 26, 1986

TABLE G.1 Summarized by Constituent-Well, sorted by Mean

G.10

-----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	.	.	188	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	928
199-H4-3	11	150	8	.	.	264	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	1158	22.8	3770	6930
199-H4-6	11	100	0	.	.	5450	5490	388	6.8	4880	6000
199-H3-1	18	100	0	.	.	6330	6050	896	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	16.8	10	15

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

16:44 TUESDAY, AUGUST 26, 1986

TABLE G.1 Summarized by Constituent-Well, sorted by Mean

-----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	23.8	14	27
199-H4-3	11	10	1	.	.	25.7	27.1	6.17	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	8.4	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=C80 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	51.8	30	250

-----Constituent List=WAC 173-303-9905					Constituent Code, Name, Units=A25 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

G.11

RCRA Compliance Ground-Water Monitoring Data
 183-R Solar Evaporation Basins, June 1985 to May 1986

16:44 TUESDAY, AUGUST 26, 1986

TABLE G.1 Summarized by Constituent-Well, sorted by Mean

-----Constituent List=WAC 178-803-9905 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		.	10.6	10	2.22	11.7	10	13

-----Constituent List=WAC 173-803-9905 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
183-H Solar Evaporation Basins, June 1985 to May 1986

15:50 TUESDAY, AUGUST 26, 1986

TABLE G.2 Summarized by Constituent-Well-Collection Date
Replicate Data Only

G.13

-----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	23.8
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	15.8	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	.	1450	1440	138	9.3	1330	1800
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	11.8	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	6.18	8.19	0.789	12.8	5.42	6.84
199-H4-5	25JUL85	4	8	0	50	11	8.29	7.57	88.5	5.42	22.2
199-H4-5	26AUG85	4	8	0	50	6.17	6.1	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	0.0285	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

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

15:51 TUESDAY, AUGUST 28, 1988

TABLE G.2 Summarized by Constituent-Well-Collection Date
Replicate Data Only

G.14

-----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	58.4	0.938	3.57
199-H3-1	01AUG85	3	4	0	15	6.91	6.57	1.49	21.5	5.63	6.54
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	1.6
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	0.508	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	59	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=A06 CHROMIUM 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	11.6	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	189	192
199-H4-5	25JUL85	4	10	0	50	472	467	28.8	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	5.89	5	1.39	24.3	5	7.77

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

15:51 TUESDAY, AUGUST 28, 1986

TABLE G.2 Summarized by Constituent-Well-Collection Date
Replicate Data Only

-----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	67800	68000	2060	3.0	65700	69800
199-H4-5	24JUN85	4	500	0	45000	15100	15000	538	3.6	14500	15800
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

G.15

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

15:51 TUESDAY, AUGUST 26, 1986

TABLE G.2 Summarized by Constituent-Well-Collection Date
Replicate Data Only

-----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	8900	10800
199-H4-5	25JUL85	4	100	0	.	9300	9220	444	4.8	8890	9860
199-H4-5	26AUG85	4	100	0	.	6420	6390	212	2.5	6200	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	78.1	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	18
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	156	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	.	288	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	2160	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	263	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	7890	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

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

15:51 TUESDAY, AUGUST 26, 1986

TABLE G.2 Summarized by Constituent-Well-Collection Date
Replicate Data Only

-----Constituent List=Site Specific					Constituent Code, Name, Units=A03 STROMUM 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	67.8	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	2.89	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

G.17

RCRA Compliance Ground-Water Monitoring Data
183-H Solar Evaporation Basins, June 1985 to May 1986

15:51 TUESDAY, AUGUST 26, 1986

TABLE G.2 Summarized by Constituent-Well-Collection Date
Replicate Data Only

81.5

-----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	28AUG85	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	.	458	223	407	89.1	220	928
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	384	52.4	14.0	329	439
199-H4-5	25JUL85	4	150	0	.	288	219	165	57.5	182	531
199-H4-5	28AUG85	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	4780	898	19.1	3550	5740
199-H4-5	28AUG85	4	100	0	.	4110	4110	86.6	2.1	4000	4210

-----Constituent List=Site Specific					Constituent Code, Name, Units=A07 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
103-H Solar Evaporation Basins, June 1985 to May 1986

15:51 TUESDAY, AUGUST 28, 1986

TABLE G.2 Summarized by Constituent-Well-Collection Date
Replicate Data Only

G.19

-----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	16.6	13.4	126	160
199-H4-5	24JUN85	4	50	0	.	180	180	8.16	4.5	170	190
199-H4-5	25JUL85	4	50	0	.	230	230	18.3	7.9	210	250
199-H4-5	28AUG85	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	3.08	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	Constituent 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
					18DEC85			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
					18DEC85			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			448					
199-H4-5	24JUN85			302				
	25JUL85			346				
	26AUG85			401				
	01OCT85			M				
	31OCT85			355				
	12DEC85			364				
	21JAN86			436				
	25FEB86			305				
	25MAR86			312				
	24APR86			352				
28MAY86			321					
199-H4-6	19JUN85			297				
	25JUL85			293				
	25AUG85			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 1988

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	28JUN85		7.40		
			01AUG85		7.70		
			27AUG85		7.90		
			03OCT85		7.80		
			31OCT85		8.10		
			13DEC85		M		
			22JAN86		8.90		
			25FEB86		7.80		
		199-H4-3		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
		199-H4-4		199-H4-4	24MAR86		7.10
					24APR86		7.50
					28MAY86		7.80
					19JUN85		7.20
					01AUG85		7.70
					26AUG85		7.50
					01OCT85		M
					01NOV85		7.40
		199-H4-5		199-H4-5	12DEC85		7.80
					21JAN86		6.60
					24FEB86		7.50
					21MAR86		7.50
24APR86					7.60		
28MAY86					7.60		
24JUN85					7.40		
25JUL85					7.50		
199-H4-6		199-H4-6	26AUG85		7.80		
			01OCT85		M		
			31OCT85		8.30		
			12DEC85		8.00		
			21JAN86		8.50		
			25FEB86		7.70		
			25MAR86		7.60		
			24APR86		7.50		
199-H4-8		199-H4-8	28MAY86		7.60		
			19JUN85		7.00		
			25JUL85		8.70		
			26AUG85		7.80		
			03OCT85		7.80		
			31OCT85		8.40		
			12DEC85		7.90		
			21JAN86		8.10		
25FEB86		7.60					
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	Constituent Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
C68	TOX	PPB	100	199-H3-1	24 JUN 85		<	23.3
					24 JUN 85	1	<	22.2
					24 JUN 85	2	<	19.7
					01 AUG 85		<	19.8
					01 AUG 85	1	<	17.0
					01 AUG 85	2	<	15.8
					27 AUG 85		<	18.3
					27 AUG 85	1	<	13.7
					27 AUG 85	2	<	15.7
					03 OCT 85		<	37.9
					31 OCT 85		<	15.8
					13 DEC 85		<	2,860
					22 JAN 86		<	16.4
					25 FEB 86		<	8.20
					24 MAR 86		<	49.5
					25 APR 86		<	27.5
					28 MAY 86		<	18.3
				199-H4-3	19 JUN 85		<	42.3
					01 AUG 85		<	55.6
					27 AUG 85		<	38.4
					01 OCT 85		<	39.8
					01 NOV 85		<	52.8
					13 DEC 85		<	137
					22 JAN 86		<	38.2
					24 FEB 86		<	27.6
					24 MAR 86		<	2,060
					24 APR 86		<	402
					28 MAY 86		<	38.8
				199-H4-4	01 AUG 85		<	93.0
					26 AUG 85		<	43.1
					01 OCT 85		<	58.7
					01 NOV 85		<	35.1
					12 DEC 85		<	622
					21 JAN 86		<	52.9
					24 FEB 86		<	26.8
					21 MAR 86		<	133
					24 APR 86		<	15.0
					28 MAY 86		<	26.8
				199-H4-5	25 JUL 85		<	27.7
					25 JUL 85	1	<	28.6
					25 JUL 85	2	<	33.6
					25 JUL 85	3	<	38.5
					28 AUG 85		<	29.4
					28 AUG 85	1	<	31.2
					28 AUG 85	2	<	29.3
					28 AUG 85	3	<	30.3
					01 OCT 85		<	32.7
					31 OCT 85		<	35.9
					12 DEC 85		<	608
					21 JAN 86		<	38.4
					25 FEB 86		<	28.0
					25 MAR 86		<	46.1
					24 APR 86		<	42.1
					28 MAY 86		<	33.2
				199-H4-6	25 JUL 85		<	32.6
					26 AUG 85		<	31.6
					03 OCT 85		<	49.9
					31 OCT 85		<	34.0
					12 DEC 85		<	149
					21 JAN 86		<	26.9
					25 FEB 86		<	20.5
					24 MAR 86		<	364
					25 APR 86		<	81.3
					28 MAY 86		<	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 1988

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	24 JUN85		<	3.00
					24 JUN85	1	<	3.00
					24 JUN85	2	<	3.00
					01 AUG85		<	3.00
					01 AUG85	1	<	3.00
					01 AUG85	2	<	3.00
					27 AUG85		<	3.00
					27 AUG85	1	<	3.00
					27 AUG85	2	<	3.00
					03 OCT85		<	3.00
					31 OCT85		<	3.00
					13 DEC85		<	3.00
					22 JAN86		<	3.00
					26 FEB86		<	3.00
					24 MAR86		<	3.00
					26 APR86		<	3.00
					28 MAY86		<	3.00
				199-H4-3	19 JUN85		<	3.00
					01 AUG85		<	23.0
					27 AUG85		<	3.00
					01 OCT85		<	3.00
					01 NOV85		<	3.00
					13 DEC85		<	3.00
					22 JAN86		<	3.00
					24 FEB86		<	3.00
					24 MAR86		<	3.00
					24 APR86		<	3.00
					28 MAY86		<	3.00
				199-H4-4	19 JUN85		<	3.00
					01 AUG85		<	23.0
					28 AUG85		<	3.00
					01 OCT85		<	4.00
					01 NOV85		<	3.00
					12 DEC85		<	3.00
					21 JAN86		<	3.00
					24 FEB86		<	3.00
					21 MAR86		<	3.00
					24 APR86		<	3.00
					28 MAY86		<	3.00
				199-H4-5	24 JUN85		<	3.00
					24 JUN85	1	<	3.00
					24 JUN85	2	<	3.00
					24 JUN85	3	<	3.00
					26 JUL85		<	3.00
					26 JUL85	1	<	3.00
					26 JUL85	2	<	3.00
					26 JUL85	3	<	3.00
					28 AUG85		<	3.00
					28 AUG85	1	<	3.00
					28 AUG85	2	<	3.00
					28 AUG85	3	<	3.00
					01 OCT85		<	3.00
					31 OCT85		<	3.00
					12 DEC85		<	3.00
					21 JAN86		<	3.00
					26 FEB86		<	3.00
					26 MAR86		<	3.00
					24 APR86		<	3.00
					28 MAY86		<	3.00
				199-H4-6	19 JUN85		<	3.00
					26 JUL85		<	4.00
					28 AUG85		<	3.00
					03 OCT85		<	3.00
					31 OCT85		<	3.00
					12 DEC85		<	3.00
					21 JAN86		<	3.00
					26 FEB86		<	3.00
					24 MAR86		<	3.00
					26 APR86		<	3.00
					28 MAY86		<	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			1,180
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		6.84										
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			6.81					
					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	<	0.088
					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
					26FEB86		<	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		<	0.284
					13DEC85		<	0.084
					22JAN86		<	0.134
					24FEB86		<	0.187
					24MAR86		<	0.204
					23APR86		<	0.276
					28MAY86		<	0.312
				199-H4-4	19JUN85		<	0.277
					01AUG85		<	0.144
					28AUG85		<	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		<	0.075
					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	<	-0.016
					01OCT85		<	-0.015
					31OCT85		<	0.070
					12DEC85		<	0.073
					21JAN86		<	0.052
					25FEB86		<	0.023
					25MAR86		<	0.019
					23APR86		<	0.076
					28MAY86		<	0.083
				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		8.57					
					27AUG85			4.03					
					27AUG85	1		4.87					
					27AUG85	2		4.33					
					03OCT85		<	2.70					
					03OCT85			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			28.6					
					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	Constituent 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	86.0
					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			48.0
					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			46.0
					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

Constituent Code	Abbrev Units	Detection Limit	Well	Date	Rep	Lab	Concentration	
A07	CADMIUM	PPB	199-H3-1	24 JUN85		H	<	2.00
				24 JUN85	1	H	<	2.00
				24 JUN85	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	5	H	<	2.00
				13DEC85			<	2.00
				22JAN86			<	2.00
				25FEB86			<	2.00
				24MAR86			<	2.00
			25APR86			<	2.00	
			28MAY86			<	2.00	
			199-H4-3	19 JUN85		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	19 JUN85		H	<	2.00
				01AUG85		H	<	2.00
				28AUG85			<	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	24 JUN85		H	<	2.00			
	24 JUN85	1	H	<	2.00			
	24 JUN85	2	H	<	2.00			
	24 JUN85	3	H	<	2.00			
	25 JUL85		H	<	2.00			
	25 JUL85	1	H	<	2.00			
	25 JUL85	2	H	<	2.00			
	25 JUL85	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	5	H	<	3.20			
	12DEC85			<	2.00			
	21JAN86			<	2.00			
	25FEB86			<	2.00			
25MAR86			<	2.00				
24APR86			<	2.00				
28MAY86			<	2.00				
199-H4-6	19 JUN85		H	<	13.0			
	25 JUL85		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	24 JUN 85		H	30.0
					24 JUN 85	1	H	23.0
					24 JUN 85	2	H	24.0
					01 AUG 85		H	31.0
					01 AUG 85	1	H	51.0
					01 AUG 85	2	H	30.0
					27 AUG 85			33.0
					27 AUG 85	1		30.0
					27 AUG 85	2		30.0
					03 OCT 85			35.0
					31 OCT 85			35.0
					31 OCT 85	S	H	50.0
					13 DEC 85			46.0
					22 JAN 86			64.0
					25 FEB 86			62.0
					24 MAR 86			62.0
					25 APR 86			47.0
					28 MAY 86			40.0
				199-H4-3	19 JUN 85		H	1,130
					01 AUG 85		H	1,030
					27 AUG 85			805
					01 OCT 85			788
					01 NOV 85			911
					13 DEC 85			827
					22 JAN 86			842
					24 FEB 86			733
					24 MAR 86			860
					24 APR 86			832
					28 MAY 86			916
				199-H4-4	19 JUN 85		H	646
					01 AUG 85		H	729
					26 AUG 85			683
					01 OCT 85			694
					01 NOV 85			548
					12 DEC 85			86.0
					21 JAN 86			580
					24 FEB 86			571
					21 MAR 86			361
					24 APR 86			115
					28 MAY 86			291
				199-H4-5	24 JUN 85		H	192
					24 JUN 85	1	H	176
					24 JUN 85	2	H	169
					24 JUN 85	3	H	184
					25 JUL 85		H	447
					25 JUL 85	1	H	451
					25 JUL 85	2	H	482
					25 JUL 85	3	H	508
					26 AUG 85			504
					26 AUG 85	1		470
					26 AUG 85	2		513
					26 AUG 85	3		486
					01 OCT 85			545
					31 OCT 85			572
					31 OCT 85	S	H	591
					12 DEC 85			427
					21 JAN 86			489
					25 FEB 86			492
					25 MAR 86			469
					24 APR 86			465
					28 MAY 86			452
				199-H4-6	19 JUN 85		H	26.0
					25 JUL 85		H	26.0
					26 AUG 85			28.0
					03 OCT 85			31.0
					31 OCT 85			10.0
					12 DEC 85			35.0
					21 JAN 86			36.0
					25 FEB 86			40.0
					24 MAR 86			41.0
					25 APR 86			49.0
					28 MAY 86			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	<
					24JUN85	2	H	<
					01AUG85		H	<
					01AUG85	1	H	<
					01AUG85	2	H	<
					27AUG85			<
					27AUG85	1		<
					27AUG85	2		<
					03OCT85			<
					31OCT85			<
					31OCT85	S	H	<
					13DEC85			<
					22JAN86			<
					25FEB86			<
					24MAR86			<
					25APR86			<
					28MAY86			<
				199-H4-3	19JUN85		H	5.00
					01AUG85		H	<
					27AUG85			<
					01OCT85			<
					01NOV85			<
					13DEC85			<
					22JAN86			<
					24FEB86			<
					24MAR86			<
					24APR86			<
					28MAY86			<
				199-H4-4	19JUN85		H	9.00
					01AUG85		H	<
					26AUG85			<
					01OCT85			<
					01NOV85			<
					12DEC85			<
					21JAN86			<
					24FEB86			<
					21MAR86			<
					24APR86			<
					28MAY86			<
				199-H4-5	24JUN85		H	6.00
					24JUN85	1	H	<
					24JUN85	2	H	<
					24JUN85	3	H	<
					25JUL85		H	6.30
					25JUL85	1	H	<
					25JUL85	2	H	<
					25JUL85	3	H	<
					26AUG85			<
					26AUG85	1		<
					26AUG85	2		7.77
					26AUG85	3		<
					01OCT85			<
					31OCT85			<
					31OCT85	S	H	11.0
					12DEC85			<
					21JAN86			<
					25FEB86			<
					25MAR86			6.39
					24APR86			<
					28MAY86			<
				199-H4-6	19JUN85		H	5.00
					25JUL85		H	<
					26AUG85			<
					03OCT85			<
					31OCT85			<
					12DEC85			<
					21JAN86			<
					25FEB86			<
					24MAR86			<
					25APR86			<
					28MAY86			<

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		
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	5	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	5	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	SELENIUM	PPB	5	199-H3-1	24 JUN 85		H	<	5.00
					24 JUN 85	1	H	<	5.00
					24 JUN 85	2	H	<	5.00
					01 AUG 85		H	<	5.00
					01 AUG 85	1	H	<	5.00
					01 AUG 85	2	H	<	5.00
					27 AUG 85			<	5.00
					27 AUG 85	1		<	5.00
					27 AUG 85	2		<	5.00
					03 OCT 85			<	5.00
					31 OCT 85			<	5.00
					31 OCT 85	S	H	<	5.00
					13 DEC 85			<	5.00
				22 JAN 86			<	5.00	
				25 FEB 86			<	5.00	
				24 MAR 86			<	5.00	
				25 APR 86			<	5.00	
				28 MAY 86			<	5.00	
				199-H4-3	19 JUN 85		H	<	5.00
					01 AUG 85		H	<	5.00
					27 AUG 85			<	5.00
					01 OCT 85			<	5.00
					01 NOV 85			<	5.00
					13 DEC 85			<	5.00
					22 JAN 86			<	5.00
					24 FEB 86			<	5.00
					24 MAR 86			<	5.00
					24 APR 86			<	5.00
28 MAY 86			<		5.00				
199-H4-4	19 JUN 85		H		<	5.00			
	01 AUG 85		H		<	5.00			
	28 AUG 85			<	5.00				
	01 OCT 85			<	5.00				
	01 NOV 85			<	5.00				
	12 DEC 85			<	5.00				
	21 JAN 86			<	5.00				
	24 FEB 86			<	5.00				
	21 MAR 86			<	5.00				
	24 APR 86			<	5.00				
	28 MAY 86			<	5.00				
	199-H4-5	24 JUN 85		H	<	5.00			
		24 JUN 85	1	H	<	5.00			
24 JUN 85		2	H	<	5.00				
24 JUN 85		3	H	<	5.00				
25 JUL 85			H	<	5.00				
25 JUL 85		1	H	<	15.0				
25 JUL 85		2	H	<	10.0				
25 JUL 85		3	H	<	5.00				
28 AUG 85				<	5.00				
28 AUG 85		1		<	5.00				
28 AUG 85		2		<	5.00				
28 AUG 85		3		<	5.00				
01 OCT 85				<	5.00				
31 OCT 85				<	5.00				
31 OCT 85		S	H	<	5.00				
12 DEC 85				<	5.00				
21 JAN 86				<	5.00				
25 FEB 86				<	5.00				
25 MAR 86				<	5.00				
24 APR 86				<	5.00				
28 MAY 86			<	5.00					
199-H4-6	19 JUN 85		H	<	5.00				
	25 JUL 85		H	<	5.00				
	28 AUG 85			<	5.00				
	03 OCT 85			<	5.00				
	31 OCT 85			<	5.00				
	12 DEC 85			<	5.00				
	21 JAN 86			<	5.00				
	25 FEB 86			<	5.00				
	24 MAR 86			<	5.00				
	25 APR 86			<	5.00				
	28 MAY 86			<	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	Constituent 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
					18DEC85		<	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
					28AUG85		<	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	0.0000
					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
					28AUG85		<	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	MITRATE	PPB	500	199-H3-1	24 JUN 85		<	M
					24 JUN 85	1		60,000
					24 JUN 85	2		58,000
					01 AUG 85			79,100
					01 AUG 85	1		68,300
					01 AUG 85	2		87,500
					27 AUG 85			65,700
					27 AUG 85	1		68,000
					27 AUG 85	2		69,800
					03 OCT 85			64,600
					31 OCT 85			72,500
					13 DEC 85			47,100
					22 JAN 86			52,400
					25 FEB 86			71,600
					24 MAR 86			74,200
					25 APR 86			54,100
					28 MAY 86			52,900
				199-H4-3	19 JUN 85			1,350,000
					01 AUG 85			621,000
					27 AUG 85			427,000
					01 OCT 85			418,000
					01 NOV 85			1,040,000
					13 DEC 85			816,000
					22 JAN 86			2,830,000
					24 FEB 86			1,000,000
					24 MAR 86			1,940,000
					24 APR 86			1,590,000
					28 MAY 86			2,890,000
				199-H4-4	19 JUN 85			1,300,000
					01 AUG 85			510,000
					28 AUG 85			444,000
					01 OCT 85			378,000
					01 NOV 85			392,000
					12 DEC 85			23,300
					21 JAN 86			225,000
					24 FEB 86			259,000
					21 MAR 86			200,000
					24 APR 86			38,700
					28 MAY 86			125,000
				199-H4-5	24 JUN 85			15,000
					24 JUN 85	1		15,000
					24 JUN 85	2		15,800
					24 JUN 85	3		14,500
					25 JUL 85			23,000
					25 JUL 85	1		22,500
					25 JUL 85	2		25,100
					25 JUL 85	3		24,500
					28 AUG 85			23,900
					28 AUG 85	1		25,900
					28 AUG 85	2		26,000
					28 AUG 85	3		23,000
					01 OCT 85			21,000
					31 OCT 85			19,300
					12 DEC 85			19,600
					21 JAN 86			19,900
					25 FEB 86			21,800
					25 MAR 86			22,300
					24 APR 86			22,400
					28 MAY 86			26,000
				199-H4-6	19 JUN 85			15,000
					25 JUL 85			20,100
					28 AUG 85			19,300
					03 OCT 85			18,800
					31 OCT 85			22,900
					12 DEC 85			29,200
					21 JAN 86			27,100
					25 FEB 86		<	29,500
					24 MAR 86			31,100
					25 APR 86			28,100
					28 MAY 86			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	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		<	895
				21MAR86		<	658
				24APR86		<	500
				28MAY86		<	500
			199-H4-5	24JUN85			500
				24JUN85	1	<	500
				24JUN85	2	<	500
				24JUN85	3	<	500
				25JUL85		<	810
				25JUL85	1	<	760
				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 1988

TABLE G.3 Raw Data, Constituent List = Quality Characteristics

Constituent Code	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	287,000
					27AUG85			225,000
					01OCT85			228,000
					01NOV85			370,000
					13DEC85			375,000
					22JAN86			447,000
					24FEB86			355,000
					24MAR86			588,000
					24APR86			542,000
					28MAY86			638,000
				199-H4-4	19JUN85		H	148,000
					01AUG85		H	169,000
					28AUG85			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	8,800
					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
					28AUG85			8,200
					28AUG85	1		8,710
					28AUG85	2		8,400
					28AUG85	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			18,700
					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 Q.3 Raw Data, Constituent List - Quality Characteristics

Constituent Code	Abbrev Units	Detection Limit	Well	Date	Rep	Lab	Concentration				
A17	MANGESE	PPB	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		<	5.00
								01NOV85		<	5.00
								13DEC85		<	5.00
								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				
				28AUG85		<	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								
28AUG85		<	5.00								
28AUG85	1	<	5.00								
28AUG85	2	<	5.00								
28AUG85	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				
				28AUG85		<	32.0				
				03OCT85		<	48.0				
				31OCT85		<	64.0				
				12DEC86		<	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

Constituent Code	Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
A19	IRON	PPB	50	199-H3-1	24 JUN85		H	584
					24 JUN85	1	H	132
					24 JUN85	2	H	184
					01AUG85		H	386
					01AUG85	1	H	236
					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	19 JUN85		H	687
					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	19 JUN85		H	1,110
					01AUG85		H	891
					28AUG85			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	24 JUN85		H	165
					24 JUN85	1	H	1,460
					24 JUN85	2	H	104
					24 JUN85	3	H	139
					25 JUL85		H	91.0
					25 JUL85	1	H	196
					25 JUL85	2	H	256
					25 JUL85	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	19 JUN85		H	547
					25 JUL85		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	Constituent 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		87,100
					27AUG85			63,800
					27AUG85	1		68,100
					27AUG85	2		68,000
					03OCT85			68,800
					31OCT85			86,200
					13DEC85			52,600
					22JAN86			58,700
					25FEB86			76,300
					24MAR86			82,800
					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			64,100
					28AUG85			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 1988

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		6,240
					03OCT85			8,570
					31OCT85			7,760
					13DEC85			8,380
					22JAN86			9,090
					26FEB86			8,880
					24MAR86			9,460
					25APR86			9,040
					28MAY86			8,700
				199-H4-3	19JUN85			6,000
					01AUG85			7,100
					27AUG85			4,570
					01OCT85			5,060
					01NOV85			5,180
					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		2,800
					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		3,830
					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
					28AUG85			6,280
					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				<
				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	8.00
					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	87,800	
				24JUN85	2	H	72,100	
				01AUG85		H	74,000	
				01AUG85	1	H	75,000	
				01AUG85	2	H	74,700	
				27AUG85			82,900	
				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			78,800	
				28MAY86			87,900	
				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			48,300					
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-H4-8	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 1988

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	24 JUN 85		H	<	10.0	
					24 JUN 85	1	H	<	10.0	
					24 JUN 85	2	H	<	8.00	
					01 AUG 85		H	<	10.0	
					01 AUG 85	1	H	<	10.0	
					01 AUG 85	2	H	<	10.0	
					27 AUG 85			<	10.0	
					27 AUG 85	1		<	10.0	
					27 AUG 85	2		<	10.0	
					03 OCT 85			<	10.0	
					31 OCT 85			<	10.0	
					31 OCT 85	S	H	<	10.0	
					13 DEC 85			<	10.0	
					22 JAN 86			<	10.0	
				26 FEB 86			<	10.0		
				24 MAR 86			<	10.0		
				26 APR 86			<	10.0		
				28 MAY 86			<	10.0		
				199-H4-3	19 JUN 85		H		74.0	
					01 AUG 85		H		32.0	
					27 AUG 85				22.0	
					01 OCT 85				21.0	
					01 NOV 85				38.0	
					13 DEC 85				39.0	
					22 JAN 86				50.0	
					24 FEB 86				48.0	
					24 MAR 86				80.0	
					24 APR 86				71.0	
					28 MAY 86				90.0	
					199-H4-4	19 JUN 85		H		17.0
						01 AUG 85		H	<	10.0
						28 AUG 85				18.0
				01 OCT 85					16.0	
				01 NOV 85				<	10.0	
12 DEC 85			<	10.0						
21 JAN 86			<	10.0						
24 FEB 86			<	10.0						
21 MAR 86			<	10.0						
24 APR 86			<	10.0						
28 MAY 86			<	10.0						
199-H4-5	24 JUN 85		H	<		10.0				
	24 JUN 85	1	H	<		10.0				
	24 JUN 85	2	H	<		10.0				
	24 JUN 85	3	H	<	10.0					
	26 JUL 85		H	<	10.0					
	26 JUL 85	1	H	<	10.0					
	26 JUL 85	2	H	<	10.0					
	26 JUL 85	3	H	<	10.0					
	26 AUG 85			<	10.0					
	26 AUG 85	1		<	10.0					
	26 AUG 85	2		<	10.0					
	26 AUG 85	3		<	10.0					
	01 OCT 85			<	10.0					
	31 OCT 85			<	10.0					
	31 OCT 85	S	H	<	10.0					
	12 DEC 85			<	10.0					
	21 JAN 86			<	10.0					
	26 FEB 86			<	10.0					
	26 MAR 86			<	10.0					
	24 APR 86			<	10.0					
	28 MAY 86			<	10.0					
	199-H4-6	19 JUN 85		H	<	10.0				
		26 JUL 85		H	<	10.0				
		28 AUG 85			<	10.0				
03 OCT 85				<	10.0					
31 OCT 85				<	10.0					
12 DEC 85				<	10.0					
21 JAN 86				<	10.0					
26 FEB 86				<	10.0					
24 MAR 86				<	10.0					
26 APR 86				<	10.0					
28 MAY 86				<	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	<	16.0
					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	<	
				28AUG85				<	
01OCT85			<						
01NOV85			<						
12DEC85			<						
21JAN86			<						
24FEB86			<						
21MAR86			<						
24APR86			<						
28MAY86			<						
199-H4-5	24JUN85		H	13.0					
	24JUN85	1	H	27.0					
	24JUN85	2	H	20.0					
	24JUN85	3	H	12.0					
	25JUL85		H	<					
	25JUL85	1	H	<					
	25JUL85	2	H	<					
	25JUL85	3	H	<					
	28AUG85			<					
	28AUG85	1		<					
	28AUG85	2		<					
	28AUG85	3		<					
	01OCT85			<					
	31OCT85			<					
	31OCT85	S	H	<					
	12DEC85			<					
	21JAN86			<					
	25FEB86			<					
	25MAR86			<					
	24APR86			<					
28MAY86			<						
199-H4-6	19JUN85		H	12.0					
	25JUL85		H	<					
	28AUG85			<					
	03OCT85			<					
	31OCT85			<					
	12DEC85			<					
	21JAN86			<					
	25FEB86			<					
	24MAR86			<					
	25APR86			<					
	28MAY86			<					

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
A14	VANADUM	PPB	5	199-H3-1	24 JUN 85		H	41.0
					24 JUN 85	1	H	28.0
					24 JUN 85	2	H	29.0
					01 AUG 85		H	20.0
					01 AUG 85	1	H	20.0
					01 AUG 85	2	H	20.0
					27 AUG 85			9.00
					27 AUG 85	1	<	5.00
					27 AUG 85	2		9.00
					03 OCT 85			14.0
					31 OCT 85			9.00
					31 OCT 85	S	H	19.0
					13 DEC 85		<	5.00
					22 JAN 86		<	5.00
					25 FEB 86		<	5.00
					24 MAR 86		<	5.00
					25 APR 86			10.0
					28 MAY 86			10.0
				199-H4-3	19 JUN 85		H	24.0
					01 AUG 85		H	14.0
					27 AUG 85			9.00
					01 OCT 85			9.00
					01 NOV 85		<	5.00
					13 DEC 85		<	5.00
					22 JAN 86		<	5.00
					24 FEB 86		<	5.00
					24 MAR 86		<	5.00
					24 APR 86		<	5.00
					28 MAY 86		<	5.00
				199-H4-4	19 JUN 85		H	16.0
					01 AUG 85		H	5.00
					26 AUG 85		<	5.00
					01 OCT 85			10.0
					01 NOV 85		<	5.00
					12 DEC 85		<	5.00
					21 JAN 86		<	5.00
					24 FEB 86		<	5.00
					21 MAR 86			5.00
					24 APR 86			6.00
					28 MAY 86			6.00
				199-H4-5	24 JUN 85		H	28.0
					24 JUN 85	1	H	37.0
					24 JUN 85	2	H	32.0
					24 JUN 85	3	H	32.0
					25 JUL 85		H	5.00
					25 JUL 85	1	<	5.00
					25 JUL 85	2	H	5.00
					25 JUL 85	3	H	5.00
					26 AUG 85		<	5.00
					26 AUG 85	1	<	5.00
					26 AUG 85	2		5.00
					26 AUG 85	3	<	5.00
					01 OCT 85			8.00
					31 OCT 85		<	5.00
					31 OCT 85	S	H	19.0
					12 DEC 85		<	5.00
					21 JAN 86		<	5.00
					25 FEB 86		<	5.00
					25 MAR 86		<	5.00
					24 APR 86		<	5.00
					28 MAY 86		<	5.00
				199-H4-6	19 JUN 85		H	18.0
					25 JUL 85		H	5.00
					26 AUG 85		<	9.00
					03 OCT 85			10.0
					31 OCT 85			5.00
					12 DEC 85		<	5.00
					21 JAN 86		<	5.00
					25 FEB 86		<	5.00
					24 MAR 86		<	5.00
					25 APR 86			8.00
					28 MAY 86			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	Constituent Abbrev Units	Detection Limit	Well	Date	Rep	Lab	Concentration
A16	ALUMNUM PPB	150	199-H3-1	24 JUN85		H	926
				24 JUN85	1	H	223
				24 JUN85	2	H	220
				01 AUG85		H	208
				01 AUG85	1	H	<
				01 AUG85	2	H	560
				27 AUG85		<	150
				27 AUG85	1	<	150
				27 AUG85	2	<	150
				03 OCT85		<	150
				31 OCT85		<	150
				31 OCT85	S	H	543
				13 DEC85		<	150
				22 JAN86		<	150
				25 FEB86		<	150
				24 MAR86		<	150
				25 APR86		<	150
				28 MAY86		<	150
			199-H4-3	19 JUN85		H	759
				01 AUG85		H	237
				27 AUG85		<	150
				01 OCT85		<	150
				01 NOV85		<	150
				13 DEC85			281
				22 JAN86		<	150
				24 FEB86		<	150
				24 MAR86		<	150
				24 APR86			270
				28 MAY86			349
			199-H4-4	19 JUN85		H	197
				01 AUG85		H	304
				26 AUG85		<	150
				01 OCT85		<	150
				01 NOV85		<	150
				12 DEC85		<	150
				21 JAN86		<	150
				24 FEB86		<	150
				21 MAR86		<	150
				24 APR86		<	150
				28 MAY86		<	150
			199-H4-5	24 JUN85		H	334
				24 JUN85	1	H	439
				24 JUN85	2	H	329
				24 JUN85	3	H	394
				25 JUL85		H	182
				25 JUL85	1	H	188
				25 JUL85	2	H	252
				25 JUL85	3	H	531
				26 AUG85		<	150
				26 AUG85	1	<	150
				26 AUG85	2	<	150
				26 AUG85	3	<	150
				01 OCT85		<	150
				31 OCT85		<	150
				31 OCT85	S	H	163
				12 DEC85		<	150
				21 JAN86		<	150
				25 FEB86		<	150
				25 MAR86		<	150
				24 APR86		<	150
				26 MAY86		<	150
			199-H4-6	19 JUN85		H	332
				25 JUL85		H	225
				26 AUG85		<	150
				03 OCT85		<	150
				31 OCT85		<	150
				12 DEC85		<	150
				21 JAN86		<	150
				25 FEB86		<	150
				24 MAR86		<	150
				25 APR86		<	150
				28 MAY86		<	150

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	Constituent Abbrev	Units	Detection Limit	Well	Date	Rep	Lab	Concentration
A18	POTASUM	PPB	100	199-H3-1	24 JUN 85		H	7,220
					24 JUN 85	1	H	5,400
					24 JUN 85	2	H	5,310
					01 AUG 85		H	7,500
					01 AUG 85	1	H	6,980
					01 AUG 85	2	H	6,540
					27 AUG 85			5,730
					27 AUG 85	1		5,270
					27 AUG 85	2		5,370
					03 OCT 85			5,760
					31 OCT 85			7,770
					31 OCT 85	S	H	8,240
					13 DEC 85			6,580
					22 JAN 86			5,950
					25 FEB 86			5,760
					24 MAR 86			6,440
					25 APR 86			6,120
					28 MAY 86			5,970
				199-H4-3	19 JUN 85		H	9,090
					01 AUG 85		H	8,350
					27 AUG 85			3,950
					01 OCT 85			4,190
					01 NOV 85			8,410
					13 DEC 85			7,150
					22 JAN 86			9,970
					24 FEB 86			7,120
					24 MAR 86			12,200
					24 APR 86			11,800
					28 MAY 86			14,300
				199-H4-4	19 JUN 85		H	6,040
					01 AUG 85		H	6,930
					26 AUG 85			6,350
					01 OCT 85			5,590
					01 NOV 85			6,220
					12 DEC 85			3,770
					21 JAN 86			4,540
					24 FEB 86			4,120
					21 MAR 86			4,130
					24 APR 86			3,870
					28 MAY 86			4,430
				199-H4-5	24 JUN 85		H	3,870
					24 JUN 85	1	H	4,150
					24 JUN 85	2	H	4,180
					24 JUN 85	3	H	4,930
					25 JUL 85		H	3,550
					25 JUL 85	1	H	4,770
					25 JUL 85	2	H	4,740
					25 JUL 85	3	H	5,740
					26 AUG 85			4,000
					26 AUG 85	1		4,210
					26 AUG 85	2		4,120
					26 AUG 85	3		4,020
					01 OCT 85			3,920
					31 OCT 85			4,850
					31 OCT 85	S	H	5,370
					12 DEC 85			4,740
					21 JAN 86			3,990
					25 FEB 86			3,470
					25 MAR 86			4,290
					24 APR 86			4,180
					28 MAY 86			4,310
				199-H4-6	19 JUN 85		H	5,390
					25 JUL 85		H	5,580
					26 AUG 85			5,110
					03 OCT 85			4,880
					31 OCT 85			5,610
					12 DEC 85			6,000
					21 JAN 86			4,990
					25 FEB 86			5,250
					24 MAR 86			5,930
					25 APR 86			5,740
					28 MAY 86			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	<
					24JUN85	2	H	10.0
					01AUG85		H	<
					01AUG85	1	H	10.0
					01AUG85	2	H	10.0
					27AUG85			<
					27AUG85	1		10.0
					27AUG85	2		10.0
					03OCT85			<
					31OCT85			10.0
					31OCT85	S	H	<
					13DEC85			10.0
					22JAN86			22.0
					25FEB86			10.0
					24MAR86			10.0
					25APR86			10.0
					28MAY86			10.0
				199-H4-3	19JUN85		H	<
					01AUG85		H	<
					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			<
					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			<
					31OCT85			10.0
					31OCT85	S	H	<
					12DEC85			10.0
					21JAN86			14.0
					25FEB86			10.0
					25MAR86			10.0
					24APR86			10.0
					28MAY86			10.0
				199-H4-6	03OCT85			<
					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	24 JUN 85		H	< M
					24 JUN 85	1	H	< 10.0
					24 JUN 85	2	H	< 10.0
					01 AUG 85		H	< 10.0
					01 AUG 85	1	H	< 10.0
					01 AUG 85	2	H	< 10.0
					27 AUG 85			< 10.0
					27 AUG 85	1		< 10.0
					27 AUG 85	2		< 10.0
					03 OCT 85			< 10.0
					31 OCT 85			< 10.0
					31 OCT 85	S	H	< 10.0
					13 DEC 85			< 10.0
					22 JAN 86			< 10.0
					25 FEB 86			< 10.0
					24 MAR 86			< 10.0
					25 APR 86			< 10.0
					28 MAY 86			< 10.0
				199-H4-3	19 JUN 85		H	< 10.0
					01 AUG 85		H	< 10.0
					27 AUG 85			< 10.0
					01 OCT 85			< 11.0
					01 NOV 85			< 10.0
					13 DEC 85			< 10.0
					22 JAN 86			< 10.0
					24 FEB 86			< 10.0
					24 MAR 86			< 10.0
					24 APR 86			< 11.4
					28 MAY 86			< 10.0
				199-H4-4	01 OCT 85			< 10.0
					01 NOV 85			< 10.0
					12 DEC 85			< 10.0
					21 JAN 86			< 10.0
					24 FEB 86			< 10.0
					21 MAR 86			< 10.0
					24 APR 86			< 10.0
					28 MAY 86			< 10.0
				199-H4-5	01 OCT 85			< 10.0
					31 OCT 85			< 10.0
					31 OCT 85	S	H	< 10.0
					12 DEC 85			< 10.0
					21 JAN 86			< 10.0
					25 FEB 86			< 10.0
					25 MAR 86			< 10.0
					24 APR 86			< 10.0
					28 MAY 86			< 10.0
				199-H4-6	03 OCT 85			< 10.0
					31 OCT 85			< 10.0
					12 DEC 85			< 10.0
					21 JAN 86			< 10.0
					25 FEB 86			< 10.0
					24 MAR 86			< 10.0
					25 APR 86			< 15.0
					28 MAY 86			< 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	24 JUN 85	H	< M
				24 JUN 85	1	H	< 10.0
				24 JUN 85	2	H	< 10.0
				01 AUG 85		H	< 10.0
				01 AUG 85	1	H	< 10.0
				01 AUG 85	2	H	< 10.0
				27 AUG 85			< 10.0
				27 AUG 85	1		< 10.0
				27 AUG 85	2		< 10.0
				03 OCT 85			< 10.0
				13 DEC 85			1,500
				22 JAN 86			< 10.0
				26 FEB 86			28.0
				24 MAR 86			36.0
				25 APR 86			< 10.0
			199-H4-3	19 JUN 85		H	< 10.0
				01 AUG 85		H	< 10.0
				27 AUG 85			< 10.0
				01 OCT 85			< 10.0
				13 DEC 85			110
				22 JAN 86			< 10.0
				24 FEB 86			34.0
				24 MAR 86			1,400
				24 APR 86			390
			199-H4-4	12 DEC 85			570
				21 MAR 86			340
			199-H4-5	12 DEC 85			600
				26 FEB 86			< 6.40
				25 MAR 86			< 2.80
			199-H4-6	12 DEC 85			140
				26 FEB 86			22.0
				24 MAR 86			470
				25 APR 86			58.0

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	199-H3-1	24JUN85			170	
				24JUN85	1		175	
				24JUN85	2		180	
				01AUG85			230	
				01AUG85	1		175	
				01AUG85	2		180	
				27AUG85			180	
				27AUG85	1		130	
				27AUG85	2		128	
				03OCT85			138	
				31OCT85			160	
				13DEC85		<	48.0	
				22JAN86		<	38.0	
			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
			28AUG85				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				
	24JUN85	3		180				
	25JUL85			220				
	25JUL85	1		240				
	25JUL85	2		250				
	25JUL85	3		210				
	28AUG85			190				
	28AUG85	1		130				
	28AUG85	2		130				
	28AUG85	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				
	28AUG85			155				
	03OCT85			190				
	31OCT85			220				
	12DEC85			98.0				
	21JAN86			74.0				
	25FEB86		<	50.0				
	24MAR86			103				
	25APR86			89.0				
	28MAY86			70.8				

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	<
					01AUG85	1	H	<
					01AUG85	2	H	<
					27AUG85			<
					27AUG85	1		<
					27AUG85	2		<
					03OCT85			<
					22JAN86			<
					25APR86			<
				199-H4-3	19JUN85		H	21.0
					01AUG85		H	<
					27AUG85			<
					01OCT85			<
					22JAN86			<
					24APR86			<

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	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	<	M
				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

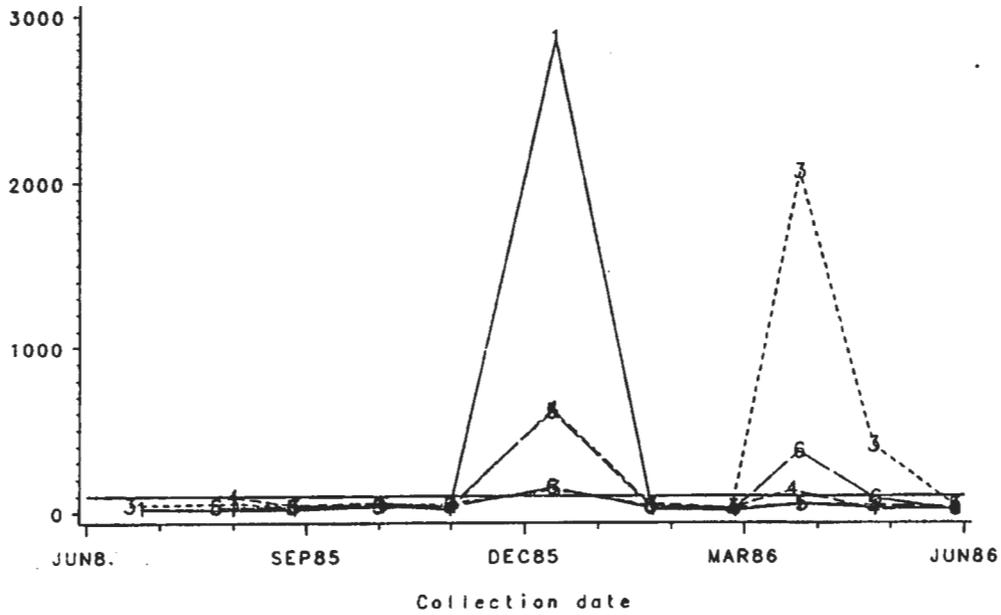
Appendix H contains graphical presentations for the chemical constituent data collected between June 1985 and May 1986 from wells located near the 183-H Solar Evaporation Basins. All replicate data have been averaged before plotting the results. The same data are plotted in two ways for different purposes.

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).

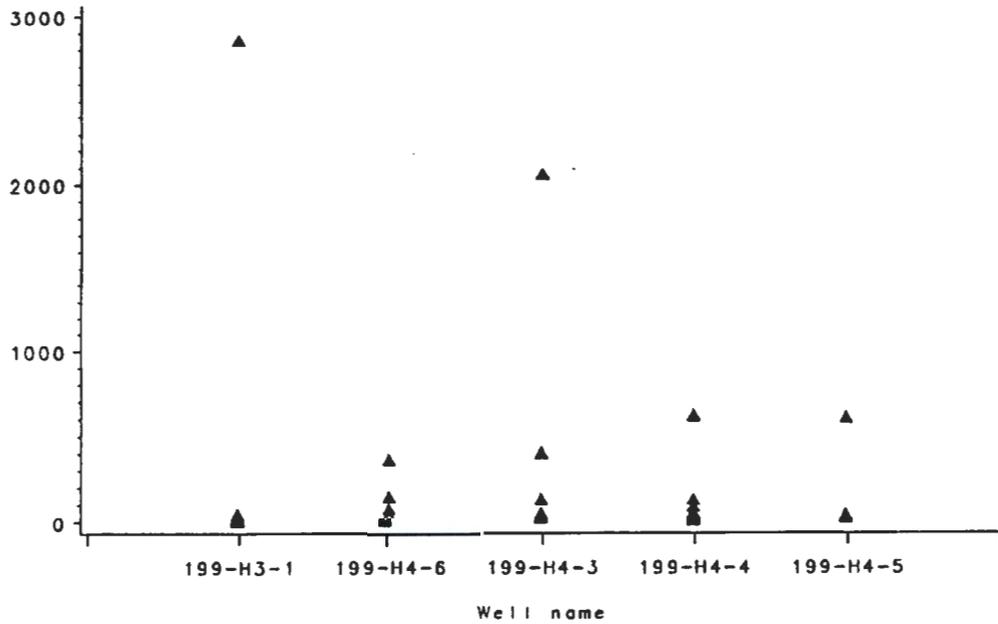
The graphs included in this appendix present data for TOX, TOC, coliform, cadmium, arsenic, mercury, selenium, lead, iron, fluoride, strontium, calcium, vanadium, aluminum, potassium, 1,1,1-trichloroethane, perchloroethylene, methylene chloride, ammonium, thallium, and bis(2-ethylhexyl) phthalate.

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Contamination Indicators Constituent=C68 TOX PPB

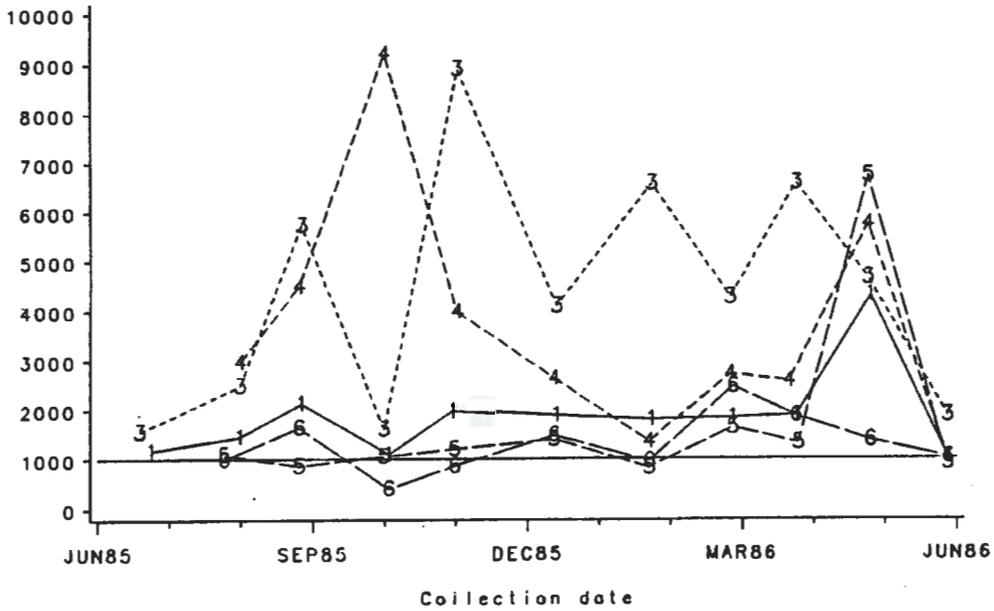


Horizontal solid line is detection limit

Constituent List=Contamination Indicators Constituent=C68 TOX PPB

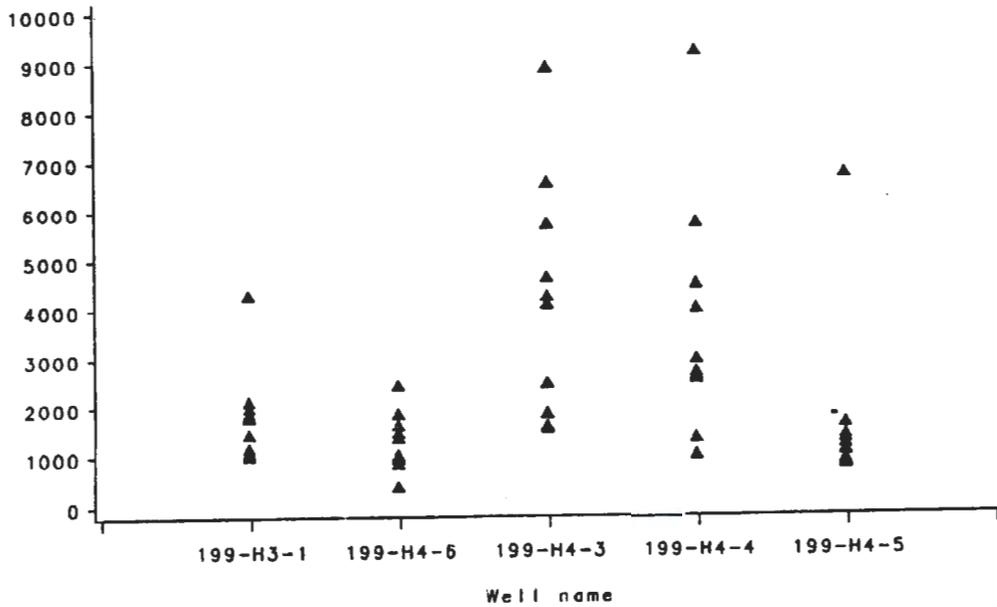


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Contamination Indicators Constituent=C69 TOC PPB

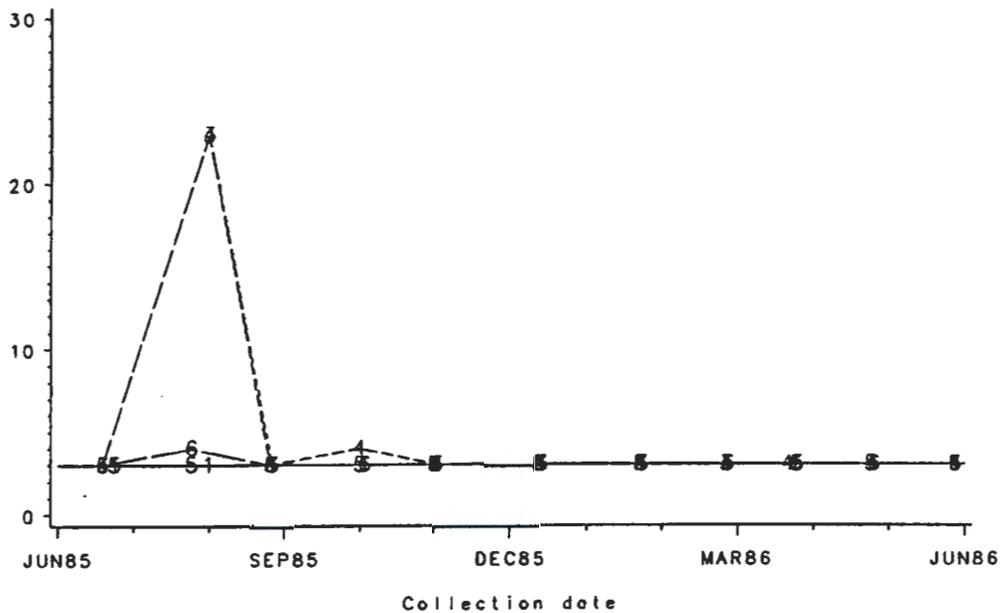


Horizontal solid line is detection limit

Constituent List=Contamination Indicators Constituent=C69 TOC PPB

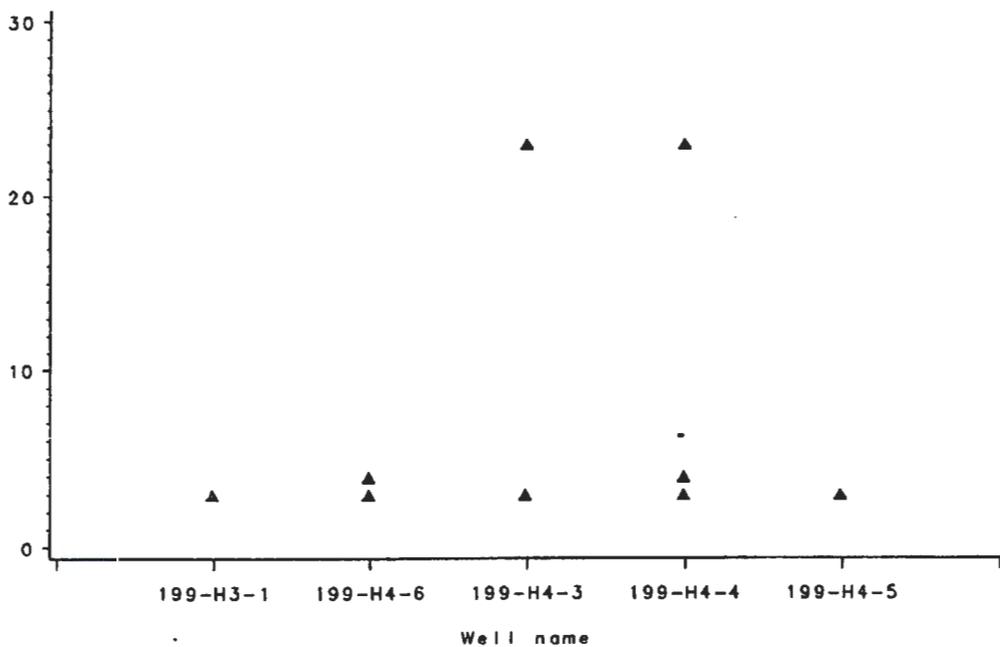


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Drinking Water Standards Constituent=109 COLIFRM MPN

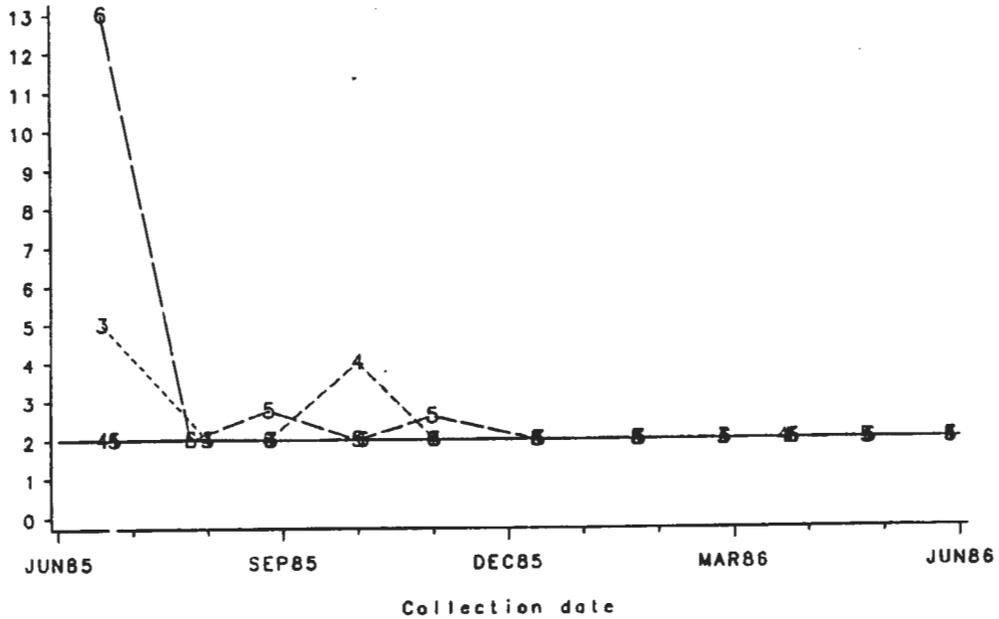


Horizontal solid line is detection limit

Constituent List=Drinking Water Standards Constituent=109 COLIFRM MPN

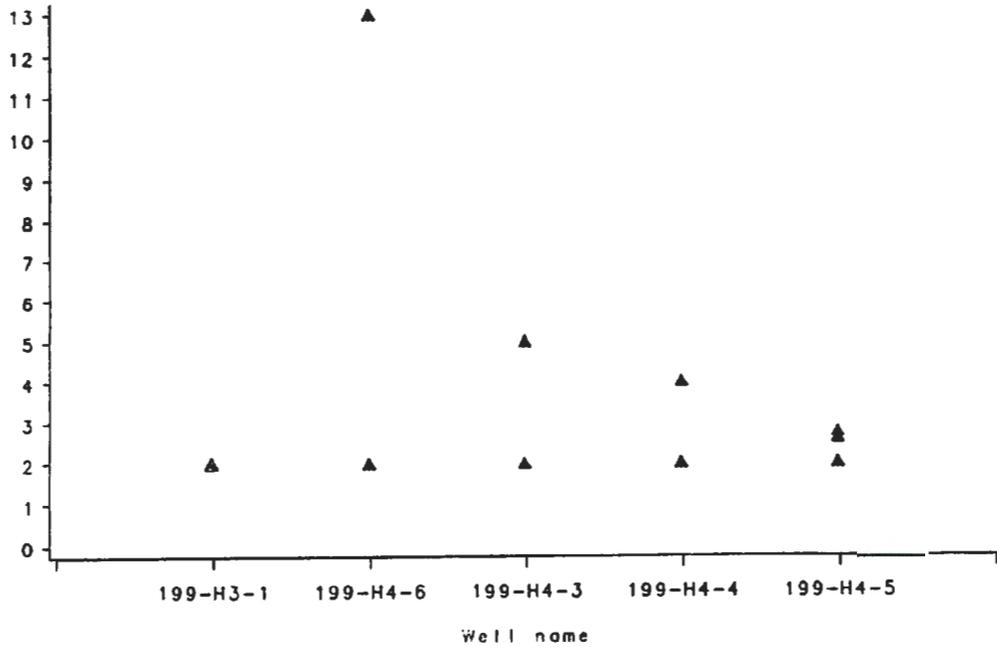


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Drinking Water Standards Constituent=A07 CADMIUM PPB

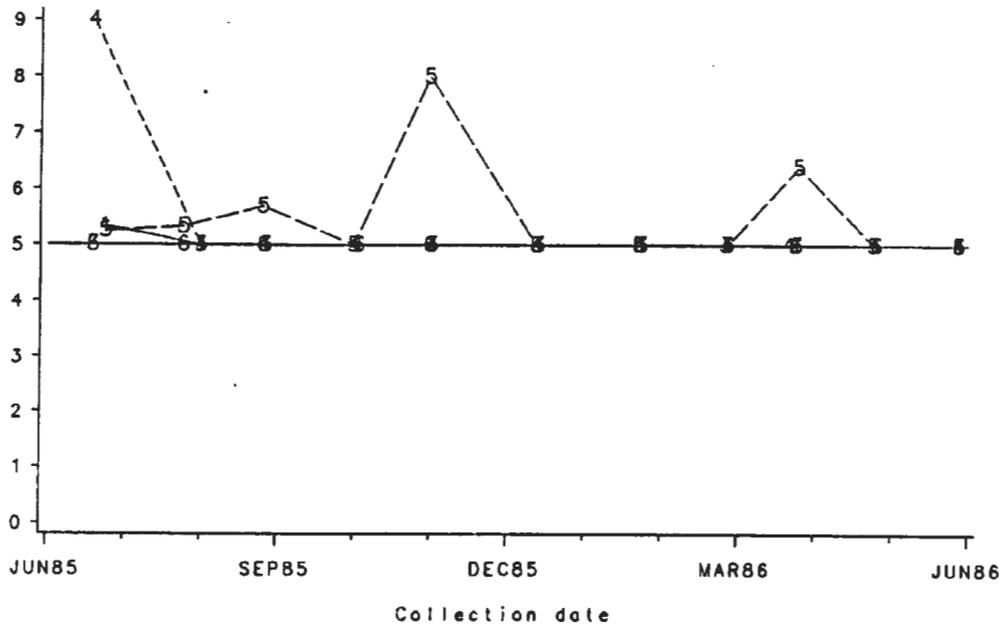


Horizontal solid line is detection limit

Constituent List=Drinking Water Standards Constituent=A07 CADMIUM PPB

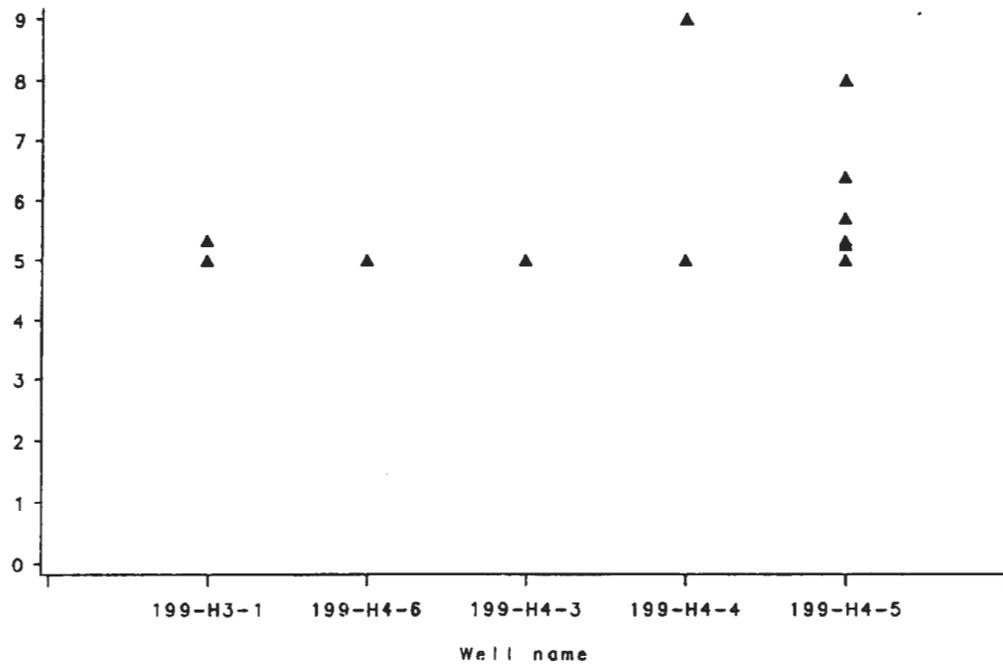


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Drinking Water Standards Constituent=A20 ARSENIC PPB

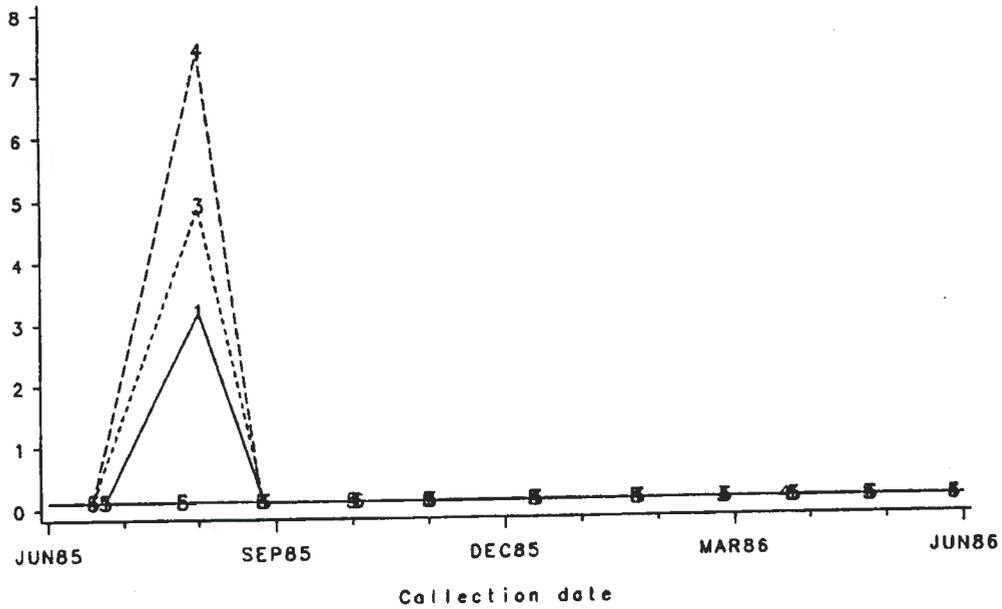


Horizontal solid line is detection limit

Constituent List=Drinking Water Standards Constituent=A20 ARSENIC PPB

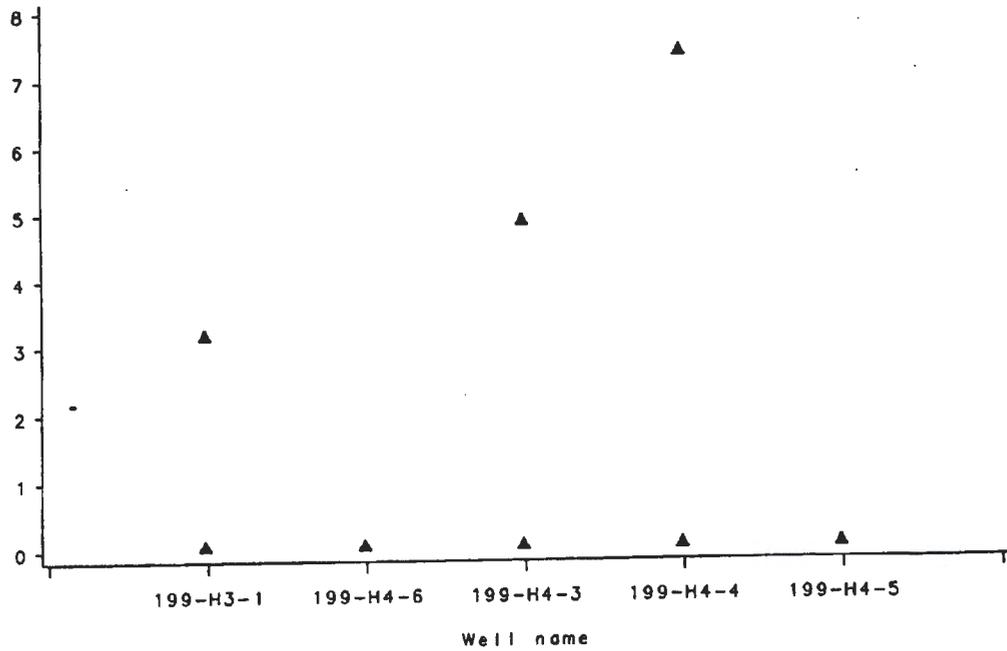


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Drinking Water Standards Constituent=A21 MERCURY PPB

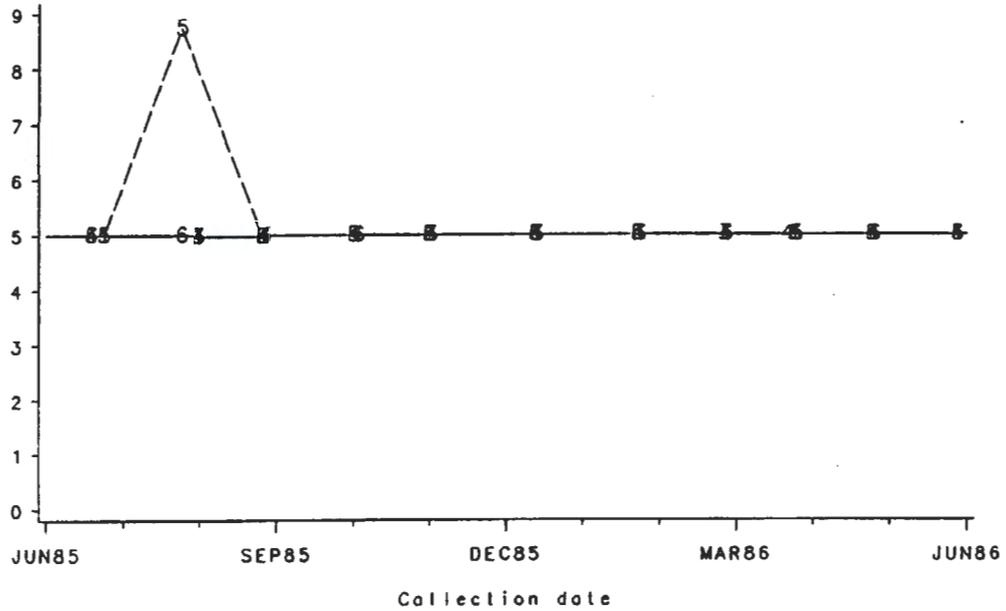


Horizontal solid line is detection limit

Constituent List=Drinking Water Standards Constituent=A21 MERCURY PPB

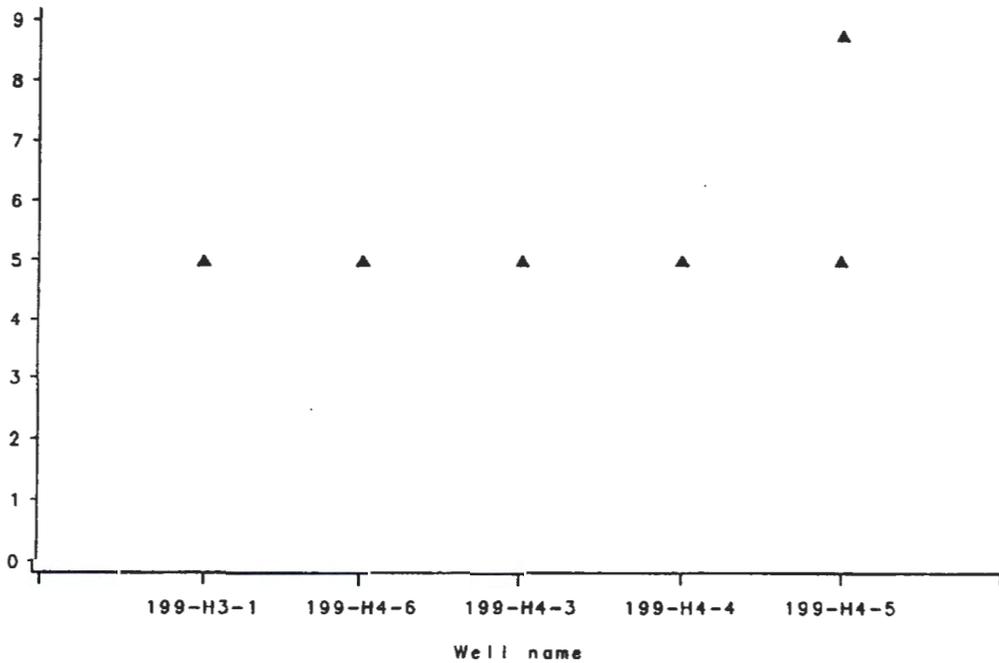


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Drinking Water Standards Constituent=A22 SELENUM PPB

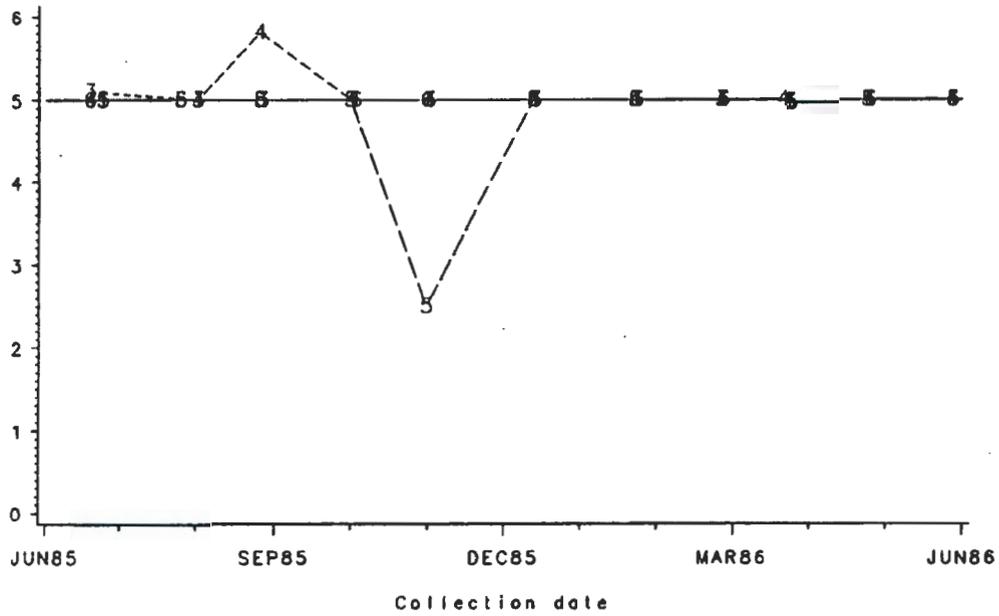


Horizontal solid line is detection limit

Constituent List=Drinking Water Standards Constituent=A22 SELENUM PPB

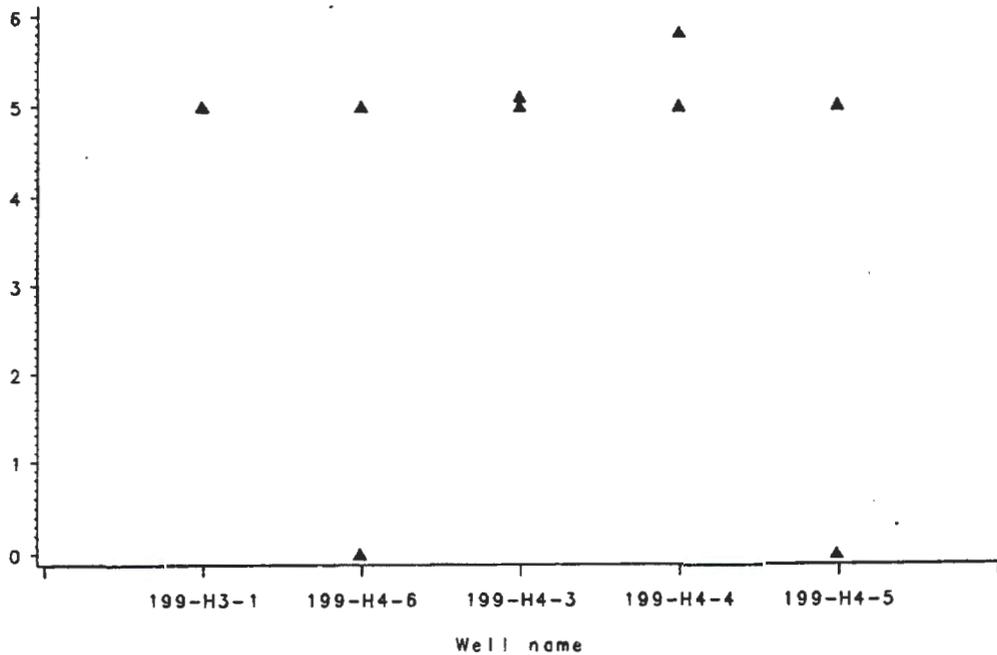


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Drinking Water Standards Constituent=A51 LEADGF PPB

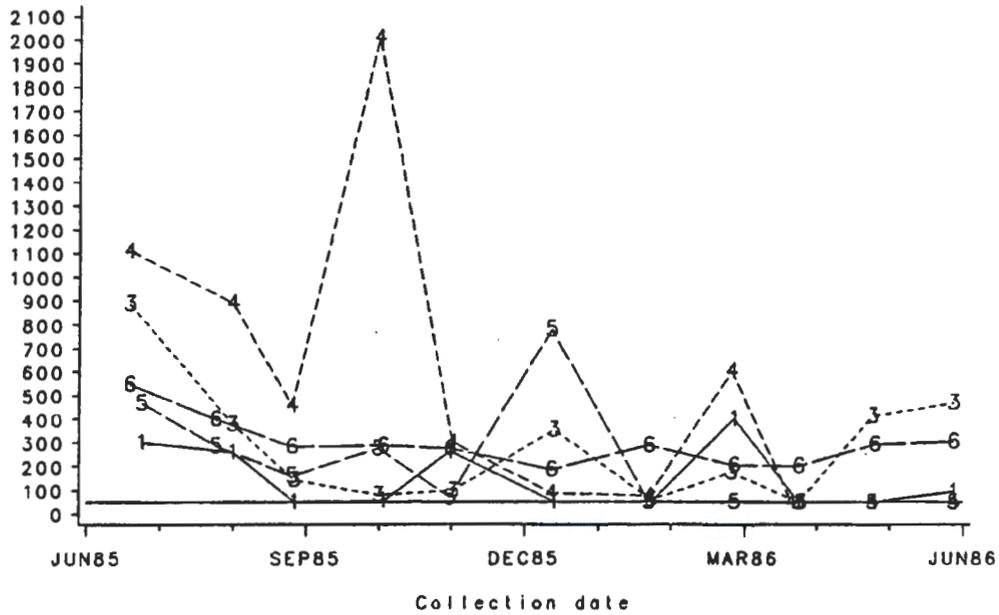


Horizontal solid line is detection limit

Constituent List=Drinking Water Standards Constituent=A51 LEADGF PPB

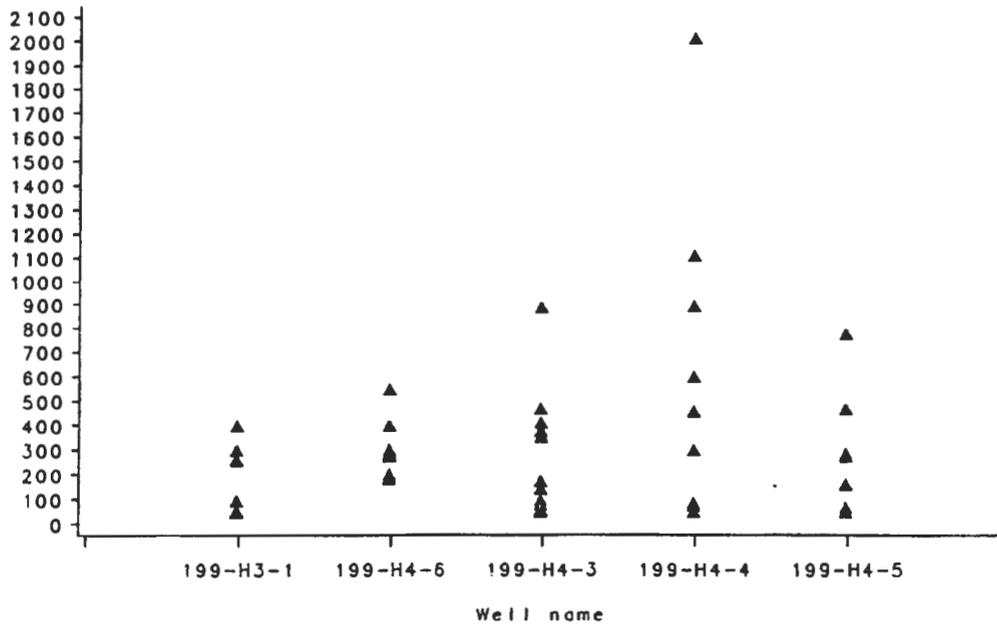


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Quality Characteristics Constituent=A19 IRON PPB

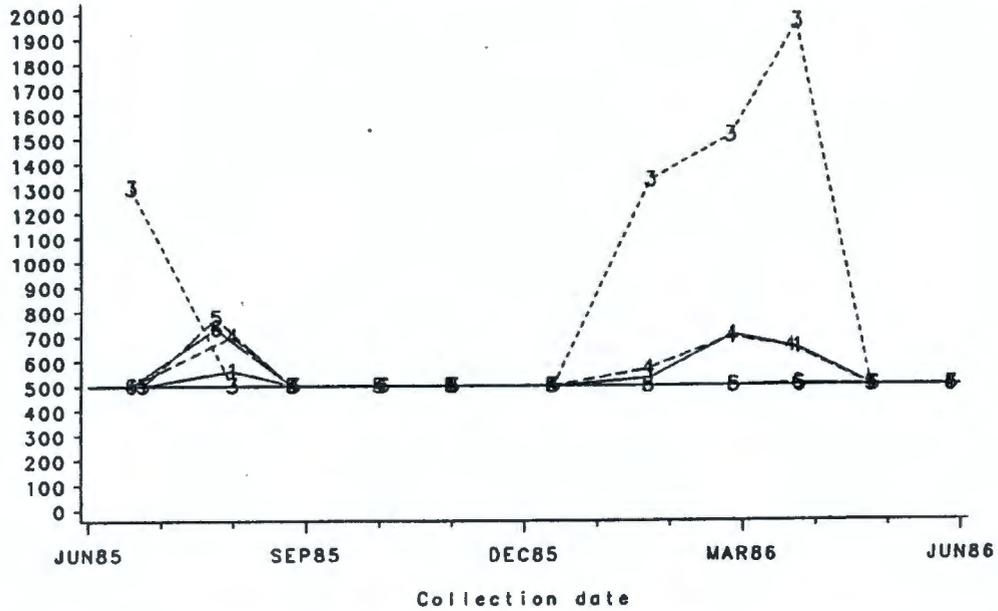


Horizontal solid line is detection limit

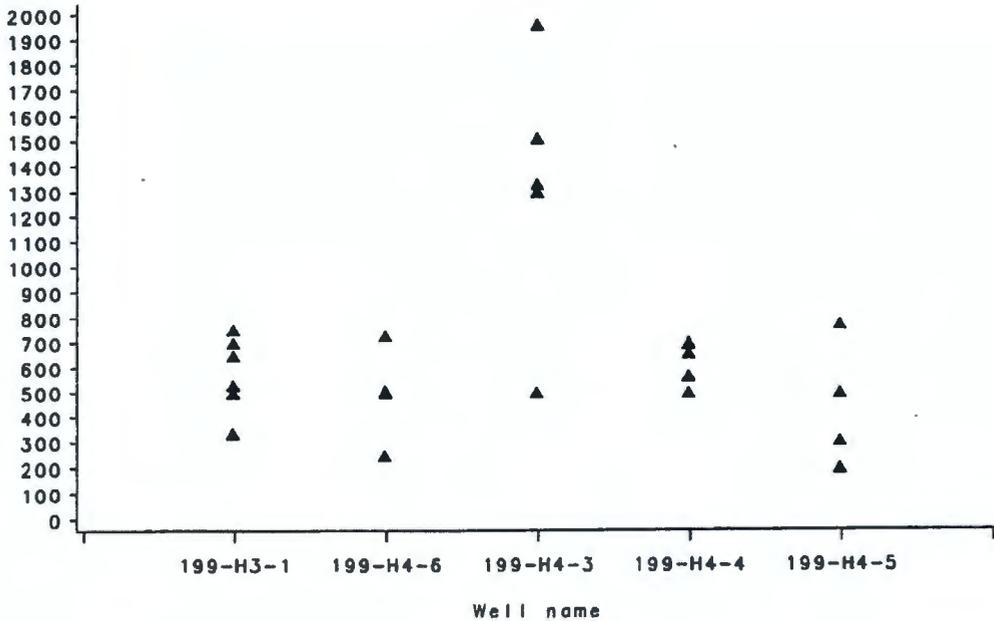
Constituent List=Quality Characteristics Constituent=A19 IRON PPB



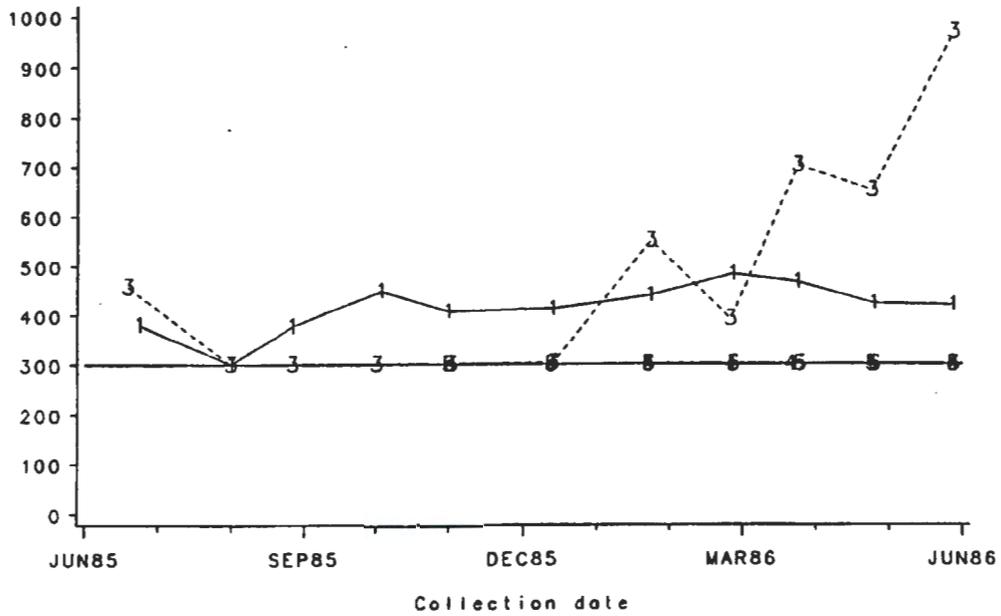
RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Drinking Water Standards Constituent=C74 FLUORID PPB



Constituent List=Drinking Water Standards Constituent=C74 FLUORID PPB

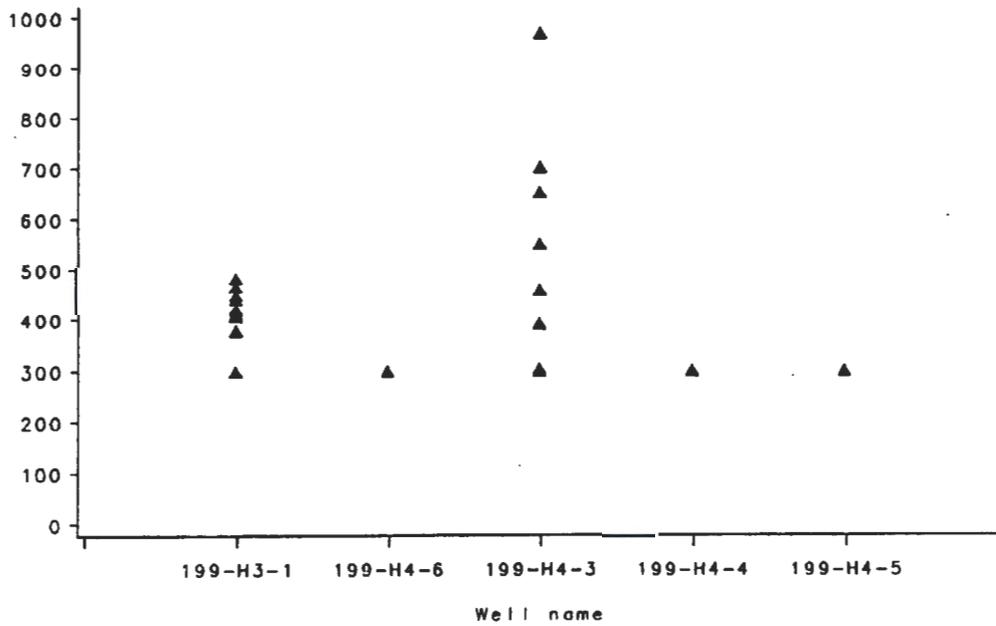


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Site Specific Constituent=A03 STRONUM PPB

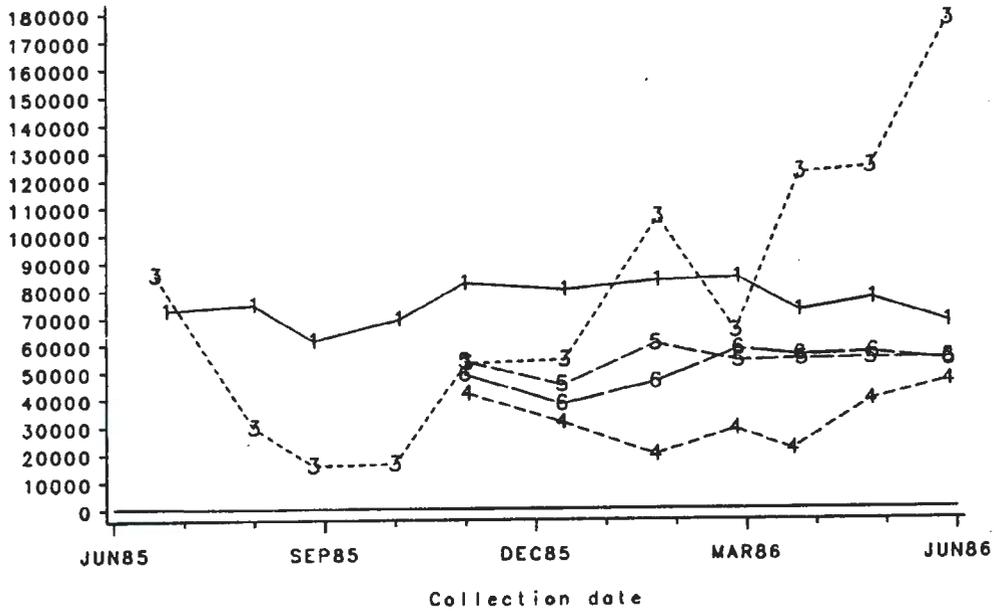


Horizontal solid line is detection limit

Constituent List=Site Specific Constituent=A03 STRONUM PPB

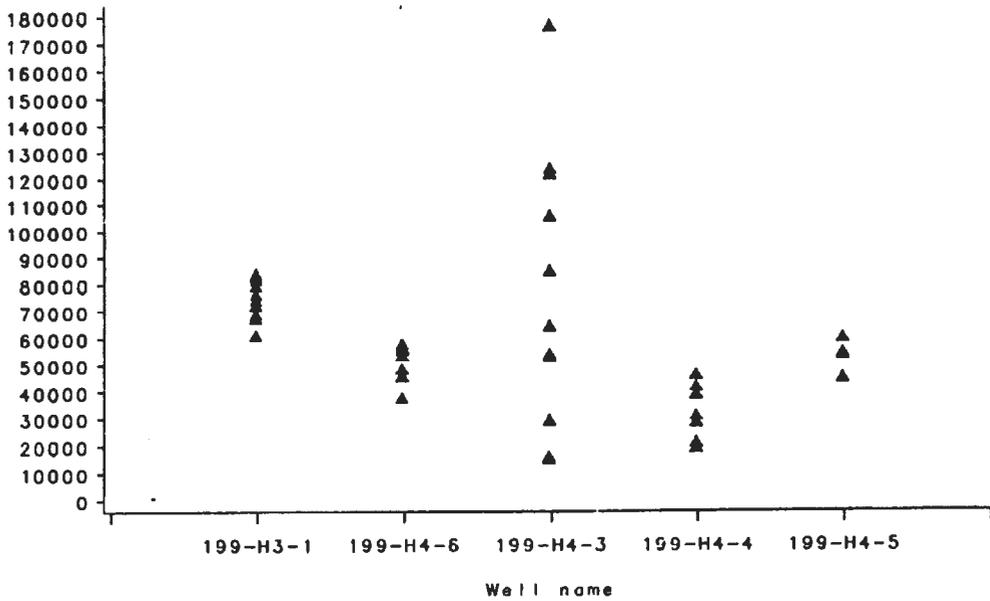


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Site Specific Constituent=A05 CALCIUM PPB

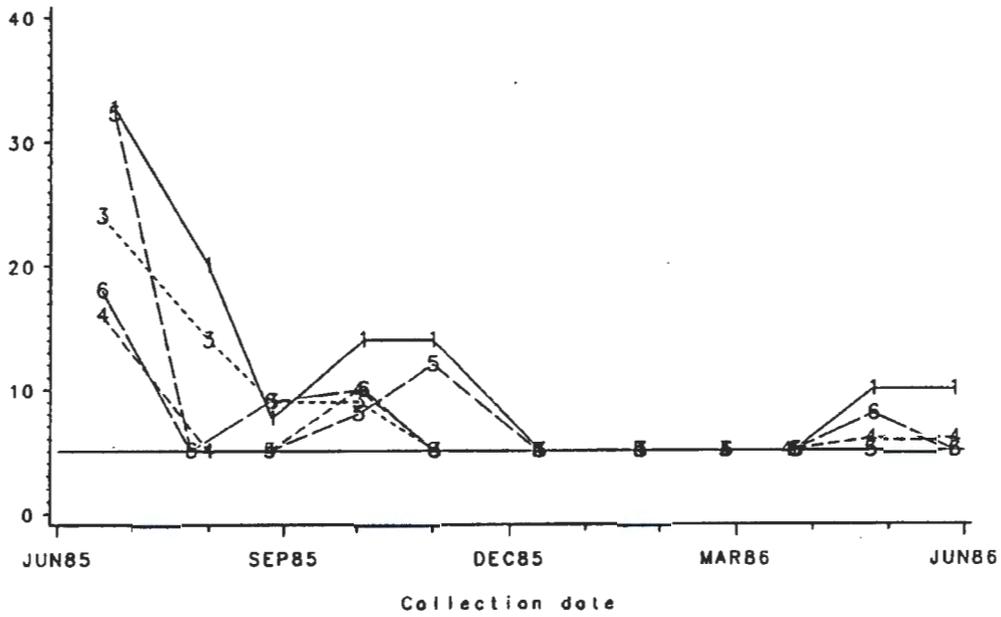


Horizontal solid line is detection limit

Constituent List=Site Specific Constituent=A05 CALCIUM PPB

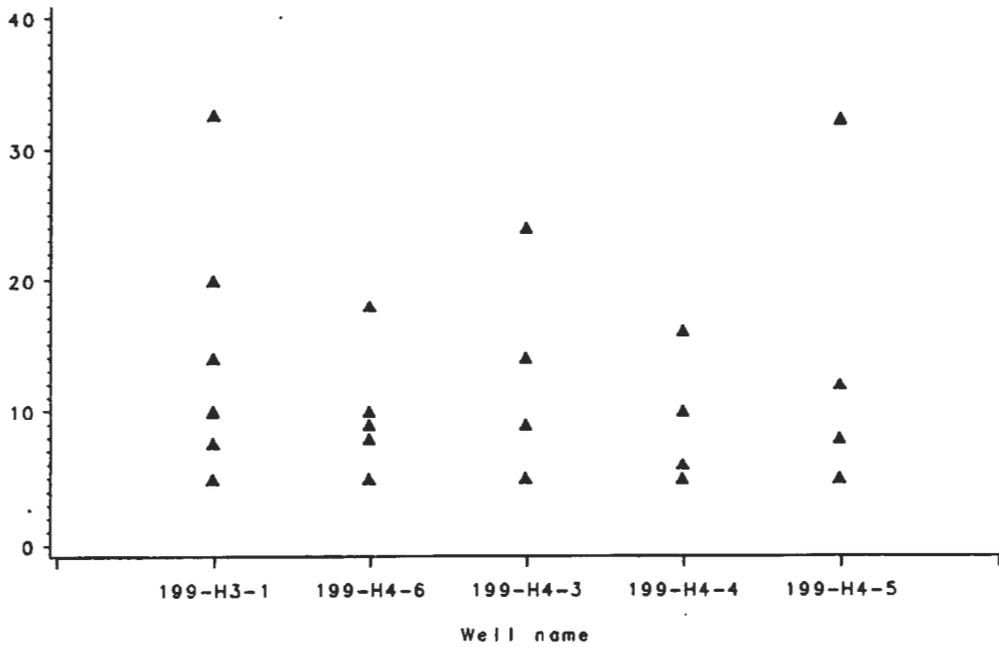


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Site Specific Constituent=A14 VANADUM PPB

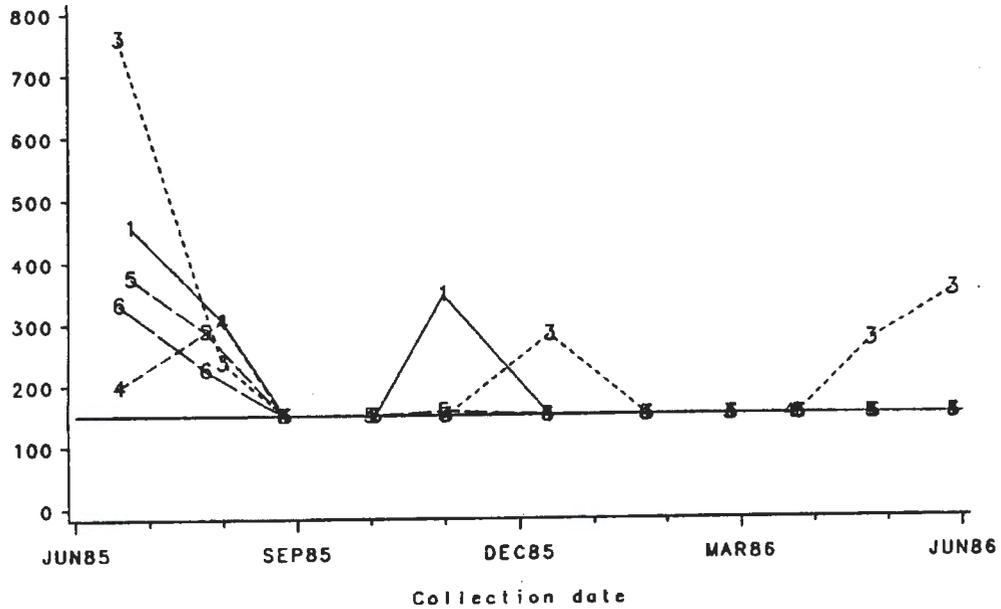


Horizontal solid line is detection limit

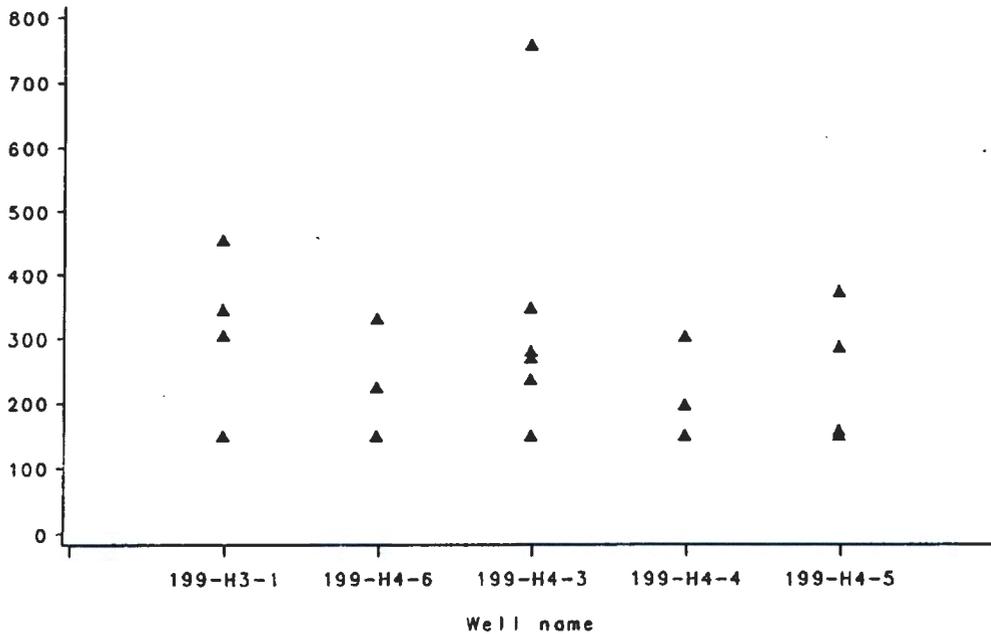
Constituent List=Site Specific Constituent=A14 VANADUM PPB



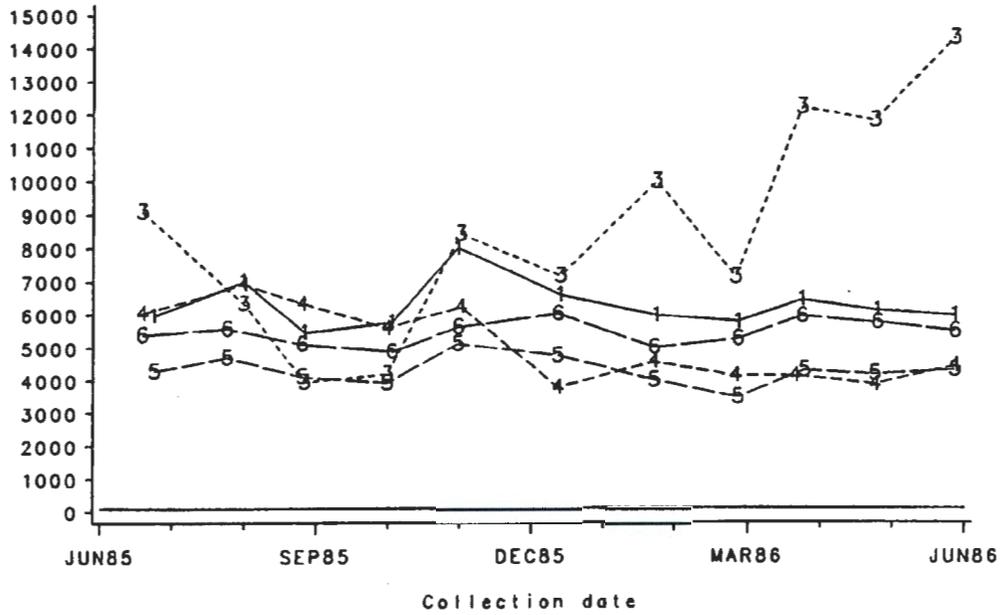
RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Site Specific Constituent=A16 ALUMNUM PPB



Constituent List=Site Specific Constituent=A16 ALUMNUM PPB

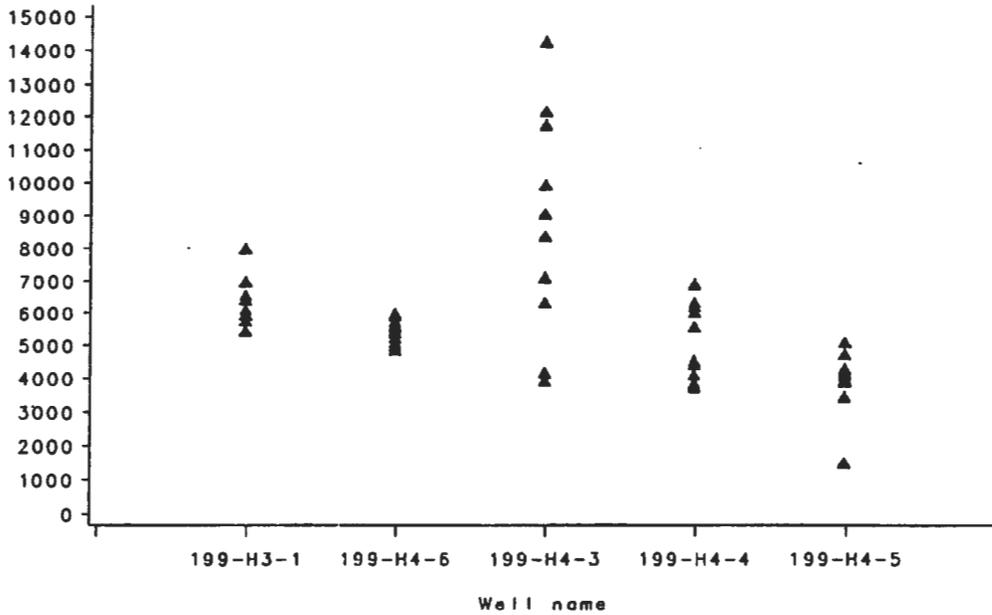


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Site Specific Constituent=A18 POTASUM PPB

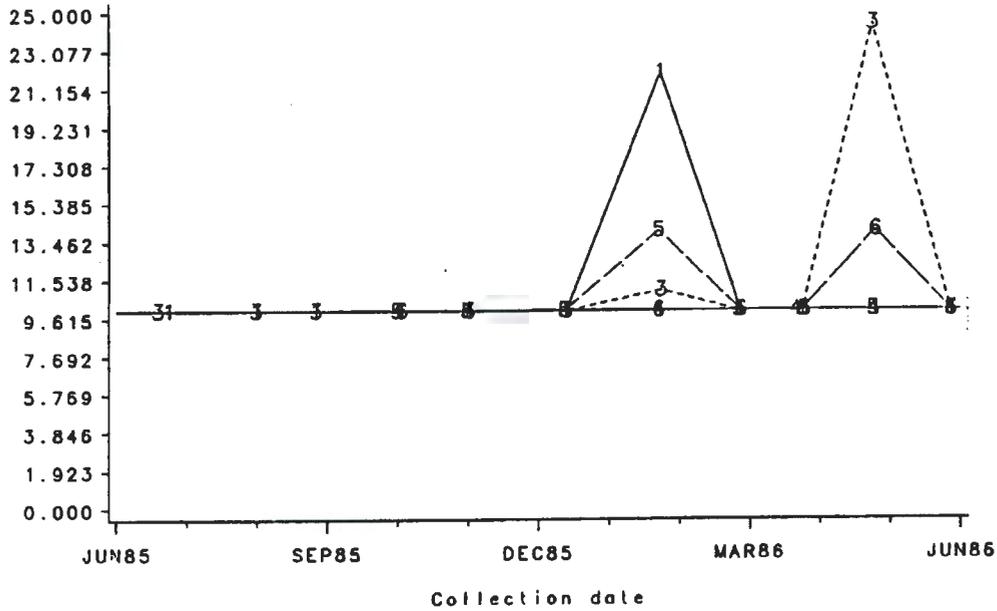


Horizontal solid line is detection limit

Constituent List=Site Specific Constituent=A18 POTASUM PPB

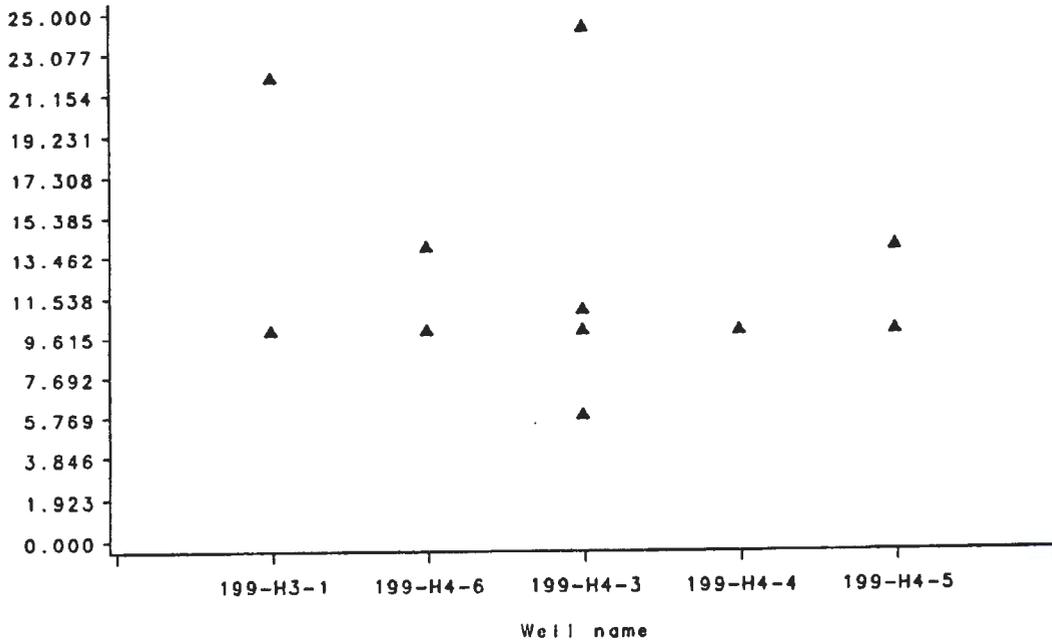


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Site Specific Constituent=A67 1,1,1-T PPB

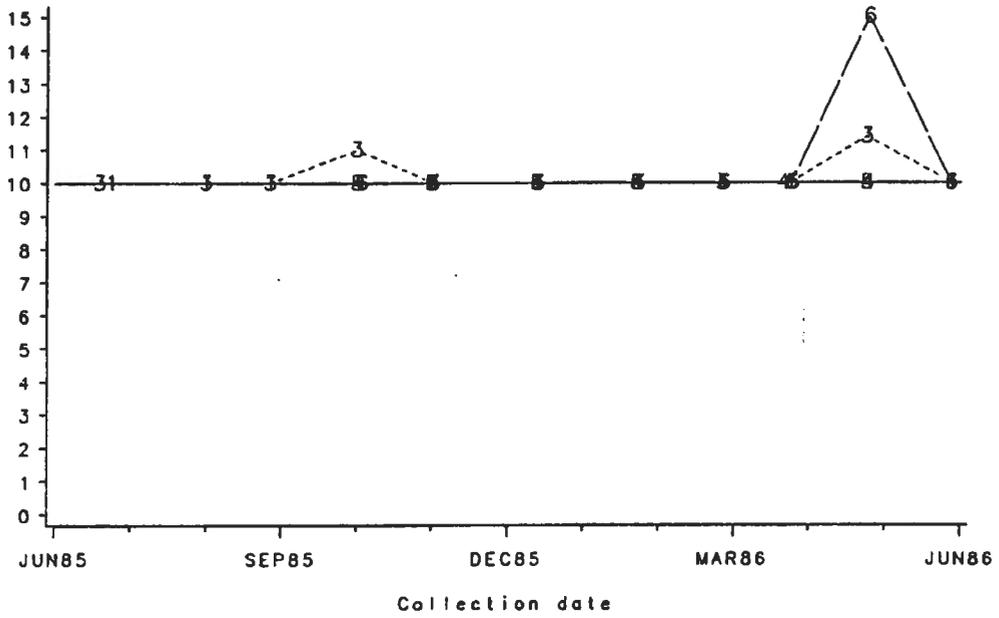


Horizontal solid line is detection limit

Constituent List=Site Specific Constituent=A67 1,1,1-T PPB

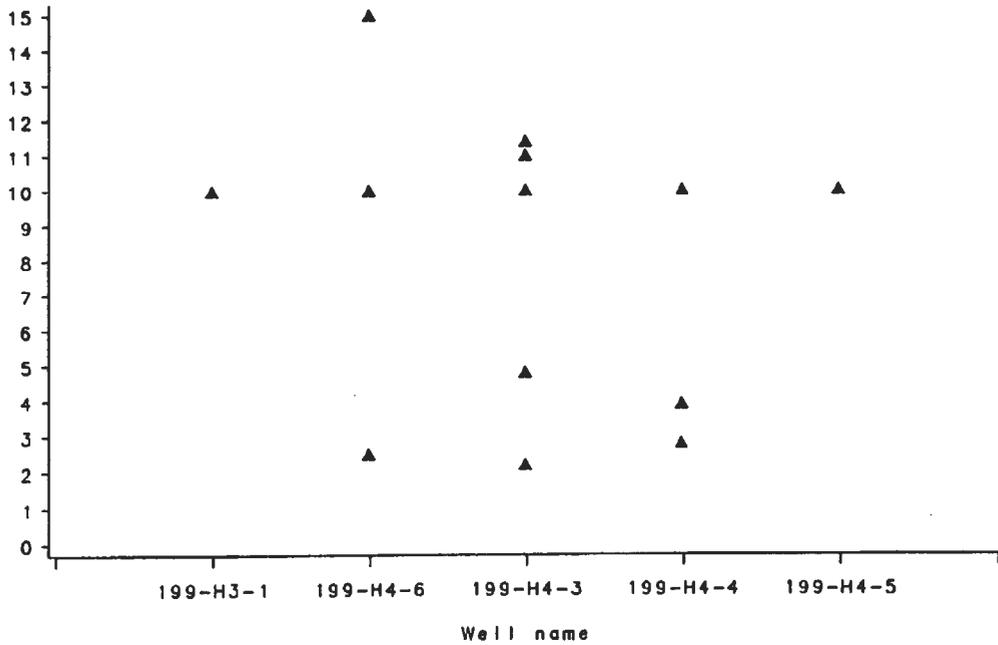


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Site Specific Constituent=A70 PERCENE PPB

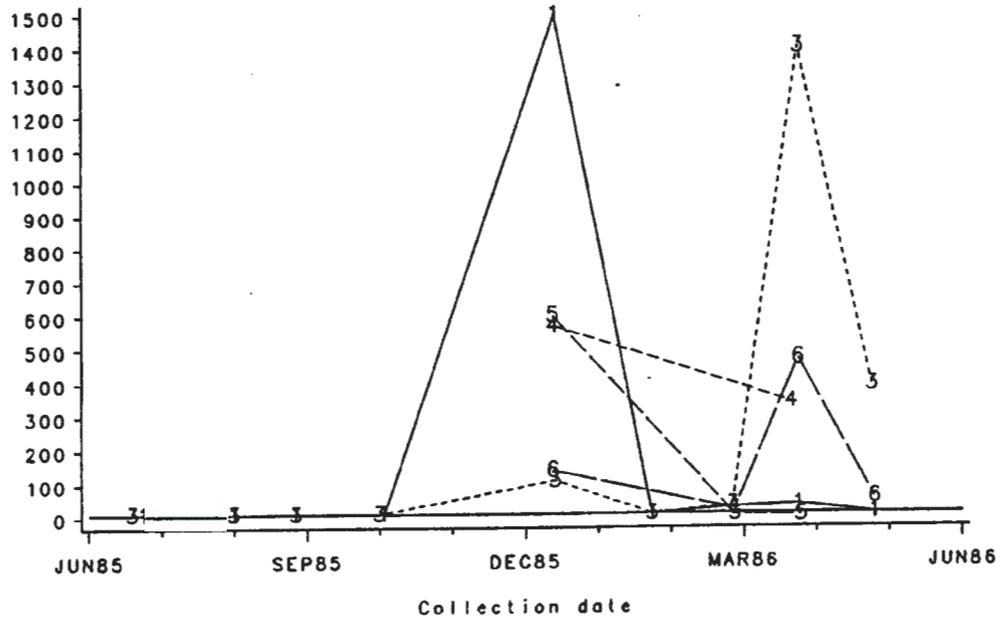


Horizontal solid line is detection limit

Constituent List=Site Specific Constituent=A70 PERCENE PPB

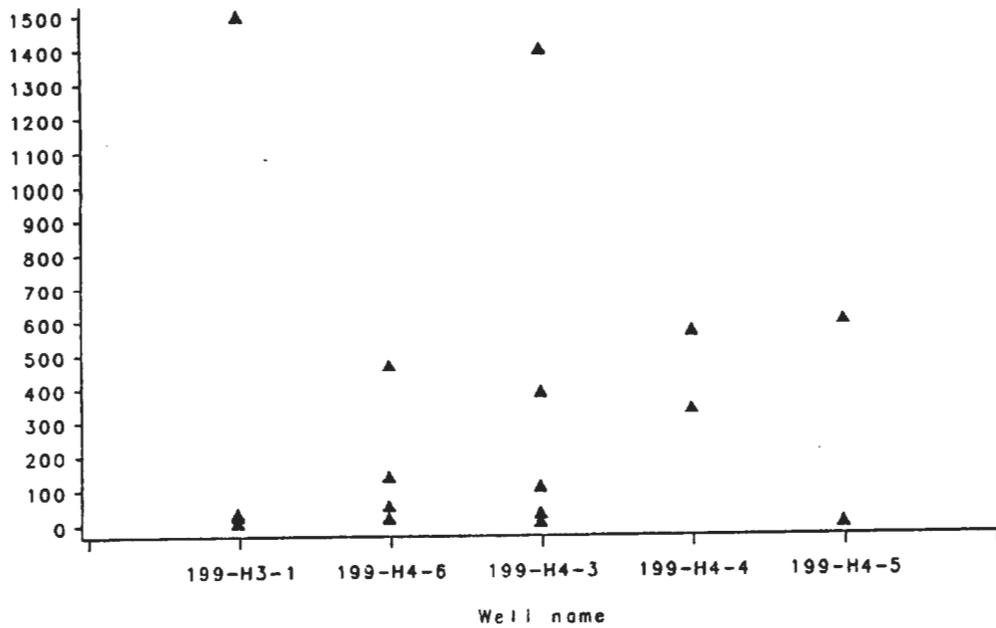


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Site Specific Constituent=A93 METHYCH PPB

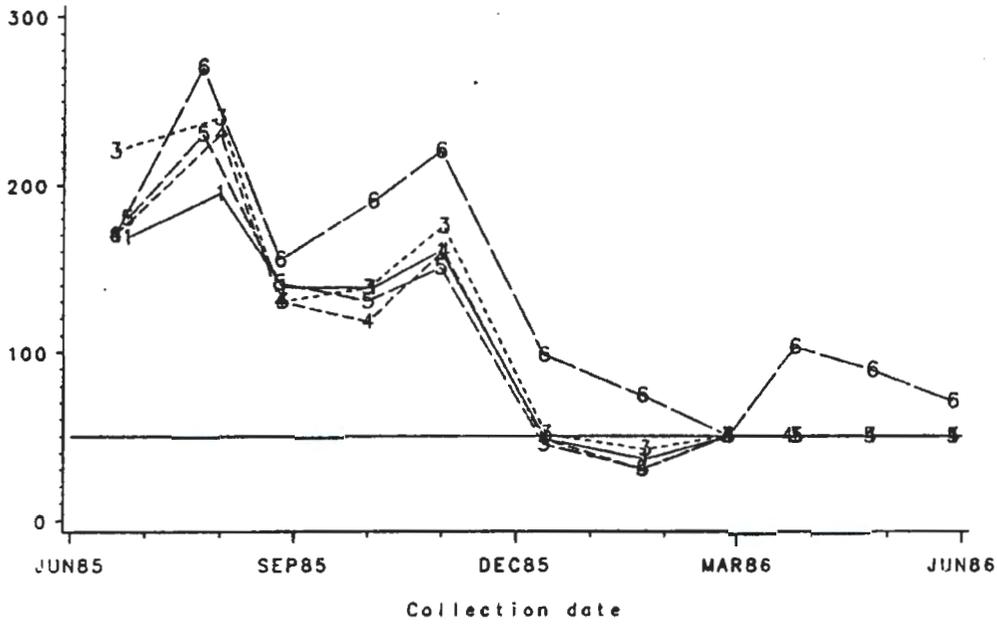


Horizontal solid line is detection limit

Constituent List=Site Specific Constituent=A93 METHYCH PPB

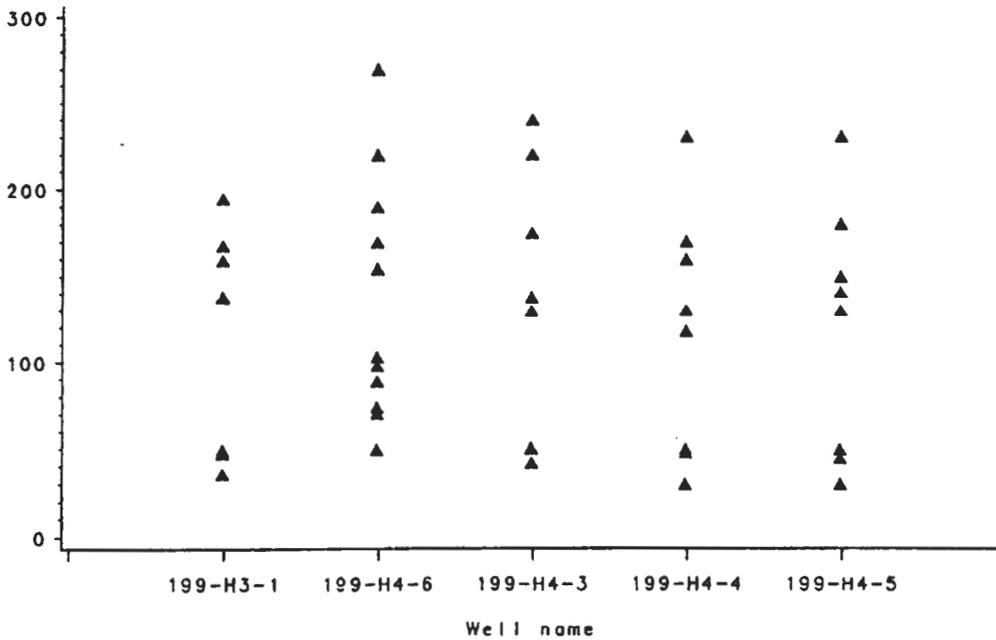


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=Site Specific Constituent=C80 AMMONIU PPB

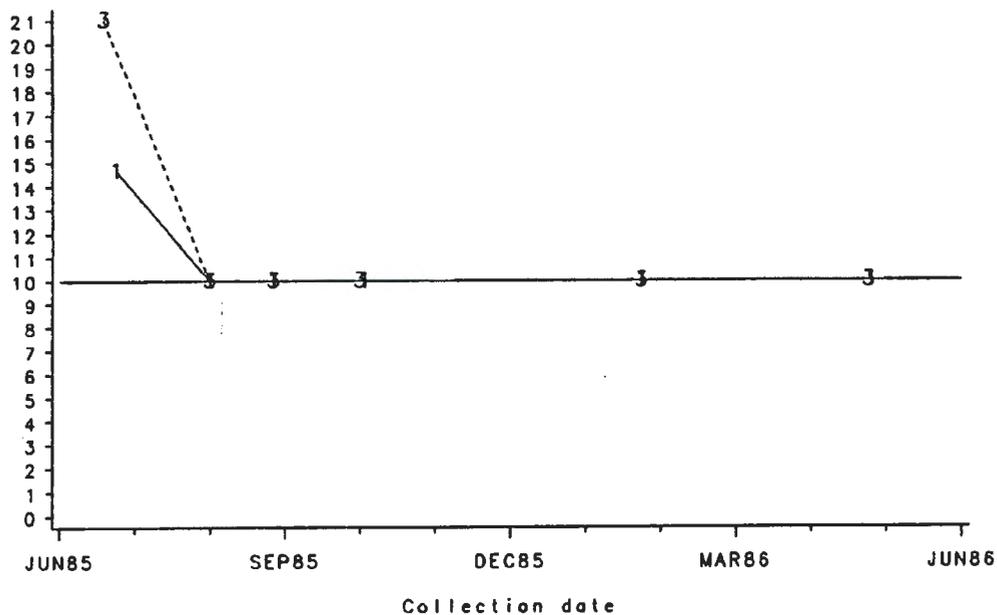


Horizontal solid line is detection limit

Constituent List=Site Specific Constituent=C80 AMMONIU PPB

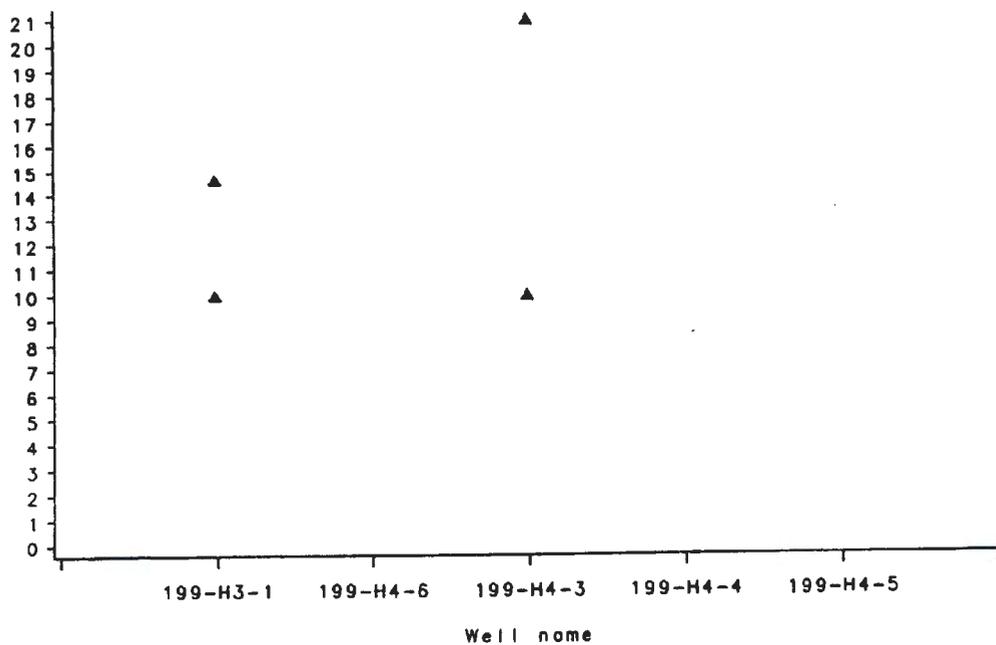


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=WAC 173-303-9905 Constituent=A23 THALIUM PPB

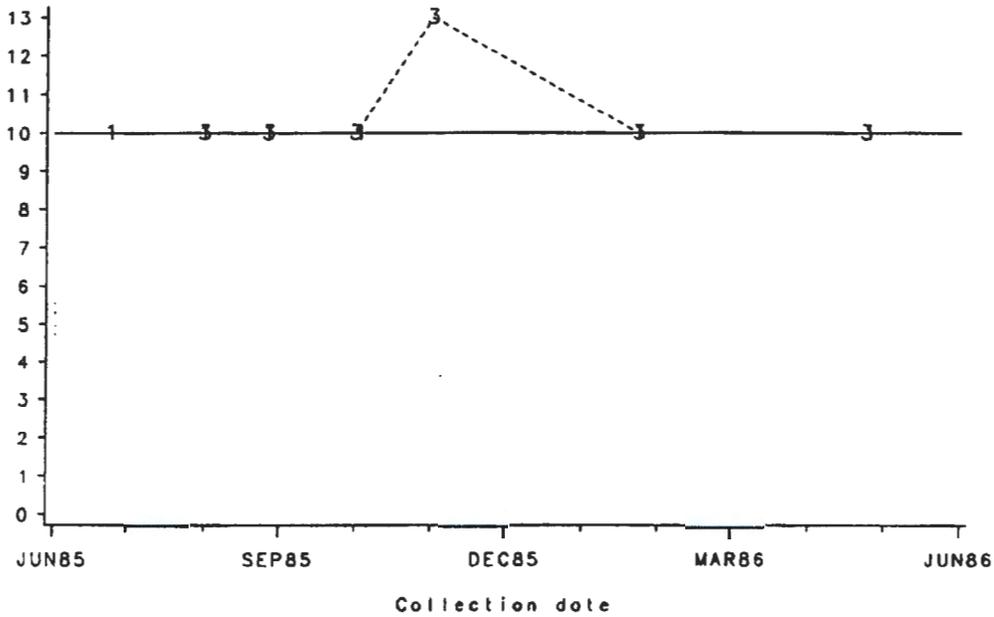


Horizontal solid line is detection limit

Constituent List=WAC 173-303-9905 Constituent=A23 THALIUM PPB

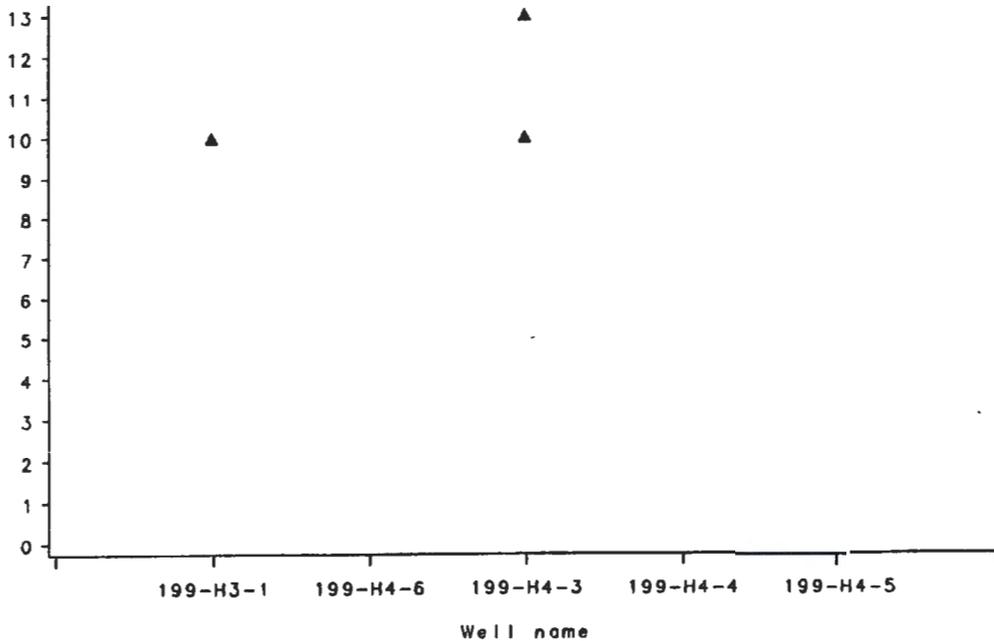


RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins, June 1985 to May 1986
 Constituent List=WAC 173-303-9905 Constituent=B40 BIS2EPH PPB



Horizontal solid line is detection limit

Constituent List=WAC 173-303-9905 Constituent=B40 BIS2EPH PPB



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 Environmental 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 $\approx 4s$.

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 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 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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
1873	199-H4-5	4,400	4,970	3,580	>2s (1770 ppb)
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	
0899	0899	10	<500	<500	

TABLE I.1. Results of Anion Analysis (October 1985) (cont)

Well Code	Well Name	Nitrate (ppb)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Sulfate (ppb)</u>			<u>Comments</u>
		<u>WHC</u>	<u>HEHF</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Fluoride (ppb)</u>			<u>Comments</u>
		<u>WHC</u>	<u>HEHF</u>	<u>UST</u>	
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	

<u>Well Code</u>	<u>Well Name</u>	<u>Chloride (ppb)</u>			<u>Comments</u>
		<u>WHC</u>	<u>HEHF</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Nitrate (ppb)</u>			<u>Comments</u>
		<u>WHC</u>	<u>HEHF</u>	<u>UST</u>	
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	

<u>Well Code</u>	<u>Well Name</u>	<u>Phosphate (ppb)</u>			<u>Comments</u>
		<u>WHC</u>	<u>HEHF</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Sulfate (ppb)</u>			<u>Comments</u>
		<u>WHC</u>	<u>HEHF</u>	<u>UST</u>	
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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Sulfate (ppb)</u>			<u>Comments</u>
		<u>WHC</u>	<u>HEHF</u>	<u>UST</u>	
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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Sulfate (ppb)</u>			<u>Comments</u>
		<u>WHC</u>	<u>HEHF</u>	<u>US1</u>	
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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Sulfate (ppb)</u>			<u>Comments</u>
		<u>WHC</u>	<u>HEHF</u>	<u>UST</u>	
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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Sulfate (ppb)</u>			<u>Comments</u>
		<u>WHC</u>	<u>HEHF</u>	<u>UST</u>	
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)			Comments
		WHC	HEHF	UST	
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)			Comments
		WHC	HEHF	UST	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Nitrate (ppb)</u>			<u>Comments</u>
		<u>WHC</u>	<u>HEHF</u>	<u>UST</u>	
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	

<u>Well Code</u>	<u>Well Name</u>	<u>Phosphate (ppb)</u>			<u>Comments</u>
		<u>WHC</u>	<u>HEHF</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Sulfate (ppb)</u>			<u>Comments</u>
		<u>WHC</u>	<u>HEHF</u>	<u>UST</u>	
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.

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- (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)		Comments
		HEHF	UST	
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)		Comments
		HEHF	UST	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Chromium (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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	

<u>Well Code</u>	<u>Well Name</u>	<u>Copper (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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)		Comments
		HEHF	UST	
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)		Comments
		HEHF	UST	
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)		Comments
		HEHF	UST	
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)		Comments
		HEHF	UST	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Chromium (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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	

<u>Well Code</u>	<u>Well Name</u>	<u>Lead (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Sodium (ppm)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Barium (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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.

<u>Well Code</u>	<u>Well Name</u>	<u>Cadmium (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Chromium (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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	

<u>Well Code</u>	<u>Well Name</u>	<u>Copper (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Lead (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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	

<u>Well Code</u>	<u>Well Name</u>	<u>Sodium (ppm)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Barium (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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.

<u>Well Code</u>	<u>Well Name</u>	<u>Cadmium (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Chromium (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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	

<u>Well Code</u>	<u>Well Name</u>	<u>Copper (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Lead (ppb)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
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	

<u>Well Code</u>	<u>Well Name</u>	<u>Sodium (ppm)</u>		<u>Comments</u>
		<u>HEHF</u>	<u>UST</u>	
1873	199-H4-5	10,000	9,300	12% difference
1874	199-H4-6	21,300	20,000	
1877	199-H4-3	560,000	638,000	
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 Evaluation."

TABLE I.12. Organic Analyses from PNL and UST Labs
(November/December 1985)

<u>Well Code</u>	<u>Well Name</u>	<u>1,1,1-Trichloroethane</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Chloroform (ppb)</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Perchloroethylene</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
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		Comments
		PNL	UST	
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)		Comments
		PNL	UST	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Perchloroethylene</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
1873	199-H4-5	0.03 ± 0.0	<10	A11 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)

<u>Well Code</u>	<u>Well Name</u>	<u>1,1,1-Trichloroethane</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Chloroform (ppb)</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
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		Comments
		PNL	UST	
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 CC14 are poorly resolved and when CC14 is present in samples, determination of 1,1,1- TCE is difficult.

TABLE I.15. Organic Analyses from PNL and UST Labs
(March 1986)

<u>Well Code</u>	<u>Well Name</u>	<u>1,1,1-Trichloroethane</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Chloroform (ppb)</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
1873	199-H4-5	22.24	27	A11 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		Comments
		PNL	UST	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>1,1,1-Trichloroethane</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
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)		Comments
		PNL	UST	
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		Comments
		PNL	UST	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>1,1,1-Trichloroethane</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Chloroform (ppb)</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Perchloroethylene</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>1,1,1-Trichloroethane</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
1873	199-H4-5	0.78 ± 0.04	<10	A11 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)

<u>Well Code</u>	<u>Well Name</u>	<u>Chloroform (ppb)</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
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)

<u>Well Code</u>	<u>Well Name</u>	<u>Perchloroethylene</u>		<u>Comments</u>
		<u>PNL</u>	<u>UST</u>	
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.	254.- 316.	ACCEPTABLE
	2	626	661	566.- 749.	588.- 725.	ACCEPTABLE
CAESIUM	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.	483.- 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.	96.1- 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 WPG16

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.- 770.	545.- 744.	ACCEPTABLE
ZINC	1	350	303	333.- 429.	345.- 417.	ACCEPTABLE
	2	850	893	782.- 994.	809.- 967.	ACCEPTABLE
ANTIMONY	3	50.5	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	20.8	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	6.78	6.54- 6.83	6.58- 6.80	ACCEPTABLE
	4	4.42	4.90	4.38- 4.59	4.41- 4.56	ACCEPTABLE
SPEC. COND. (UMHOS/CM AT 25 C)	1	510	560	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	0.20- 11.3	0.59- 10.9	ACCEPTABLE
MAGNESIUM	1	18.84	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	9.98	8.29- 11.5	8.69- 11.1	ACCEPTABLE
POTASSIUM	1	22.40	25.0	20.0- 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	2.48	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 WPO16

LABORATORY: MA023

PARAMETERS	SAMPLE NUMBER	REPORT VALUE	TRUE VALUE*	ACCEPTANCE LIMITS	WARNING LIMITS	PERFORMANCE EVALUATION
DENANDS 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
DOD	1	0.227	0.240	.107- .351	.138- .320	ACCEPTABLE
	2	0.901	0.666	.335- .901	.407- .829	CHECK FOR ERROR
DDE	1	0.152	0.178	.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- .665	.277- .592	ACCEPTABLE
HEPTACHLOR EPOXIDE	1	0.075	0.075	.0396- .111	.0487- .102	ACCEPTABLE
	2	0.341	0.360	.196- .484	.233- .448	ACCEPTABLE

* BASED UPON THEORETICAL CALCULATIONS, OR A REFERENCE VALUE WHEN NECESSARY.

PERFORMANCE EVALUATION REPORT

DATE: 06/03/86

WATER POLLUTION STUDY NUMBER WPO16

LABORATORY: MA023

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- 32.0	19.6- 30.9	ACCEPTABLE
	2	89.0	77.3	46.6- 108.	54.2- 100.	ACCEPTABLE
CHLOROFORM	1	7.00	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- 109.	58.5- 102.	ACCEPTABLE
BROMOCHLOROMETHANE	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- 20.9	13.7- 26.7	ACCEPTABLE
	2	107	95.6	64.7- 142.	74.4- 132.	ACCEPTABLE
BROMOFORM	1	48.2	50.6	28.1- 75.1	34.0- 69.2	ACCEPTABLE
	2	31.9	30.4	14.5- 49.0	18.8- 44.7	ACCEPTABLE
METHYLENE CHLORIDE	1	24.5	20.9	10.8- 30.0	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: 06/03/96

WATER POLLUTION STUDY NUMBER WPO16

LABORATORY: WAB23

PARAMETERS	SAMPLE NUMBER	REPORT VALUE	TRUE VALUE*	ACCEPTANCE LIMITS	WARNING LIMITS	PERFORMANCE EVALUATION
VOLATILE HALOCARBOONS IN MICROGRAMS PER LITER:						
CHLOROBENZENE	1	25.9	29.4	20.2- 38.1	22.5- 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	17.3- 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 (IN MG/L)	1	0.783	1.05	.609- 1.36	.706- 1.27	ACCEPTABLE
	2	0.522	0.600	.343- .807	.401- .748	ACCEPTABLE
NON-FILTERABLE RESIDUE (IN MG/L)	1	31.0	35.6	26.6- 37.5	28.0- 36.1	ACCEPTABLE
	2	56.7	65.2	50.8- 69.2	53.1- 66.9	ACCEPTABLE
OIL AND GREASE (IN MG/L)	1	7.35	16.0	7.40- 22.1	9.24- 20.3	NOT ACCEPTABLE
	2	5.40	11.0	3.98- 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

J.2

STATEMENT OF WORK

WELL DRILLING SPECIFICATIONS
183-H SOLAR EVAPORATION BASINS

July 15, 1986

1.0 GENERAL1.1 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

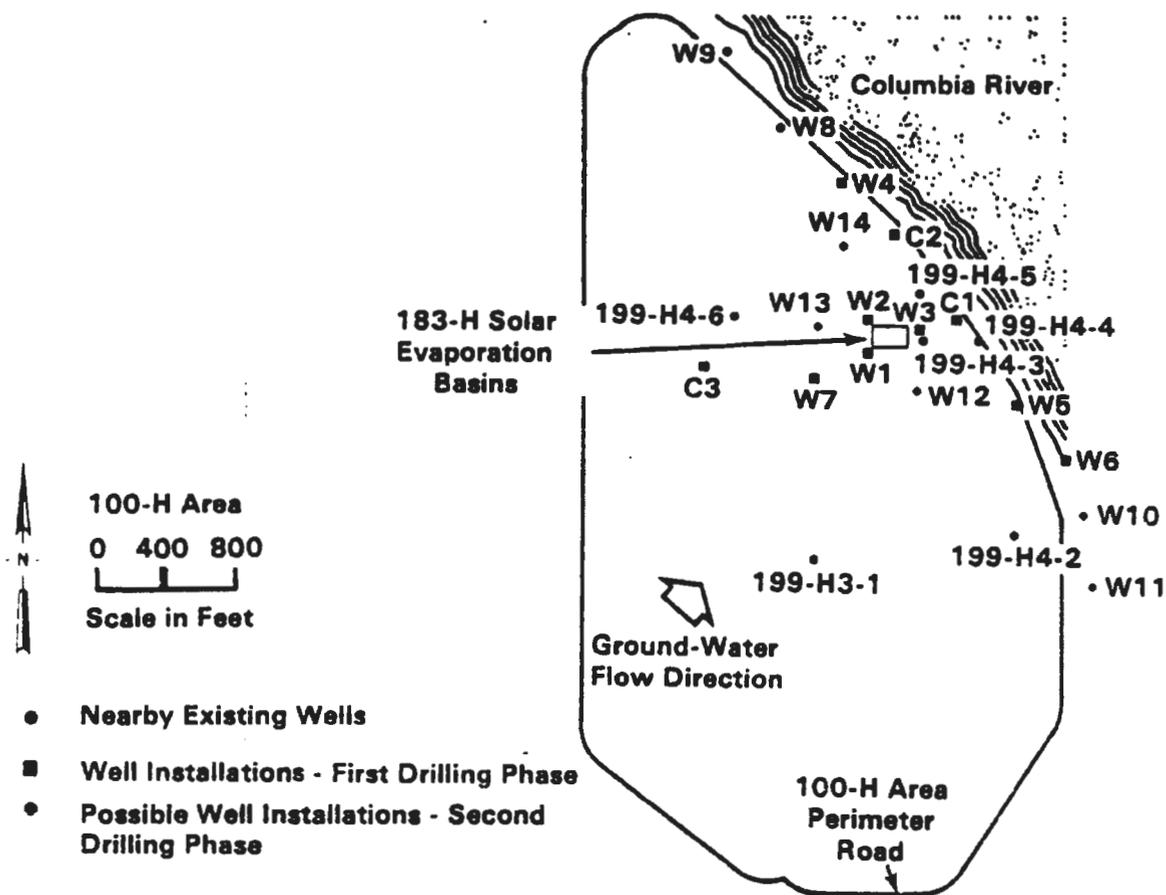


FIGURE 1. Well Location Map of the 100-H Area

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

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/ft³ 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.

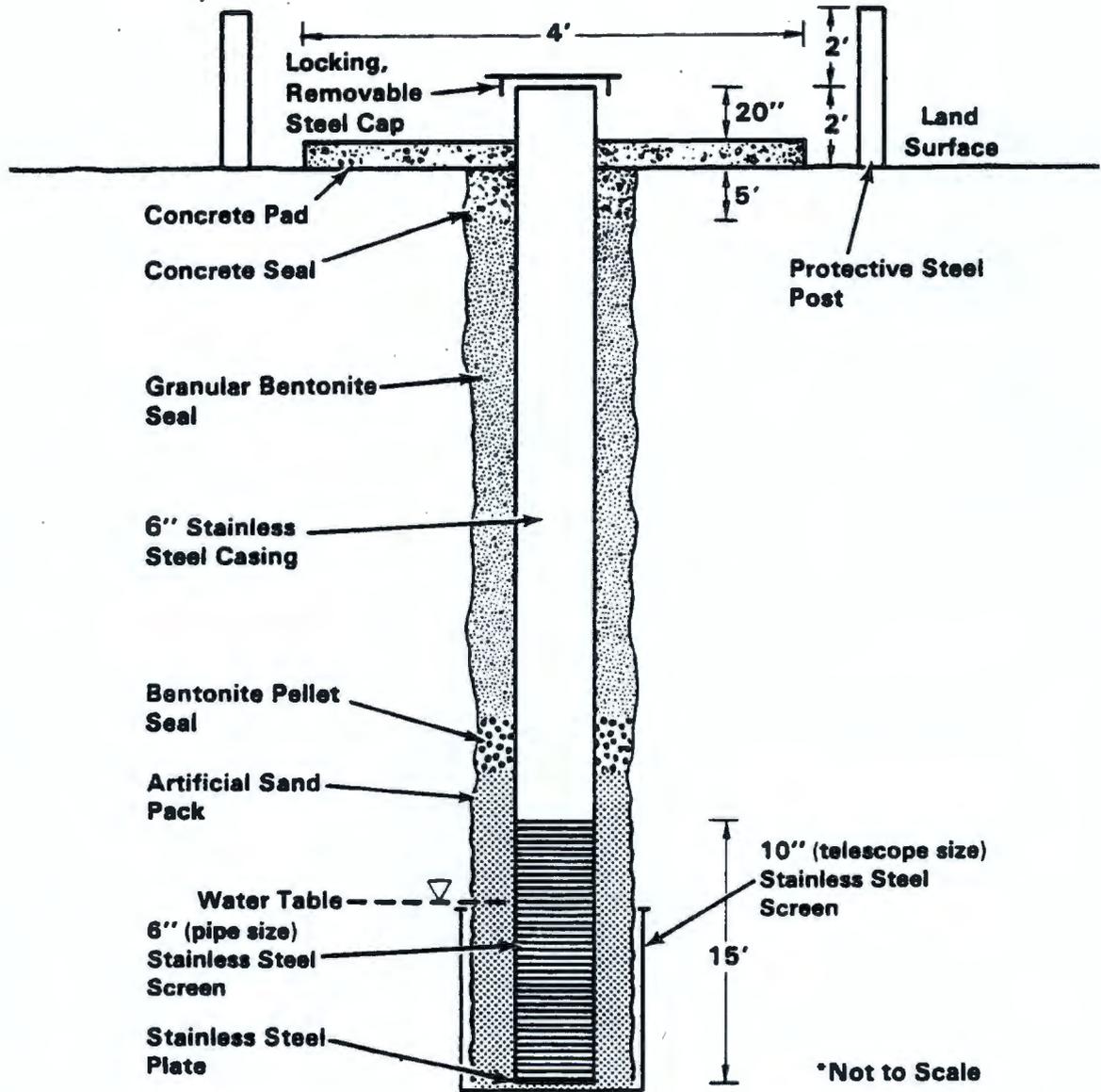


FIGURE 3. Single Shallow Wells Completed in Hanford Gravels

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.

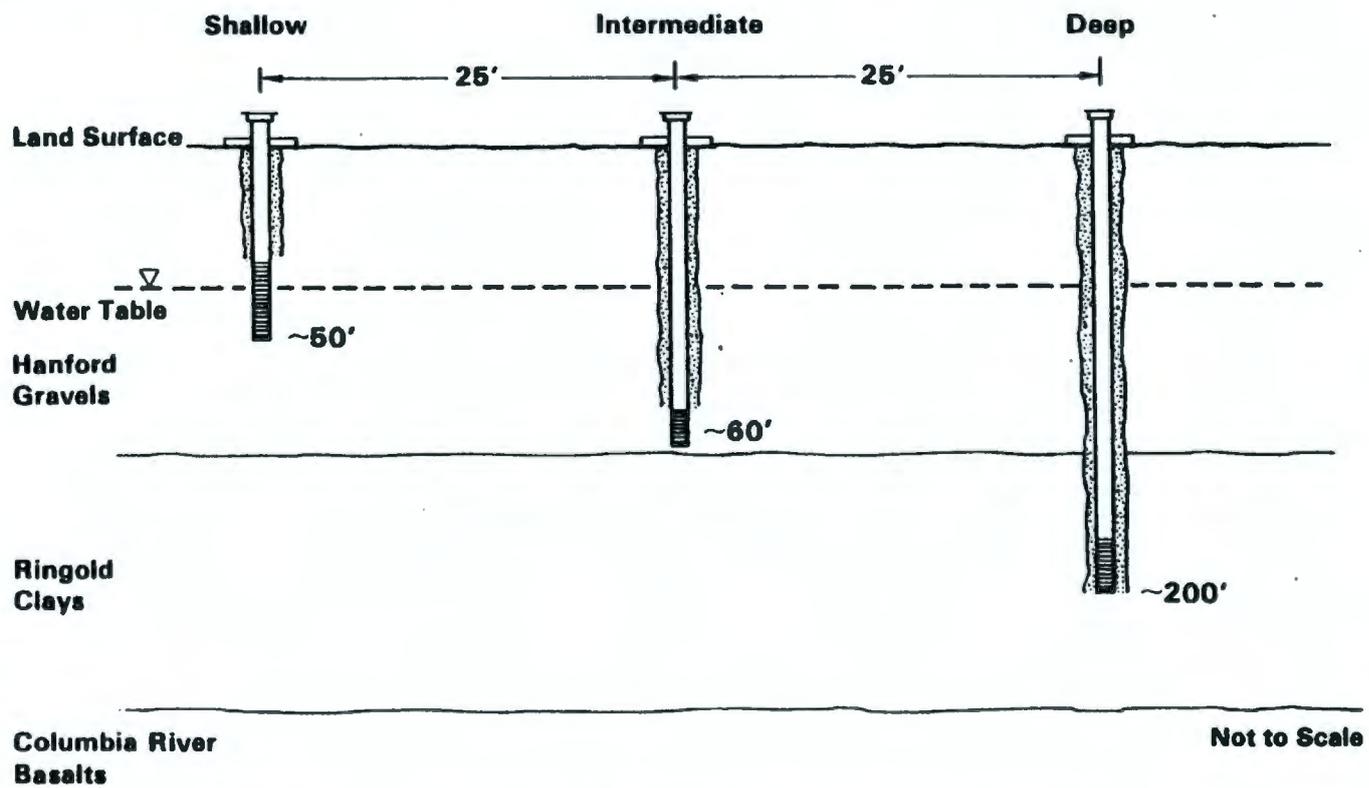


FIGURE 4. Cross Sectional View of Well Cluster Completion

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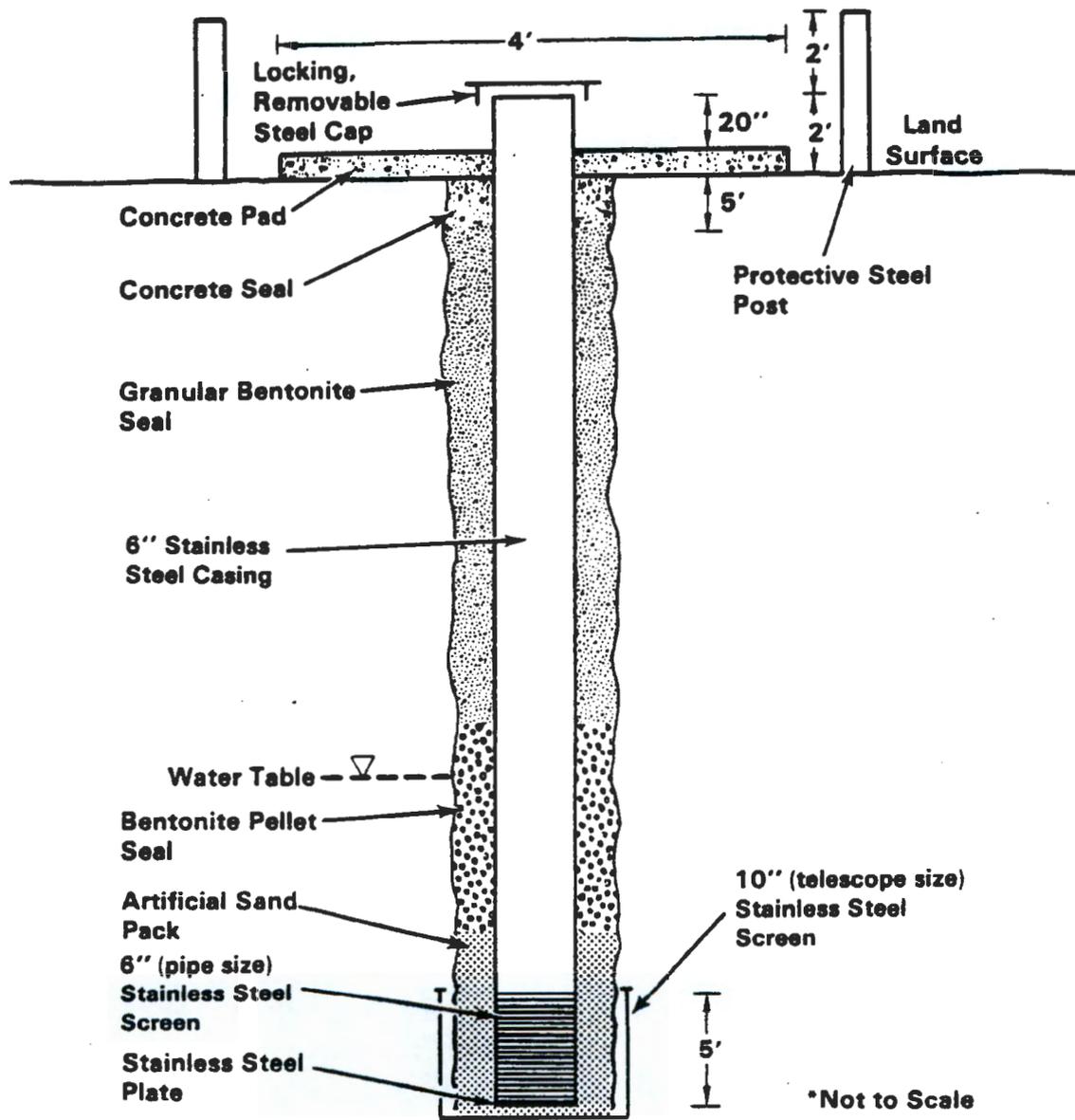


FIGURE 5. Intermediate Wells Completed at Top of Ringold Clays

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 shelly 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.

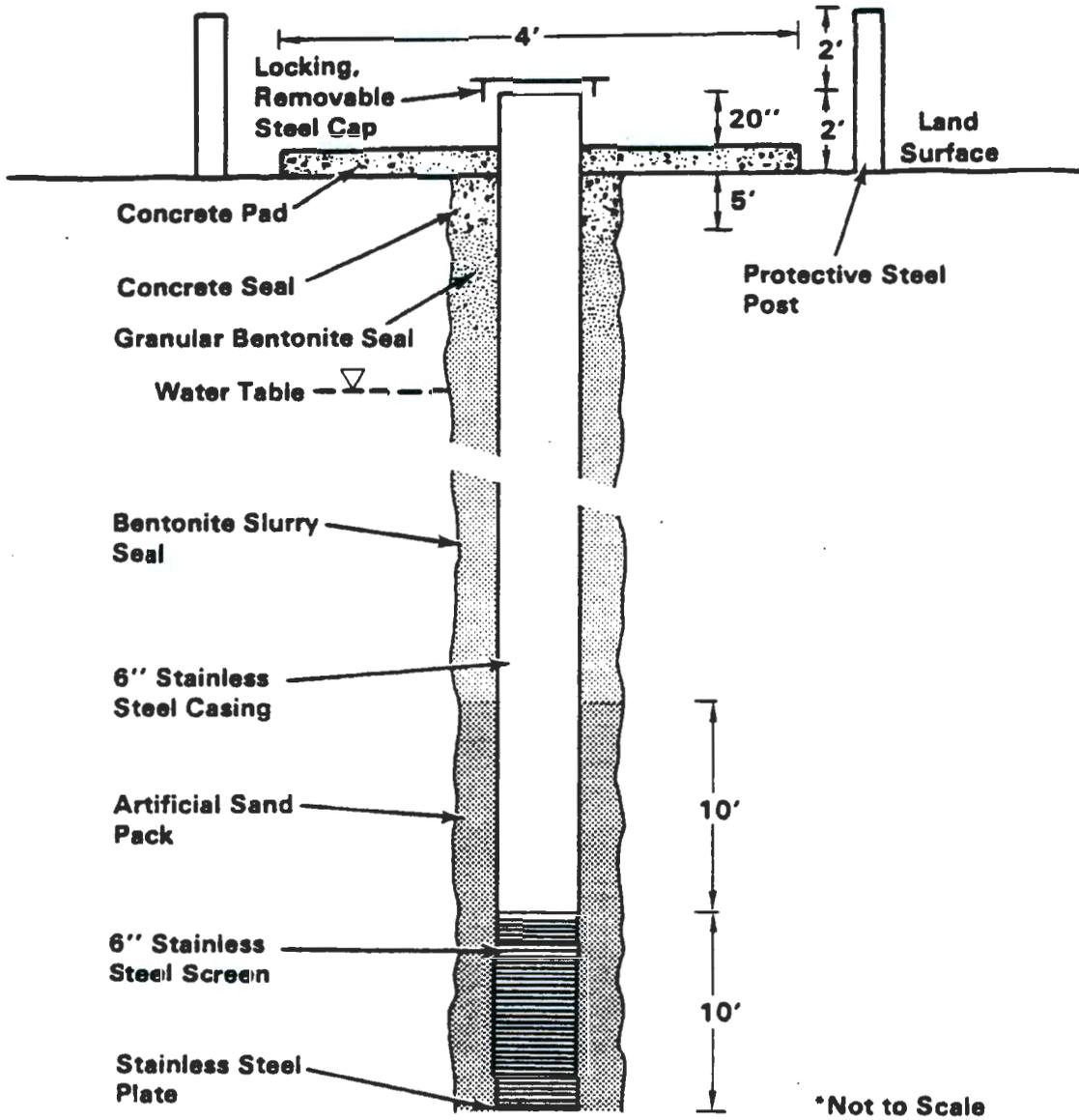


FIGURE 6. Deep Wells Completed Within Ringold Clays

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.