
Geohydrologic Characterization of the Area Surrounding the 183-H Solar Evaporation Basins

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December 1988

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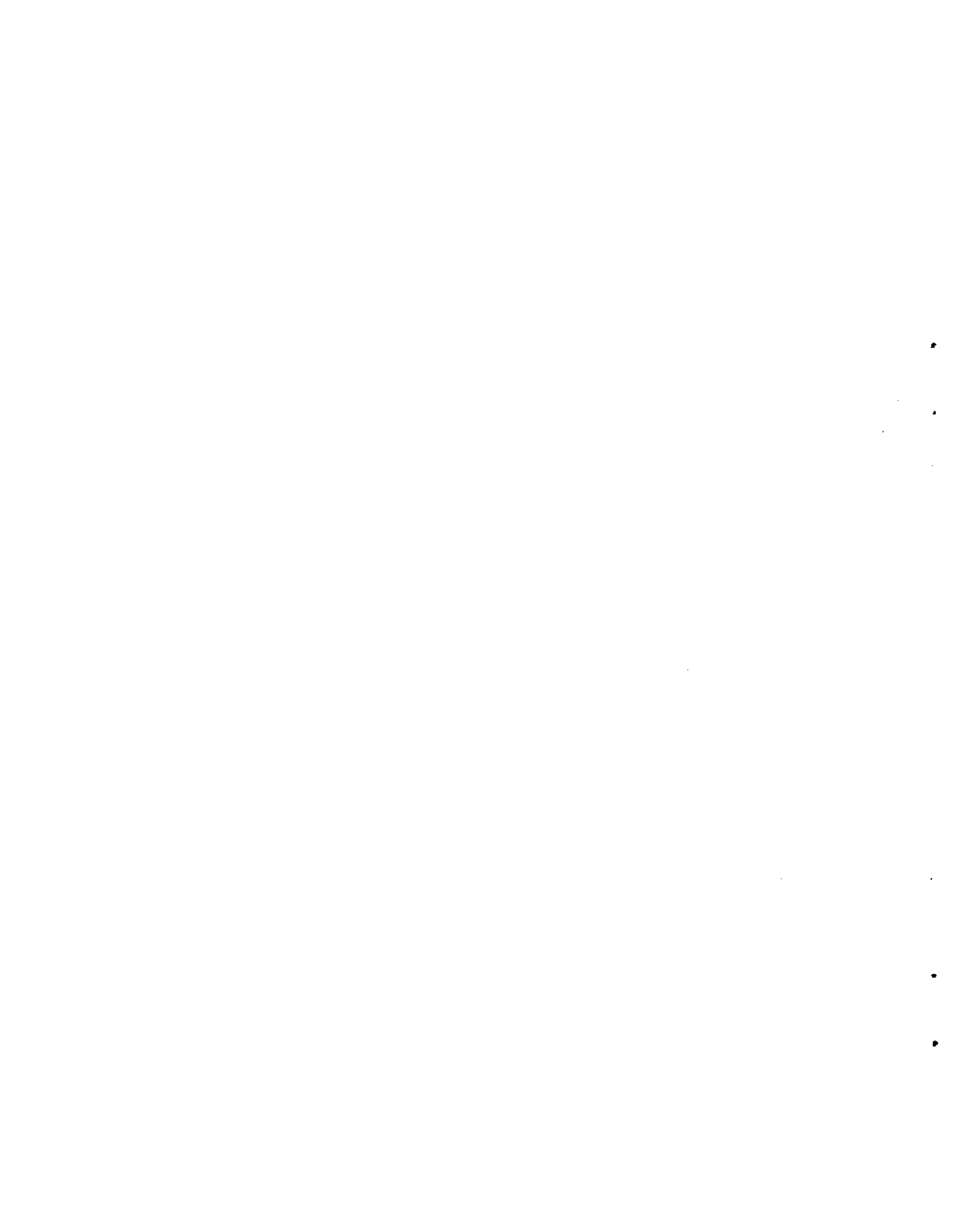
GEOHYDROLOGIC CHARACTERIZATION OF THE
AREA SURROUNDING THE 183-H SOLAR
EVAPORATION BASINS

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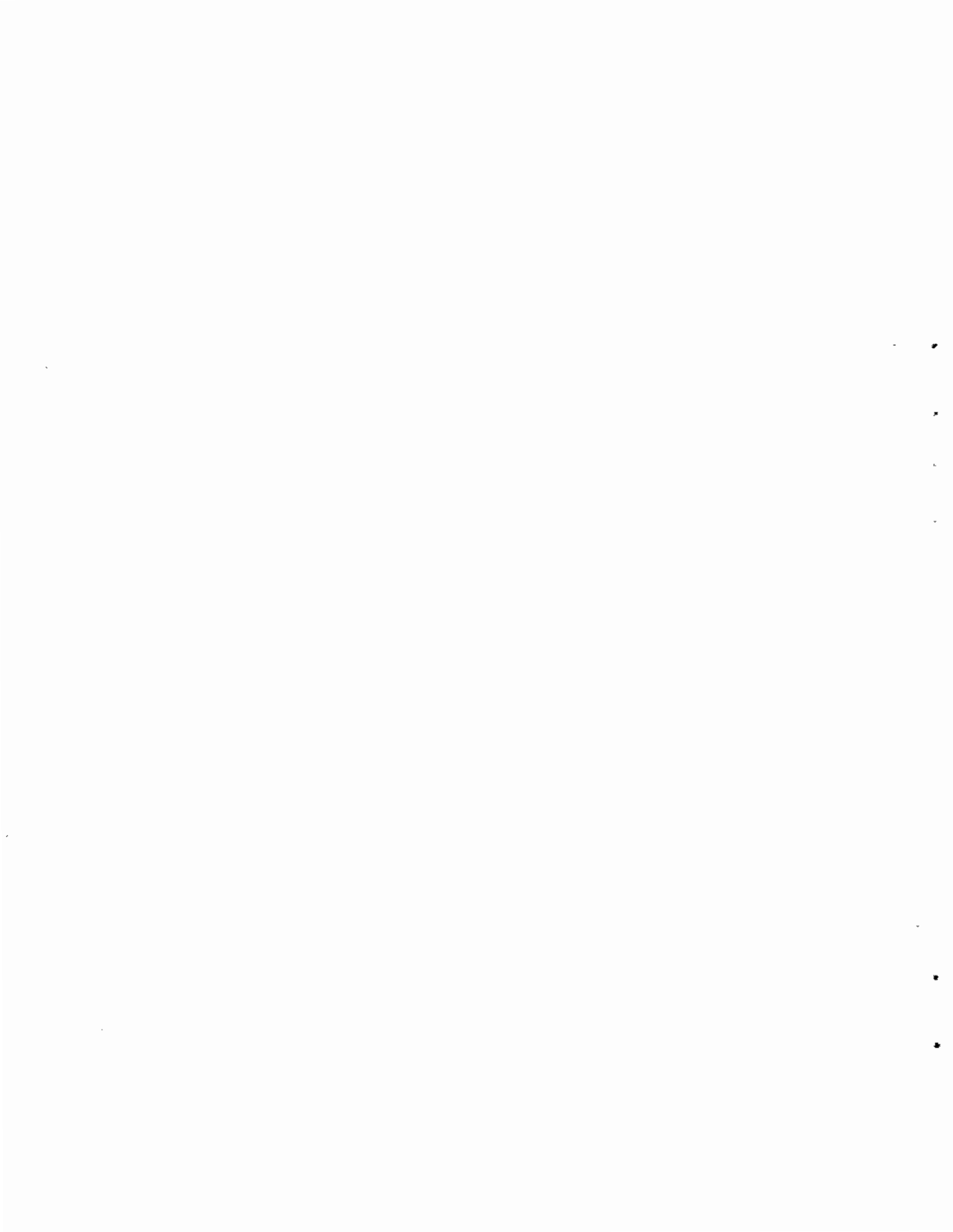


SUMMARY

Since June 1985, the Pacific Northwest Laboratory has been conducting a geohydrologic investigation of the area surrounding the 183-H Solar Evaporation Basins (183-H Basins), located on the Hanford Site in southeastern Washington State. The purpose of this investigation is to achieve regulatory compliance with the applicable ground-water monitoring requirements of the Resource Conservation and Recovery Act (RCRA) and the Washington Administrative Code (WAC).

An assessment-level compliance monitoring project was established for the 183-H Basins because hazardous waste constituents were known to have entered the ground water beneath the facility. Three phases were defined for this project with work being concentrated in five areas: geology, hydrology, ground-water monitoring, geochemistry, and ground-water modeling.

These characterization activities have resulted in the definition of principal lithologic and hydrostratigraphic units. Ground-water monitoring results indicated a contamination peak, which occurred between April and August 1986. Further monitoring has shown that nitrate, sodium, gross alpha, and gross beta are the clearest indicators of ground-water contamination attributable to the 183-H Basins. In addition, the concentrations of these contaminants are affected by variations in Columbia River stage. Future studies will focus on continued ground-water monitoring throughout the closure and post-closure periods for the 183-H Basins, sampling of the Columbia River and nearby ground-water springs, and soil sampling adjacent to the facility.



CONTENTS

SUMMARY	iii
1.0 INTRODUCTION	1
1.1 PRE-1985 MONITORING PROGRAM	1
1.2 INTERIM STATUS MONITORING PROGRAM	3
2.0 BACKGROUND	9
2.1 REGIONAL PHYSIOGRAPHY AND GEOHYDROLOGY	9
2.1.1 Climate of the Hanford Site	9
2.1.2 Geology of the Hanford Site	11
2.1.3 Hydrology of the Hanford Site	16
2.2 DESCRIPTION OF THE 183-H BASINS	18
2.3 OPERATIONAL HISTORY OF THE 183-H BASINS	21
2.4 WASTE CHARACTERIZATION	22
2.4.1 Basin #1 Sampling	24
2.4.2 Basin #2 Sampling	30
3.0 GEOLOGY OF THE 100-H AREA	33
3.1 SADDLE MOUNTAINS BASALT FORMATION	33
3.2 RINGOLD FORMATION	45
3.2.1 Silty Clayey Sand to Sandy Silty Clay Unit	48
3.2.2 Silty Sand Unit	48
3.2.3 Gravelly Silty Sand Unit	49
3.3 HANFORD FORMATION	49
4.0 HYDROLOGY OF THE 100-H AREA	53
4.1 LOWER CONFINED AQUIFER	53
4.2 UPPER CONFINED AQUIFER	53

4.3	SILTY SAND AND GRAVELLY SILTY SAND UNITS	56
4.4	SATURATED SEDIMENTS OF THE HANFORD FORMATION	58
4.5	UNSATURATED SEDIMENTS OF THE HANFORD FORMATION	67
5.0	DESCRIPTION OF THE WELL INSTALLATION AND GEOHYDROLOGIC CHARACTERIZATION EFFORT	73
5.1	DETAILS OF WELL DESIGN AND CONSTRUCTION	73
5.1.1	Wells Installed Before 1985	73
5.1.2	Phase II Wells	75
5.1.3	Phase III Wells	77
5.2	FIELD METHODS	77
5.3	WELL LOCATIONS	78
6.0	SAMPLING AND ANALYSIS PLAN	81
6.1	SAMPLING SCHEDULE	81
6.2	SAMPLE ANALYSES	84
6.3	QUALITY CONTROL	84
6.4	SAMPLING PUMPS	87
6.5	SAMPLE COLLECTION	89
6.6	SAMPLE PRESERVATION AND SHIPMENT	91
6.7	CHAIN OF CUSTODY	92
7.0	ANALYTICAL RESULTS	95
7.1	SUMMARY OF RESULTS TO DATE	95
8.0	STATISTICAL EVALUATIONS	113
8.1	DESCRIPTIVE STATISTICS	113
8.2	CLUSTER WELL STATISTICS	114
8.3	LINEAR REGRESSION ANALYSES	115
9.0	CONTAMINANT PLUME DESCRIPTION	123

9.1	BACKGROUND CONCENTRATIONS	123
9.2	HORIZONTAL EXTENT OF CONTAMINATION	125
9.3	VERTICAL EXTENT OF CONTAMINATION	146
9.4	GEOCHEMICAL INTERACTION OF SELECTED CONSTITUENTS	152
9.5	PATHLINE ANALYSIS	154
10.0	CONCLUSIONS	159
11.0	RECOMMENDATIONS	163
	REFERENCES	165
APPENDIX A	- CONSTRUCTION DIAGRAMS, LITHOLOGIC DIAGRAMS, AND GEOPHYSICAL LOGS FOR THE 100-H AREA WELLS	A.1
APPENDIX B	- BASIC DESCRIPTIVE STATISTICS FOR THE 68 CONSTITUENTS THAT HAD AT LEAST ONE VALUE ABOVE THE DETECTION LIMIT	B.1



FIGURES

1	Location of the Hanford Site	1
2	Locations of the Original Monitoring Wells	2
3	Annual Average Concentrations of Nitrate in Well 199-H4-3	4
4	Annual Average Concentrations of Chromium in Well 199-H4-3	4
5	Locations of the Phase II Wells	5
6	Locations of the Phase III Wells	7
7	Structural Geology of the Pasco Basin	10
8	Generalized Geologic Cross Section of the Hanford Site	12
9	Stratigraphic Units Present in the Pasco Basin	13
10	Distribution of the Ringold Formation Section Types	15
11	Water Table Elevations for June 1987	17
12	100-H Area Map	19
13	Schematic Cross Section of the 183-H Basins	20
14	Plan View of the 183-H Basins	21
15	Sample Locations for Basin #1	25
16	Concentrations of Copper, Sulfur, and Zirconium in the Slurry Liquid and Slurry Solid from Basin #1	28
17	Concentrations of Chromium, Iron, Manganese, and Tin in the Slurry Liquid and Slurry Solid from Basin #1	29
18	Concentrations of Molybdenum, Nickel, and Uranium in the Slurry Liquid and Slurry Solid from Basin #1	29
19	Concentrations of Chloride, Chromium, Copper, and Potassium in the Basin #1 Slurry Liquid and Basin #2 Solution	32
20	Sediment Classification	34
21	Generalized Geologic Column for the 100-H Area	35
22	Three-Dimensional Distribution and Stratigraphic Correlations of the Geologic Formations Beneath the 100-H Area	37

23	Locations of the 100-H Area Cross Sections	38
24	Cross Sections A-A' and B-B' of the Stratigraphic Formations Beneath the 100-H Area	39
25	Cross Sections C-C' and D-D' of the Stratigraphic Formations Beneath the 100-H Area	41
26	Cross Sections E-E' and F-F' of the Stratigraphic Formations Beneath the 100-H Area	43
27	Top-of-Basalt Map	47
28	Surface of the Ringold Formation Beneath the 100-H Area	50
29	Aerial Photograph of the 100-H Area	52
30	Generalized Hydrostratigraphic Column for the 100-H Area	54
31	Hydrographs for Wells 199-H4-15A, 199-H4-15B, and 199-H4-15C	55
32	Hydrographs for Wells 199-H3-2A, 199-H3-2B, and 199-H3-2C	59
33	Hydrographs for Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C.	59
34	Hydraulic Conductivity (K) Values for the Silty Sand and Gravelly Silty Sand Units Within the Ringold Formation	60
35	Hydraulic Conductivity (K) Values for the Unconfined Aquifer	60
36	Transmissivity (T) Values for the Silty Sand and Gravelly Silty Sand Units Within the Ringold Formation	61
37	Transmissivity (T) Values for the Unconfined Aquifer	61
38	Relative Water Levels in the Columbia River and 100-H Area Monitoring Wells	63
39	100-H Area Water Table Map Corresponding to Low Columbia River Stage	64
40	100-H Area Water Table Map Corresponding to Mean Columbia River Stage	65
41	100-H Area Water Table Map Corresponding to High Columbia River Stage	66
42	Closure Schedule for the 183-H Basins	83
43	Field Record Form	90

44	Chain-of-Custody Form	93
45	Sample Analysis Request Form	94
46	Specific Conductance in the Original Monitoring Wells	98
47	Gross Alpha Concentrations in the Original Monitoring Wells	99
48	Gross Beta Concentrations in the Original Monitoring Wells	100
49	Nitrate Concentrations in the Original Monitoring Wells	101
50	Barium Concentrations in the Original Monitoring Wells	102
51	Sulfate Concentrations in the Original Monitoring Wells	103
52	Sodium Concentrations in the Original Monitoring Wells	104
53	Strontium Concentrations in the Original Monitoring Wells	105
54	Calcium Concentrations in the Original Monitoring Wells	106
55	Nickel Concentrations in the Original Monitoring Wells	107
56	Copper Concentrations in the Original Monitoring Wells	108
57	Potassium Concentrations in the Original Monitoring Wells	109
58	Chromium Concentrations in the Original Monitoring Wells	110
59	Nitrate Concentration Trends in Well 199-H4-3	118
60	Sodium Concentration Trends in Well 199-H4-3	119
61	Nitrate Concentration Trends in Well 199-H4-4	120
62	Sodium Concentration Trends in Well 199-H4-4	121
63	Nitrate Concentrations, September 1987	126
64	Nitrate Concentrations, December 1986	127
65	Nitrate Concentrations, May 1987	128
66	Filtered Sodium Concentrations, September 1987	129
67	Filtered Sodium Concentrations, December 1986	130
68	Filtered Sodium Concentrations, May 1987.	131
69	Gross Alpha Concentrations, September 1987	132

70	Gross Alpha Concentrations, December 1986	133
71	Gross Alpha Concentrations, May 1987	134
72	Gross Beta Concentrations, September 1987	135
73	Gross Beta Concentrations, December 1986	136
74	Gross Beta Concentrations, May 1987	137
75	Horizontal Distribution of Nitrate Concentrations	138
76	Horizontal Distribution of Filtered Sodium Concentrations	139
77	Horizontal Distribution of Gross Alpha Concentrations	140
78	Horizontal Distribution of Gross Beta Concentrations	141
79	Filtered Chromium Concentrations, September 1987	142
80	Filtered Chromium Concentrations, December 1986	143
81	Filtered Chromium Concentrations, May 1987	144
82	Horizontal Distribution of Filtered Chromium Concentrations	145
83	Nitrate Concentrations with Depth in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C	147
84	Filtered Sodium Concentrations with Depth in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C	148
85	Gross Alpha Concentrations with Depth in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C	149
86	Gross Beta Concentrations with Depth in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C	150
87	Filtered Chromium Concentrations with Depth in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C	151
88	Breakthrough Curves for Nitrate and Chromium	153
89	Finite-Element Grid Used for Simulations	156
90	Simulated Pathlines	157

TABLES

1	Quantities of Selected Materials Discharged to the 183-H Basins in 1985	23
2	Characterization Results for the Solid Waste Fraction of the Basin #1 Slurry	26
3	Characterization Results for the Liquid Waste Fraction of the Basin #1 Slurry	27
4	Analytical Results for the Basin #2 Solution	31
5	General Characteristics of the Geologic Formations Beneath the 100-H Area	36
6	X-Ray Fluorescence Analysis of Basalt Chips from Two 100-H Area Wells	46
7	Vertical Hydraulic Conductivity Values for Split-Spoon Samples	56
8	Summary of Aquifer Testing Results	57
9	Field Moisture Contents and Water Retention Characteristics for the Phase II and III Wells	68
10	Completion Data for the 100-H Area Wells	74
11	FY 1988 Sampling Schedule for the 100-H Area Wells	82
12	Standard List of Analyses for the 100-H Area Ground-Water Samples	85
13	Proposed Schedule and Sample Analyses for Future 100-H Area Ground-Water Samples	88
14	Chemical Constituents Used for Linear Regression Trend Analyses	115
15	Wells Used for Linear Regression Trend Analyses	116
16	Background Concentrations	123
17	Comparison of Background Values from Selected Upgradient Wells Near the 183-H Basins with Background Values on the Hanford Site	124

18	Sodium Dichromate Inventories for Four Inactive Waste Disposal Facilities at the 100-H Area	146
19	Travel Time and Distances	158

1.0 INTRODUCTION

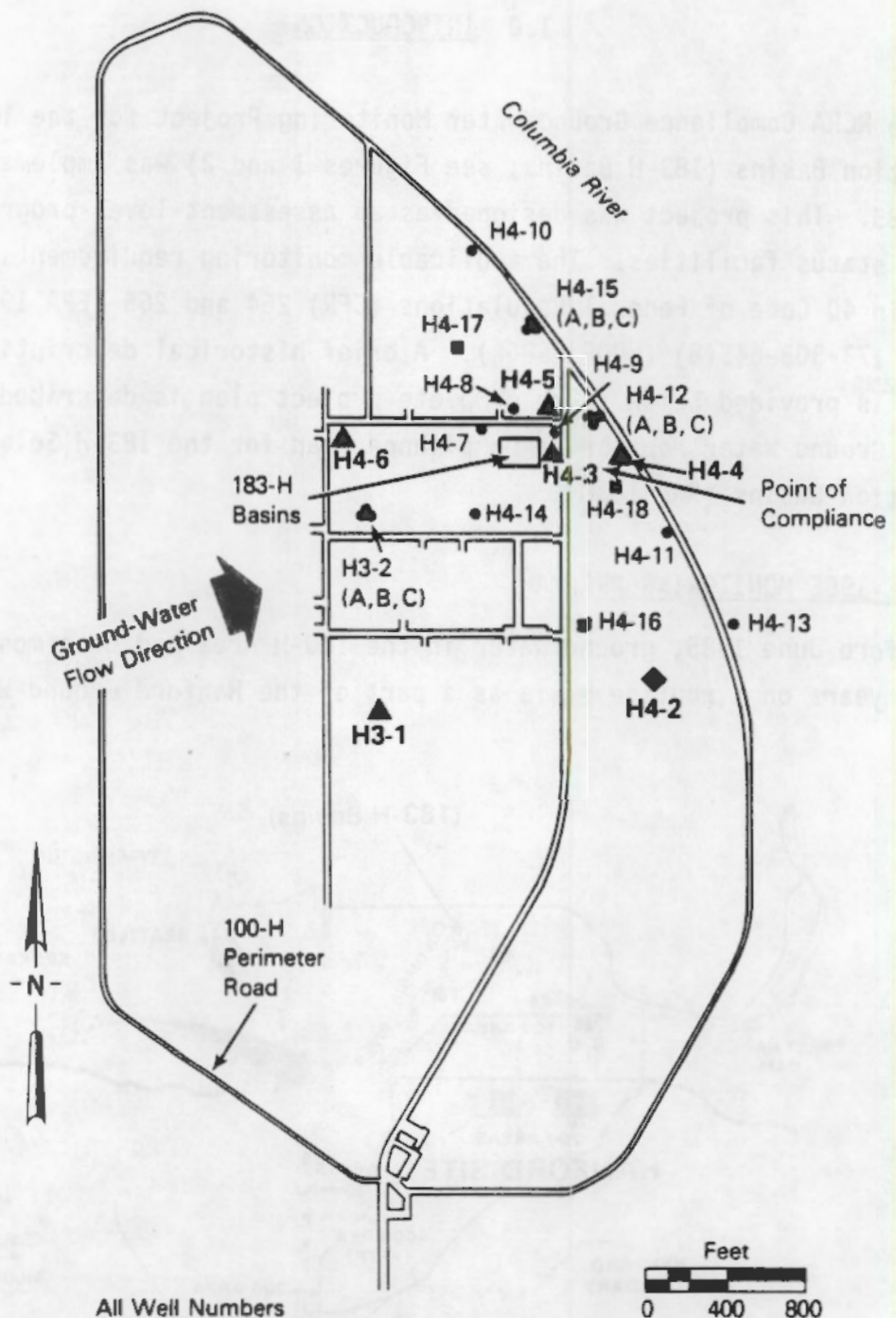
The RCRA Compliance Ground-Water Monitoring Project for the 183-H Solar Evaporation Basins (183-H Basins; see Figures 1 and 2) was implemented in June 1985. This project was designed as an assessment-level program for interim status facilities. The applicable monitoring requirements are described in 40 Code of Federal Regulations (CFR) 264 and 265 (EPA 1984) and the WAC 173-303-645(8) (WDOE 1986a). A brief historical description of the project is provided below. The complete project plan is described in the Revised Ground-Water Monitoring Compliance Plan for the 183-H Solar Evaporation Basins (PNL 1986).

1.1 PRE-1985 MONITORING PROGRAM

Before June 1985, ground water in the 100-H Area had been monitored for several years on a routine basis as a part of the Hanford Ground-Water



FIGURE 1. Location of the Hanford Site



All Well Numbers
Are Prefixed by 199-

- ▲ Original Monitoring Network
- Phase II Wells
- Phase III Wells
- ◆ Well Used Only for Geohydrologic Characterization

FIGURE 2. Locations of the Original Monitoring Wells

Monitoring Project. A network of five wells (199-H3-1, 199-H4-3, 199-H4-4, 199-H4-5, and 199-H4-6) was used by that project to monitor the unconfined aquifer. Another well, 199-H4-2, was drilled into basalt in 1952. Data from this well were used only for geohydrologic characterization activities. The locations of these six wells relative to the 183-H Basins and the general direction of ground-water flow are shown in Figure 2.

Shortly after completion in 1974, sampling of Well 199-H4-3 began. Continued sampling and review of the analytical data accumulated through 1978 revealed that nitrate and chromium levels in this well were increasing. Evaluation of the data indicated that Basin #1, which was the only basin in use at the time, was the apparent source of the ground-water contamination. As shown in Figures 3 and 4, the concentrations of nitrate and chromium in this well peaked in 1978.

1.2 INTERIM STATUS MONITORING PROGRAM

In February 1985, detailed plans for an interim status ground-water monitoring project for the 183-H Basins were developed. This facility-specific effort was designed 1) to collect additional site-specific geohydrologic data needed to more fully characterize the 100-H Area and support decisions concerning the monitoring network for the 183-H Basins, and 2) to conduct an expanded sampling and analysis effort to determine both the extent of contamination originating from the basins and the rate of contaminant movement.

Three phases were defined for this project, with work concentrated in five areas: geology, hydrology, geochemistry, ground-water modeling, and ground-water monitoring. Phase I of the project was initiated in June 1985, with 1) the development of a sampling program for the existing wells, 2) the development of a ground-water flow model, and 3) the compilation of all available data into the Revised Ground-Water Monitoring Compliance Plan for the 183-H Solar Evaporation Basins (PNL 1986). In Phase II of the project, the sampling program was expanded with the installation of 16 wells (Figure 5), and the Interim Characterization Report for the Area Surrounding the 183-H Basins (PNL 1987) was completed. Three additional wells were installed

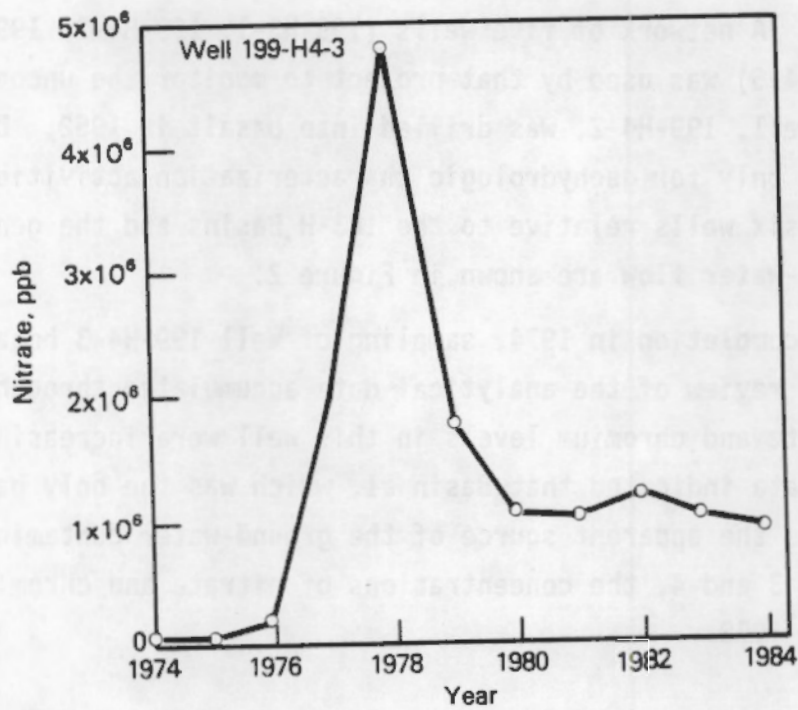


FIGURE 3. Annual Average Concentrations of Nitrate in Well 199-H4-3

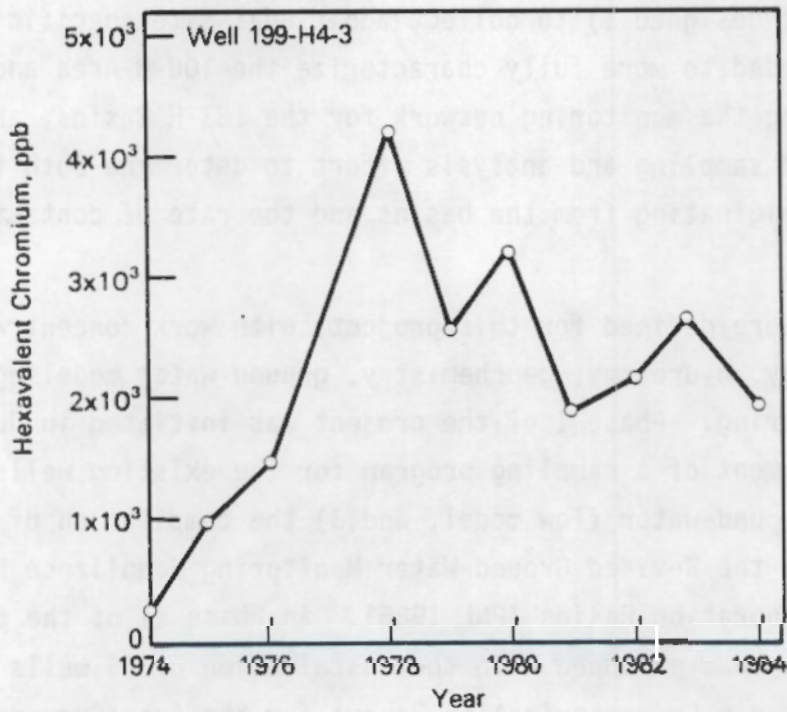
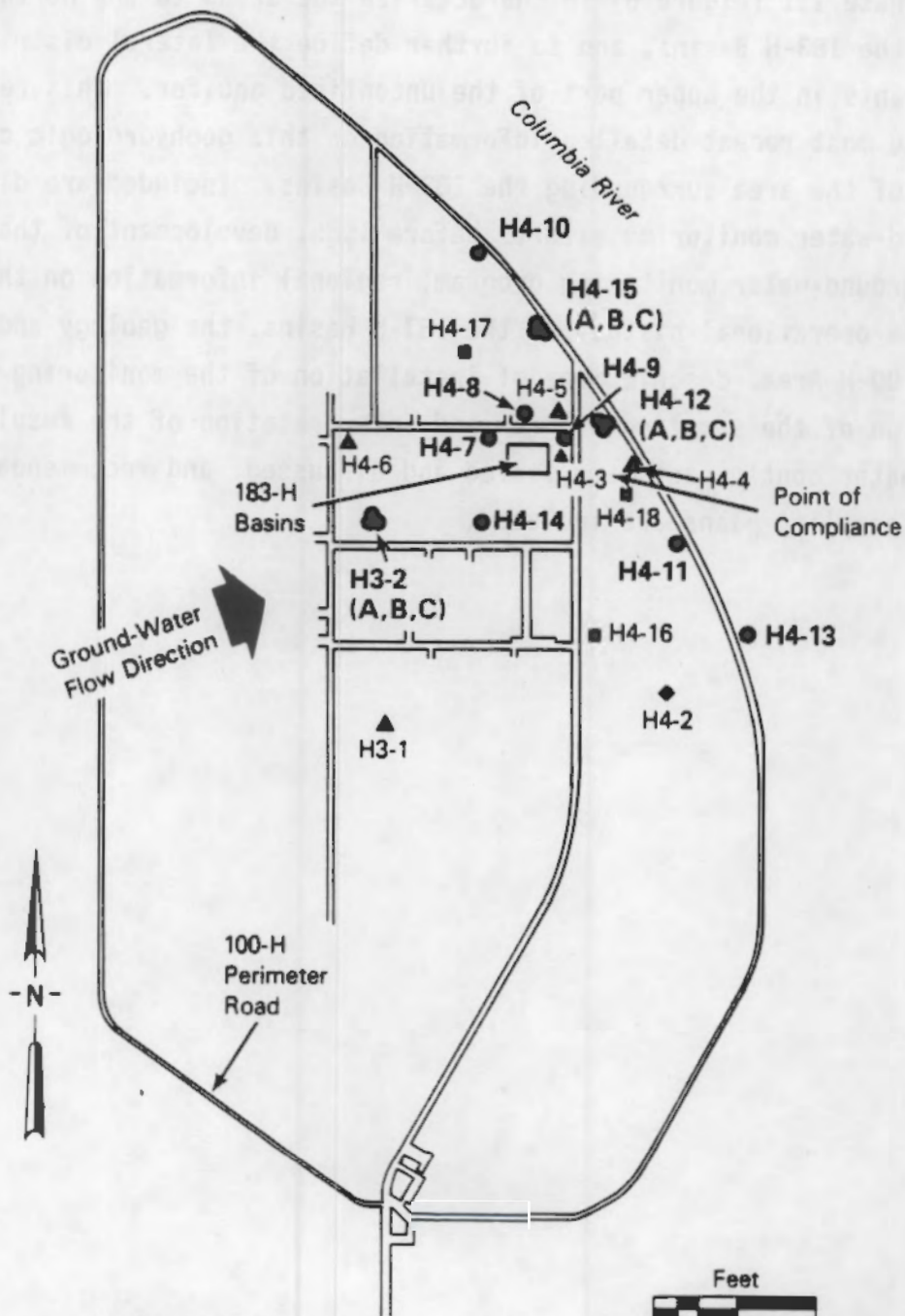


FIGURE 4. Annual Average Concentrations of Chromium in Well 199-H4-3

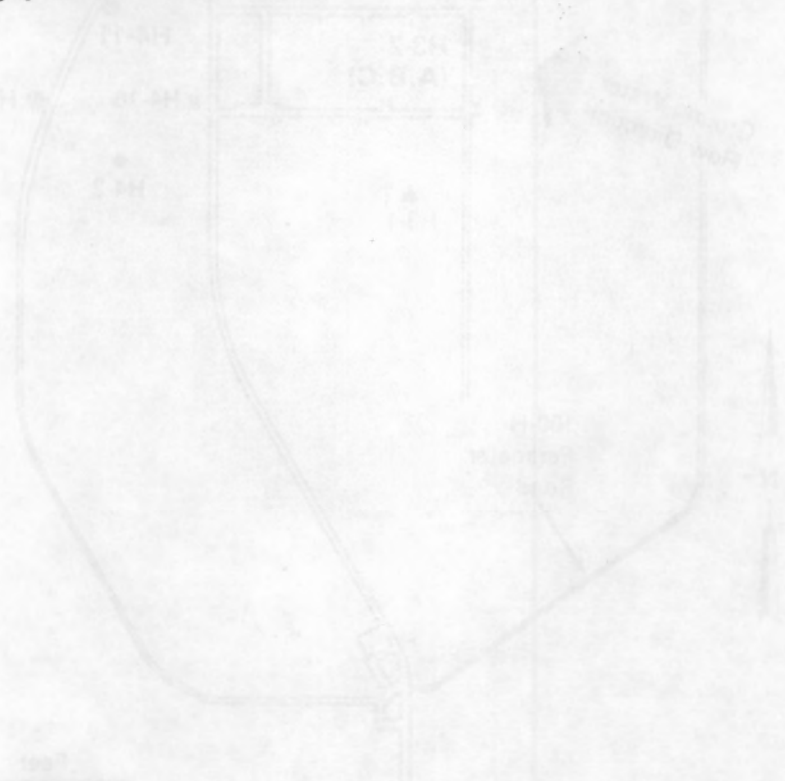


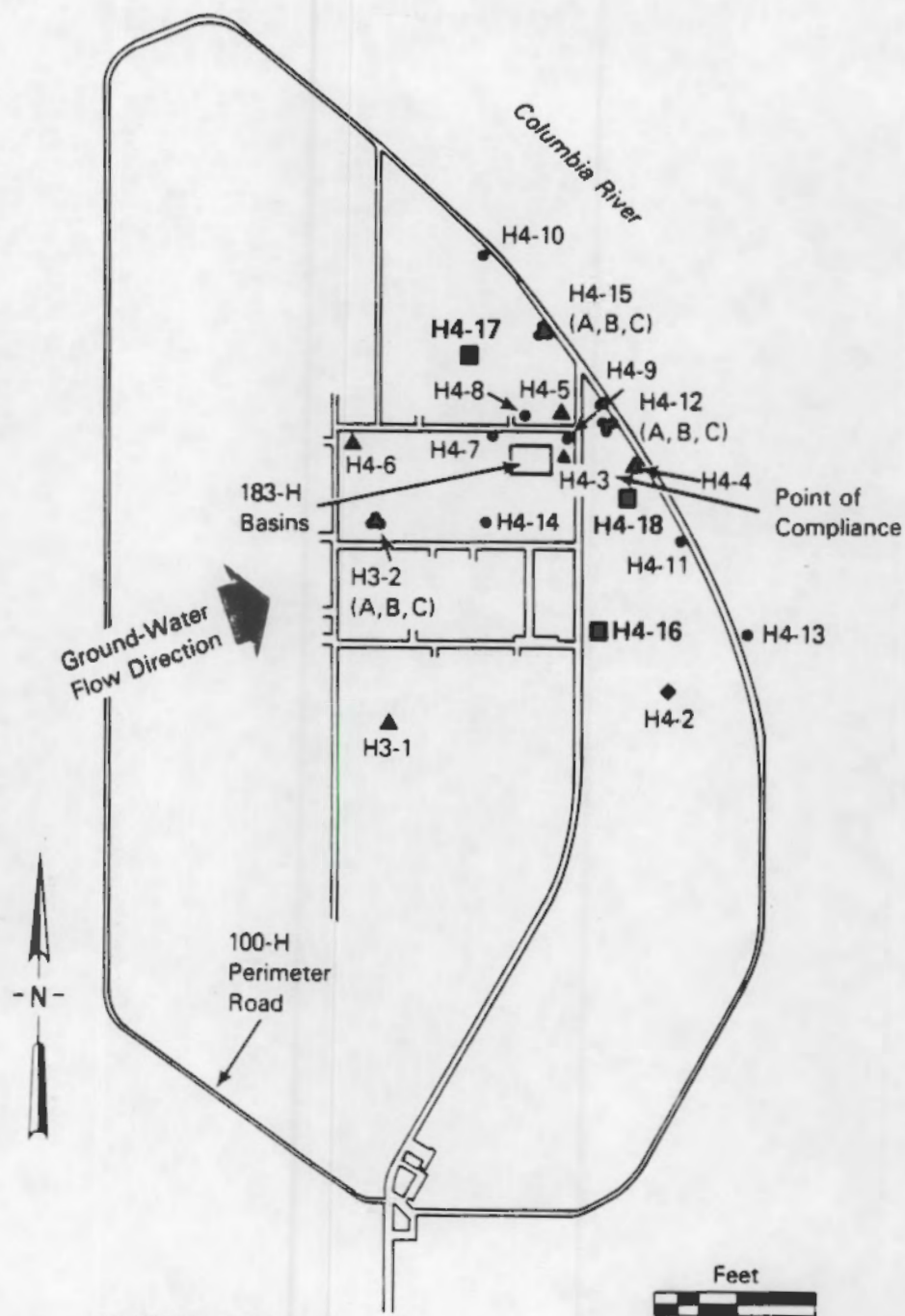
All Well Numbers
Are Prefixed by 199-

- ▲ Original Monitoring Network
- Phase II Wells
- Phase III Wells
- ◆ Well Used only for Geohydrologic Characterization

FIGURE 5. Locations of the Phase II Wells

during Phase III (Figure 6) to characterize the areas to the north and south-east of the 183-H Basins, and to further define the lateral distribution of contaminants in the upper part of the unconfined aquifer. This report contains the most recent detailed information on this geohydrologic characterization of the area surrounding the 183-H Basins. Included are discussions of ground-water monitoring efforts before 1985, development of the interim status ground-water monitoring program, regional information on the Hanford Site, the operational history of the 183-H Basins, the geology and hydrology of the 100-H Area, descriptions of installation of the monitoring wells, and the design of the sampling program and interpretation of the results. Ground-water contaminants are tabled and discussed, and recommendations for further sampling plans are included.





All Well Numbers
Are Prefixed by 199-

- ▲ Original Monitoring Network
- Phase II Wells
- Phase III Wells
- ◆ Well Used only for Geohydrologic Characterization

FIGURE 6. Locations of the Phase III Wells

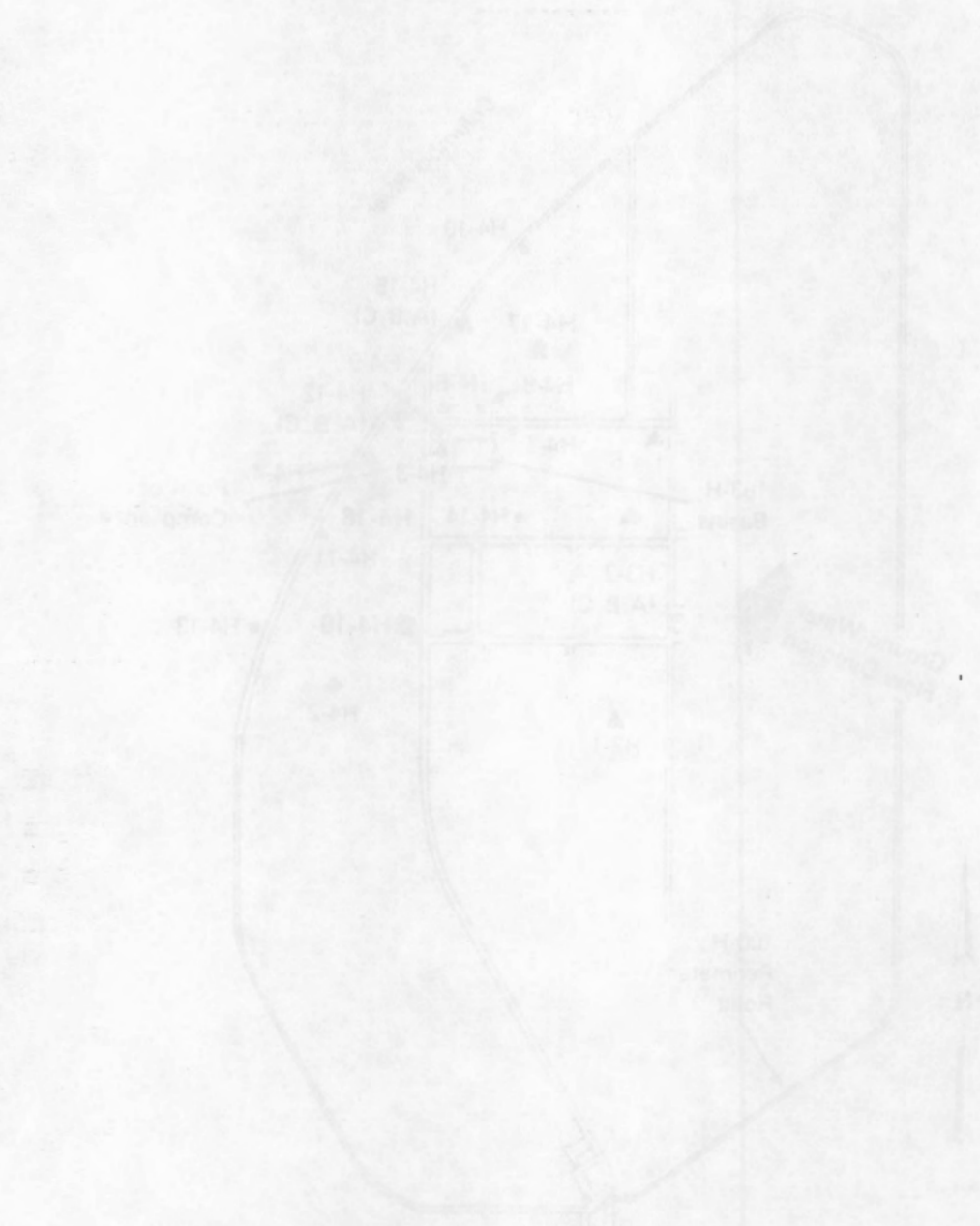


FIGURE 1. Location of the Part III Wells

1. The Part III wells are located in the area shown in Figure 1.

2.0 BACKGROUND

This section of the report provides background information on the regional physiography and geohydrology of the Hanford Site. Descriptions of the 183-H Basins, waste management activities, and waste characterization are also included.

2.1 REGIONAL PHYSIOGRAPHY AND GEOHYDROLOGY

The Hanford Site is located in a semiarid region of south-central Washington State within the Pasco Basin (Figure 1). The site occupies an area of approximately 560 mi² and is used for reactor and fuel processing operations, waste storage, and waste disposal. The adjacent lands to the west, north, and east are primarily range and agricultural lands. The Tri-Cities (Richland, Kennewick, and Pasco) comprise the nearest population center and are located approximately 5 mi southeast of the Site.

The Hanford Site overlies the structural low point of the Pasco Basin and is bounded to the southwest, west, and north by large anticlinal ridges (Figure 7). These basaltic ridges trend to the east and southeast from the Cascade Mountains. The Site is bounded to the north and east by the Columbia River and Ringold bluffs and to the south by the Yakima River.

The elevations of the Hanford Site vary from 3583 ft above mean sea level (msl) on Rattlesnake Mountain at the southwestern border of the Site to 345 ft above msl in the southeast corner of the Site near the 300 Area.

2.1.1 Climate of the Hanford Site

The climate of the Hanford Site is greatly affected by the Cascade Mountains to the west (Stone et al. 1983). The site is located in the rain shadow formed by the mountains. The average annual precipitation on the Hanford Site ranges from less than 7 in. at the Hanford Meteorological Station near the 200 Areas to slightly more than 15 in. atop Rattlesnake Mountain at the southwest border of the site (Gephart et al. 1979). More than 30% of this precipitation occurs in November, December, and January,

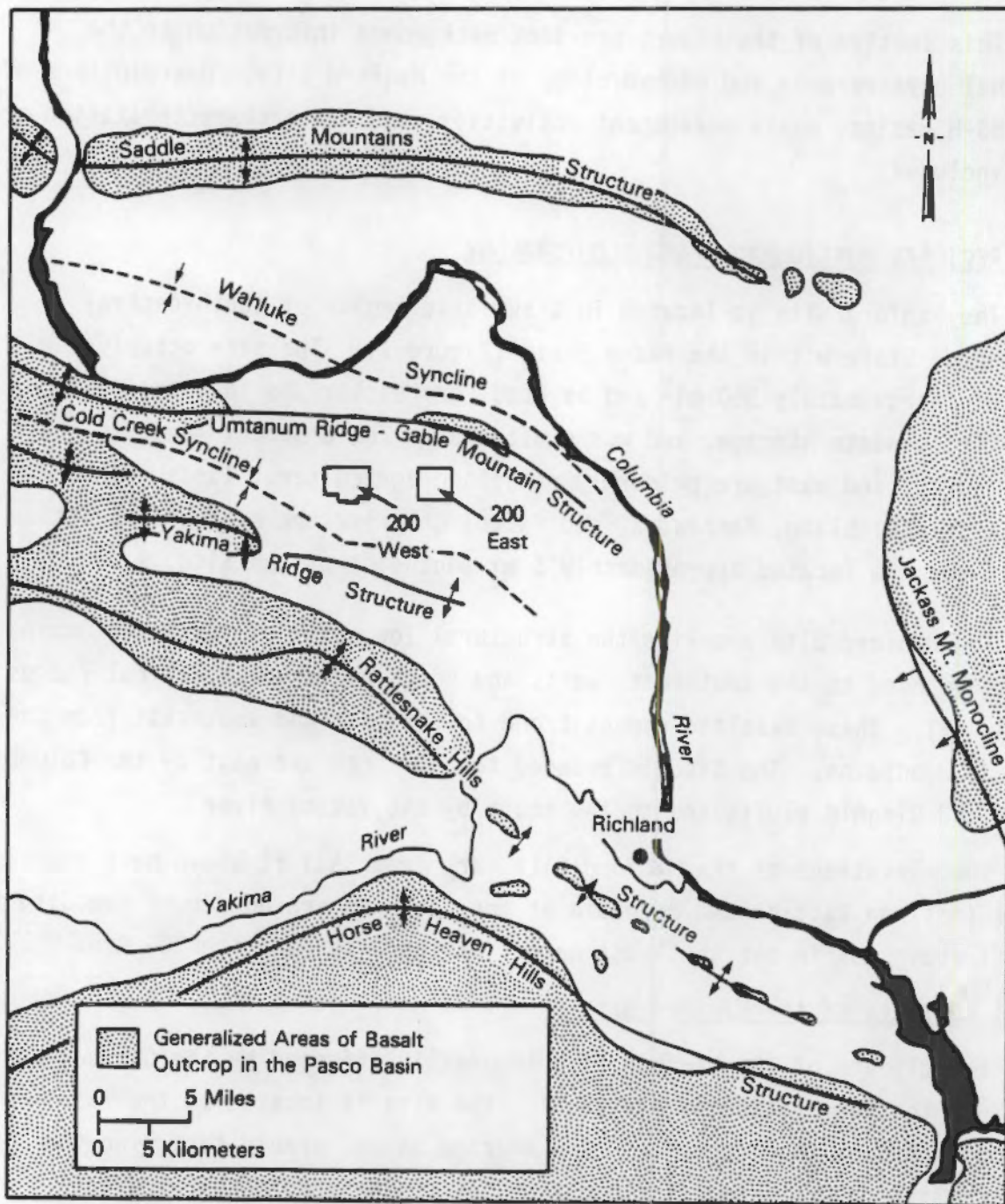


FIGURE 7. Structural Geology of the Pasco Basin (modified from DOE 1984)

with 38% of the precipitation from December to February occurring in the form of snow (Stone et al. 1983).

The wind at the Hanford Site is controlled in a large part by the Cascade Range, which serves as a source of cold air drainage. With the added effects of topographic channeling, average hourly wind speeds in June can vary from 5 to 13 mi/h during the day. The hourly average wind speeds for days in January are about 6 mi/h. Temperatures at the Hanford Site can vary greatly, with winter minima ranging from -27° to +22°F and summer maxima ranging from 100° to 115°F (Stone et al. 1983). Winters are generally mild, and summers are hot.

2.1.2 Geology of the Hanford Site

The principal geologic units beneath the Hanford Site are, in ascending order: the Columbia River Basalt Group with interbeds of the Ellensburg Formation, the Ringold Formation, the Plio-Pleistocene Unit (early "Palouse" soil), and the Hanford formation. Locally, Pleistocene/Holocene alluvium, colluvium, and eolian deposits veneer the surface. A generalized geologic cross section of the Site is shown in Figure 8. A summary of the major stratigraphic units present in the Pasco Basin is shown in Figure 9.

Columbia River Basalt Group -- The tholeiitic flood basalts of the Columbia River Basalt Group form the bedrock of the Pasco Basin. This thick sequence of basalt was formed between 6 and 17 million years before present (mybp) when large volumes of lava erupted from fissures in the southeastern portion of the Columbia Plateau. The Columbia River Basalt Group is subdivided into five formations (Ledgerwood et al. 1978; Swanson et al. 1979) and consists of more than 48,000 mi³ of basalt covering more than 59,900 mi². Beneath the Pasco Basin, this basalt sequence may be as much as 14,000 ft thick. Flows of the Columbia River Basalt Group are interbedded with and overlain by Miocene-Pliocene epiclastic and volcanoclastic sediments of the Ellensburg Formation (Myers and Price et al. 1979).

Ringold Formation -- Following cessation of the Columbia River Basalt volcanism, sediments of the Ringold Formation accumulated in the Pasco Basin.

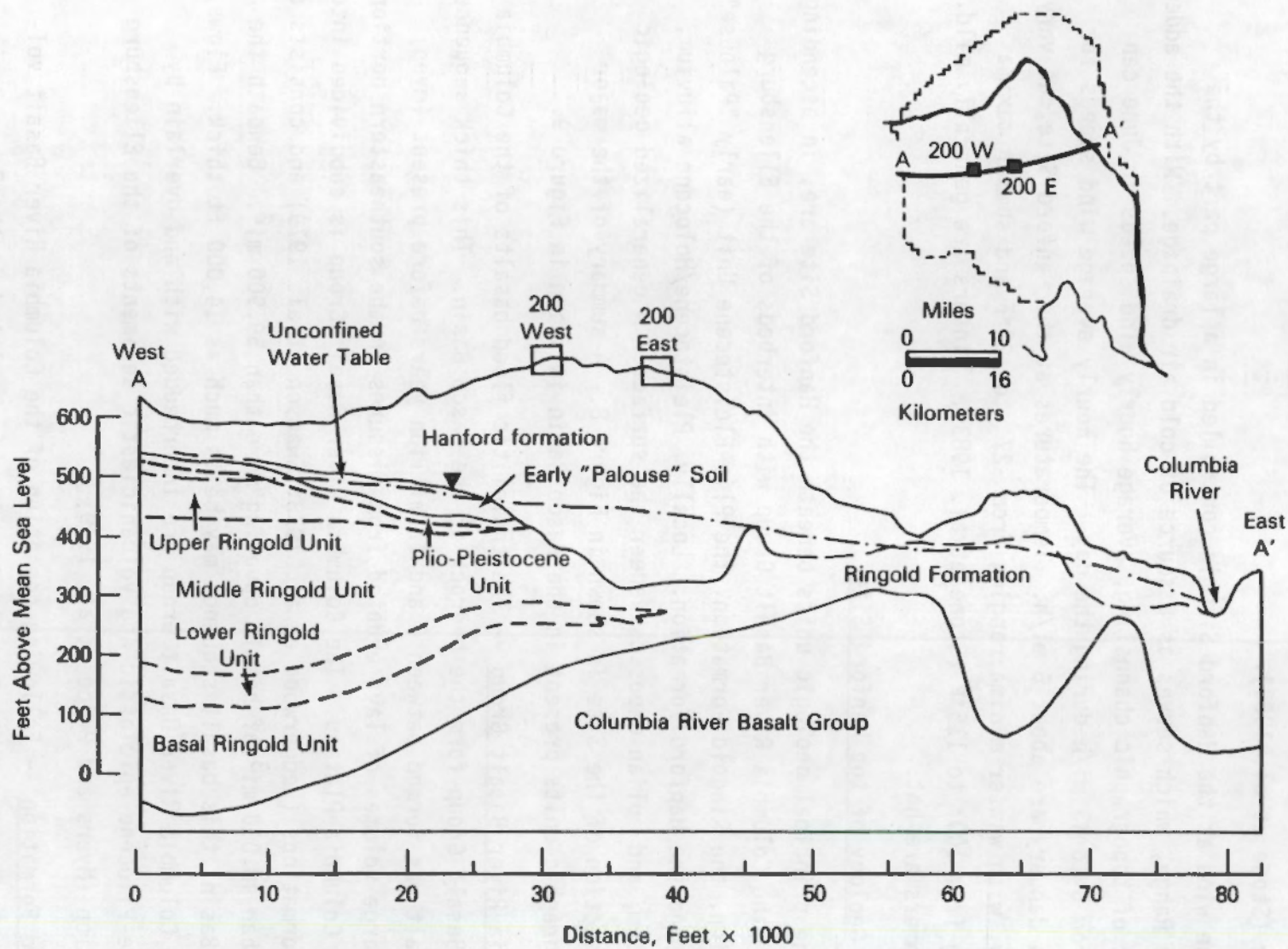


FIGURE 8. Generalized Geologic Cross Section of the Hanford Site (Tallman et al. 1979)

Period	Epoch	Group	Subgroup	Formation	K-Ar Age Years x 10e	Member or Sequence	Geologic Mapping Symbol	Sediment Stratigraphy or Basalt Flows					
QUATERNARY	Pleistocene/ Holocene					Surficial Units	Ql	Loess					
							Qd	Sand Dunes					
							Qa, Qaf	Alluvium and Alluvial Fans					
							Qld	Landslides					
							Qt	Talus					
							Qco	Colluvium					
	Pleistocene		Hanford			Touchet Beds/ Pasco Gravels	Qht/Qhp						
								Plio-Pleistocene Unit					
	Pliocene		Ringold				Trs	Upper Ringold					
								Trc	Middle Ringold				
								Trla	Lower Ringold				
								Trg	Basal Ringold				
								Fanglomerate					
TERTIARY	Miocene	Columbia River Basalt Group	Yakima Basalt Subgroup	Saddle Mountains Basalt	8.5	Ice Harbor Member	Ti	Tig Tim Tib	Goose Island Flow Martindale Flow Basin City Flow Levey Interbed				
					10.5	Elephant Mountain Member	Tem	Tem ₂ Tem ₁	Ward Gap Flow Elephant Mountain Flow Rattlesnake Ridge Interbed				
					12.0	Pomona Member	Tp	Tp ₂ Tp ₁	Upper Pomona Flow Lower Pomona Flow Selah Interbed				
						Esquatzel Member	Te	Te ₂ Te ₁	Upper Gable Mountain Flow Gable Mountain Interbed Lower Gable Mountain Flow Cold Creek Interbed				
						Asotin Member	Ta		Huntzinger Flow				
						Wilbur Creek Member	Tw		Wahluke Flow				
						Umatilla Member	Tu	Tu _s Tu _u	Sillusi Flow Umatilla Flow Mabton Interbed				
					13.6	Priest Rapids Member	Tpr	Tpr ₁ Tpr ₂	Lolo Flow Rosalia Flows Quincy Interbed				
						Rosa Member	Tr	Tr ₂ Tr ₁	Upper Rosa Flow Lower Rosa Flow Squaw Creek Interbed				
						Frenchman Springs Member	Tf	Tf _s Tf _p	Sentinel Gap Flow Wallula Gap Flow Sand Hollow Flows Silver Falls Flows Ginkgo Flows Palouse Falls Flow				
					15.6	Sentinel Bluffs Sequence	Tsb		Vantage Interbed Undifferentiated Flows Rocky Coulee Flow Levering Flow Cohasset Flow Unnamed Flow Birkett Flow Undifferentiated Flows McCoy Canyon Flow Intermediate-Mg Flow				
						Schwana Sequence	Ts		Low-Mg Flow Above Umtanum Umtanum Flow High-Mg Flows Below Umtanum Very High-Mg Flow				
					16.1				At Least 30 Low-Mg Flows				
													Ellensburg Formation Tel

FIGURE 9. Stratigraphic Units Present in the Pasco Basin (after Reidel and Fecht 1981)

These sediments were deposited between 8.5 and 3.7 mybp in a fluvial/flood plain environment (Myers and Price et al. 1979) to reach a thickness of more than 1200 ft.

Within the Pasco Basin, the Ringold Formation has been classified into three stratigraphic section types (Tallman et al. 1981). Section type I, located throughout the central Pasco Basin, is subdivided into four textural units: 1) sand and gravel of the basal Ringold unit; 2) clay, silt, and fine sand with minor gravel lenses of the lower Ringold unit; 3) occasionally cemented sand and gravel of the middle Ringold unit; and 4) silt and fine sand of the upper Ringold unit (Tallman et al. 1981). Section type II consists of predominantly silt, sand, and clay with minor gravel lenses, and is found north and east of Gable Mountain. Section type III is composed of talus, slope wash, and sidestream deposits that occur along the flanks of anticlinal ridges and interfinger with the central basin deposits. The distribution of these section types is shown in Figure 10.

Plio-Pleistocene Unit -- The Plio-Pleistocene unit overlies the Ringold Formation in the western part of the Hanford Site near the 200-West Area. This eolian silt and fine sand unit (referred to as the early "Palouse" soil) was deposited as reworked Ringold sediments. Relatively high caliche contents are found in much of this unit.

Hanford Formation -- The Hanford formation lies unconformably on the eroded surface of the Ringold Formation, the Plio-Pleistocene unit, and, locally, the basalt bedrock. The Hanford formation consists of catastrophic flood sediments that were deposited when ice dams in western Montana and northern Idaho were breached, and massive volumes of water spilled abruptly across eastern and central Washington. The floods scoured the land surface, locally eroding the Ringold Formation, upper basalt flows, and interbeds. Thick sequences of sediments were deposited by several episodes of Pleistocene flooding, with the last major flood sequence dated about 12,000 years before present (ybp) (Fecht et al. 1985). These sediments have locally been divided into two main facies, termed the "Pasco Gravels" facies and the "Touchet Beds" facies. The Pasco Gravels facies are composed of poorly sorted gravels and coarse sand indicative of a high-energy depositional

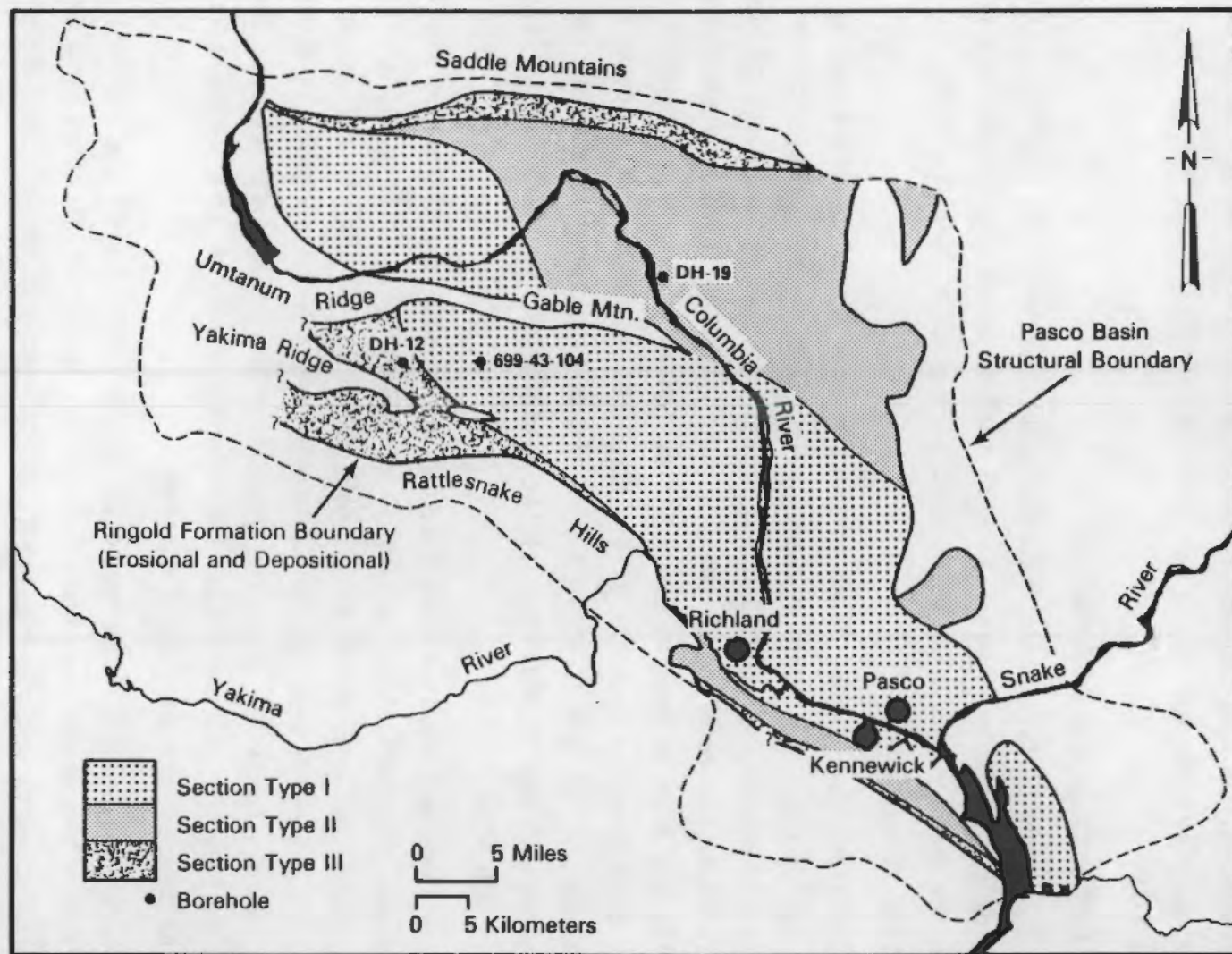


FIGURE 10. Distribution of the Ringold Formation Section Types (after Tallman et al. 1981)

environment. The Touchet Beds facies consist of rhythmically bedded sequences of graded silt, sand, and minor gravel units (Myers and Price et al. 1979). These sediments are limited to areas where slack-water conditions existed. Eolian sediments, consisting of loess, active and inactive sand dunes, alluvium, and colluvium, locally veneer the surface of the Hanford Site.

2.1.3 Hydrology of the Hanford Site

The primary surface-water features associated with the Hanford Site are the Columbia and Yakima rivers. Several surface ponds and ditches are present onsite and are generally associated with reactor fuel and waste processing activities.

Flow along the Hanford Reach of the Columbia River is controlled by Priest Rapids Dam. The average annual river flow in this area, based on 65 years of records, is about 110,000 ft³/s. Large-scale flooding of the Columbia River has occurred in the past, but the likelihood of such flooding recurring has been reduced by the construction of several flood control/water storage dams upstream from the Site. Normal Columbia River elevations within the Site range from 394 ft above msl at the northwestern boundary of the Site near Vernita to 341 ft above msl at the southeastern boundary of the Site near the 300 Area.

Ground water beneath the Site occurs under both unconfined and confined conditions. The unconfined aquifer is contained predominantly within the silts, sands, and gravels of the Ringold Formation in the central Pasco Basin. To the north and east of Gable Mountain, the water table is found within the glaciofluvial sands and gravels of the Hanford formation. The basalt surface or, in some areas, the clay zones of the lower Ringold unit form the base of the unconfined aquifer.

Sources of natural recharge to the unconfined aquifer are rainfall and run-off from the higher bordering elevations, water infiltrating from small ephemeral streams, and river water along influent reaches of the Yakima and Columbia rivers. From the recharge areas to the west, the unconfined ground water flows primarily eastward to the discharge areas along the Columbia River (Figure 11). The general eastward flow is affected locally by the

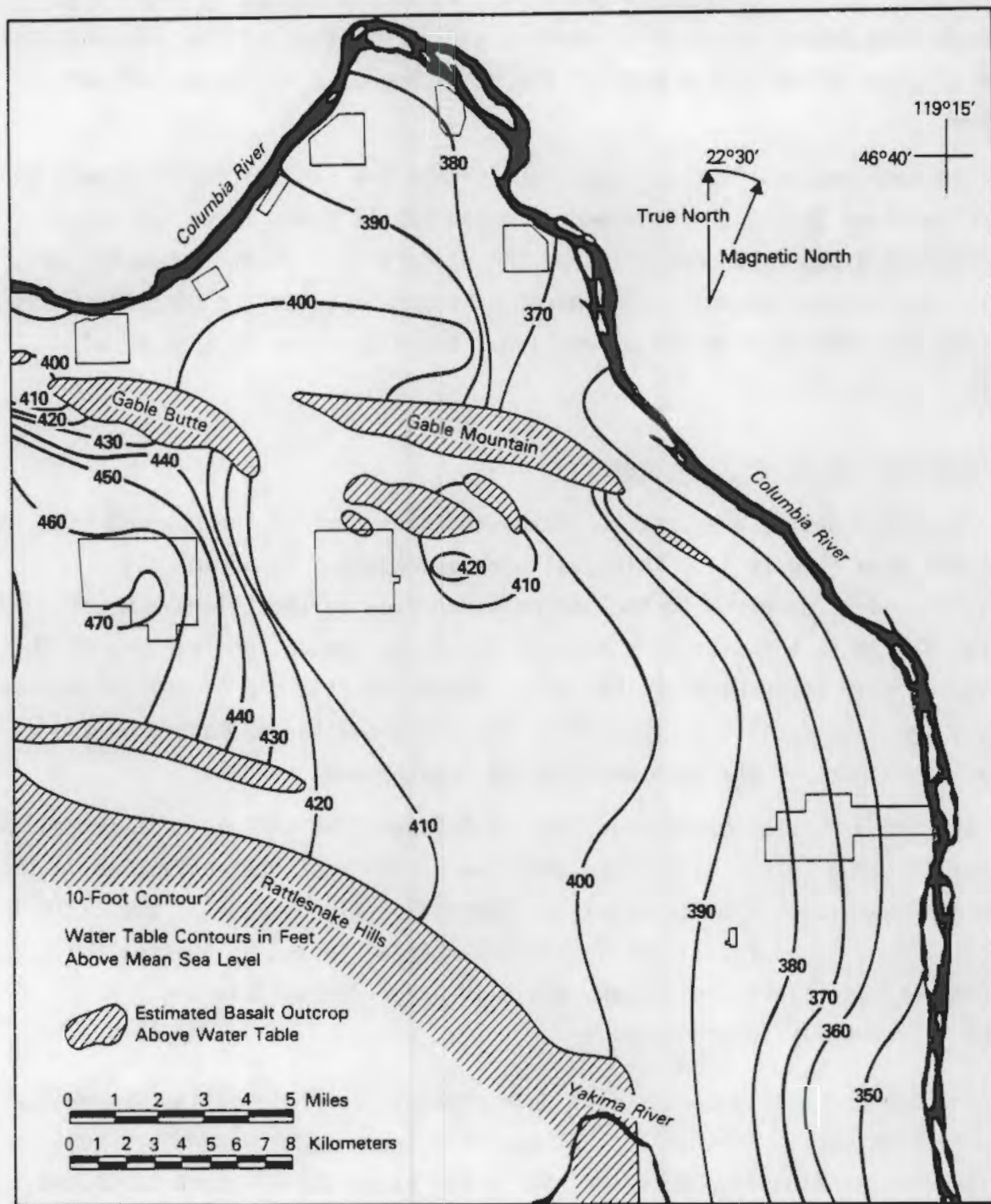


FIGURE 11. Water Table Elevations for June 1987 (from Schatz et al. 1987)

ground-water mounds beneath the 200 Areas, which are caused by artificial recharge from onsite disposal of cooling water. This artificial recharge to disposal sites accounts for most of the total recharge to the unconfined aquifer.

The confined aquifers are contained within the sedimentary interbeds and interflow zones that occur between the dense basalt flows in the Columbia River Basalt Group. In some areas of the Hanford Site (i.e., Gable Mountain Pond), significant hydraulic communication occurs between the unconfined and confined aquifers as a result of erosional unconformities (Graham et al. 1984).

2.2 DESCRIPTION OF THE 183-H BASINS

The 183-H Basins are located in the northern part of the Hanford Site in the 100-H Area (Figure 1). This oval 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 12 is a map of the 100-H Area showing the main facilities, including the 183-H Basins, which 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 (ERDA 1975). Since the shutdown of the reactor, activities in the 100-H Area have been limited mainly to storage of mixed waste 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.

The 183-H facility consists of four separate concrete basins surrounded by an earthen berm. Figure 13 is a schematic cross section showing the facility's dimensions and relationship to the water table. Each basin consists of a flocculator basin (shallow section) and a subsidence basin (deep section), as shown in the plan view of the facility in Figure 14. The concrete floor is 6 in. thick in the subsidence basin and 10 in. thick in the

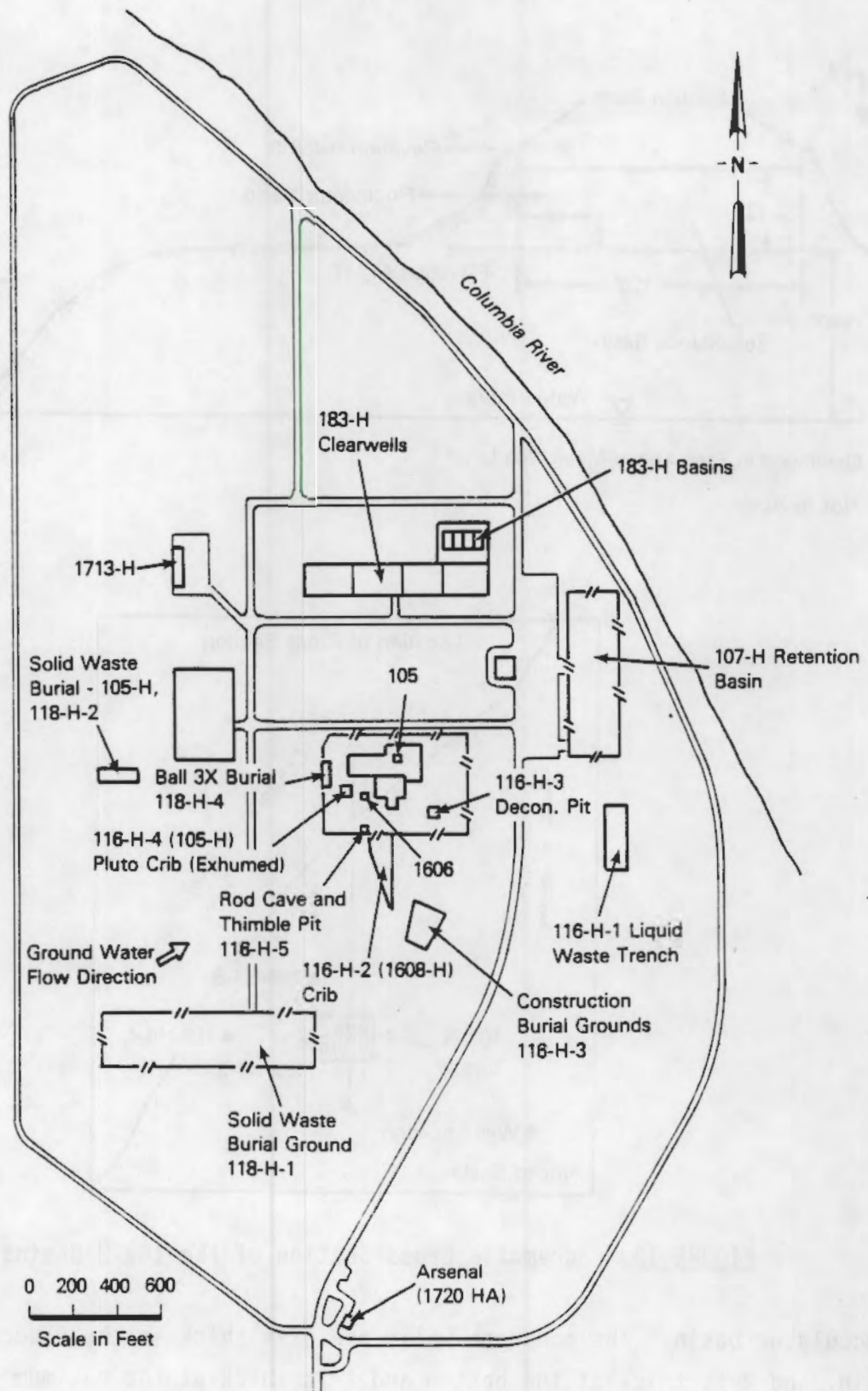


FIGURE 12. 100-H Area Map

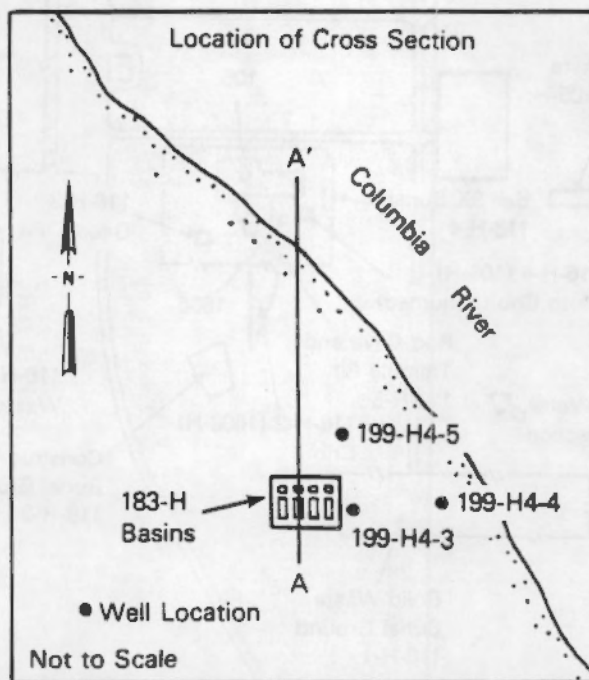
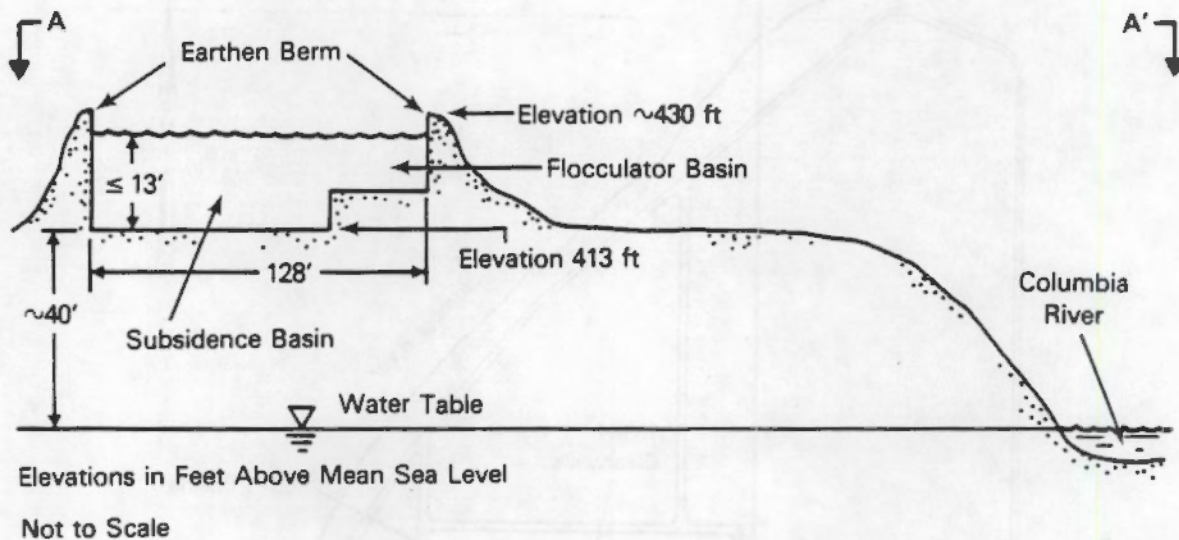


FIGURE 13. Schematic Cross Section of the 183-H Basins

flocculator basin. The concrete walls are 1 ft thick in the flocculator basin, and 2 ft thick at the bottom and 1 ft thick at the maximum fill level in the subsidence basin.

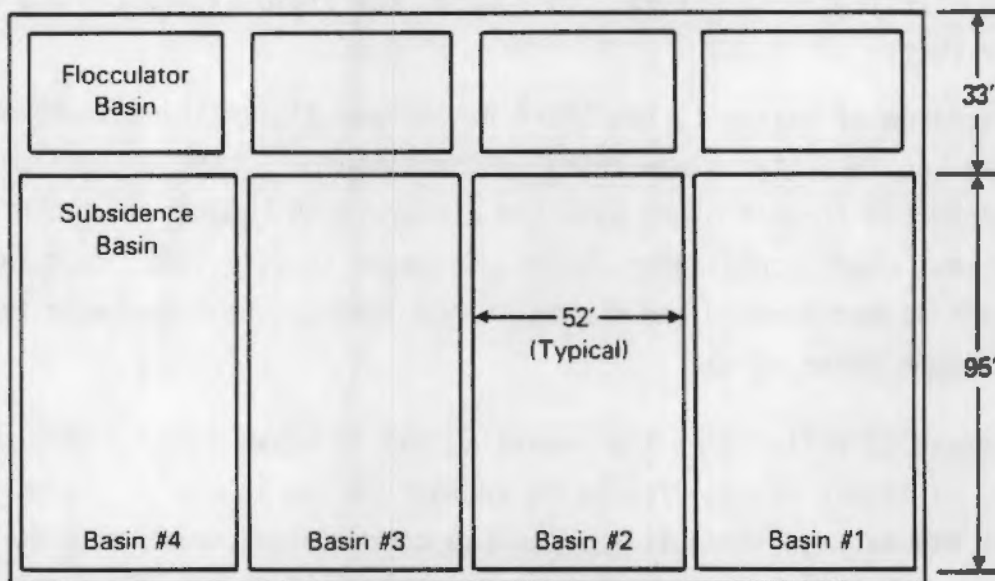


FIGURE 14. Plan View of the 183-H Basins (from Greager 1982)

2.3 OPERATIONAL HISTORY OF THE 183-H BASINS

From 1943 to 1964, the 183-H Basins were used as flocculator/subsidence basins for the 100-H water treatment plant. The basins were inactive until 1973, when they were designated for use as evaporation basins for storage and treatment of waste solutions from the 300 Area fuel fabrication facility. At that time, the basins were modified by permanently plugging the drains with concrete and installing a pipeline for filling the basins (Greager 1982).

Mixed wastes from the 300 Area fuel fabrication facilities were first discharged to basin #1 in June 1973. After 2 months of service, use of the basin was postponed for more than 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 in well 199-H4-3, and was attributed to seepage of wastes from this unlined basin (Figure 3). Basins #2 and #3 were prepared for use by coating the walls and floors with urethane. Basin #1 was permanently removed from service, and the liquid wastes were pumped to basins #2 and #3, leaving a sludge. Filling of these two basins to capacity led to use of

basin #4 starting in late 1982. This basin was lined with butyl and hypalon (Greager 1982).

Discharge of wastes to the 183-H Basins was discontinued in November 1985, and the facility is now being decommissioned. These activities are being conducted in accordance with the closure requirements of the RCRA regulations. The decommissioning process began in July 1985, when the sludge from basin #1 was removed and the walls and floors were decontaminated with a high-pressure water spray.

Removal of wastes from the remaining basins began in July 1986 with the transfer of liquid wastes from basin #2 into basins #3 and #4. Sludge from basin #2 was packaged into 55-gal painted carbon steel drums with 90-mil liners, and shipped to retrievable storage in the 200-West Area. Depth of wastes in each of these three basins before removal was 7 to 8 ft, for an estimated total of 620,000 gal of liquid and 36,000 ft³ of solid material. This work was completed in September 1986. The walls and floors of basin #2 were cleaned with an air-water lance. A cement-mortar mixture was used to grout existing piping and patch the walls and floors.

In October 1986, a 36-mil hypalon liner was installed in basin #2, and the liquid wastes from basins #3 and #4, approximately 498,800 gal, were then pumped into basin #2. Sludge from basin #3 was packaged into 55-gal galvanized steel drums with 90-mil liners, and shipped to retrievable storage in the 200-West Area. A 36-mil hypalon liner was then installed in basin #3. This work was completed in October 1987.

Plans for the remainder of the waste-removal process include removing the sludge from basin #4. The liquid wastes will then be distributed equally into basins #2 and #3 to evaporate or be disposed of offsite.

2.4 WASTE CHARACTERIZATION

The primary wastes discharged to the 183-H Basins were acid solutions (HNO₃, H₂SO₄, HF, and H₂CrO₄) neutralized with sodium hydroxide (NaOH). These wastes were generated from routine operations in the 300 Area fuel fabrication facilities. Table 1 gives the quantities of selected materials

TABLE 1. Quantities of Selected Materials Discharged to the 183-H Basins in 1985 (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	97,000
Uranium	440

discharged to the basins for the period January 1 through November 8, 1985. These materials are also representative of waste solutions discharged before January 1, 1985. The annual discharge rate rose steadily to a maximum of 369,000 gal in 1985 (Rokkan 1986). The total volume of routine waste discharged to the 183-H Basins since 1973 was 2,542,000 gal. In November 1985, all shipments of waste to the 183-H Basins were halted.

The neutralized chemical waste contained high concentrations of nitrate and copper resulting from the use of nitric acid in the copper stripping procedures used in the fuel fabrication process. Chromium wastes, including hexavalent chromium (Cr^{6+}), were also discharged to the basin. Most of the hexavalent chromium was derived from the use of chromic acid in the fuel fabrication process. After 1983, hexavalent chromium was reduced to Cr^{3+} before disposal to the basins. Two other minor sources of chromium were derived from the etching of stainless steel by a hydrofluoric/nitric acid bath (mostly Cr^{3+}) and from the disposal of approximately 300 gal/year of various industrial solutions (Greager 1982).

Small quantities of other chemical wastes were also discharged to the 183-H Basins on a nonroutine basis. These wastes were required to be non-flammable, nonexplosive, and compatible with the fuel fabrication wastes before disposal was allowed. Constituents in these wastes included:

- cadmium and cadmium compounds
- copper and copper compounds
- oxalic acid

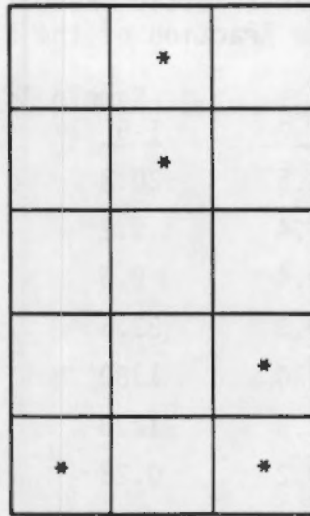
- cyanide compounds
- mercury compounds
- barium perchlorate
- hydrazine
- chromium and chromium compounds
- vanadium pentoxide
- lead compounds
- nickel and nickel compounds.

Slurry samples from basin #1 and solution samples from basin #2 were collected and chemically characterized in October 1984 and November 1986, respectively. Characterization of these samples provided a detailed description of the wastes and identified potential ground-water contaminants associated with the 183-H Basins.

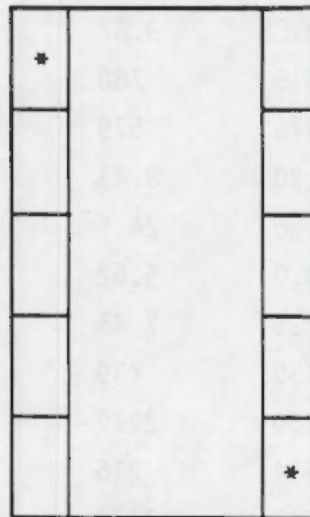
2.4.1 Basin #1 Sampling

Seven randomly selected samples, five inner and two outer (Figure 15), were collected for analysis from basin #1 using core tubes driven into the waste. The waste material within the core tube was then frozen with liquid nitrogen before removal. This procedure allowed observation of the stratification of each core. In general, the inner cores consisted of a hard crystalline surface layer, which softened into a high liquid content slurry; this was followed by another crystalline layer, then a thick black slurry to the bottom of the basin. The thickness of the inner cores ranged from approximately 14 to 28 in., depending on the sampling location. The slurry samples were separated into liquid and solid phases by centrifuging. Each phase was then submitted for chemical analysis (Vedder 1985).

The outer cores contained no liquid phase and consisted mostly of sodium sulfate with some bird droppings from swallows nesting in the basin. Similar analyses were performed on both the outer and inner samples.



* Inner Samples Randomly Selected for Analysis



* Outer Samples Randomly Selected for Analysis

FIGURE 15. Sample Locations for Basin #1

The results of radiological and chemical analyses performed on the solid and liquid phases of the homogenized waste core material from basin #1, shown in Tables 2 and 3, respectively, indicate a wide variability in chemical composition among sampling locations. This variability is probably related to the operational history of the facility. As acidic solutions with various chemical constituents were neutralized with NaOH and discharged into the

TABLE 2. Characterization Results for the Solid Waste Fraction of the Basin #1 Slurry

Component	Units	Sample Identification				
		I-2	I-5	I-12	I-13	I-15
Na	%	23.5	20.3	18.8	19.5	17.7
F ⁻	%	5.4	6.2	6.1	6.4	6.1
NO ₃ ⁻	%	10.4	9.6	7.4	6.9	6.1
SO ₄ ²⁻	%	19.8	23.5	20.3	19.7	17.7
Cr	ppm	930	1380	1450	1280	1380
Cu	%	12.6	12.8	12.7	11.2	10.0
Fe	%	0.2	0.23	0.28	0.29	0.3
Mn	ppm	1540	2130	2360	2190	2380
Mo	ppm	189	338	364	396	419
Ni	ppm	64	169	183	163	169
S	%	10.38	9.67	7.86	8.42	7.46
Sn	ppm	516	780	902	925	943
U	ppm	375	579	678	685	647
Zr	%	1.90	3.43	3.55	3.32	3.85
⁶⁰ Co	pCi/g	1.56	24.5	28.2	12.1	22.1
¹³⁷ Cs	pCi/g	<3.0	5.62	<3.3	<2.3	<2.8
⁵⁴ Mn	pCi/g	<2.5	7.45	<2.7	<1.7	<2.5
⁹⁹ Tc	pCi/g	<439	<39	<116	<90	<93
²³⁴ U	pCi/g	6960	2920	9030	5470	5900
²³⁵ U	pCi/g	454	216	602	409	401
²³⁸ U	pCi/g	4940	2130	6390	3980	4170

basin, several different chemical reactions occurred, resulting in the formation of precipitates both before and after disposal. The precipitates eventually settled to the bottom of the basin, forming several solid and slurry-like layers. In addition, the slurry samples from basin #1 were collected after a 7-year period of inactivity. During this time, substantial amounts of precipitates formed as solubility products were exceeded as a result of evaporation.

TABLE 3. Characterization Results for the Liquid Waste Fraction of the Basin #1 Slurry

Component	Units	Sample Identification				
		I-2	I-5	I-12	I-13	I-15
pH	--	9.53	9.32	9.54	9.66	9.71
Na	ppm	130,000	134,000	92,000	92,000	86,000
Br	ppm	87.9	78	68.9	69.8	67
Cr	ppm	53	85	60	63	60
Cr(VI)	ppm	50	81	57	60	54
Cu	ppm	520	560	360	170	180
Fe	ppm	<4.4	13	8	<4.4	<4.5
K	ppm	430	2,370	347	309	299
Mn	ppm	<7.6	<9.5	<8.4	<7.2	<7.9
Mo	ppm	11.9	11	9.4	<7.9	<7.6
Ni	ppm	17	19	15	17	16
S	ppm	3,600	9,290	8,280	9,270	10,170
Sn	ppm	<5.6	<5.3	<6.1	<5.9	<6.1
U	ppm	662	628	619	684	673
Zr	ppm	520	560	360	280	170
F ⁻	ppm	2,700	2,700	4,100	5,100	5,100
Cl ⁻	ppm	900	800	600	600	500
NO ₃ ⁻	ppm	280,000	290,000	180,000	190,000	160,000
SO ₄ ²⁻	ppm	13,000	20,000	24,000	28,000	31,000
⁶⁰ Co	pCi/L	473	<270	<180	<270	<180
¹³⁷ Cs	pCi/L	<90	<180	<135	<180	<135
⁵⁴ Mn	pCi/L	<90	<180	<135	<180	<135
⁹⁹ Tc	pCi/L	8.90E+05	7.00E+05	7.88E+05	8.68E+05	4.94E+05
²³⁴ U	pCi/L	2.68E+05	3.65E+05	2.38E+05	2.60E+05	2.36E+05
²³⁵ U	pCi/L	1.89E+04	2.36E+04	1.66E+04	1.62E+04	1.67E+04
²³⁸ U	pCi/L	1.90E+05	2.64E+05	1.66E+05	1.90E+05	1.69E+05

Comparisons of the slurry solid and slurry liquid concentrations for copper, sulfur, and zirconium; chromium, iron, manganese, and tin; and molybdenum, nickel, and uranium are shown in Figures 16, 17, and 18, respectively. As shown in these figures, all elements listed, with the exception of uranium, had higher concentrations in the solid phase of the slurry than the liquid. These differences indicate that the solubility product of compounds containing these elements had been exceeded and precipitates were formed. This also means the solids were in equilibrium with the liquid before the waste was removed.

The notably different behavior for uranium may be related to the complex chemistry involved with this element. Uranium, in the neutralized process waste, initially existed as a highly insoluble diuranate complex. Upon

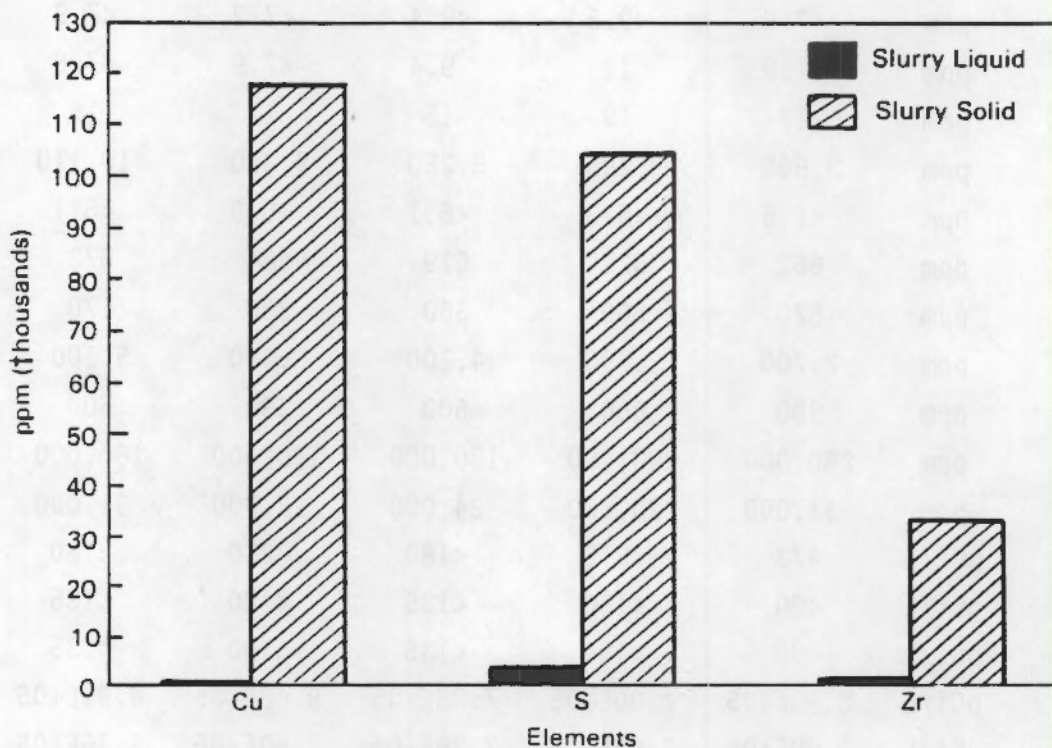


FIGURE 16. Concentrations of Copper, Sulfur, and Zirconium in the Slurry Liquid and Slurry Solid from Basin #1

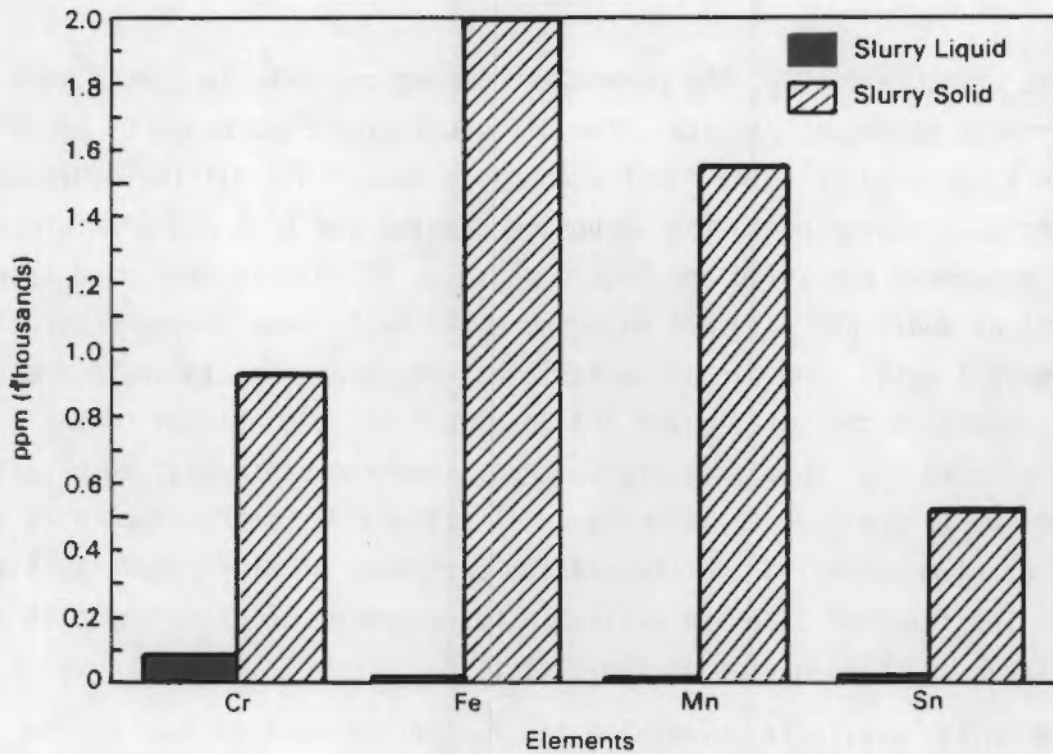


FIGURE 17. Concentrations of Chromium, Iron, Manganese, and Tin in the Slurry Liquid and Slurry Solid from Basin #1

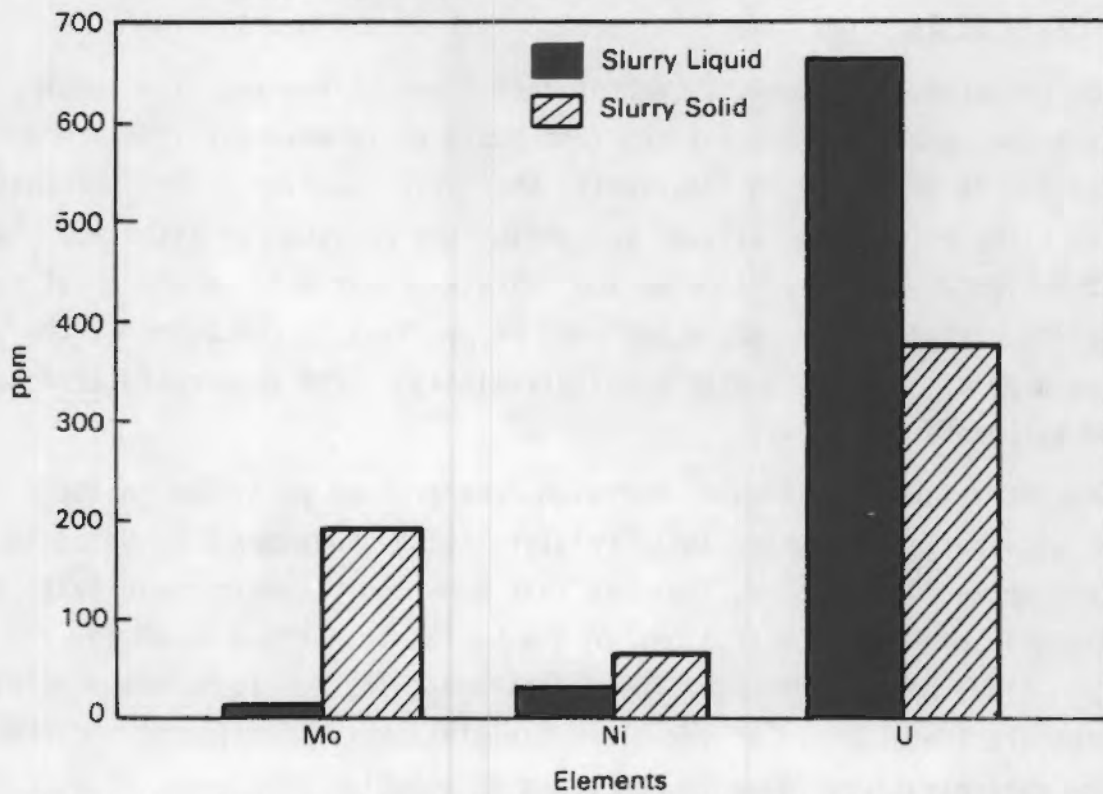


FIGURE 18. Concentrations of Molybdenum, Nickel, and Uranium in the Slurry Liquid and Slurry Solid from Basin #1

exposure to atmospheric CO₂, the diuranate complex converts to a much more soluble uranium carbonate complex. Two different scenarios could be postulated from this behavior. The first scenario assumes that all the diuranate complex has been converted to the carbonate complex and that the uranium is in equilibrium between the solid and liquid phases. If this is true, the uranium concentrations would probably not have increased much above the concentration in the slurry liquid. The second scenario assumes that the diuranate complex is still present in the solid phase and is slowly being converted to the carbonate complex. If this scenario is true, then the concentration of uranium in solution would continue to increase until all the diuranate complex is converted to uranium carbonate and the uranium carbonate complex saturates the solution. Insufficient data are available to determine which scenario is more representative of the behavior in the basins.

Based on the available chemical data, the constituent content of the solution that leaked from basin #1 would probably approach the concentration of constituents in the liquid phase of the slurry shown in Table 3.

2.4.2 Basin #2 Sampling

Concentrations of chemical constituents found in the solution samples collected one foot below the surface from basin #2 in November 1986 are shown in Table 4. As indicated in this table, the basin solution is predominantly a sodium nitrate solution (113,000 ppm sodium and 260,000 ppm nitrate). Two other solution components, fluoride and sulfate, contribute to the total anion composition with 2,200 ppm and 8,900 ppm, respectively. Furthermore, the solution had a pH of 10.5 and a high total alkalinity, 2,700 ppm, calculated as calcium carbonate (Table 4).

Concentrations of chloride, chromium, copper, and potassium in the October 1984 basin #1 slurry liquid relative to the November 1986 basin #2 solution, shown in Figure 19, indicate that some constituents could exist at significantly higher concentrations in the basins than those found in basin #2. The concentrations of the constituents in the liquid phase of basin #1, which are the averages of the slurry samples, were significantly higher than the concentrations found in the basin #2 solution.

TABLE 4. Analytical Results for the Basin #2 Solution (November 1986)

<u>Parameter</u>	<u>Units</u>	<u>Concentration</u>
pH	-	10.5
Eh	mV	290
Al	ppm	2
As	ppm	<0.8
B	ppm	2
Ba	ppm	0.1
Ca	ppm	0.6
Cd	ppm	<0.4
Co	ppm	<0.1
Cr	ppm	8.3
Cu	ppm	4.1
Fe	ppm	<0.5
K	ppm	160
Li	ppm	1.0
Mg	ppm	3.5
Mn	ppm	<0.2
Mo	ppm	0.5
Na	ppm	113,000
Ni	ppm	3.4
P	ppm	<1.0
Pb	ppm	<0.6
Si	ppm	10
Sr	ppm	<2
Zn	ppm	<2
F ⁻	ppm	2,200
Cl ⁻	ppm	200
NO ₂ ⁻	ppm	600
NO ₃ ⁻	ppm	260,000
SO ₄ ⁻	ppm	8,900
Alkalinity as CaCO ₃	ppm	2,722

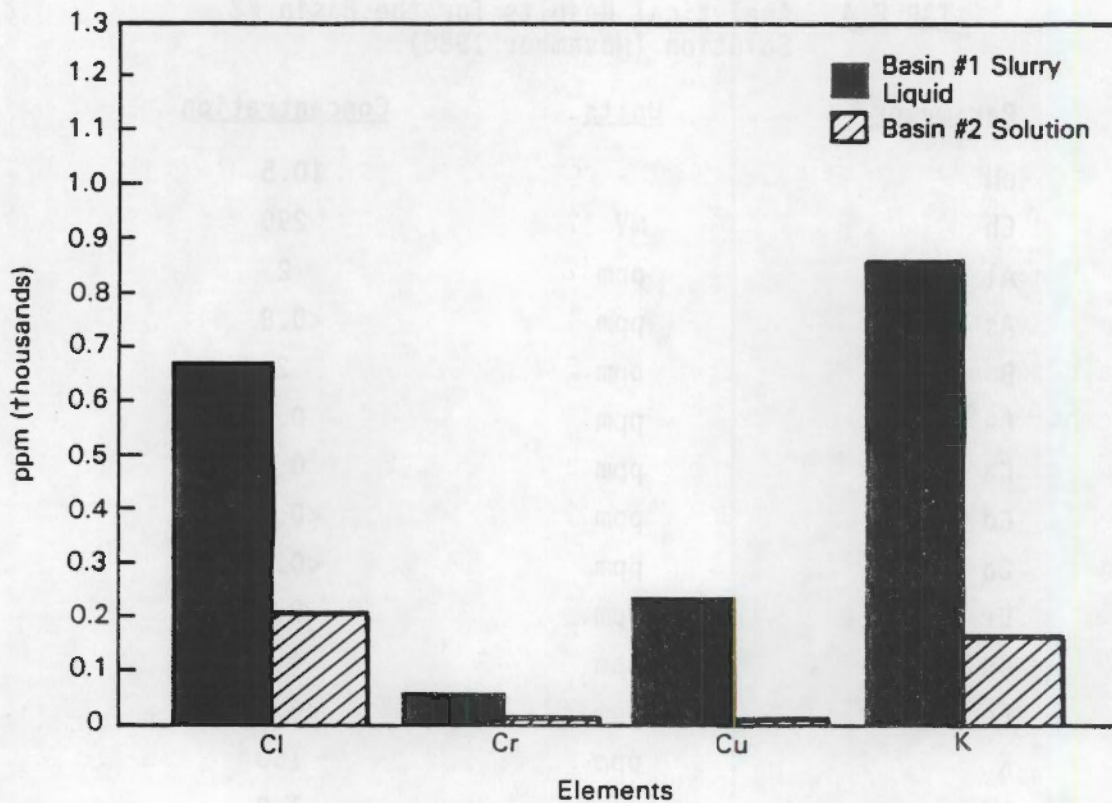


FIGURE 19. Concentrations of Chloride, Chromium, Copper, and Potassium in the Basin #1 Slurry Liquid and Basin #2 Solution

Given the analytical results from the wastes contained in basins #1 and #2, the following constituents were present in sufficient quantities to be identified as potential ground-water contaminants associated with the 183-H Basins: chromium, technetium, sodium, uranium, fluoride, nitrate, and sulfate. In addition, copper and nickel were identified; however, the usefulness of these two constituents was thought to depend on geochemical interaction (absorption) in the soil column and dilution factors in the ground water. These results were used in developing the sampling program to monitor for site-specific constituents.

3.0 GEOLOGY OF THE 100-H AREA

The following discussion focuses on the principal lithologic units, distribution, and thicknesses of the geologic formations beneath the 100-H Area. Specific interpretation of the lithologic units is based on geologic sample descriptions, geophysical logs, and sediment analyses from the 100-H Area wells, the generalized stratigraphy of the Pasco Basin (Figure 9) and a top-of-basalt map (Myers and Price et al. 1979). Textural divisions, derived from ternary diagrams (Figure 20), were chosen from the sieve data and correlated with sample descriptions and geophysical logs. Well construction diagrams, lithologic diagrams, and geophysical logs for the 100-H Area wells are contained in Appendix A.

Three major stratigraphic formations were encountered during drilling operations at the 100-H Area. They are, in ascending order: the Saddle Mountains Basalt Formation, the Ringold Formation, and the Hanford formation. Figure 21 is a generalized geologic column for the 100-H Area, showing the order, principal lithologic units, average elevation, and relative degree of consolidation of these formations. Table 5 lists the general lithologic characteristics for each formation. Figure 22 is a fence diagram illustrating the three-dimensional distribution and stratigraphic correlations between the formations of the 100-H Area. Figure 23 shows the locations of six cross sections. The detailed cross sections, both parallel and perpendicular to ground-water flow, are included in Figures 24 through 26. A discussion of each stratigraphic formation follows. Further references to depth in this discussion are given in feet below land surface, with elevation in feet above msl in parentheses.

3.1 SADDLE MOUNTAINS BASALT FORMATION

The Saddle Mountains Basalt Formation is the uppermost formation of the Columbia River Basalt Group underlying the 100-H Area. The Saddle Mountains Basalt Formation was encountered in Well 199-H4-15C at a depth of 314 ft (91 ft above msl). Geologic samples were characterized as dark-grey and black to very dark-brown basalt mixed with increasing amounts of yellowish-brown and rust-colored clay with depth. Basalt density appeared to decrease

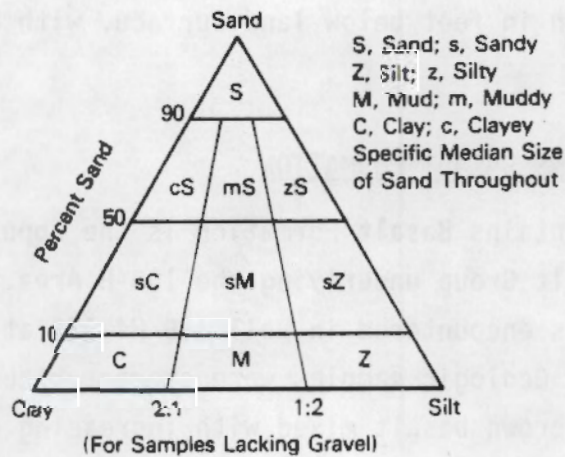
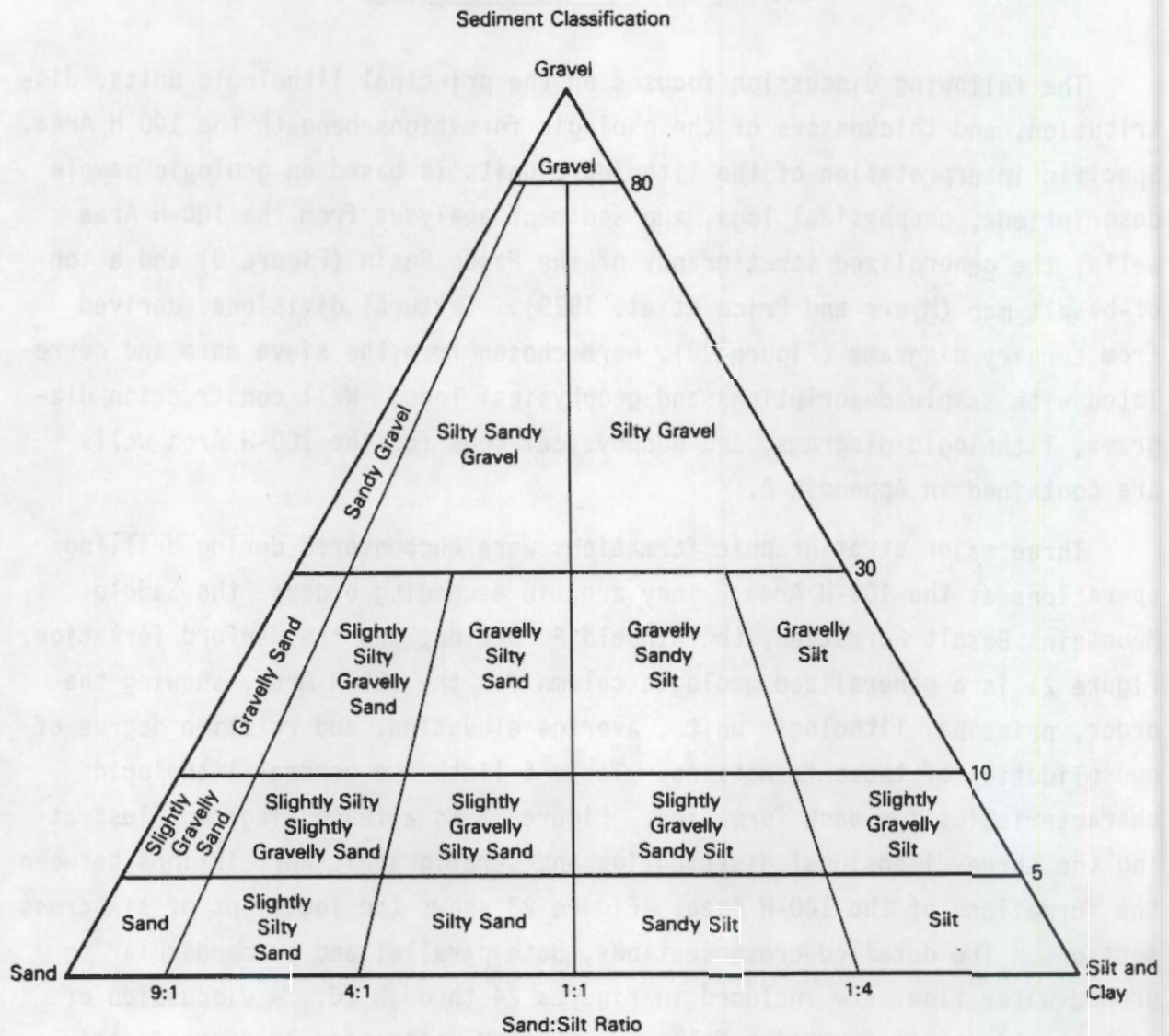


FIGURE 20. Sediment Classification (modified from Folk 1968)

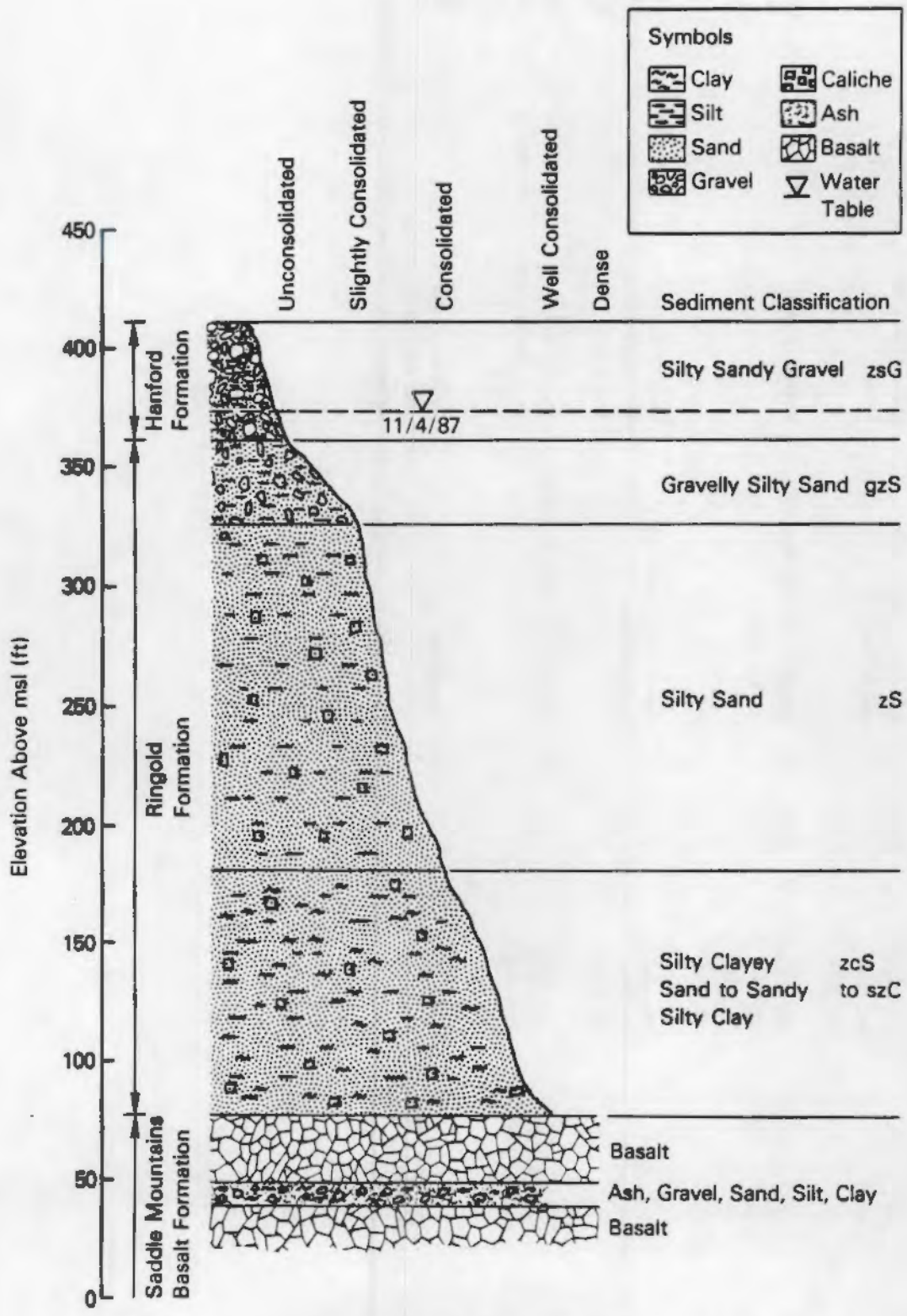


FIGURE 21. Generalized Geologic Column for the 100-H Area

TABLE 5. General Characteristics of the Geologic Formations Beneath the 100-H Area

<u>Formation</u>	<u>Unit/Member</u>	<u>Texture</u>	<u>Sorting</u>	<u>Mineralogy</u>	<u>Color</u>	<u>HCL Reaction</u>	<u>Consolidation</u>
Hanford Formation	Silty Sandy Gravel	50% Gravel 40% Sand 10% Silt	Poor	Basaltic, Quartz-Rich, and Metamorphic	Gray, Black, and Brown	None to Strong	Unconsolidated
Ringold Formation	Gravelly Silty Sand	5% Gravel 70% Sand 20% silt 5% Clay	Poor	Quartz-Rich and Basaltic with Caliche	Reddish Brown	Strong	Unconsolidated to Slightly Consolidated
	Silty Sand	75% Sand 15% silt 10% Clay	Well	Quartz-Rich and Basaltic with Caliche	Reddish Brown, Yellowish Brown, and Brown	Slight to Strong	Slightly Consolidated to Consolidated
	Silty Clayey Sand to Sandy Silty Clay	50% Sand 25% silt 25% Clay	Well	Quartz-Rich with Caliche	Yellow, Green, Blue, Brown, and Black	Slight to Strong	Consolidated to Well Consolidated
	Elephant Mountain	80% Basalt 20% Clay		Basaltic	Dark Grey, Black, and Very Dark Brown		Dense
Saddle Mountains Basalt	Interflow Zone	Ash, Gravel, Sand, Silt and Clay					
	Elephant Mountain	Basalt					

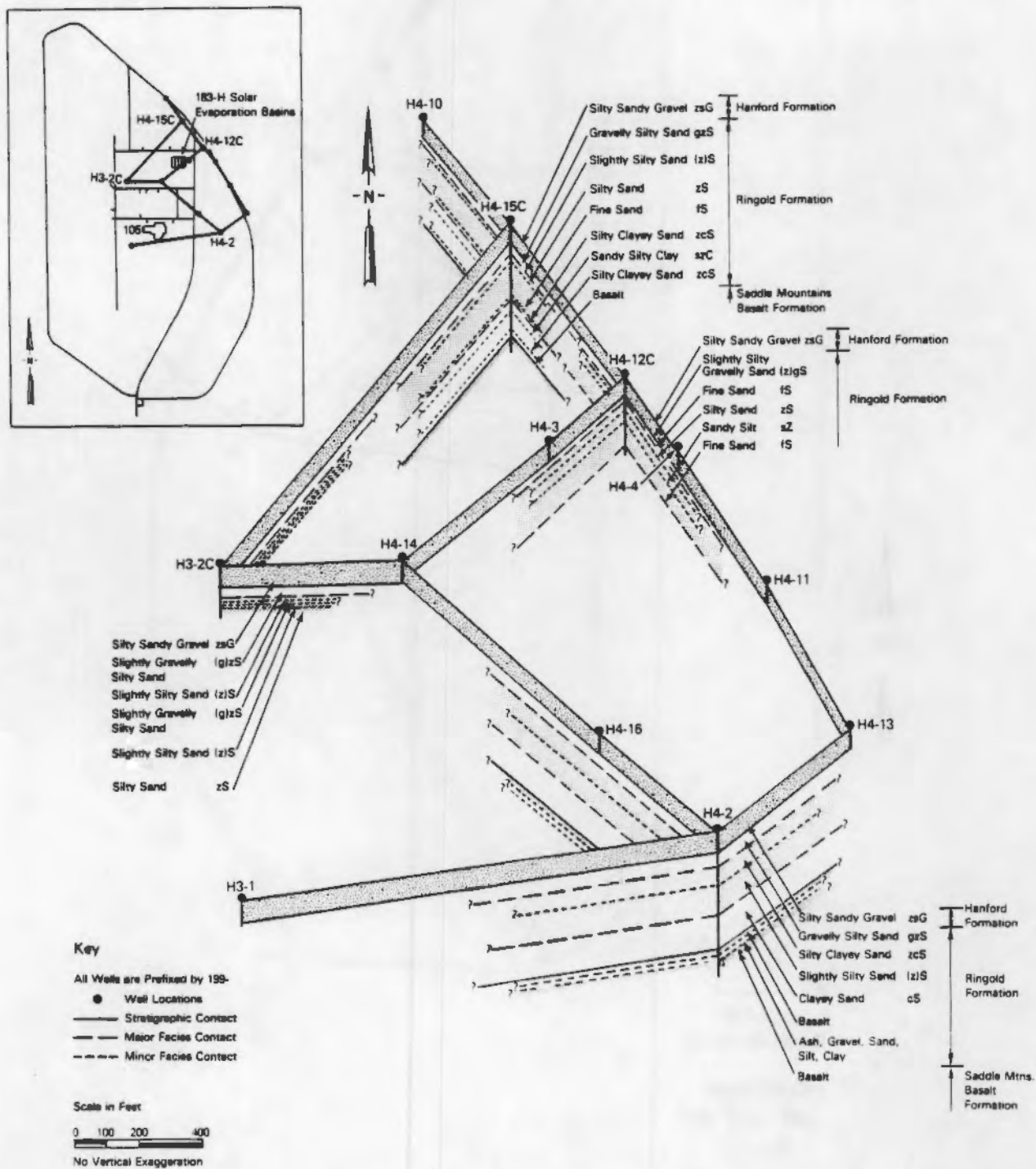


FIGURE 22. Three-Dimensional Distribution and Stratigraphic Correlations of the Geologic Formations Beneath the 100-H Area

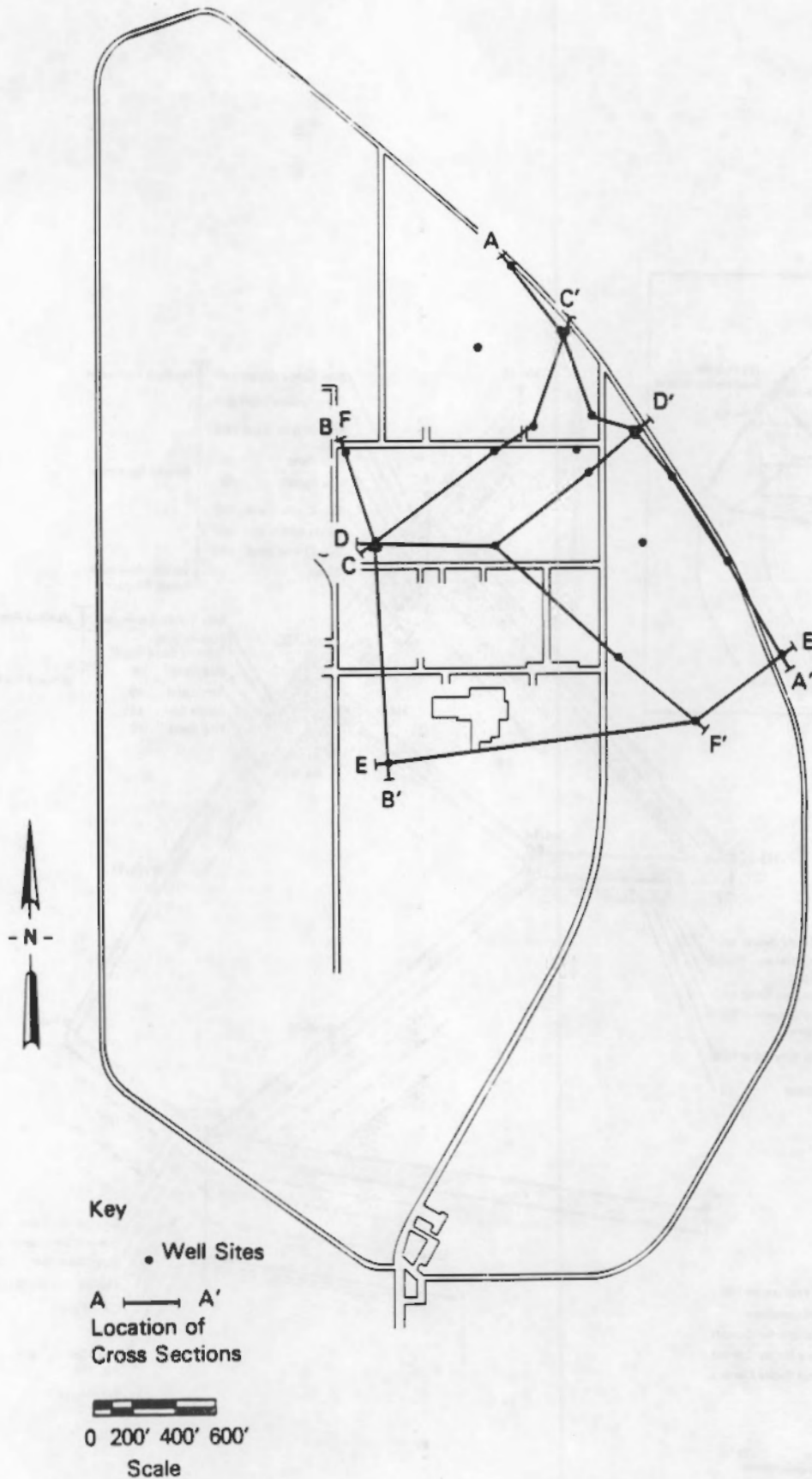
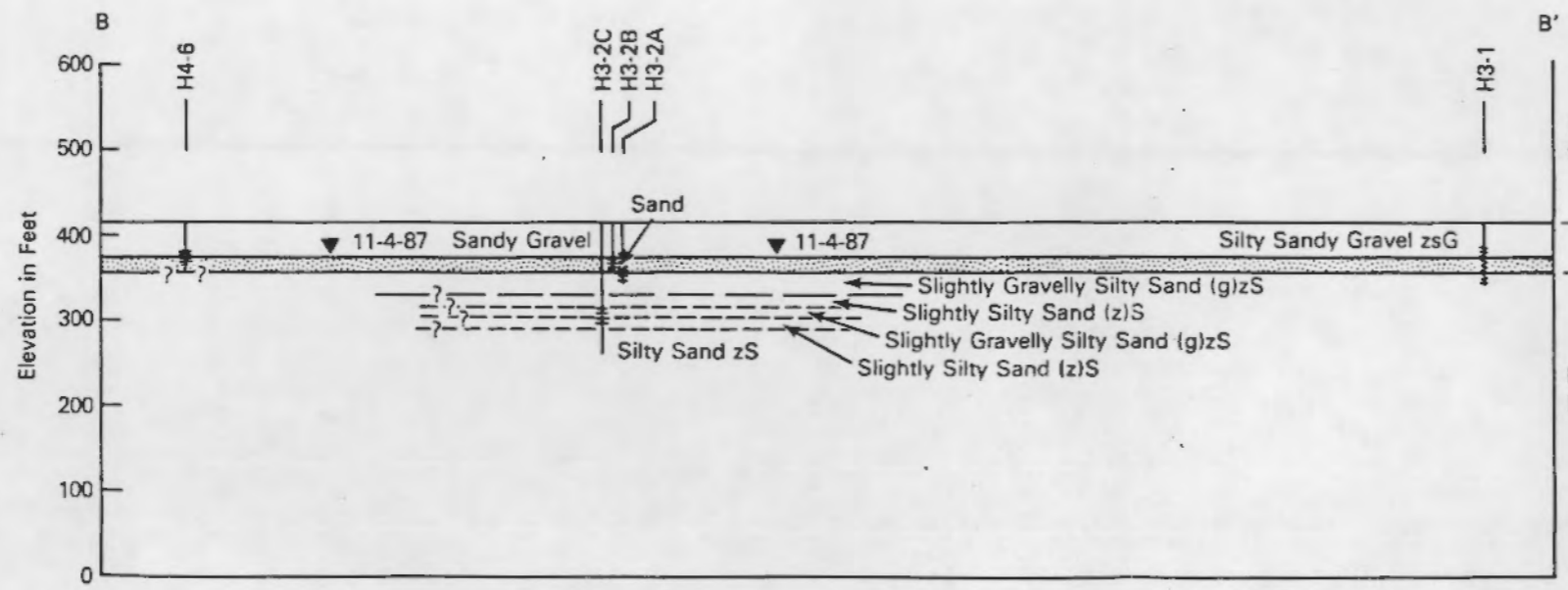
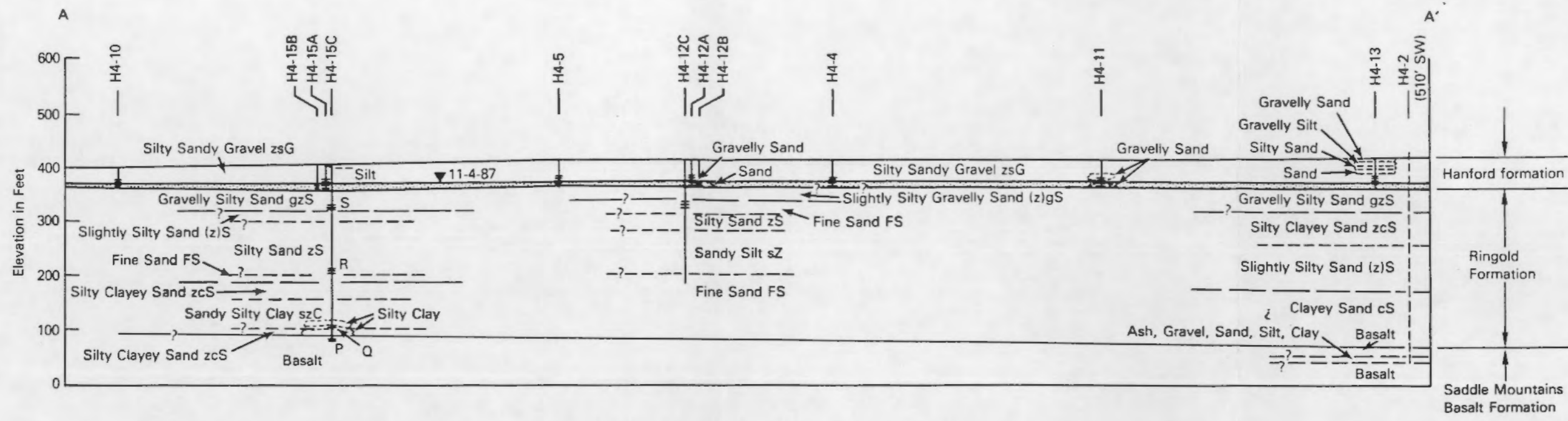


FIGURE 23. Locations of the 100-H Area Cross Sections (shown in Figures 24 through 26)



1. Well Designation - All Wells Prefixed by 199-
 - Well Number → H4-2 H4-2 H4-2 (510' SW)
 - Ground Surface →
- Solid Line When on Plane of Cross Section.
- Long Dash When Location Approximated.
- Short Dash When Projected to Plane of Cross Section. Distance and Direction are Given.
- Piezometer Designations Given Next to Screened Intervals.

2. Contact Lines
 - Stratigraphic —————
 - Major Facies - - - - -
 - Minor Facies - - - - - (Querried Where Inferred)

3. Elevation Datum - Mean Sea Level
4. Water Table
 - Date of Water Level Measurements is Given

5. Well Completion
 - Well Screen
 - Perforations

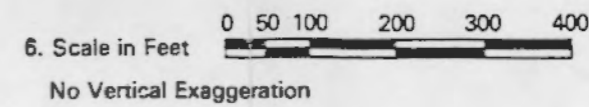
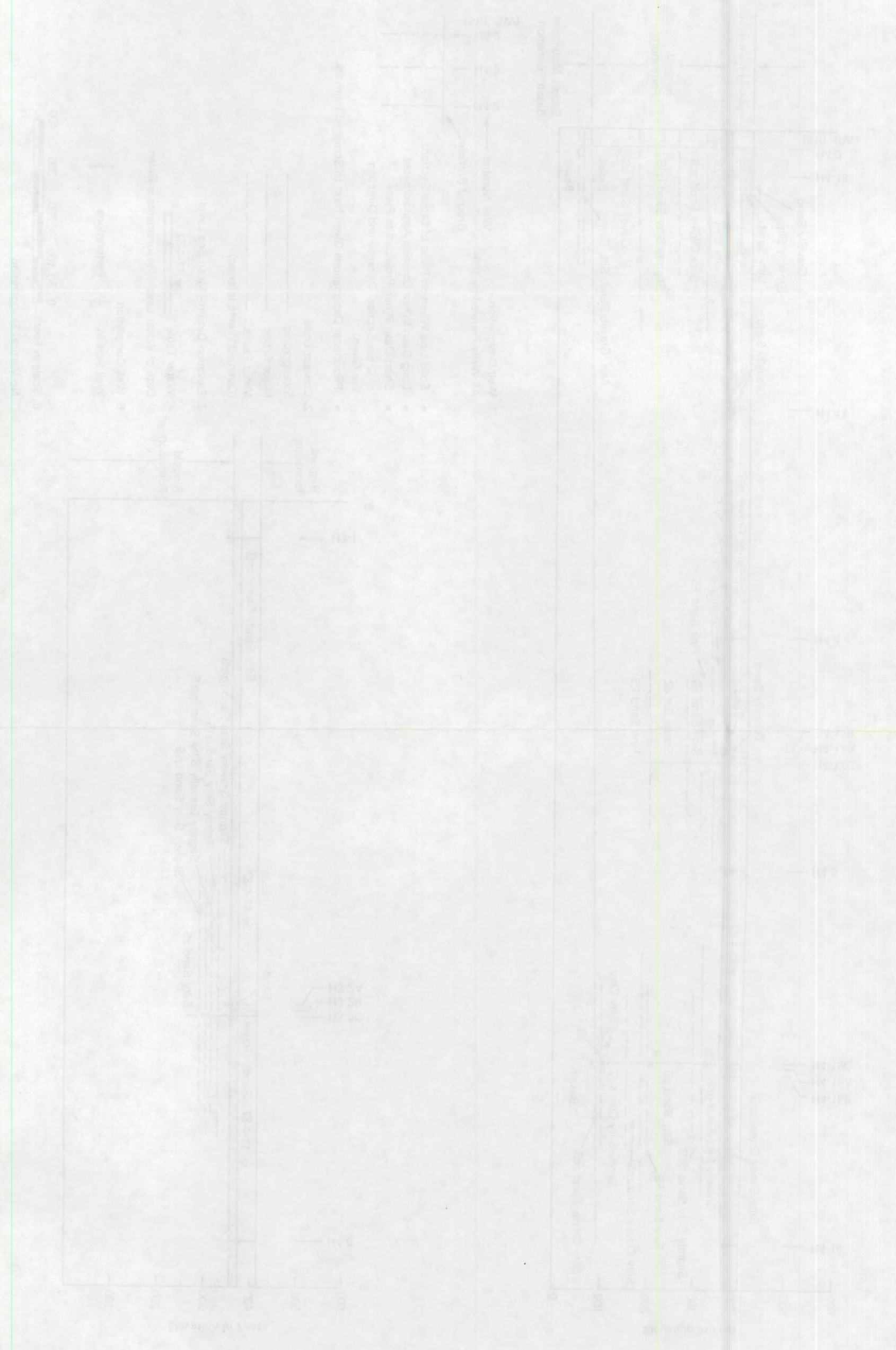
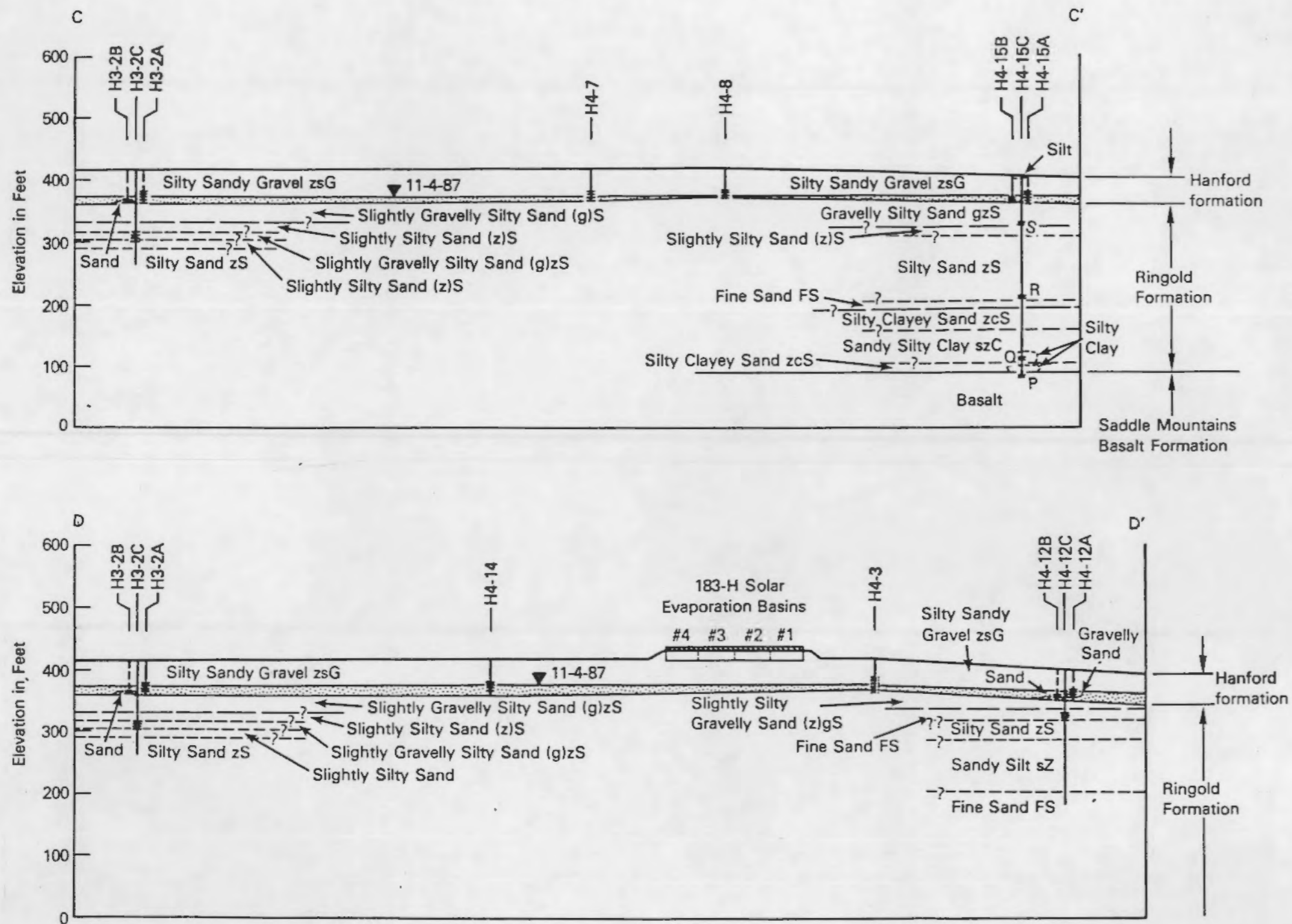


FIGURE 24. Cross Sections A-A' and B-B' of the Stratigraphic Formations Beneath the 100-H Area

Figure 3.1. Conceptual Model of the Hydrologic Cycle in the Watershed

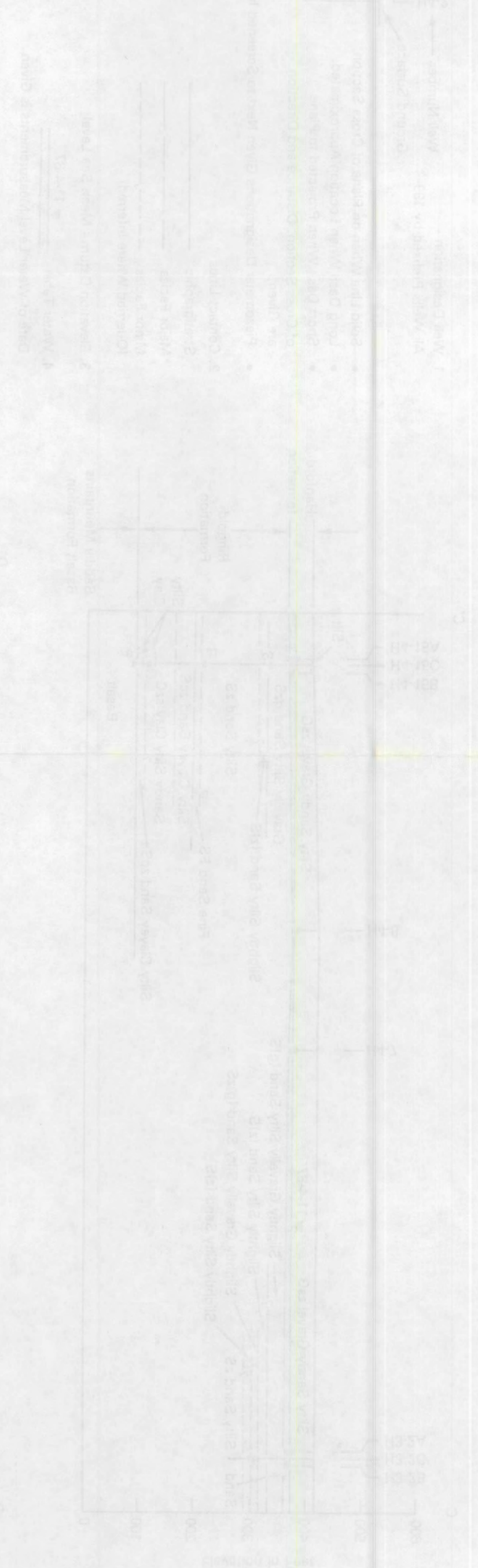
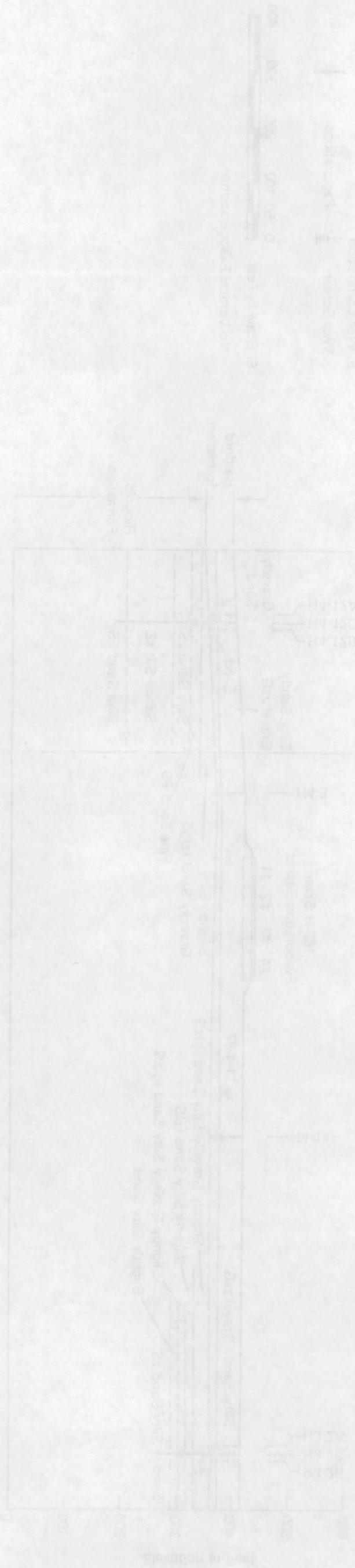




1. Well Designation - All Wells Prefixed by 199-
 - Well Number → H4-2 H4-2 H4-2 (510' SW)
 - Ground Surface →
 - Solid Line When on Plane of Cross Section.
 - Long Dash When Location Approximated.
 - Short Dash When Projected to Plane of Cross Section. Distance and Direction are Given.
 - Piezometer Designations Given Next to Screened Intervals.
2. Contact Lines
 - Stratigraphic —————
 - Major Facies - - - - -
 - Minor Facies - - - - - (Querried Where Inferred)
 3. Elevation Datum - Mean Sea Level
 4. Water Table 11-4-87
Date of Water Level Measurements is Given
 5. Well Completion
 - Well Screen Perforations
 6. Scale in Feet
No Vertical Exaggeration

FIGURE 25. Cross Sections C-C' and D-D' of the Stratigraphic Formations Beneath the 100-H Area

SECTION C-C AND D-D, AT 25' INTERVALS, SHOWING THE 100' VIEWS



NO FURTHER EXPLANATIONS
 1. 2 1/2\"/>

1. 2 1/2\"/>

2. 2 1/2\"/>

3. 2 1/2\"/>

4. 2 1/2\"/>

5. 2 1/2\"/>

6. 2 1/2\"/>

7. 2 1/2\"/>

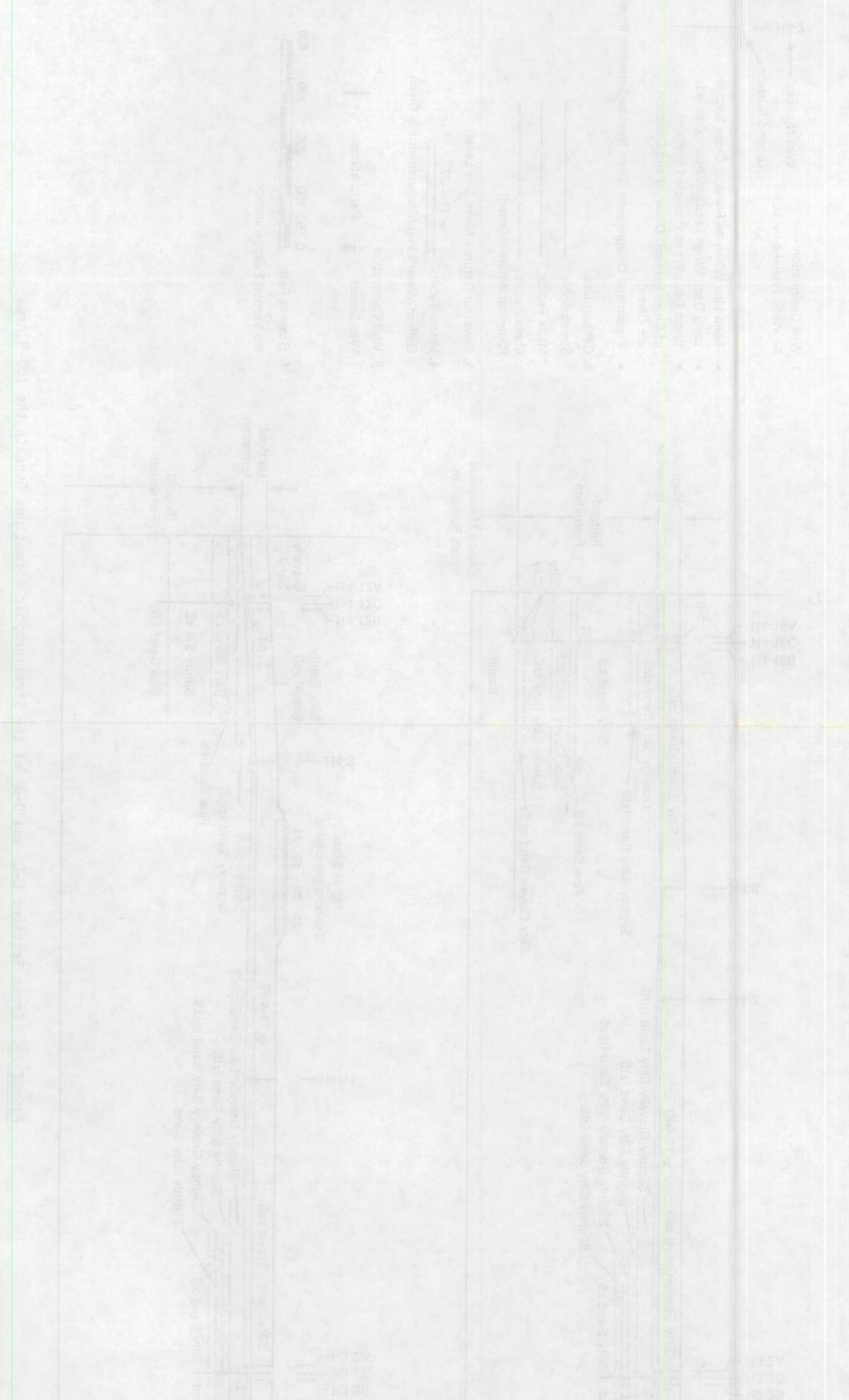
8. 2 1/2\"/>

9. 2 1/2\"/>

10. 2 1/2\"/>

11. 2 1/2\"/>

SECTION C-C AND D-D, AT 25' INTERVALS, SHOWING THE 100' VIEWS



NO FURTHER EXPLANATIONS
 1. 2 1/2\"/>

2. 2 1/2\"/>

3. 2 1/2\"/>

4. 2 1/2\"/>

5. 2 1/2\"/>

6. 2 1/2\"/>

7. 2 1/2\"/>

8. 2 1/2\"/>

9. 2 1/2\"/>

10. 2 1/2\"/>

11. 2 1/2\"/>

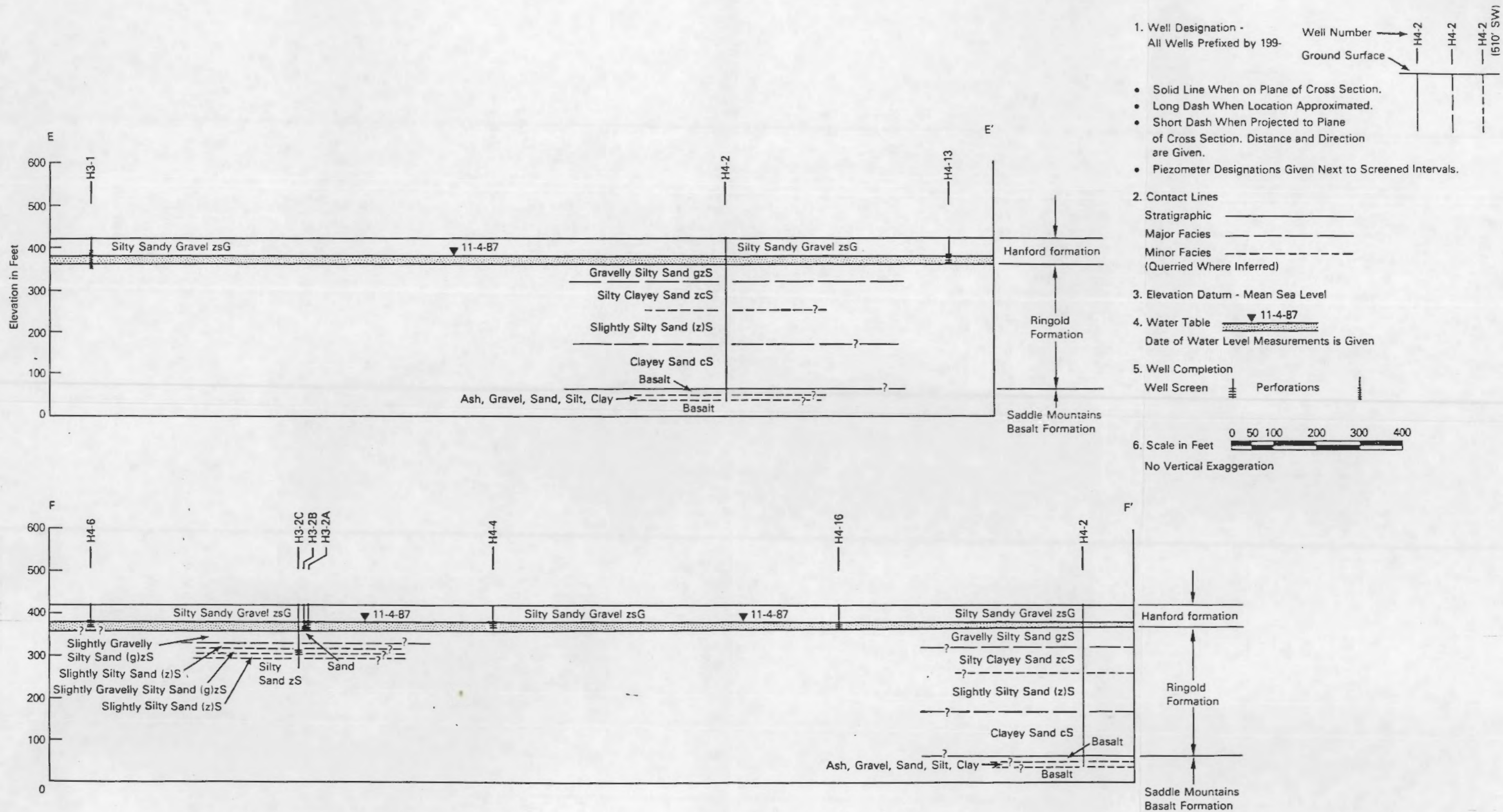
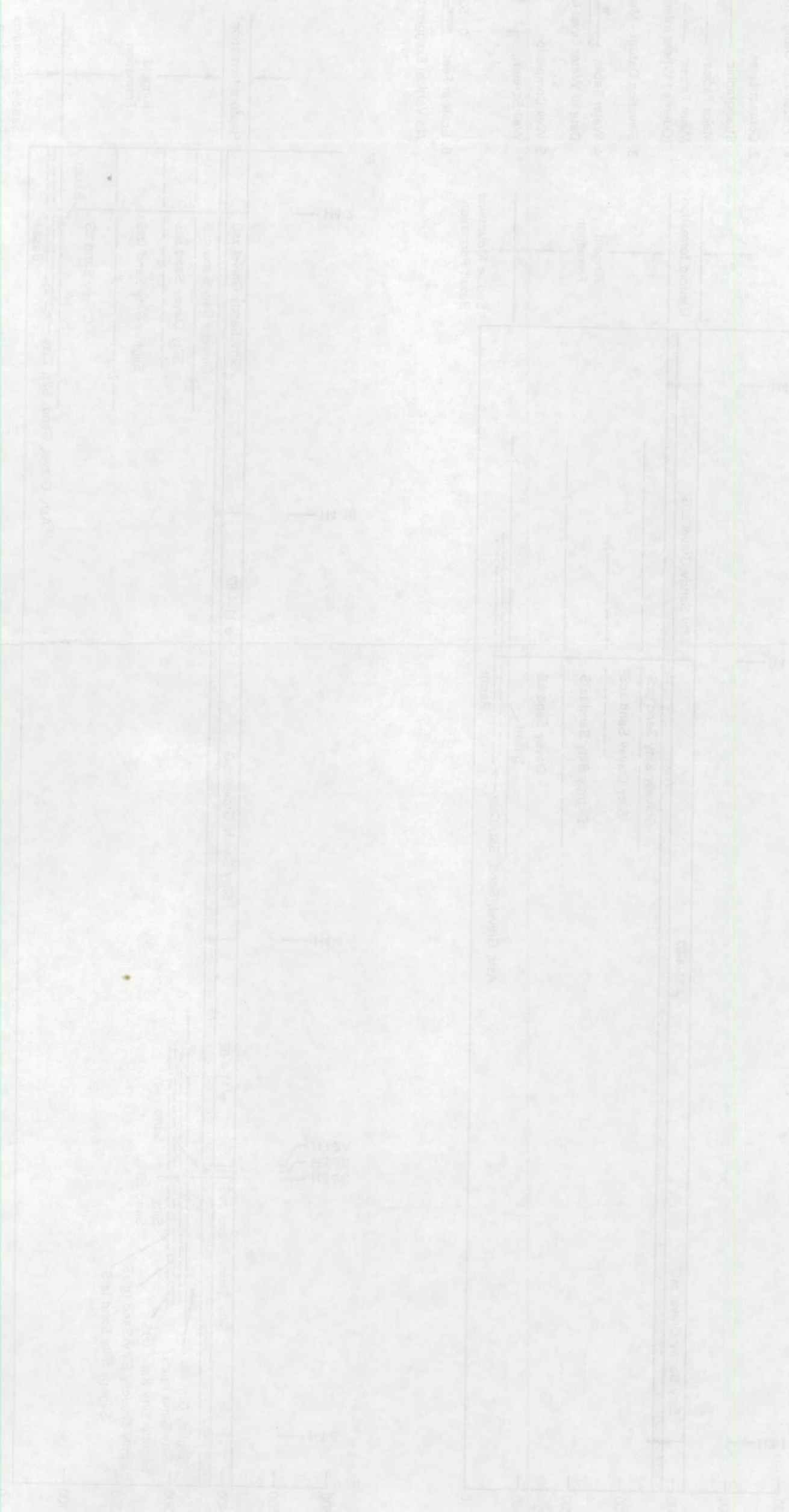


FIGURE 26. Cross Sections E-E' and F-F' of the Stratigraphic Formations Beneath the 100-H Area

FIGURE 10: CROSS SECTION 2-7, 100 FT. OF THE PLYMOUTH TOWNSHIP BRIDGE, 100 FT. VIEW



1. Concrete Deck (see notes on page 11)
2. Steel Girder (see notes on page 11)
3. Masonry Abutment (see notes on page 11)
4. Bridge Deck (see notes on page 11)
5. Bridge Deck (see notes on page 11)
6. Bridge Deck (see notes on page 11)
7. Bridge Deck (see notes on page 11)
8. Bridge Deck (see notes on page 11)
9. Bridge Deck (see notes on page 11)
10. Bridge Deck (see notes on page 11)

with depth, as indicated by a faster drill rate, increased clay content, and finer drill cuttings. No structural features such as fractures, folds, or faults were noted during drilling operations.

Well 199-H4-2 was drilled into basalt in April 1952. Basalt was noted from a depth of 355 ft (64 ft above msl) to 370 ft (49 ft above msl) and again at 381 ft (38 ft above msl), but no further descriptive comments were found in the drilling log. An interflow zone containing ash, gravel, sand, silt, and clay-sized material was described from a depth of 370 ft (49 ft above msl) to 381 ft (38 ft above msl).

Myers and Price et al. (1979) indicate that the topmost (youngest) basalt flow in the 100-H Area is the Elephant Mountain Member of the Saddle Mountains Basalt Formation. X-ray fluorescence analysis of basalt chips (Table 6) from 355 ft and 385 ft in Well 199-H4-2 and 324 to 325 ft in Well 199-H4-15C confirm the chemical type as Elephant Mountain. This basalt member was extruded from feeder dikes in southeast Washington approximately 10.5 mybp, near the end of the Columbia River Basalt volcanism. Myers and Price et al. (1979) also indicate that this member consists of two flows and that both the upper and lower flows are present beneath the 100-H Area. It is further suggested that the lower flow may be as much as 100 ft thick. Drilling logs from Well 199-H4-2 indicate that the upper flow may be at least 20 ft thick. Figure 27, the top-of-basalt map, shows that the Elephant Mountain Member dips to the south and southwest directly beneath the 100-H Area. This dip reflects the gently sloping attitude of the northern limb of the Wahluke syncline.

3.2 RINGOLD FORMATION

The Saddle Mountains Basalt Formation is overlain by the Ringold Formation. The Ringold Formation consists predominantly of sands, silts, and clays, with minor amounts of gravel. Tallman et al. (1981) describe these sediments as being section type II of the Ringold Formation. The upper portion of the Ringold Formation outcrops along the prominent White Bluffs that form the eastern bank of the Columbia River, across from the 100-H Area. Myers and Price (1981) suggest that the Ringold sediments were deposited in a

TABLE 6. X-Ray Fluorescence Analysis of Basalt Chips from Two 100-H Area Wells

Well No.:	199-H4-2	199-H4-15C	199-H4-2
Depth:	355 ft Below Land Surface	324 - 325 ft Below Land Surface	385 ft Below Land Surface
Analysis Date:	February 21, 1987	February 21, 1987	January 15, 1988
Chemical Type:	Elephant Mountain	Elephant Mountain	Elephant Mountain

<u>Element Compound</u>	<u>Chemical Composition (wt%)</u>	<u>Chemical Composition (wt%)</u>	<u>Chemical Composition (wt%)</u>
SiO ₂	50.58	49.83	52.00
Al ₂ O ₃	13.25	13.27	13.39
TiO ₂	3.825	3.855	3.426
Fe ₂ O ₃	15.78	16.44	13.08
MnO	0.190	0.177	0.209
CaO	9.22	9.06	9.34
MgO	3.52	3.96	4.20
K ₂ O	0.73	0.63	1.16
Na ₂ O	2.12	2.03	2.66
P ₂ O ₅	0.566	0.571	0.540
Ni	0.0018	0.0016	0.0007
Cr	0.0044	0.0022	0.0036
Sc	0.0037	0.0030	0.0036
V	0.0471	0.0476	0.0414
Ba	0.0627	0.0443	0.0501
Rb	0.0021	0.0022	0.0027
Sr	0.0279	0.0276	0.0257
Zr	0.0262	0.0267	0.0237
Y	0.0054	0.0051	0.0046
Nb	0.0024	0.0025	0.0027
Ga	0.0023	0.0023	0.0025
Cu	0.0044	0.0009	0.0028
Zn	0.0168	0.0152	0.0146

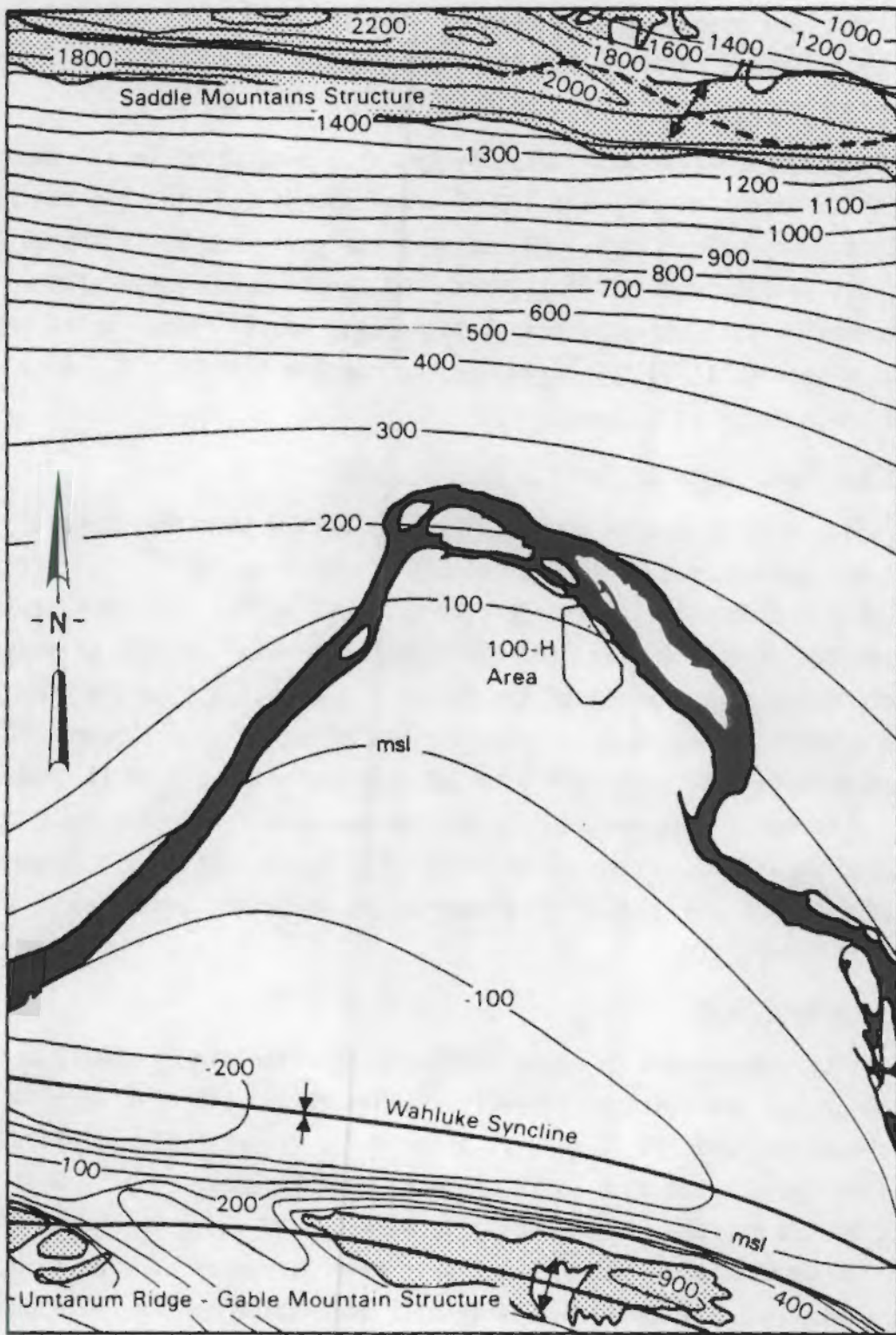


FIGURE 27. Top-of-Basalt Map (contours in feet above msl; modified from Myers and Price et al. 1979)

fluvial/floodplain environment between 8.5 and 3.7 mybp. The Ringold sediments in this portion of the Pasco Basin are further described as a floodplain-overbank stratigraphic section type (Myers and Price 1981).

The Ringold Formation was partially or fully penetrated in all the 100-H wells with the exception of Wells 199-H4-4 and 199-H4-6. Geologic sample descriptions, geophysical logs, and sediment analyses from Wells 199-H3-2C, 199-H4-2, 199-H4-12C, and 199-H4-15C resulted in the subdivision of the Ringold Formation into three principal lithologic units. These units are, in ascending order: 1) silty clayey sand to sandy silty clay, 2) silty sand, and 3) gravelly silty sand.

3.2.1 Silty Clayey Sand to Sandy Silty Clay Unit

The silty clayey sand to sandy silty clay unit within the Ringold Formation was encountered in two wells, 199-H4-15C at a depth of 212 ft (193 ft above msl) and 199-H4-2 at 249 ft (170 ft above msl). This unit typically consists of 50% sand, 25% silt, and 25% clay, with minor amounts of gravel and caliche noted near the top of the basalt. The unit was further characterized as well sorted, quartz rich, and consolidated to well consolidated. The fine materials reacted slightly in 10% hydrochloric acid (HCl), whereas the caliche strongly effervesced. Color changes were frequent within this unit, including yellow, green, blue, brown, and black. This unit is approximately 100 ft thick and appears to slope to the south and southwest at the same rate as the basalt.

3.2.2 Silty Sand Unit

The silty clayey sand to sandy silty clay is overlain by a well-sorted silty sand unit. The contacts in Wells 199-H4-15C and 199-H4-2 were 84 ft (321 ft above msl) and 100 ft (319 ft above msl), respectively. This unit was partially penetrated at a depth of 84 ft (332 ft above msl) in Well 199-H3-2C and 72 ft (338 ft above msl) in Well 199-H4-12C. This unit consists of 75% sand, 15% silt, and 10% clay. Several lenses of fine sand, slightly gravelly silty sand, and sandy silt were noted in the individual wells. The sediments were both quartz rich and basaltic, with some caliche present. The colors are reddish-brown, yellowish-brown, and brown. The fine

materials reacted slightly in 10% HCl, whereas the caliche strongly effervesced. This unit is approximately 145 ft thick.

3.2.3 Gravelly Silty Sand Unit

The gravelly silty sand forms the top of the Ringold Formation and was partially or fully penetrated in all but two of the 100-H Area wells. This unit was poorly sorted, consisting of 5% gravel, 70% sand, 20% silt, and 5% clay. The sediments were both quartz-rich and basaltic, with increased amounts of caliche present. The unit was further characterized as reddish-brown and unconsolidated to slightly consolidated. The gravelly silty sand is approximately 35 ft thick. The top of this unit is an erosional unconformity, with peak elevations located to the east and northeast of the 183-H Basins (Figure 28).

3.3 HANFORD FORMATION

The Ringold Formation is overlain by a composite of unconsolidated and poorly sorted sediments, which comprise the Hanford formation. These surficial sediments were characterized as a silty sandy gravel, although texture and mineralogy varied significantly between wells. The sediments contained a mixture of boulders, cobbles, pebbles, sand, and silt. Backfill materials, silt and sand pipe linings, and coal fly ash were noted on the surface and at depths to 30 ft. The backfill materials were often indistinguishable from the in situ gravels and sands. As a result, the Hanford formation is treated as a single silty sandy gravel unit.

The silty sandy gravel consists of 50% gravel, 40% sand, and 10% silt. The gravels are composed of mainly subrounded to rounded basaltic clasts with some quartz-rich and metamorphic clasts present. The silts and sands were described as grey, black, and brown quartz-rich and basaltic grains. The grains were angular to subangular and ranged from very coarse to very fine sand. Calcium carbonate deposits were noted on several clasts and effervesced strongly in 10% HCl. The reaction of the sands varied from none to slight. Lenses of gravelly sand and medium sand were noted in Wells 199-H4-11 and 199-H4-13; however, no cross-borehole correlations were evident. The Hanford formation is approximately 65 ft thick at the 100-H Area.

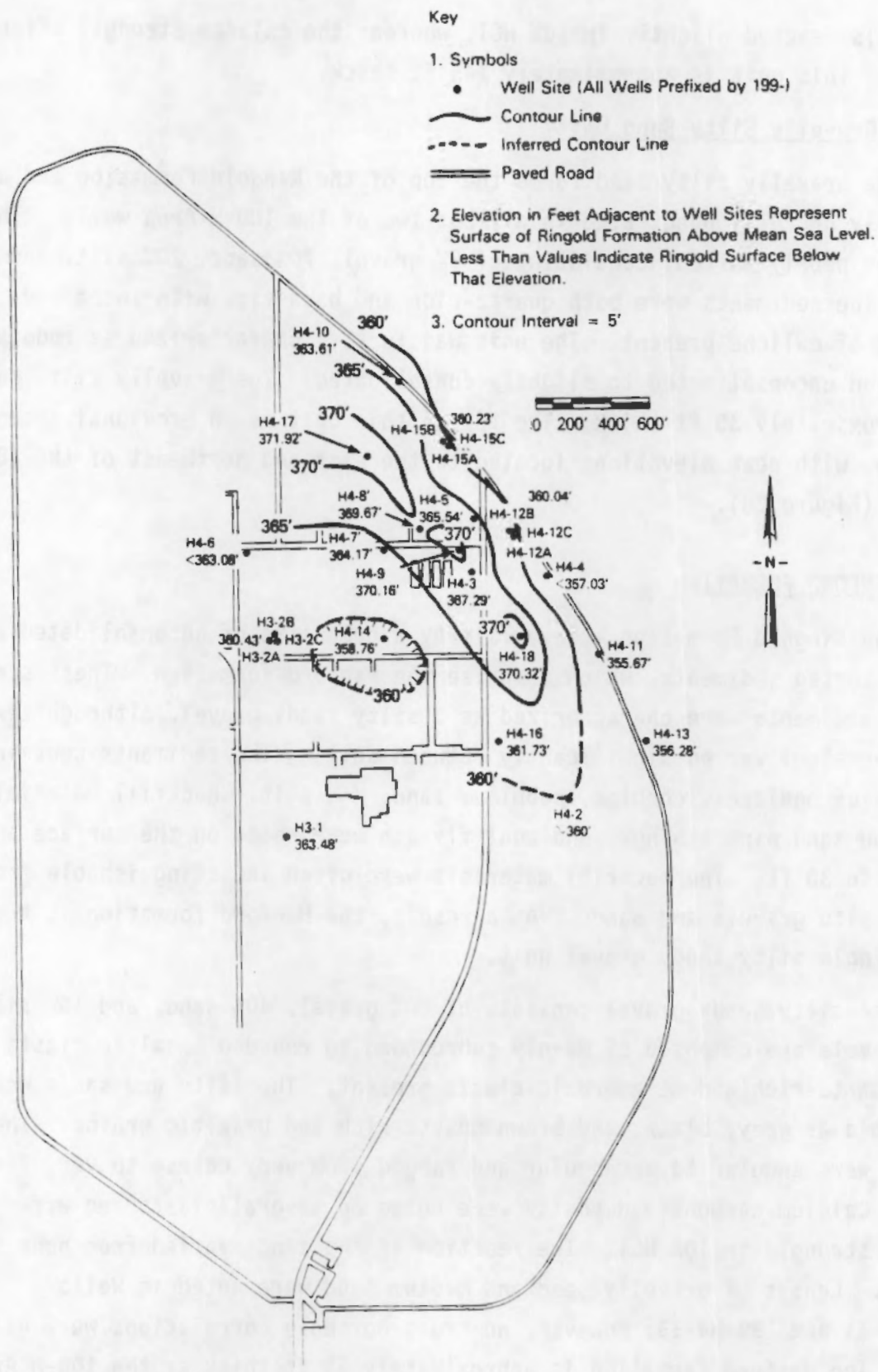


FIGURE 28. Surface of the Ringold Formation Beneath the 100-H Area

The topography of the 100-H Area has been severely modified by past operational and waste management activities and no geomorphic features other than the present Columbia River channel can be identified (Figure 29).



FIGURE 29. Aerial Photograph of the 100-H Area

4.0 HYDROLOGY OF THE 100-H AREA

The following discussion focuses on the principal hydrostratigraphic units beneath the 100-H Area. Specific interpretation of the hydrostratigraphic units is based on geologic sample descriptions, geophysical logs, sediment analyses, water level measurements, and aquifer testing results.

Five principal hydrostratigraphic units were encountered beneath the 100-H Area. They are, in ascending order: 1) a lower confined aquifer (within the Saddle Mountains Basalt Formation), 2) an upper confined aquifer (within the silty clayey sand to sandy silty clay unit of the Ringold Formation), 3) the silty sand and gravelly silty sand units of the Ringold Formation, 4) the saturated sediments of the Hanford formation, and 5) the unsaturated sediments of the Hanford formation. Figure 30 is a generalized hydrostratigraphic column for the 100-H Area.

4.1 LOWER CONFINED AQUIFER

The lower confined aquifer occurs within the uppermost basalt flow of the Saddle Mountains Basalt Formation and was penetrated in two wells, 199-H4-2 and 199-H4-15C. Piezometer (P) in Well 199-H4-15C was completed from 325 to 327 ft in a water-bearing zone (318 to 330 ft) within the basalt. This piezometer has a water level higher than land surface and is capped to prevent it from flowing. The upper portion of the basalt (314 to 318 ft) contains no water and appears to be the confining layer for this aquifer. Well 199-H4-2 also penetrates this aquifer and has a water level above land surface.

4.2 UPPER CONFINED AQUIFER

The upper confined aquifer occurs within the silty clayey sand to sandy silty clay unit of the Ringold Formation. The water level in this aquifer is monitored in Well 199-H4-15C (Q) at a depth of 295 to 297 ft. Before May 1987, this water level indicated a difference in hydraulic head of approximately 30 ft greater than the water table, as shown in the hydrographs for cluster Wells 199-H4-15A, 199-H4-15B, and 199-H4-15C (Figure 31). However,

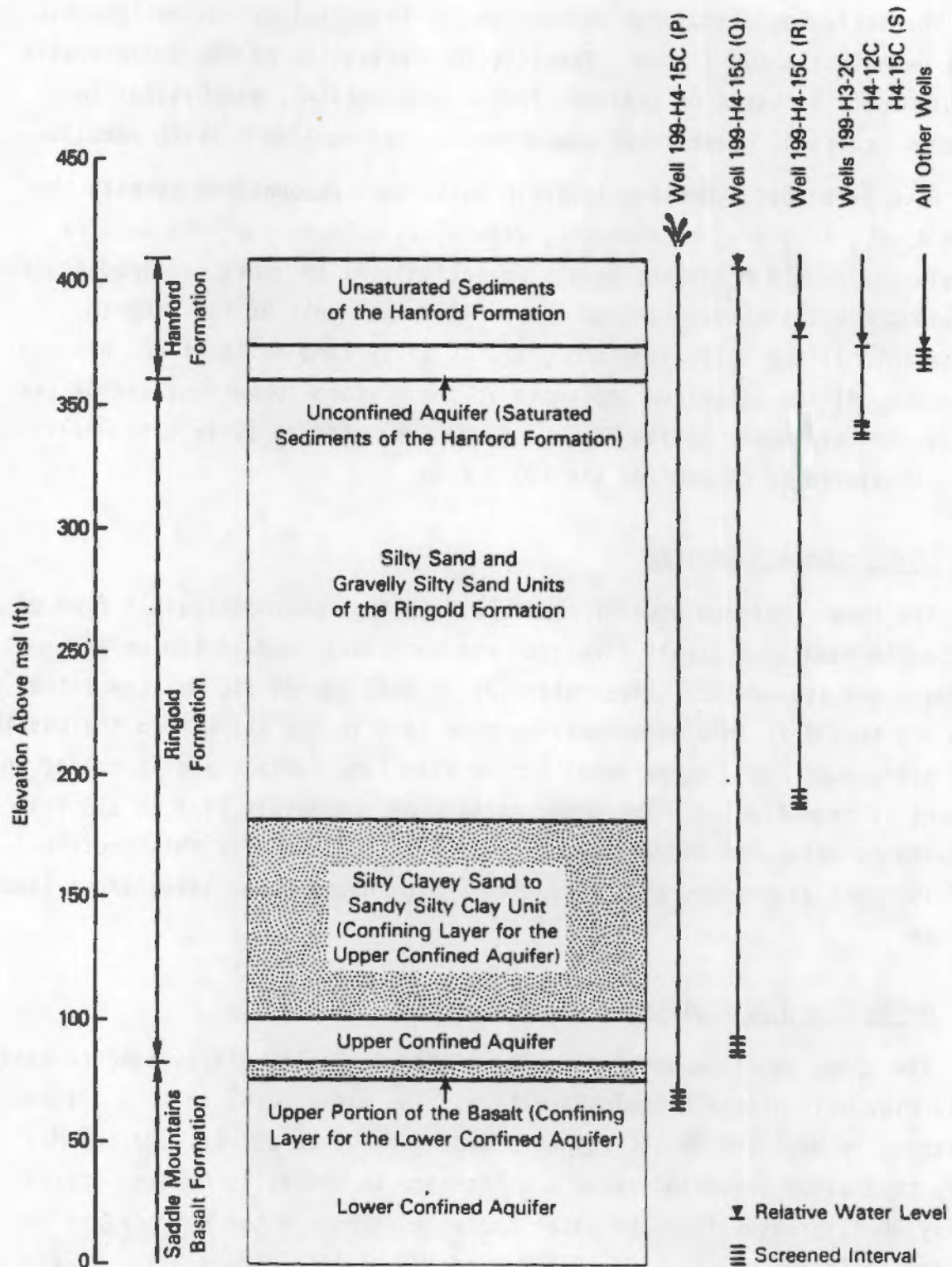


FIGURE 30. Generalized Hydrostratigraphic Column for the 100-H Area

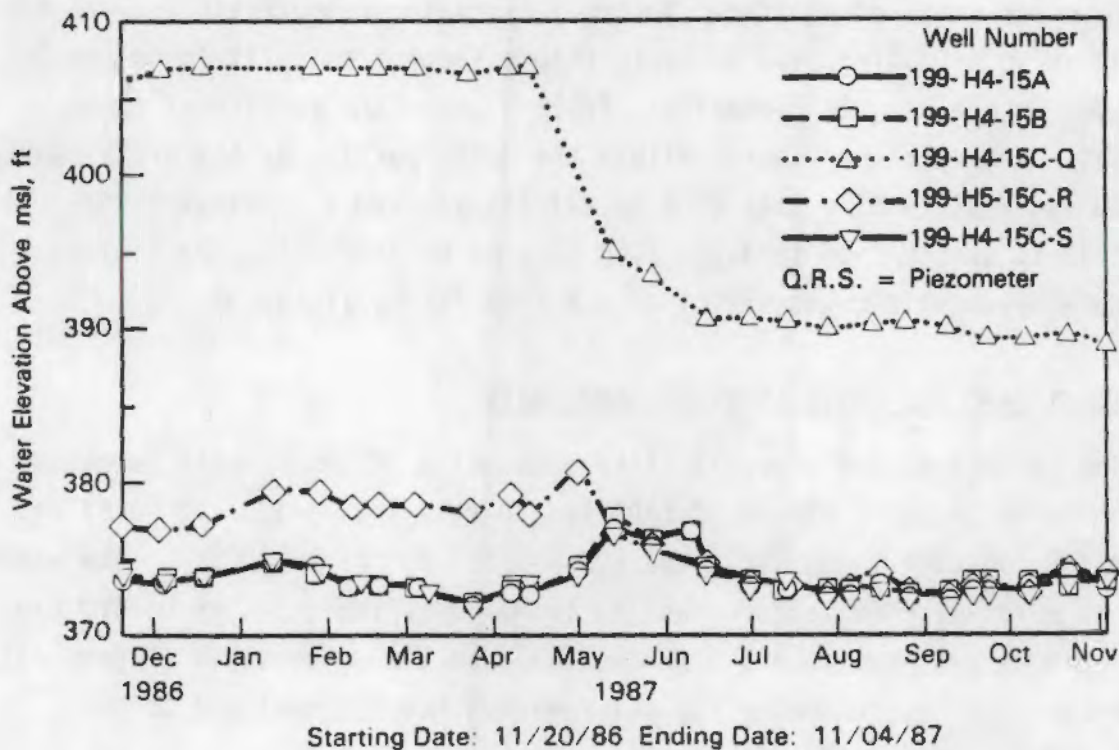


FIGURE 31. Hydrographs for Wells 199-H4-15A, 199-H4-15B, and 199-H4-15C

testing of piezometers (Q) and (R) in May 1987 may have altered the integrity of the bentonite seals adjacent to their screened intervals. Cloudy water noted at the surface following testing was assumed to be a result of well development. The hydrographs in Figure 31 indicate that piezometer (Q) has lost approximately 15 ft of hydraulic head and piezometer (R) has lost approximately 3 ft of hydraulic head. Piezometer (R) has reached equilibrium with Wells 199-H4-15A, 199-H4-15B, and 199-H4-15C (S).

The large vertical separation and seals between these screened intervals were thought to have provided sufficient protection from hydraulic interconnection prior to testing. The annulus around the piezometers may reseal with time as the silty clayey sand to sandy silty clay and silty sand units settle through lithostatic pressure. Observation of the piezometers for several years may be necessary to determine if this process is occurring.

The upper portion of the silty clayey sand to sandy silty clay unit of the Ringold Formation (approximately 80 ft) is considered the confining layer

for the upper confined aquifer. Vertical hydraulic conductivities were calculated using a falling head analysis (Klute 1986) from split-spoon samples collected in the Ringold Formation. Table 7 shows the results of these analyses. The sample collected within the upper portion of the silty clayey sand to sandy silty clay unit (275 to 277 ft) yielded a vertical horizontal conductivity of 1.0 E-04 ft/day. Slug testing of piezometer (Q) yielded a horizontal hydraulic conductivity of 1.4 E-01 ft/day (Table 8).

4.3 SILTY SAND AND GRAVELLY SILTY SAND UNITS

The silty sand and gravelly silty sand units of the Ringold Formation are monitored in Wells 199-H3-2C (100 to 110 ft), 199-H4-12C (72 to 82 ft), 199-H4-15C (R) (195 to 197 ft), and 199-H4-15C (S) (78 to 80 ft). The water level in piezometer (R) before testing in May 1987 indicated an upward hydraulic gradient approximately 3 ft greater than the water table (Figure 31). The water level in piezometer (S) has remained nearly identical to Wells 199-H4-15A and 199-H4-15B (Figure 31).

The hydrographs for cluster Wells 199-H3-2A, 199-H3-2B, and 199-H3-2C are shown in Figure 32. Wells 199-H3-2A and 199-H3-2B are completed in the Hanford formation. The water levels for these wells are nearly identical.

The hydrographs for cluster Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C are shown in Figure 33. Wells 199-H4-12A and 199-H4-12B are completed in the Hanford formation. The water levels for these wells are nearly identical.

Two split-spoon samples were collected from within the silty sand and gravelly silty sand units. Vertical hydraulic conductivity values of

TABLE 7. Vertical Hydraulic Conductivity Values for Split-Spoon Samples

<u>Well</u>	<u>Depth (ft)</u>	<u>Hydraulic Conductivity (ft/day)</u>
199-H4-12C	125 - 127	1.5 E-02
199-H4-15C	120 - 122	2.9 E-03
199-H4-15C	275 - 277	1.0 E-04

TABLE 8. Summary of Aquifer Testing Results

Well No.	Screened	Geologic Formation	Hydrostra-	Length	T Value ^(a) (ft ² /day)	K Value ^(a) (ft/day)	Specific Capacity (gal/d/ft)
	Interval (ft)		tigraphic ^(a) Unit	of Water Column (ft)			
199-H3-2A	36 - 51	Hanford	Unc Aq	10	19,000	1,900	72.1
199-H3-2B	50 - 55	Hanford	Unc Aq	15	600	100	3.1
199-H3-2C	100 - 110	Ringold	SS&GSS	70	390	39	1.2
199-H4-7	38 - 53	Hanford	Unc Aq	10	690 ^(b)	70 ^(b)	3.1
199-H4-8	38 - 48	Hanford	Unc Aq	4	No Test	No Test	No Test
199-H4-9	36 - 46	Hanford	Unc Aq	3	No Test	No Test	No Test
199-H4-10	23 - 38	Hanford	Unc Aq	10	53,500	5,900	69.6
199-H4-11	38 - 58	Hanford	Unc Aq	11	1,070	70	9.6
199-H4-12A	33 - 48	Hanford	Unc Aq	10	2,670	210	10.7
199-H4-12B	45 - 50	Hanford	Unc Aq	13	635	50	1.5
199-H4-12C	72 - 82	Ringold	SS&GSS	43	620	60	1.9
100-H4-13	37 - 52	Hanford	Unc Aq	10	4,240	420	5.7
199-H4-14	38 - 53	Hanford	Unc Aq	4 ^(b)	1,050	250 ^(c)	6.1
199-H4-15A	27 - 42	Hanford	Unc Aq	10	2,340	200	10.0
199-H4-15B	37 - 42	Hanford	Unc Aq	12	5,530	460	4.1
199-H4-15C(S)	78 - 80	Ringold	SS&GSS	50	No Test	No Test	No Test
199-H4-15C(R)	194 - 196	Ringold	SS&GSS	160	1,760	350	--
199-H4-15C(Q)	295 - 297	Ringold	Upp Con Aq	293	0.7	0.14	--
199-H4-15C(P)	325 - 327	Ringold	Low Con Aq	327	No Test	No Test	No Test
199-H4-16	43 - 58	Hanford	Unc Aq	10	2,200	220	10.2
199-H4-17	35 - 45	Hanford	Unc Aq	4	No Test	No Test	No Test
199-H4-18	40 - 50	Hanford	Unc Aq	7	550	80	2.6

(a) Unc Aq = Unconfined Aquifer; SS&GSS = Silty Sand & Gravelly Silty Sand; Upp Con Aq = Upper Confined Aquifer; Low Con Aq = Lower Confined Aquifer; T = Transmissivity; K = Hydraulic Conductivity.

(b) This number is an estimate.

(c) A hydraulic conductivity value could not be reliably calculated at this well because the test dewatered a highly transmissive zone of indeterminate thickness in the upper portion of the well bore.

1.5 E-2 ft/day and 2.9 E-3 ft/day were measured for the 125- to 127-ft sample in Well 199-H4-12C and from 120 to 122 ft in Well 199-H4-15C, respectively (Table 7). Slug testing of piezometer (R) resulted in a horizontal hydraulic conductivity of 350 ft/day (Table 8).

Although water level measurements indicate a hydraulic connection between the silty sand and gravelly silty sand units of the Ringold Formation and the overlying unconfined aquifer within the Hanford formation, a permeability contrast appears to exist at the contact between these formations. This contrast in permeability is indicated by 1) higher silt and clay contents in the Ringold Formation (Table 5), 2) lower bailing yields in the Ringold Formation during well construction, 3) aquifer testing in the Hanford formation, which produced only minor hydraulic effects in the Ringold Formation, 4) generally lower hydraulic conductivities and transmissivities in the Ringold Formation (Figures 34 through 37), and 5) generally lower concentrations of contaminants in the Ringold Formation.

4.4 SATURATED SEDIMENTS OF THE HANFORD FORMATION

The unconfined aquifer occurs within the Hanford formation and is monitored in the remaining 16 wells. This aquifer ranges in thickness from 3 to 15 ft. This variation in thickness results from the erosional unconformity at the contact between the Hanford and Ringold Formations (Figure 28) and the variation of the water table. The water table is typically located 30 to 50 ft below land surface at the 100-H Area.

Ground-water flow in the 100-H Area is generally northeast and east toward the Columbia River (Figure 1). Water levels are measured in the wells twice monthly, using a graduated steel tape. Continuous head measurements are collected with transducers in Wells 199-H4-4 and 199-H4-5. All water level measurements are subtracted from the surveyed casing elevations to determine water table elevations.

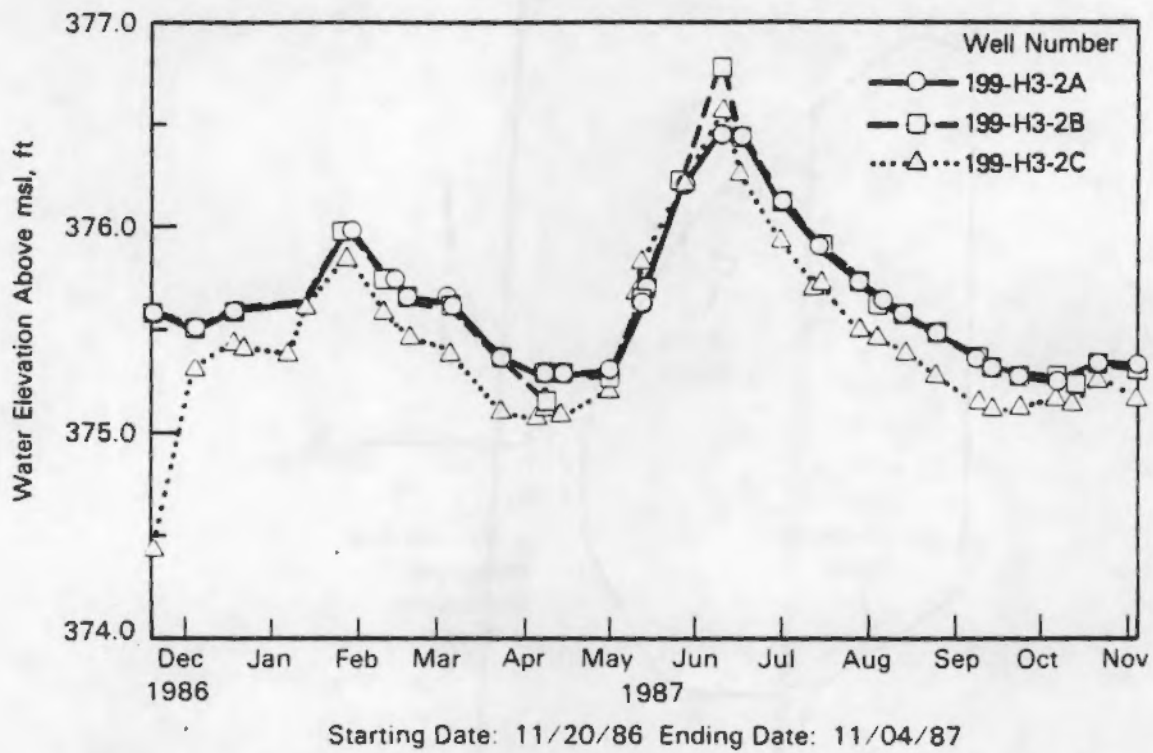


FIGURE 32. Hydrographs for Wells 199-H3-2A, 199-H3-2B, and 199-H3-2C

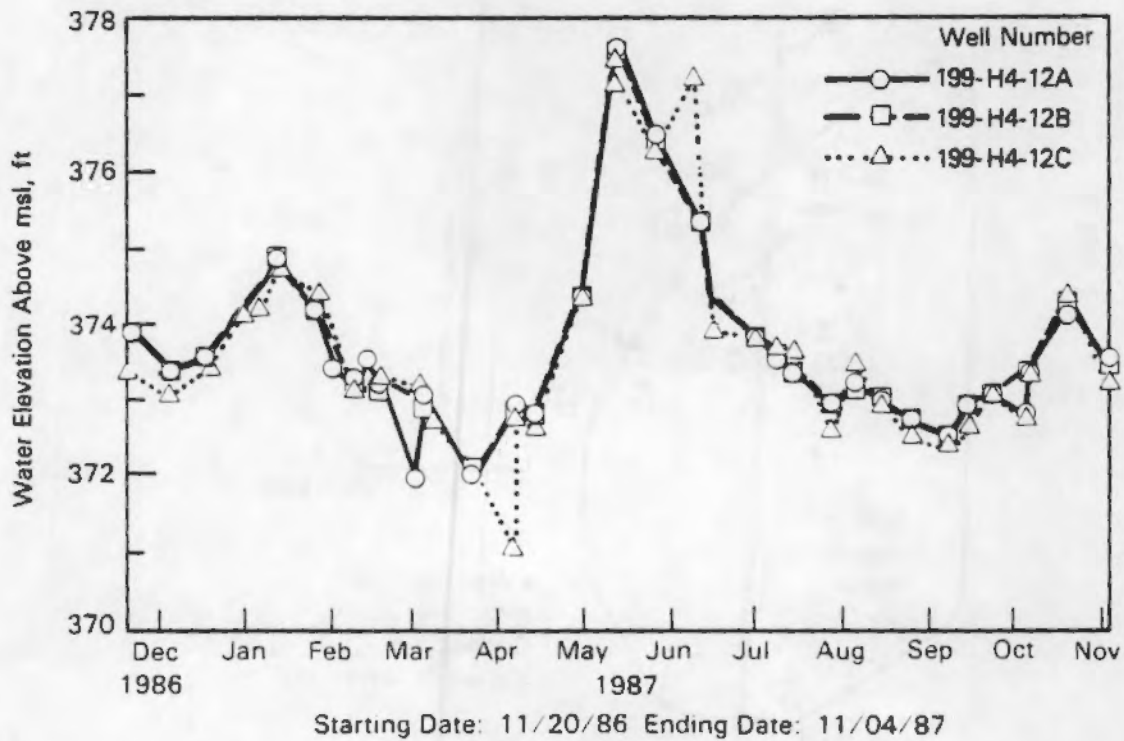


FIGURE 33. Hydrographs for Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C

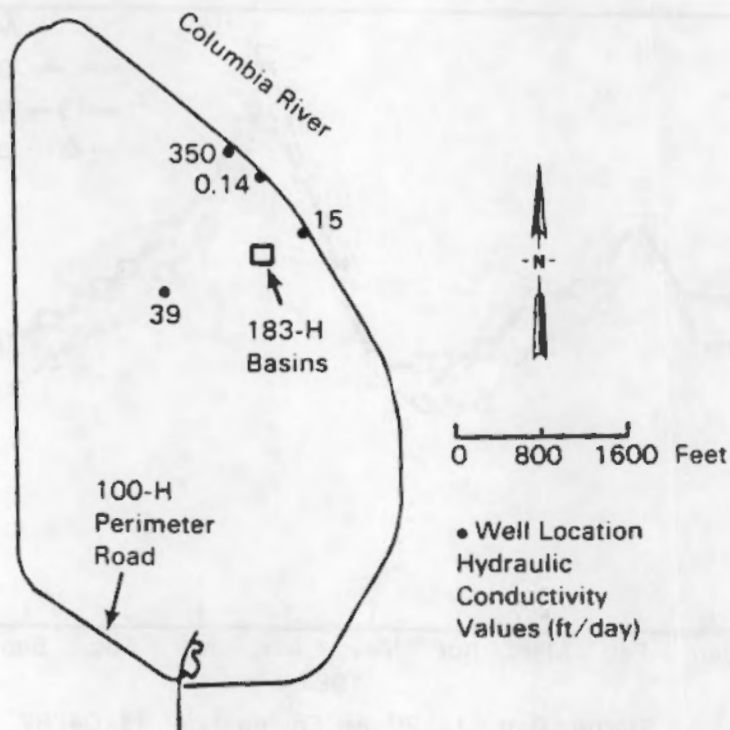


FIGURE 34. Hydraulic Conductivity (K) Values for the Silty Sand and Gravelly Silty Sand Units Within the Ringold Formation

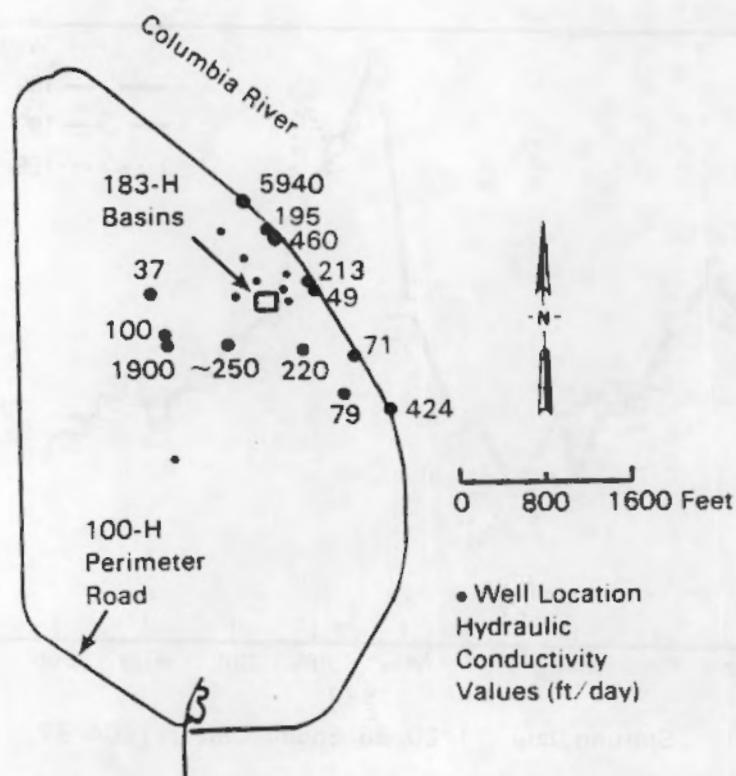


FIGURE 35. Hydraulic Conductivity (K) Values for the Unconfined Aquifer

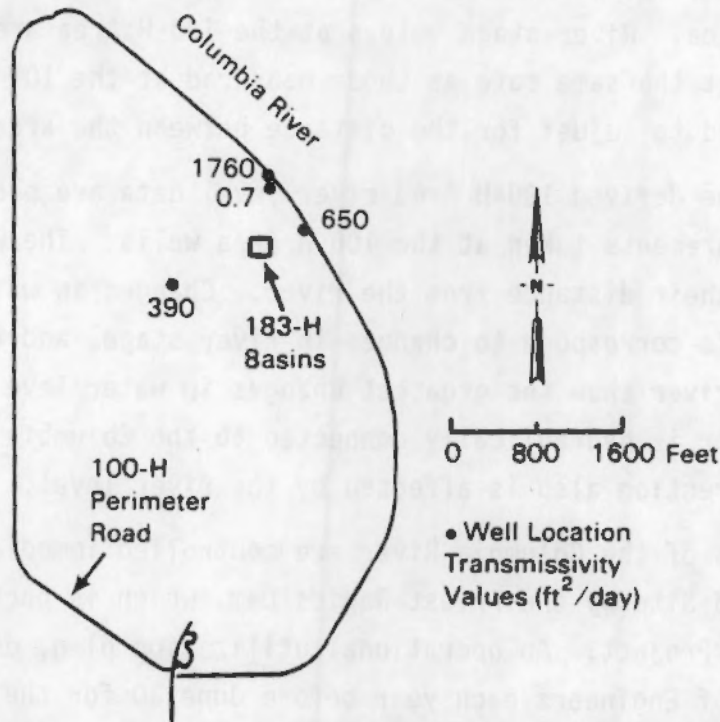


FIGURE 36. Transmissivity (T) Values for the Silty Sand and Gravelly Silty Sand Units Within the Ringold Formation

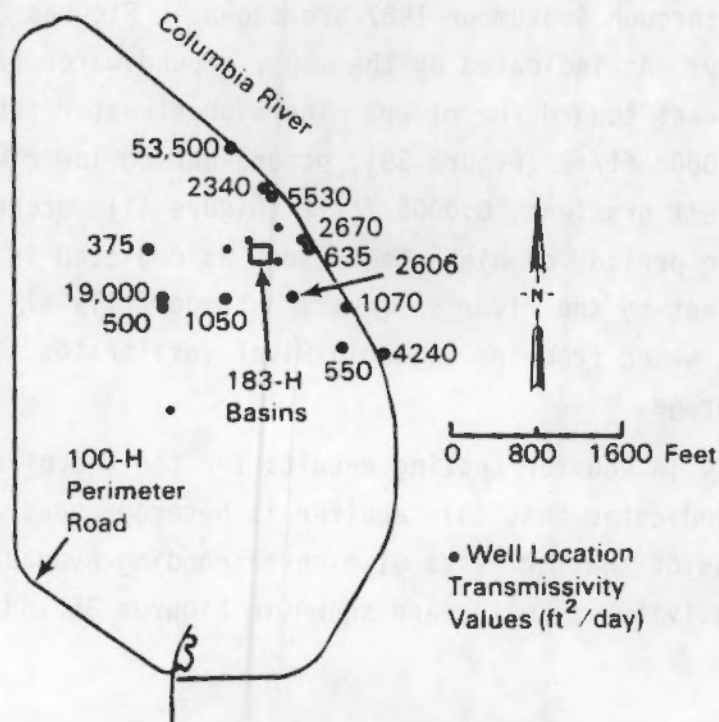


FIGURE 37. Transmissivity (T) Values for the Unconfined Aquifer

Columbia River level data are collected from the Hanford Generating Plant at the 100-N Area. River-stage values at the 100-H Area are then assumed to increase at the same rate as those measured at the 100-N Area. A set time lag is used to adjust for the distance between the areas.

In Figure 38, the derived 100-H Area river level data are plotted with the water level measurements taken at the 100-H Area wells. The wells are plotted relative to their distance from the river. Changes in water table elevation in all wells correspond to changes in river stage, and those wells located nearest the river show the greatest changes in water level. Because the unconfined aquifer is hydraulically connected to the Columbia River, ground-water flow direction also is affected by the river level.

The fluctuations of the Columbia River are controlled immediately upstream of the Hanford Site by the Priest Rapids Dam, which is part of the Columbia Basin Water Project. An operational utilization plan, developed by the U.S. Army Corps of Engineers each year before June 30 for the forthcoming year, administers the water releases and river levels in the system.

Water table maps for the unconfined aquifer corresponding to low (September 1987), mean (December 1986), and high (May 1987) Columbia River stages for September 1986 through September 1987 are shown in Figures 39, 40, and 41, respectively. As indicated by the maps, ground-water flow is generally northeast and east toward the river. The highest water table gradient across the site, 0.0008 ft/ft (Figure 39), occurs during low river stage, and conversely, the lowest gradient, 0.0005 ft/ft (Figure 41), occurs at the high river stage. During periods of high stage, such as depicted in Figure 41, the hydraulic gradient to the river is reversed temporarily all the way to the 183-H Basins as water from the Columbia River infiltrates the unconfined aquifer as bank storage.

The variability in aquifer testing results for the unconfined aquifer, given in Table 8, indicates that this aquifer is heterogeneous at the 100-H Area. The locations of aquifer tests with corresponding hydraulic conductivity and transmissivity estimates are shown in Figures 35 and 37, respectively.

RCRA Compliance Groundwater Monitoring Project
183-H Solar Evaporation Basins Assessment Program
Relative Well Water Levels Affected by Columbia River

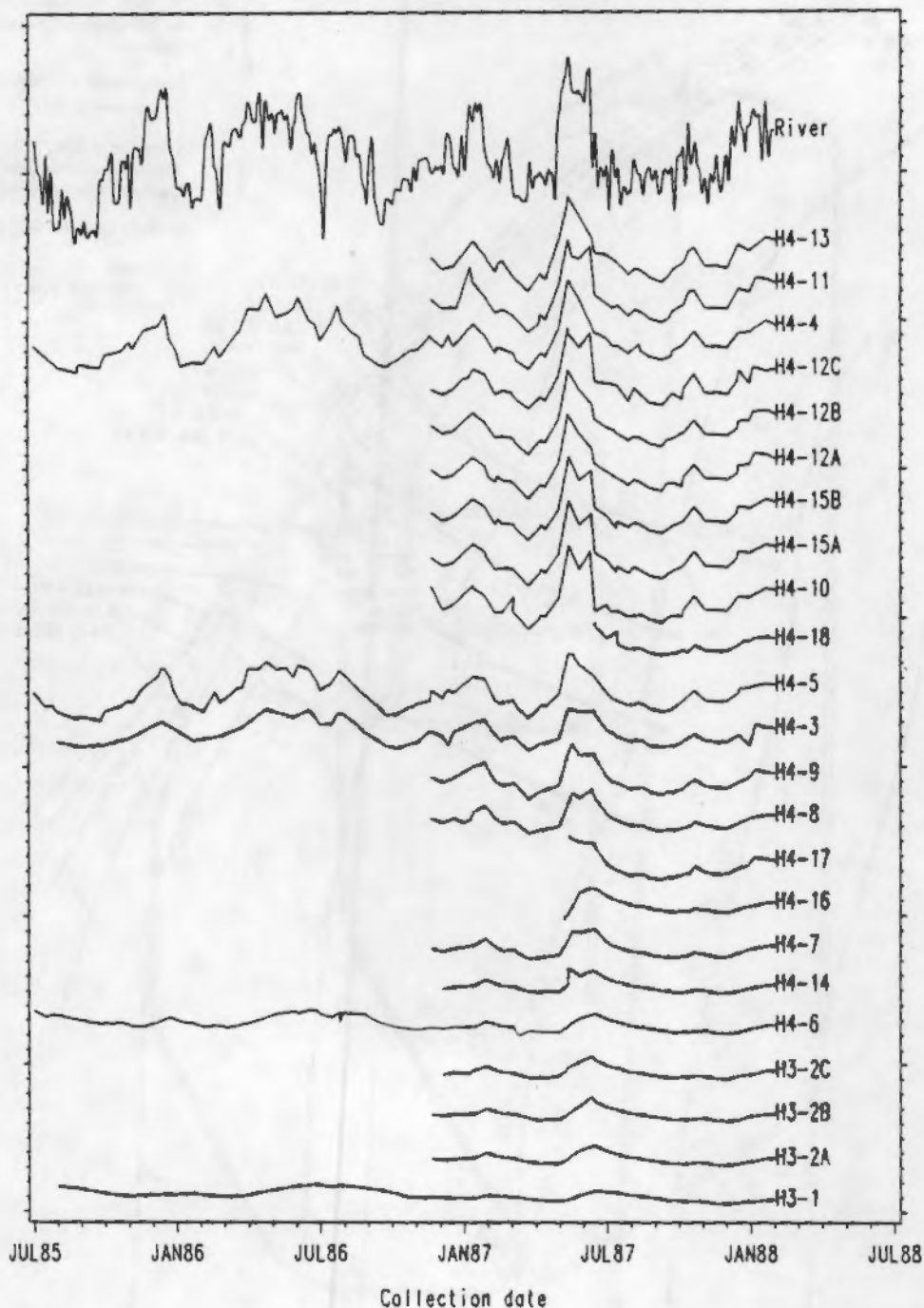


FIGURE 38. Relative Water Levels in the Columbia River and 100-H Area Monitoring Wells. (Wells are plotted relative to distance from the river. Vertical axis is marked in 1-ft intervals for estimating fluctuations in individual wells, but not for comparing water levels between wells.)

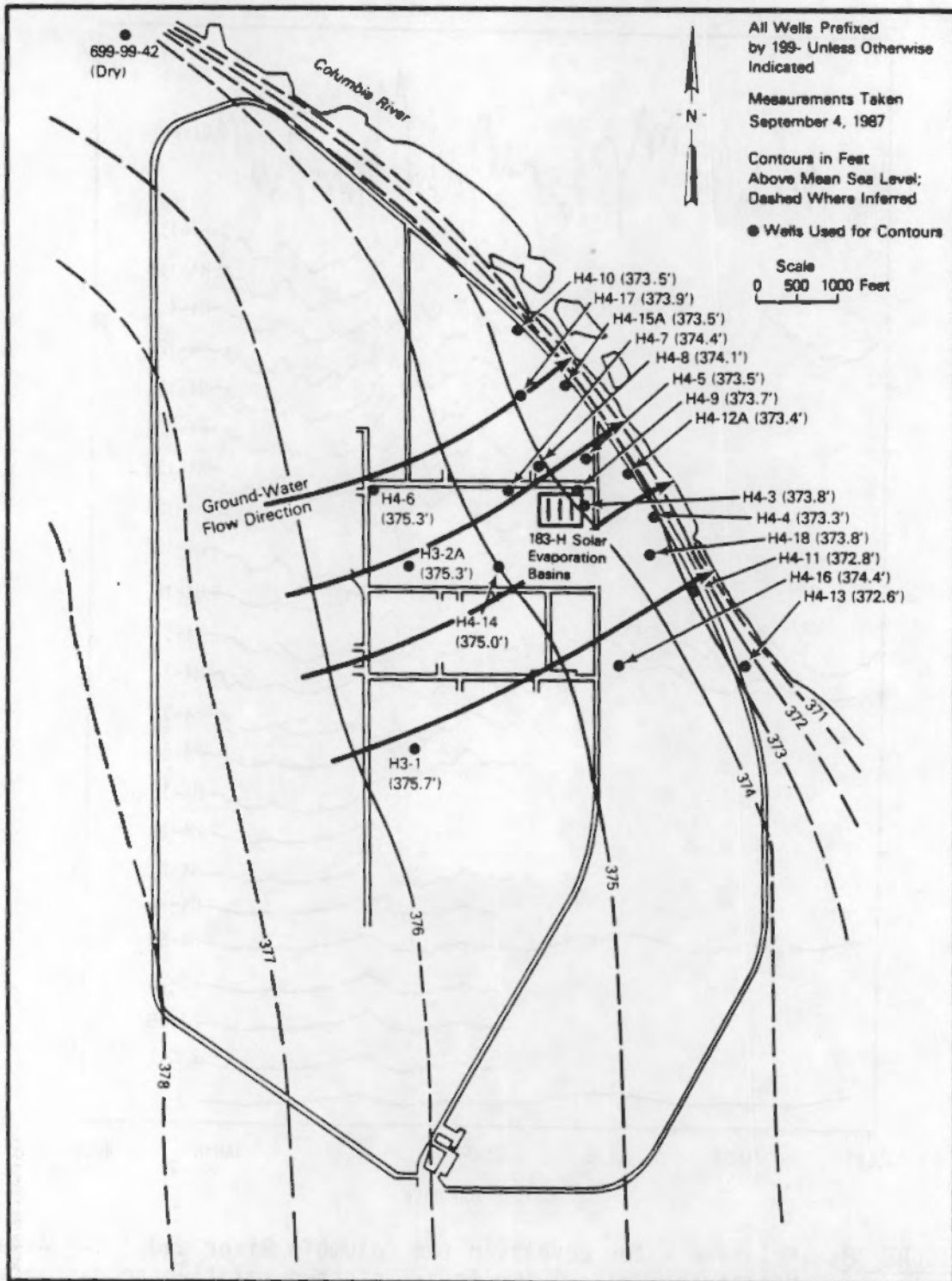


FIGURE 39. 100-H Area Water Table Map Corresponding to Low Columbia River Stage (September 1987)

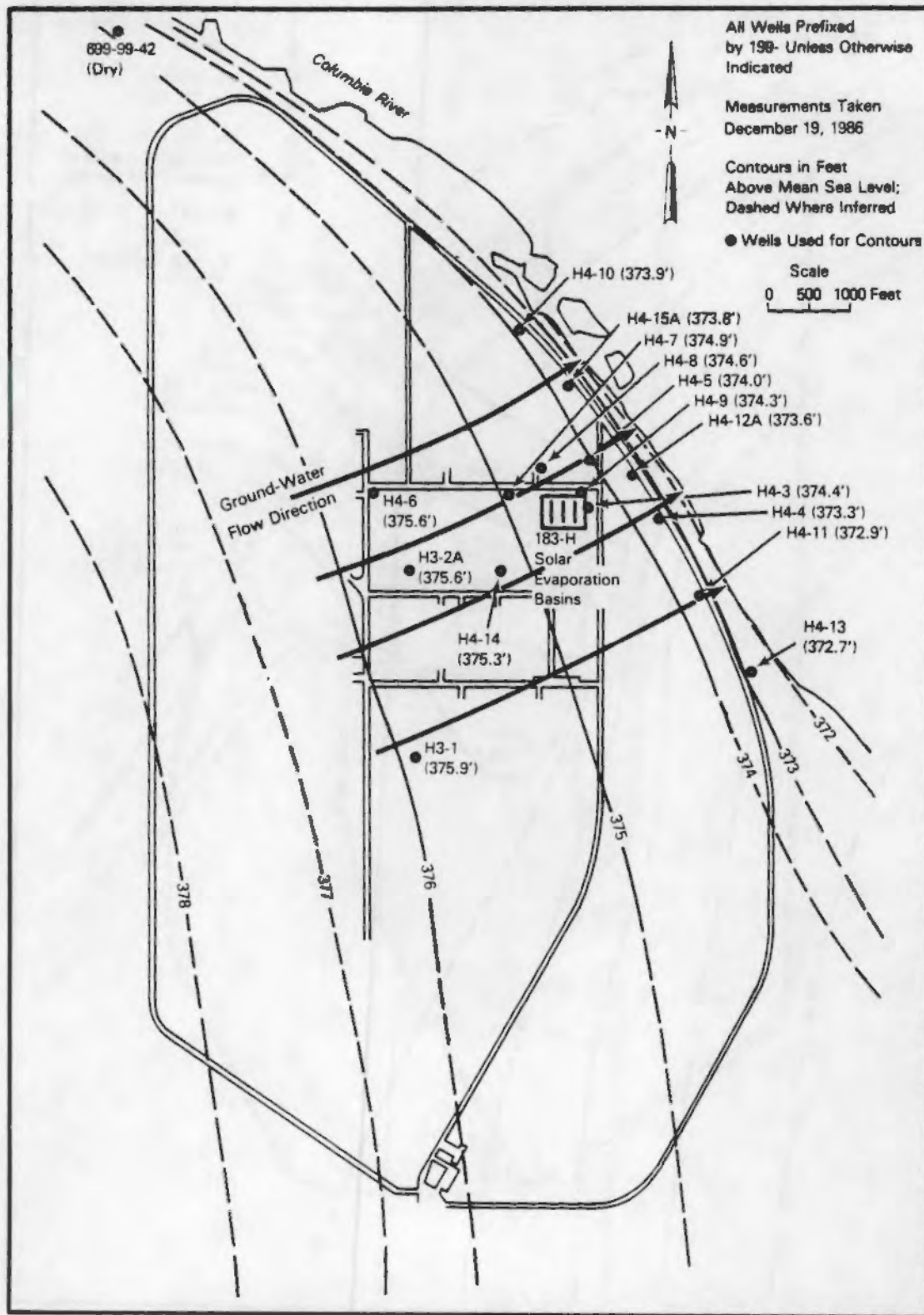


FIGURE 40. 100-H Area Water Table Map Corresponding to Mean Columbia River Stage (December 1986)

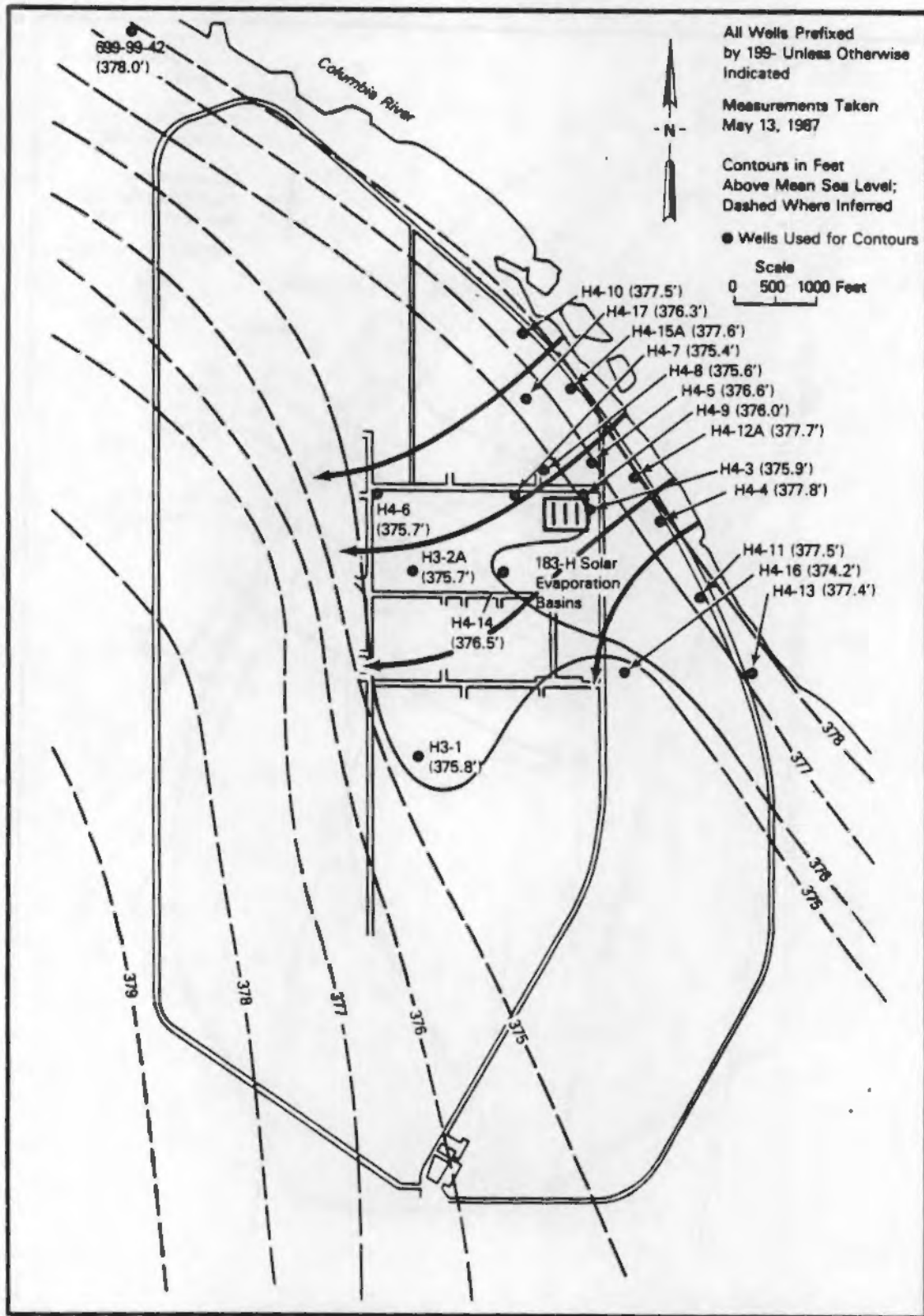


FIGURE 41. 100-H Area Water Table Map Corresponding to High Columbia River Stage (May 1987)

4.5 UNSATURATED SEDIMENTS OF THE HANFORD FORMATION

The unsaturated sediments of the Hanford formation extend from the land surface to approximately 30 to 50 ft below land surface. These sediments are a composite of unconsolidated and poorly sorted boulders, cobbles, pebbles, sand, and silt. Table 9 lists the field moisture contents and moisture contents at selected pressures, respectively, for the Phase II and III wells. These samples were collected with a drive barrel above the water table.

TABLE 9. Field Moisture Contents and Water Retention Characteristics for the Phase II and III Wells

Well No.	Depth (ft)	Field Water Content (wt%)	Water Retention (wt%)		
			0.1 bar	0.3 bar	1.0 bar
199-H3-2A	4 - 5	1.15	6.44	3.44	2.34
199-H3-2A	9 - 10	1.24	9.75	6.20	3.40
199-H3-2A	14 - 15	1.41	11.33	8.18	4.72
199-H3-2A	19 - 20	1.18	10.78	7.82	4.54
199-H3-2A	24 - 25	1.80	5.11	3.12	1.94
199-H3-2A	29 - 30	1.56	9.29	5.91	3.98
199-H3-2A	39 - 40	1.71	11.08	6.73	4.64
199-H3-2B	4 - 5	2.20	12.99	5.63	3.82
199-H3-2B	9 - 10	1.19	8.73	5.07	2.71
199-H3-2B	14 - 15	1.56	12.10	8.89	5.71
199-H3-2B	19 - 20	1.44	11.59	7.05	3.81
199-H3-2B	24 - 25	--	13.48	6.47	5.26
199-H3-2B	29 - 30	--	13.63	4.80	4.94
199-H3-2B	34 - 35	--	18.00	8.29	5.96
199-H3-2B	39 - 40	--	26.96	21.31	3.94
199-H3-2C	3 - 5	1.39	11.19	7.87	5.13
199-H3-2C	9 - 10	0.83	10.16	6.92	4.29
199-H3-2C	14 - 15	1.32	11.57	8.70	5.28
199-H3-2C	19 - 20	1.31	11.86	8.49	4.69
199-H3-2C	24 - 25	1.73	12.98	9.63	4.80
199-H3-2C	29 - 30	1.56	9.85	5.97	3.17
199-H3-2C	34 - 35	1.56	11.57	8.78	4.10
199-H3-2C	39 - 40	4.23	13.07	10.38	6.36
199-H4-7	4 - 5	2.67	7.33	4.49	4.15
199-H4-7	8 - 10	2.92	7.82	3.83	3.67
199-H4-7	14 - 15	3.81	6.32	5.59	5.59
199-H4-7	19 - 20	4.44	10.93	9.87	6.89
199-H4-7	24 - 25	1.76	9.13	3.20	4.22
199-H4-7	29 - 30	1.99	12.16	6.71	5.94
199-H4-7	34 - 35	1.64	13.21	8.18	7.85
199-H4-7	39 - 40	2.31	13.57	9.79	6.88
199-H4-8	5 - 6	4.98	10.12	6.30	6.14
199-H4-8	9 - 10	1.60	6.71	5.25	2.28
199-H4-8	14 - 15	1.57	7.83	6.63	3.41

TABLE 9. (contd)

Well No.	Depth (ft)	Field Water Content (wt%)	Water Retention (wt%)		
			0.1 bar	0.3 bar	1.0 bar
199-H4-8	19 - 20	1.66	9.26	6.27	3.73
199-H4-8	24 - 25	1.65	7.91	6.08	2.70
199-H4-8	29 - 30	1.76	9.27	7.36	3.71
199-H4-8	34 - 35	1.94	12.33	11.88	3.90
199-H4-8	39 - 40	1.69	9.69	7.69	3.79
199-H4-8	44 - 45	4.54	8.81	7.18	4.04
199-H4-9	4 - 5	8.77	17.06	7.98	6.36
199-H4-9	10	3.44	12.94	6.17	5.24
199-H4-9	14 - 15	6.84	10.05	6.36	6.06
199-H4-9	19 - 20	6.54	11.68	7.12	6.55
199-H4-9	24 - 25	3.83	10.79	6.16	5.18
199-H4-9	29 - 30	1.58	11.36	9.66	6.01
199-H4-9	35 - 36	1.57	14.91	12.36	7.71
199-H4-9	40	2.15	7.49	6.61	3.68
199-H4-10	5 - 6	8.35	11.87	5.29	5.37
199-H4-10	9 - 10	2.37	7.36	3.17	2.83
199-H4-10	15 - 16	2.37	9.57	6.42	4.84
199-H4-10	19 - 20	1.37	9.11	5.69	4.21
199-H4-10	24 - 25	2.47	9.35	5.49	4.45
199-H4-10	29 - 30	3.03	10.17	7.02	5.91
199-H4-11	4 - 5	7.35	9.41	6.45	4.01
199-H4-11	9 - 10	2.97	9.65	6.21	3.51
199-H4-11	14 - 15	1.69	5.21	3.96	2.54
199-H4-11	19 - 20	2.24	4.61	6.25	2.39
199-H4-11	24 - 25	1.99	14.22	7.74	3.03
199-H4-11	29 - 30	2.78	15.30	7.76	2.88
199-H4-11	34 - 35	3.08	8.91	6.04	4.04
199-H4-11	39 - 40	2.76	11.74	9.13	6.02
199-H4-11	44 - 45	3.60	10.56	5.22	4.31
199-H4-12A	4 - 5	3.56	11.27	5.68	3.98
199-H4-12A	9 - 10	1.76	7.27	4.59	1.92
199-H4-12A	14 - 15	2.67	9.14	6.04	4.19
199-H4-12A	19 - 20	2.07	8.44	9.87	2.82
199-H4-12A	24 - 25	1.73	9.67	6.20	3.04
199-H4-12A	29 - 30	2.04	9.62	6.69	3.34
199-H4-12A	34 - 35	3.00	11.91	7.52	4.72

TABLE 9. (contd)

Well No.	Depth (ft)	Field Water Content (wt%)	Water Retention (wt%)		
			0.1 bar	0.3 bar	1.0 bar
199-H4-12B	4 - 5	1.99	14.63	8.55	3.38
199-H4-12B	9 - 10	1.59	9.61	5.98	2.95
199-H4-12B	14 - 15	1.75	12.00	6.96	4.34
199-H4-12B	19 - 20	1.55	11.24	6.32	4.04
199-H4-12B	24 - 25	1.94	12.87	6.86	3.63
199-H4-12B	29 - 30	1.90	10.84	6.61	4.49
199-H4-12B	34 - 35	2.47	16.84	9.54	5.09
199-H4-12C	5	1.57	16.86	7.78	3.80
199-H4-12C	10	1.62	18.06	7.18	3.11
199-H4-12C	14 - 15	1.78	21.03	9.02	3.11
199-H4-12C	19 - 20	1.95	21.22	11.47	3.24
199-H4-12C	24 - 25	2.20	9.46	5.48	3.42
199-H4-12C	29 - 30	1.38	9.26	5.71	3.98
199-H4-12C	34 - 35	2.47	10.54	7.64	5.32
199-H4-13	4 - 5	3.26	8.49	5.80	4.49
199-H4-13	9 - 10	10.70	11.99	8.52	6.00
199-H4-13	14 - 15	5.89	10.74	7.32	6.02
199-H4-13	19 - 20	6.19	9.96	7.04	6.05
199-H4-13	24 - 25	2.27	8.48	3.59	2.40
199-H4-13	29 - 30	2.91	5.45	3.12	2.47
199-H4-13	34 - 35	2.83	8.05	3.08	3.64
199-H4-13	39 - 40	2.54	8.34	2.20	3.67
199-H4-14	4 - 5	--	15.31	8.12	5.14
199-H4-14	9 - 10	--	12.23	9.91	6.51
199-H4-14	14 - 15	--	11.87	5.44	5.82
199-H4-14	19 - 20	--	24.23	19.37	6.34
199-H4-14	24 - 25	--	13.19	10.84	6.64
199-H4-14	29 - 30	--	16.63	11.83	7.39
199-H4-14	34 - 35	--	12.41	9.15	5.91
199-H4-14	39 - 40	--	14.22	10.48	6.75
199-H4-15A	4 - 5	2.20	11.57	6.49	3.77
199-H4-15A	9 - 10	2.10	10.69	6.50	3.77
199-H4-15A	14 - 15	--	9.75	7.92	4.30
199-H4-15A	19 - 20	--	14.53	10.74	6.94
199-H4-15A	24 - 25	--	16.03	11.49	7.84
199-H4-15A	29 - 30	--	18.04	13.49	9.83

TABLE 9. (contd)

Well No.	Depth (ft)	Field Water Content (wt%)	Water Retention (wt%)		
			0.1 bar	0.3 bar	1.0 bar
199-H4-15B	4 - 5	3.99	10.04	5.86	4.49
199-H4-15B	9 - 10	--	11.49	7.65	5.61
199-H4-15B	14 - 15	--	16.79	11.66	8.98
199-H4-15B	19 - 20	--	17.19	12.39	8.56
199-H4-15B	24 - 25	--	18.85	13.90	9.98
199-H4-15B	29 - 30	--	21.53	15.28	9.86
199-H4-15C	3 - 5	7.05	16.18	11.34	7.49
199-H4-15C	9 - 10	2.17	11.62	7.48	5.02
199-H4-15C	14 - 15	1.96	10.28	6.80	4.06
199-H4-15C	19 - 20	3.61	10.11	6.62	3.91
199-H4-15C	24 - 25	3.39	11.76	8.98	5.57
199-H4-15C	29 - 30	2.36	9.55	6.78	3.95
199-H4-16	4 - 5	3.06	15.27	8.45	6.06
199-H4-16	9 - 10	1.14	6.16	3.71	2.13
199-H4-16	14 - 15	1.37	13.30	7.26	5.02
199-H4-16	19 - 20	1.25	8.46	4.84	3.28
199-H4-16	24 - 25	1.30	10.11	6.76	5.17
199-H4-16	29 - 30	1.32	8.45	4.96	4.17
199-H4-16	34 - 35	1.29	12.27	7.92	5.32
199-H4-16	39 - 40	1.41	10.41	6.13	3.69
199-H4-16	44 - 45	1.44	11.89	7.30	4.39
199-H4-17	4 - 5	3.68	17.88	7.33	5.59
199-H4-17	9 - 10	3.20	12.96	6.38	5.04
199-H4-17	14 - 15	1.87	12.02	5.83	4.19
199-H4-18	4 - 5	2.49	14.34	10.29	6.48
199-H4-18	9 - 10	1.46	13.18	7.93	4.91



5.0 DESCRIPTION OF THE WELL INSTALLATION AND GEOHYDROLOGIC CHARACTERIZATION EFFORT

This section of the report provides information on the details of well design and construction, field methods employed during construction, and well locations.

5.1 DETAILS OF WELL DESIGN AND CONSTRUCTION

The monitoring wells at the 100-H Area can be divided into three groups based on construction design: 1) wells constructed with perforated carbon steel casing, 2) wells constructed with carbon steel casing and stainless steel screen, and 3) wells constructed with stainless steel casing and screen. All the wells were installed using the cable-tool drilling method. Completion data for these wells are given in Table 10. Construction diagrams, lithologic diagrams, and geophysical logs for each well are contained in Appendix A.

5.1.1 Wells Installed Before 1985

Wells 199-H3-1 and 199-H4-3 were constructed with 8-in. and 6-in. perforated carbon steel casing, respectively. Well 199-H3-1 was installed upgradient of the 183-H Basins in 1960 as part of a sitewide network to monitor tritium and nitrate in the ground water at the Hanford Site. The well is perforated from 29 to 74 ft. Well 199-H4-3 was installed directly downgradient from the 183-H Basins in 1974 and is perforated from 34 to 55 ft. Both these wells are designed to monitor the top of the unconfined aquifer. Initial depths to water were 45 ft in Well 199-H3-1 and 39 ft in Well 199-H4-3. In 1987, concrete pads and protective steel posts were installed around both these wells to prevent pooling of water and to protect the surface casing.

Wells 199-H4-4, 199-H4-5, and 199-H4-6 were installed in 1983 for the specific purpose of monitoring the 183-H Basins. These wells were constructed with carbon steel casing and telescoping stainless steel screen. The wells are screened in the upper portion of the unconfined aquifer, from 33 to 43 ft, 32 to 42 ft, and 39 to 49 ft, respectively. Initial depths to

TABLE 10. Completion Data for the 100-H Area Wells

Well No.	Completion Date	Construction Materials		Depth (ft) ^(a)			Hydrostratigraphic Unit ^(b)	Coordinates	
		Casing	Screen	to Bottom ^(a)	to Water	of Screened Interval			
<u>Original Monitoring Wells</u>									
199-H3-1	08-00-60	Carbon Steel	Perforated	75	45	29-74	Unc Aq	N 96994.3	W 40052.2
199-H4-3	05-00-74	Carbon Steel	Perforated	55	39	34-55	Unc Aq	N 96372.3	W 39079.7
199-H4-4	06-00-83	Carbon Steel	Stainless	50	36	33-43	Unc Aq	N 96356.3	W 38684.8
199-H4-5	05-00-83	Carbon Steel	Stainless	60	36	32-42	Unc Aq	N 96438.7	W 39064.5
199-H4-6	05-00-83	Carbon Steel	Stainless	54	41	39-49	Unc Aq	N 96472.9	W 40245.0
<u>Phase I] Wells</u>									
199-H3-2A	11-04-86	Stainless	Stainless	51	41	36-51	Unc Aq	N 96018.6	W 40117.0
199-H3-2B	11-14-86	Stainless	Stainless	55	40.5	50-55	Unc Aq	N 96041.9	W 40104.9
199-H3-2C	10-15-86	Stainless	Stainless	110	41	100-110	SS&GSS	N 96019.4	W 40092.5
199-H4-7	09-22-86	Stainless	Stainless	53	43	38-53	Unc Aq	N 96479.0	W 39526.7
199-H4-8	09-11-86	Stainless	Stainless	48	44	38-48	Unc Aq	N 96580.0	W 39341.1
199-H4-9	09-24-86	Stainless	Stainless	46	43	36-46	Unc Aq	N 96488.3	W 39136.2
199-H4-10	09-22-86	Stainless	Stainless	38	29	23-38	Unc Aq	N 97348.6	W 39449.1
199-H4-11	10-10-86	Stainless	Stainless	53	43	38-53	Unc Aq	N 95943.7	W 38419.8
199-H4-12A	11-04-86	Stainless	Stainless	48	38	33-48	Unc Aq	N 96549.5	W 38854.0
199-H4-12B	11-11-86	Stainless	Stainless	50	37	45-50	Unc Aq	N 96568.3	W 38869.6
199-H4-12C	10-03-86	Stainless	Stainless	82	36	72-82	SS&GSS	N 96572.8	W 38845.3
199-H4-13	11-20-86	Stainless	Stainless	52	42	37-52	Unc Aq	N 95506.3	W 38166.9
199-H4-14	12-05-86	Stainless	Stainless	53	43	38-53	Unc Aq	N 96024.8	W 39529.2
199-H4-15A	11-11-86	Stainless	Stainless	42	32	27-42	Unc Aq	N 97012.0	W 39197.0
199-H4-15B	11-19-86	Stainless	Stainless	42	30	37-42	Unc Aq	N 97032.2	W 39212.3
199-H4-15C(P) ^(c)	10-29-86	Stainless	Stainless	327	Flowing	325-327	Low Con Aq	N 97033.5	W 39185.8
199-H4-15C(O) ^(c)	10-29-86	Stainless	Stainless	297	0.25	295-297	Upp Con Aq	N 97033.5	W 39185.8
199-H4-15C(R) ^(c)	10-29-86	Stainless	Stainless	196	27.5	194-196	SS&GSS	N 97033.5	W 39185.8
199-H4-15C(S) ^(c)	10-29-86	Stainless	Stainless	80	30.5	78-80	SS&GSS	N 97033.5	W 39185.8
<u>Phase II] Wells</u>									
199-H4-16	04-30-87	Stainless	Stainless	57.5	48.5	42.5-57.5	Uncon Aq	N 95496.0	W 38945.8
199-H4-17	05-08-87	Stainless	Stainless	45	41.5	35-45	Uncon Aq	N 96961.0	W 39607.7
199-H4-18	05-26-87	Stainless	Stainless	51	45	40-50	Uncon Aq	N 96036.8	W 38825.2

(a) All depths are given in feet relative to land surface.

(b) Unc Aq = Unconfined Aquifer; SS&GSS = Silty Sand & Gravelly Silty Sand; Upp Con Aq = Upper Confined Aquifer;

Low Con Aq = Lower Confined Aquifer.

(c) Piezometers.

water were 36 ft in Well 199-H4-4, 36 ft in Well 199-H4-5, and 41 ft in Well 199-H4-6. A cement seal, extending from the ground surface down to a depth of approximately 20 ft, was placed around the outside of the carbon steel casing. In 1987, concrete pads and protective steel posts were installed around each of these wells to prevent pooling of water and to protect the surface casing.

5.1.2 Phase II Wells

In 1986, the monitoring network was expanded with the addition of 16 wells, including seven single shallow wells and three clusters consisting of three wells each (shallow, intermediate, and deep). The cluster wells are located approximately 25 ft apart in a triangular arrangement. The Phase II wells were constructed and completed in accordance with RCRA and WAC regulations in 40 CFR 265, WAC 173-160, and WAC 173-303-645(8) (CFR 1987; WDOE 1986a,b) and the specifications contained in the Interim Characterization Report for the Area Surrounding the 183-H Basins (PNL 1987). Some modifications to the original well designs and locations were made in response to the initial data collected during the drilling of the deep wells. The modifications and general construction information are addressed in the following discussion.

All the Phase II wells, with the exception of 199-H4-15C, were constructed with 6-in. type 304 stainless steel casing and screen. Sand filter packs were placed around each screened interval, and the annulus was sealed with bentonite pellets, bentonite slurry (below the water table), granular bentonite (above the water table), and concrete. A concrete pad and protective steel posts were placed around each well to prevent pooling of water and to protect the surface casing.

The deep wells within each cluster (199-H3-2C, 199-H4-12C, and 199-H4-15C) were the first to be drilled in Phase II. This strategy allowed for the definition of significant geohydrologic units and anticipation of geologic conditions at the remaining well locations. The planned completion zone within the Ringold Formation, a gravel unit noted on the drilling log of Well 199-H4-2, was not encountered upon drilling to 220 ft in Wells 199-H4-12C and 199-H4-15C, and 155 ft in Well 199-H3-2C. Therefore, alternate

completion strategies based on the drilling logs and geophysical logs were chosen for Wells 199-H3-2C, 199-H4-12C, and 199-H4-15C.

Well 199-H4-15C was continued into the top of basalt to fully characterize the suprabasalt geology. The well was completed with four 2-in. piezometers: (P), set from 325 to 327 ft within the Saddle Mountains Basalt; (Q), set from 295 to 297 ft within the silty clayey sand to sandy silty clay unit of the Ringold Formation; (R), set from 194 to 196 ft within the silty sand unit of the Ringold Formation; and (S), set from 78 to 80 ft within the gravelly silty sand unit of the Ringold Formation. The piezometers were constructed with 2-in.-diameter stainless steel casing and screen. Sand filter packs were placed around each 20-slot screen. The interval between piezometers (P) and (Q) was sealed with bentonite pellets and neat cement. All other intervals between piezometers were sealed with bentonite slurry and bentonite pellets. A ball valve and pressure gauge were installed on piezometer (P) to prevent it from flowing.

Water-bearing zones within the Ringold Formation were chosen for completion of Wells 199-H3-2C and 199-H4-12C. Well 199-H4-12C was completed within the gravelly silty sand unit of the Ringold Formation at a depth of 72 to 82 ft. The well was backfilled from 220 to 82 ft with a bentonite slurry seal, bentonite pellet seal, and artificial sand pack. A sand filter pack was placed around the screened interval, and the annulus was sealed with bentonite pellets, bentonite slurry, granular bentonite, and concrete. The well was completed with a 10-slot stainless steel screen.

Well 199-H3-2C was completed within the gravelly silty sand unit of the Ringold Formation at a depth of 100 to 110 ft. The well was backfilled from 155 ft to 110 ft with a bentonite slurry seal, bentonite pellet seal, and artificial sand pack. A sand filter pack was placed around the screened interval, and the annulus was sealed with bentonite pellets, bentonite slurry, granular bentonite, and concrete. The well was completed with a 10-slot stainless steel screen.

The intermediate depth cluster wells (199-H3-2B, 199-H4-12B, and 199-H4-15B) were completed at the top of the Ringold Formation to monitor the lower portion of the unconfined aquifer. The wells were completed at 50 to

55 ft, 45 to 50 ft, and 37 to 42 ft, respectively. The actual completion intervals were shallower than the anticipated depths of approximately 60 ft because of an erosional unconformity between the Ringold and Hanford Formations. The wells were completed with 20-slot stainless steel screens. Initial depths to water were 40.5 ft for Well 199-H3-2B, 37 ft for Well 199-H4-12B, and 30 ft for Well 199-H4-15B.

The single shallow wells (199-H4-7, 199-H4-8, 199-H4-9, 199-H4-10, 199-H4-11, 199-H4-13, and 199-H4-14) and shallow cluster wells (199-H3-2A, 199-H4-12A, and 199-H4-15A) were completed in the upper portion of the unconfined aquifer. The shallowest of these, Well 199-H4-10, was completed from 23 to 38 ft; the deepest of these, Wells 199-H4-11 and 199-H4-14, were completed from 38 to 53 ft. All but two of the shallow wells were completed with 15-ft sections of 20-slot screen. Wells 199-H4-8 and 199-H4-9 were completed with 10-ft sections of 20-slot screen because of their short water columns. Initial depths to water for the shallow wells ranged from 29 to 44 ft.

5.1.3 Phase III Wells

Three additional shallow wells, 199-H4-16, 199-H4-17, and 199-H4-18, were installed during Phase III to further characterize the area to the north and southeast of the 183-H Basins. These wells were completed at 42.5 to 57.5 ft, 35 to 45 ft, and 40 to 50 ft, respectively. Initial depths to water ranged from 41.5 to 48.5 ft. Well specifications and installation protocol for these wells were the same as those used for the single shallow and shallow cluster wells in Phase II.

5.2 FIELD METHODS

Geologic samples were collected at 5-ft intervals and when changes in formation appeared during drilling operations. Soil moisture samples were collected above the water table when drilling with a drive barrel. Each sample was characterized by the well site geologist and recorded on a drilling log.

Selected lithologic samples were analyzed in the PNL Soils Laboratory for the following parameters: 1) grain-size distribution, 2) soil moisture

content, 3) soil moisture retention, 4) bulk density, 5) bulk porosity, and 6) hydraulic conductivity. Samples were selected for these tests as follows:

- Grain-size distribution was performed on all samples.
- Soil moisture content and soil moisture retention were performed on all drive-barrel samples collected above the water table.
- Bulk density was performed on six to eight samples from Wells 199-H3-2C, 199-H4-12C, and 199-H4-15C.
- Bulk porosity was calculated for the bulk density samples.
- Hydraulic conductivity was performed on a total of three split-spoon samples from Wells 199-H4-12C and 199-H4-15C.

Results from these analyses have been incorporated into the discussions in "Geology of the 100-H Area," Section 3.0, and "Hydrology of the 100-H Area," Section 4.0.

Wells 199-H3-1, 199-H4-3, 199-H4-4, 199-H4-5, and 199-H4-6 were geophysically logged in 1986 with natural gamma and neutron probes. These two logs and a density log were run in each of the Phase II and III wells upon completion of drilling. The temperature probe was used in Well 199-H4-15C to help locate the top of the bentonite slurry seals during completion. The natural gamma, neutron, and density logs for each well are shown in Appendix A.

Aquifer tests were performed on selected wells during installation and on most other wells after completion. The methods used and results obtained are summarized in Table 8.

5.3 WELL LOCATIONS

Twenty-five wells are currently located in the 100-H Area (Figure 2). Hanford Site coordinates for the wells are provided in Table 10. Well 199-H4-2 was used only for geohydrologic characterization and is capped to prevent it from flowing. Well 199-H4-15C has been dedicated to hydraulic head measurements. The remaining 23 ground-water monitoring wells comprise the ground-water sampling network for the 183-H Basins.

The following ground-water monitoring wells are located hydraulically upgradient of and directly within the flow related to the 183-H Basins:

199-H3-2A	199-H3-2C	199-H4-7
199-H3-2B	199-H4-6	199-H4-14

The following ground-water monitoring wells are located hydraulically downgradient of and directly within the flow related to the 183-H Basins:

199-H4-3	199-H4-9	199-H4-12B
199-H4-4	199-H4-11	199-H4-12C
199-H4-5	199-H4-12A	199-H4-18

The following ground-water monitoring wells are not located within the flow directly related to the 183-H Basins:

199-H3-1	199-H4-13	199-H4-16
199-H4-8	199-H4-15A	199-H4-17
199-H4-10	199-H4-15B	

The point of compliance for the 183-H Basins is Well 199-H4-3 (Figure 2). This well is located approximately 75 ft downgradient of the facility and has shown the highest concentrations of contaminants attributable to the 183-H Basins.



6.0 SAMPLING AND ANALYSIS PLAN

6.1 SAMPLING SCHEDULE

Ground-water sampling for hazardous waste constituents was initiated on a monthly basis in June 1985 for the five wells in the original monitoring network (Figure 2). This frequency was chosen to define the seasonal variability expected in the analytical data resulting from the proximity of the 183-H Basins and the wells to the Columbia River. On completion, the Phase II and III wells were added to the monthly sampling schedule. Wells 199-H3-2C, 199-H4-7, 199-H4-8, 199-H4-10, 199-H4-11, and 199-H4-12C were initially sampled in December 1986. Wells 199-H3-2A, 199-H4-9, and 199-H4-15A were initially sampled in January 1987. The remaining Phase II wells (199-H3-2B, 199-H4-12A, 199-H4-12B, 199-H4-13, 199-H4-14, and 199-H4-15B) were added to the sampling network in February 1987. Well 199-H4-16 was initially sampled in May 1987, and Wells 199-H4-17 and 199-H4-18 were initially sampled in June 1987.

The sampling schedule for Fiscal Year (FY) 1988 is shown in Table 11. Sample collection for Wells 199-H3-1, 199-H4-5, and 199-H4-6 is now conducted on a quarterly basis. Monthly sampling of the Phase II and III wells will continue for at least 1 year after initial sampling. Those wells which are not located hydraulically downgradient of and directly within the flow related to the 183-H Basins (199-H3-2A, 199-H3-2B, 199-H3-2C, 199-H4-7, 199-H4-8, 199-H4-10, 199-H4-13, 199-H4-14, 199-H4-15A, 199-H4-15B, 199-H4-16, and 199-H4-17) will then be sampled quarterly through the end of FY 1988.

The proposed sampling schedule for the period beyond FY 1988 (extending through the closure and post-closure periods) is based on analytical results obtained to date. Both the number of wells to be sampled and the sampling frequency are subject to change, pending results of future characterization activities at the facility. Beginning in FY 1989, Wells 199-H3-2A, 199-H4-3, 199-H4-4, 199-H4-5, 199-H4-6, 199-H4-9, 199-H4-12A, 199-H4-12B, 199-H4-12C, and 199-H4-18 will be sampled on a quarterly basis until closure activities commence and during the post-closure period. Sampling of these wells will

TABLE 11. FY 1988 Sampling Schedule for the 100-H Area Wells

<u>Well</u>	<u>O</u>	<u>N(a)</u>	<u>D</u>	<u>J</u>	<u>F</u>	<u>M</u>	<u>A</u>	<u>M</u>	<u>J</u>	<u>J</u>	<u>A</u>	<u>S</u>
199-H3-1			X			X			X			X
199-H3-2A	X		X			X			X			X
199-H3-2B	X		X			X			X			X
199-H3-2C	X					X			X			X
199-H4-3	X		X	X	X	X	X	X	X	X	X	X
199-H4-4	X		X	X	X	X	X	X	X	X	X	X
199-H4-5			X			X			X			X
199-H4-6			X			X			X			X
199-H4-7	X					X			X			X
199-H4-8	X					X			X			X
199-H4-9	X		X	X	X	X	X	X	X	X	X	X
199-H4-10	X					X			X			X
199-H4-11	X		X	X	X	X	X	X	X	X	X	X
199-H4-12A	X		X	X	X	X	X	X	X	X	X	X
199-H4-12B	X		X	X	X	X	X	X	X	X	X	X
199-H4-12C	X		X	X	X	X	X	X	X	X	X	X
199-H4-13	X		X			X			X			X
199-H4-14	X		X			X			X			X
199-H4-15A	X		X			X			X			X
199-H4-15B	X		X			X			X			X
199-H4-16	X		X	X	X	X	X					X
199-H4-17	X		X	X	X	X	X	X				X
199-H4-18	X		X	X	X	X	X	X	X	X	X	X
TOTALS	20		19	10	10	23	10	9	21	8	8	23 = 161

(a) Per verbal direction from DOE-RL, sampling of all wells in the 100-H Area was suspended during November 1987.

increase to a monthly frequency during closure activities. Sampling of the remaining 13 wells will be conducted on an annual basis. The schedule for closure of the 183-H Basins is shown in Figure 42.

6.2 SAMPLE ANALYSES

The standard list of analyses currently being conducted on the 100-H Area ground-water samples is given in Table 12. These analyses include the primary drinking water standards (DWS), water quality parameters, contamination indicators, and specific dangerous waste constituents known to have been discharged to the 183-H Basins. Table 12 also contains information on the bottle types used for collection, sample preservation techniques, analytical methods, and detection limits for each of the constituents. Additional dangerous waste constituents listed in the WAC 173-303-9905 are analyzed on a quarterly basis at the point of compliance, Well 199-H4-3, and Well 199-H3-1. The WAC 173-303-9905 constituent list may change pending the Washington State Department of Ecology (WDOE) adoption of 40 CFR 264 and 270 Appendix IX. As particular analyses become obsolete for characterization and/or modeling activities, they will be deleted, unless mandated by regulations.

Proposed sample analyses to be conducted on the 100-H Area ground-water samples for the period beyond FY 1988 (extending through the closure and post-closure periods) are listed in Table 13. These analyses and frequencies are based on current results and are subject to change in the types of constituents and frequency analyzed, pending future characterization activities at the facility.

6.3 QUALITY CONTROL

A Quality Control (QC) Program for the Ground-Water Monitoring Project at the 183-H Basins was established to document the quality of the analytical results being produced by the primary analytical laboratory, United States Testing Company (UST). This program features submission of blind standards, replicates, and blanks, as well as investigation of problems and follow-up with corrective actions. Selected field samples are also analyzed by independent laboratories to verify the analytical results. UST participates in interlaboratory comparisons and U.S. Environmental Protection Agency- (EPA-) sponsored Performance Studies. UST performs and reports the results of routine internal QC procedures and corrective actions.

TABLE 12. Standard List of Analyses for the 100-H Area Ground-Water Samples

<u>Constituent</u>	<u>Preservation^(a,b)</u>	<u>Collection and Methods^(c)</u>	<u>Detection Limit (ppb)^(d)</u>
<u>ICP Metals</u>			
Barium	P, HNO ₃ to pH < 2	SW-846, #6010	6
Cadmium			2
Chromium			10
Silver			10
Sodium			200
Nickel			10
Copper			10
Vanadium			5
Aluminum			150
Manganese			5
Potassium			100
Iron			30
Calcium			50
Zinc	5		
Arsenic	P, HNO ₃ to pH < 2	SW-846, #7060	5
Mercury	G, 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	3
<u>IC^(e)</u>			
Nitrate	P, None	(f)	500
Sulfate			500
Fluoride			500
Chloride			500
Phosphate			1000
Total Organic Halogen	G, H ₂ SO ₄ to pH < 2 No headspace	SW-846, #9020	100
Total Organic Carbon	G, H ₃ PO ₄ to pH < 2	Std. Methods #505	1000
Total Carbon	G, None	Std. Methods #505	1000
Ammonium Ion	G, H ₂ SO ₄ to pH < 2	Std. Methods #417 A-E	50

TABLE 12. (contd)

<u>Constituent</u>	<u>Preservation (a,b)</u>	<u>Collection and Methods (c)</u>	<u>Detection Limit (ppb) (d)</u>
Phenol	G, None	SW-846, #8040	10
<u>Pesticides</u>			
Endrin	G, None	SW-846, #8080	0.1
Methoxychlor			3
Toxaphene			1
Lindane (4 isomers)			0.1
<u>Herbicides</u>			
2,4-D	G, None	SW-846, #8150	2
2,5,5-TP silvex			2
<u>Volatile Organics (VOA)</u>			
Tetrachloromethane	G, No headspace	SW-846, #8240	5
Methylethyl Ketone			10
1,1,1-Trichloroethane			5
1,1,2-Trichloroethane			5
1,1,2-Trichloroethene			5
Tetrachloroethene			5
Xylene (O,P)			5
Xylene (M)			5
Methylene Chloride			10
Chloroform			5
Hexone			10
Radium	P, HNO ₃ to pH < 2	EPA Method #903.0 EPA/600/4-80-032 (Krieger 1980)	1 pCi/L
Gross Alpha	P, HNO ₃ to pH < 2	EPA Method EPA/680/4-75-001 (Johns 1975)	4 pCi/L
Gross Beta	P, HNO ₃ to pH < 2	EPA Method EPA/680/4-75-001 (Johns 1975)	8 pCi/L

TABLE 12. (contd)

<u>Constituent</u>	<u>Preservation^(a,b)</u>	<u>Collection and Methods^(c)</u>	<u>Detection Limit (ppb)^(d)</u>
Uranium	P, HNO ₃ to pH < 2	Fluorometric (hexane extraction)	4 pCi/L
Technetium-99	P, HNO ₃ to pH < 2		15 pCi/L
Total Dissolved Solids	P, None	Std. Methods #209	--
Coliform Bacteria	P, None	Std. Methods #908A	2.2 MPN
pH (lab)	P, None	Std. Methods #423	--
Temperature	Field Measurement		
Specific Conductance	Field Measurement		
pH	Field Measurement		

(a) P = Plastic; G = Glass.

(b) All samples will be cooled to 4°C on collection.

(c) Constituents grouped together are analyzed by the same method.

(d) Detection limit units except where indicated.

(e) IC = Ion Chromatography.

(f) Based on EPA-600/4-84-017 (O'Dell et al. 1984).

6.4 SAMPLING PUMPS

Dedicated sampling pumps have been installed in each well. Each of the five wells in the original monitoring network has an electric submersible pump for purging the well and collecting samples that are analyzed for non-volatile constituents and a bladder pump for collecting samples that are analyzed for volatile, semivolatile, and other organic chemicals.

In September 1985, investigations by the manufacturer^(a) confirmed the existence of low levels of chlorinated hydrocarbon contaminants in a shipment

(a) Q.E.D. Environmental Systems, Inc., Ann Arbor, Michigan.

TABLE 13. Proposed Schedule and Sample Analyses for Future 100-H Area Ground-Water Samples^(a)

<u>Constituent^(b)</u>	<u>FY 1989 Frequency</u>	<u>Closure Period Frequency</u>	<u>Post-Closure Period Frequency</u>
Nitrate (IC)	Quarterly	Monthly	Quarterly
Chromium (ICP)	Quarterly	Monthly	Quarterly
Gross Alpha	Quarterly	Monthly	Quarterly
Gross Beta	Quarterly	Monthly	Quarterly
Uranium (UChem)	Quarterly	Monthly	Quarterly
Technetium	Quarterly	Monthly	Quarterly
TOX	Quarterly	Monthly	Quarterly
Alkalinity	Quarterly	Monthly	Quarterly
pH	Quarterly	Monthly	Quarterly
9905 ^(c)	Annually on point-of- compliance well only	Annually on point-of- compliance well only	Annually on point-of- compliance well only

(a) Analysis for 9905 constituents will only be conducted for Well 199-H4-3. Analysis for the remaining constituents will be conducted for Wells 199-H3-2A, 199-H4-3, 199-H4-4, 199-H4-5, 199-H4-6, 199-H4-9, 199-H4-12A, 199-H4-12B, 199-H4-12C, and 199-H4-18 per this schedule. All other wells will be sampled annually for non-9905 constituents.

(b) IC = Ion Chromatography; ICP = Inductively Coupled Plasma; UChem = Chemical Analysis for Uranium.

(c) The 9905 constituent list may change pending WDOE's adoption of 40 CFR 264 and 270, Appendix IX.

of bladder pumps used at the Hanford Site. Further investigation determined that none of the pumps used in the 100-H Area were from the affected shipment.

Piston-actuated sampling pumps have been installed in all Phase II and III sampling wells. These pumps are used for both purging and sampling. Table 10 provides information on the pump intake settings and initial depths

to water for all of the wells. Additional information on the pump types, materials, and intake settings is given in Appendix A.

6.5 SAMPLE COLLECTION

Ground-water samples are collected on a routine basis in 23 wells surrounding the 183-H Basins. The samples are collected by teams of two trained Senior Environmental Radiation Protection Technologists (SERPTs). Hazardous materials sampling procedures have been developed and specifically designed to ensure the integrity of these samples. These procedures include pump operation, borehole purging, field measurements (water levels, temperature, specific conductance, and pH), sample collection, sample preservation and shipment, and chain of custody. A brief summary of these procedures follows.

Water level measurements are taken each time a well is sampled, before purging. These depth-to-water measurements are taken from the designated measuring point on the top of the well casing using a graduated steel tape. The procedure is then repeated until two steel tape measurements agree within ± 0.05 ft. The well is purged following the sample collection procedure corresponding to the type of dedicated pump(s) installed in the well. The purge time is calculated based on the volume of water within the well and the pump discharge rate.

A minimum of three borehole volumes of water is removed from each well to ensure that the sample collected is representative of the water in the aquifer surrounding the well. Temperature, conductivity, and pH measurements are taken during purging of the well and just before sample collection. Measurements taken during purging are used to help ensure that the well bore has been sufficiently evacuated as indicated by stabilization of these three parameters. The temperature is considered stable when two consecutive measurements agree within 0.2°C . Conductivity is considered stable when two consecutive measurements agree within 10 mhos. The pH is considered stable when two consecutive measurements agree within 0.2 pH units. The final temperature, conductivity, and pH measurements are recorded as the analytical values for the sample. All field measurements and observations are recorded on field record forms (Figure 43).

After the well has been properly purged, ground-water samples are collected through Teflon^(a) tubing (submersible and piston pumps) or polyethylene tubing (bladder pump). Extreme care is taken to avoid potential sources of contamination. As each container is filled, a sample seal is placed around the cap to maintain sample integrity during transport to the laboratory. After collection, the sample containers are surveyed with a Geiger-Müller (G-M) instrument. Counts greater than 200 cpm are recorded on the field record form, and radiation work procedures take precedence. An average of three wells are sampled per day by each SERPT team.

6.6 SAMPLE PRESERVATION AND SHIPMENT

Sample preservation is required for those constituents that are not chemically stable. Methods of sample preservation are intended to 1) retard biological action, 2) retard hydrolysis, and 3) reduce sorption effects. Specific preservation methods include pH control, chemical addition, refrigeration, and protection from light. Table 12 lists the constituents analyzed, bottle types used for collection, sample preservation methods, analytical methods, and detection limits for each constituent.

Sample containers are purchased precleaned and are selectively analyzed to confirm EPA protocols. Chemical additions and pH controls are performed by the analytical subcontractor before the bottles are labeled and sent to the field. Procedure manuals containing the sample preservation and handling techniques for each analytical method are maintained by the analytical subcontractor.

After collection, samples are placed in an ice chest and cooled to 4°C. Light-sensitive samples are collected in amber glass bottles. Because of the proximity of the analytical laboratory to the site, Washington State Department of Transportation (WSOOT) packaging requirements do not apply. Samples are normally delivered directly to the laboratory on the day of collection. If the SERPTs return from the field after contractual receiving hours at the

(a) [®]Teflon is a registered trademark of E. I. du Pont de Nemours and Company, Wilmington, Delaware.

laboratory, the samples are stored overnight in a secured refrigerator and delivered at the beginning of the following business day.

6.7 CHAIN OF CUSTODY

The chain-of-custody procedure ensures the integrity of the samples from the time of collection through data reporting. The procedure contains instructions for sample labels, sample seals, field record forms, chain-of-custody forms, sample analysis request forms, and sample delivery. Laboratory acceptance procedures and copies of the sample log-in forms are also included. Copies of the chain-of-custody form and sample analysis request form are shown in Figures 44 and 45, respectively.



Pacific Northwest Laboratories
P.O. Box 399
Burien, Washington 98148

CHAIN OF CUSTODY

Company Contact: _____ Telephone: _____

Samples Collected by: _____ Date: _____ Time: _____

Sample Location: _____

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

Remarks: _____

Method of Shipment: _____

Sample Identification

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

CHAIN OF POSSESSION

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

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

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

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

FIGURE 44. Chain-of-Custody Form

SAMPLE ANALYSIS REQUEST

Pacific Northwest Laboratory
 P O Box 999
 Richland WA 99352

United States Testing Company, Inc.
 2800 George Washington Way
 Richland WA 99353

Collector _____ Received by _____

Date /Time Sampled _____ Title _____

Company Contact _____ Date _____ Time _____

CHAIN OF CUSTODY NO. _____	WATER _____	SOIL _____	OIL _____
SAMPLE ID _____	OTHER _____		
UST SAMPLE ID _____			

CODE	CONSTITUENT								
062	SUSP SOLID								
109	COLIFORM BACTERIA								
111	BETA								
124	URANIUM								
181	RADON								
191	CONDUCTIVITY								
199	pH								
212	ALPHA								
725	ICP METALS 8010								
726	ICP METALS 8010 ENHANCED								
727	METHOD 8130 ENHANCED								
728	PESTICIDES 8080								
729	PESTICIDES 8080 ENHANCED								
730	VGA METHOD 8240								
731	VGA METHOD 8240 ENHANCED								
732	A/B/N 8270								
733	A/B/N 8270 ENHANCED								
734	PESTICIDES METHOD 8140								
735	NETRATE, SULPHATE, (IC)								
736	DIRECT AQUEOUS INJECTION								
737	HERBICIDE 8150 ENHANCED								
738	HERBICIDE 2,4-D, 2,4,5-TP SILVER								
739	PCB								
740	FILTERED ICP METALS								
741	FILTERED ICP METALS ENHANCED								
A20	ARSENIC								
A21	MERCURY								
A22	SELENIUM								
A23	THALLIUM								
A24	THIOUREA 8110								
A51	LEAD BY GPAA								
C68	TOX								
C69	TOC								
C70	CYANIDE								
C77	PERCHLORATE								
C78	SULFIDE								
C80	AMMONIUM ION								
C81	ETHYLENE GLYCOL								
C86	DIOXIN								
C87	CITRUS RED 43								
H16	TOTAL CARBON								
H17	TOTAL DISSOLVED SOLIDS								
H37	FILTERED ARSENIC								
H38	FILTERED MERCURY								
H39	FILTERED SELENIUM								
H40	FILTERED THALLIUM								
H41	FILTERED LEAD								
H42	TOX - LOWER DET LIMIT								
H57	PHENOL								
H58	ALKALINITY								
H59	OIL & GREASE								
H62	HYDRAZINE (HDL)								
H63	FLUORIDE (HDL)								
H64	BISMUTH								
H65	NITRATE (HDL)								

DR79 68

PAGE - 1

FIGURE 45. Sample Analysis Request Form

7.0 ANALYTICAL RESULTS

The raw analytical data collected from the ground-water monitoring network at the 100-H Area for June 1985 through December 1987 are included in the quarterly progress reports for the Ground-Water Monitoring Compliance Projects for Hanford Site Facilities (DOE 1986; 1987a,b,c,d; 1988).

7.1 SUMMARY OF RESULTS TO DATE

The following discussion contains a summary of the ground-water sampling results from June 1985 through October 1987.

Pesticides and herbicides from the list of primary DWS, phenol from the ground-water quality parameters, and most of the constituents listed in the WAC 173-303-9905 generally have not been detected in ground-water samples from the 183-H monitoring network. The following general classes of constituents have been reported at detectable levels: contamination indicators; most of the metals and radioactive constituents and a few of the volatile organic compounds from the list of primary DWS; most of the ground-water quality parameters; and most of the site-specific constituents. In addition, Maximum Contaminant Levels (MCLs) have been exceeded by one or more samples for the following constituents: coliform bacteria, screening limits for gross alpha and gross beta, strontium-90, cadmium, chromium, mercury, selenium, and nitrate.

Most of the constituents that have been detected in the monitoring network exhibit a large degree of variability and require detailed analysis. Constituents with a small degree of variability include laboratory pH, coliform, filtered and unfiltered cadmium, silver, arsenic, mercury, selenium, lead, beryllium, phosphate, 1,1,1-trichloroethane, perchloroethylene, thallium, bis(2-ethylexy) phthalate, total carbon, total dissolved solids (TDS), laboratory pH, cobalt-60, strontium-90, and uranium. These constituents are either not considered to be indicative of contamination in the ground water attributable to the 183-H Basins, or information is too limited to make defensible conclusions. A short summary for each of these constituents follows.

- Cadmium - sporadically reported in several wells usually at or near the detection limit of 2 ppb
- Silver - reported once in Well 199-H4-3
- Arsenic - consistently reported in several wells near the 183-H Basins at levels just above the detection limit of 5 ppb
- Mercury - reported in several wells in July 1985 but otherwise below the detection limit of 0.1 ppb
- Selenium - reported twice in Well 199-H4-5 and once in Well 199-H4-9
- Lead - sporadically reported in several wells, usually at or near the detection limit of 5 ppb
- Beryllium - reported twice at the detection limit of 5 ppb
- Phosphate - reported once above the detection limit of 1000 ppb
- 1,1,1-Trichloroethane - sporadically reported in several wells
- Perchloroethylene - sporadically reported in several wells
- Thallium - reported once above the detection limit of 10 ppb in the initial sampling in June 1985
- Bis(2-ethylexyl) phthalate - reported once above the detection limit of 10 ppb
- Total carbon - initially reported in October 1987
- TDS - initially reported in October 1987
- Laboratory pH - initially reported in October 1987
- Cobalt-60 - limited data, mostly less than counting error
- Strontium-90 - limited data, near 1 pCi/L except one value
- Uranium - limited data, initially analyzed in March 1988.

Sufficient data are available for the following constituents to allow their use in the characterization of the contaminated ground water at the 100-H Area: specific conductance, field pH, total organic halides (TOX), and

total organic carbon (TOC) from the list of contamination indicators; gross alpha, gross beta, radium, nitrate, fluoride, filtered and unfiltered barium and chromium from the list of drinking water standards; sulfate, chloride, filtered and unfiltered sodium, manganese, and iron from the list of ground-water quality parameters; and chloroform, ammonium, filtered and unfiltered strontium, zinc, calcium, nickel, copper, vanadium, aluminum, potassium, and magnesium from the list of site-specific constituents.

Review of these data revealed that concentrations of approximately 20 constituents showed very marked increases in the point-of-compliance well, 199-H4-3, between April and August 1986. Concentrations of this magnitude have not been repeated since that time.

Plots of concentration versus time for specific conductance, gross alpha, gross beta, nitrate, barium, sulfate, sodium, strontium, calcium, nickel, copper, and potassium clearly indicate when this peak occurred (Figures 46 through 57). Chromium (Figure 58), although it does not exhibit a similar concentration peak as the other indicator constituents, remains above the MCL of 50 ppb for most of the wells in the present network.

Additional constituents to be used as indicators of contamination from the 183-H Basins are TOC, radium, fluoride, chloroform, and magnesium. Alkalinity, pH, and TOX will be used for geochemical modeling. A short summary of the remaining constituents that do not appear to be indicative of ground-water contamination from the 183-H Basins follows:

- Manganese - concentrations in Well 199-H4-3 are lower than in background Well 199-H4-6
- Iron - concentrations are lower during the April to August 1986 peak
- Chloride - no discernible increase in concentrations over background
- Zinc - concentrations are lower than background
- Vanadium - no discernible increase in concentrations over background

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Phase I Wells, June 1985 to October 1987
 Plotting symbols are abbreviations of Well name
 Horizontal solid line is detection limit
 Constituent-191 CONDFLD UMHO EPA Limit-None

86

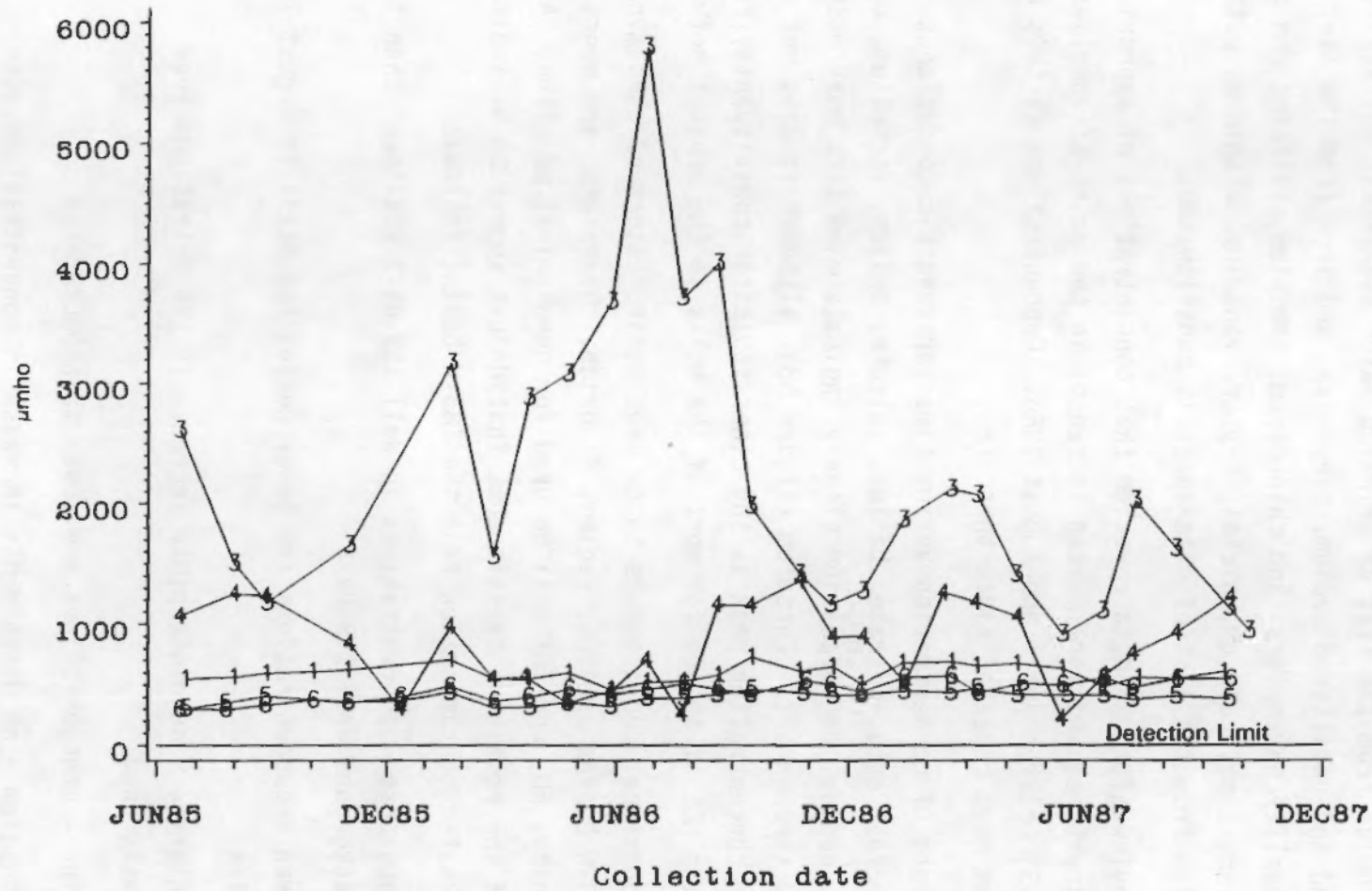


FIGURE 46. Specific Conductance in the Original Monitoring Wells

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Phase I Wells, June 1985 to October 1987
 Plotting symbols are abbreviations of Well name
 Horizontal solid line is detection limit
 Constituent-212 ALPHA PCI/L Screening Limit-15

66

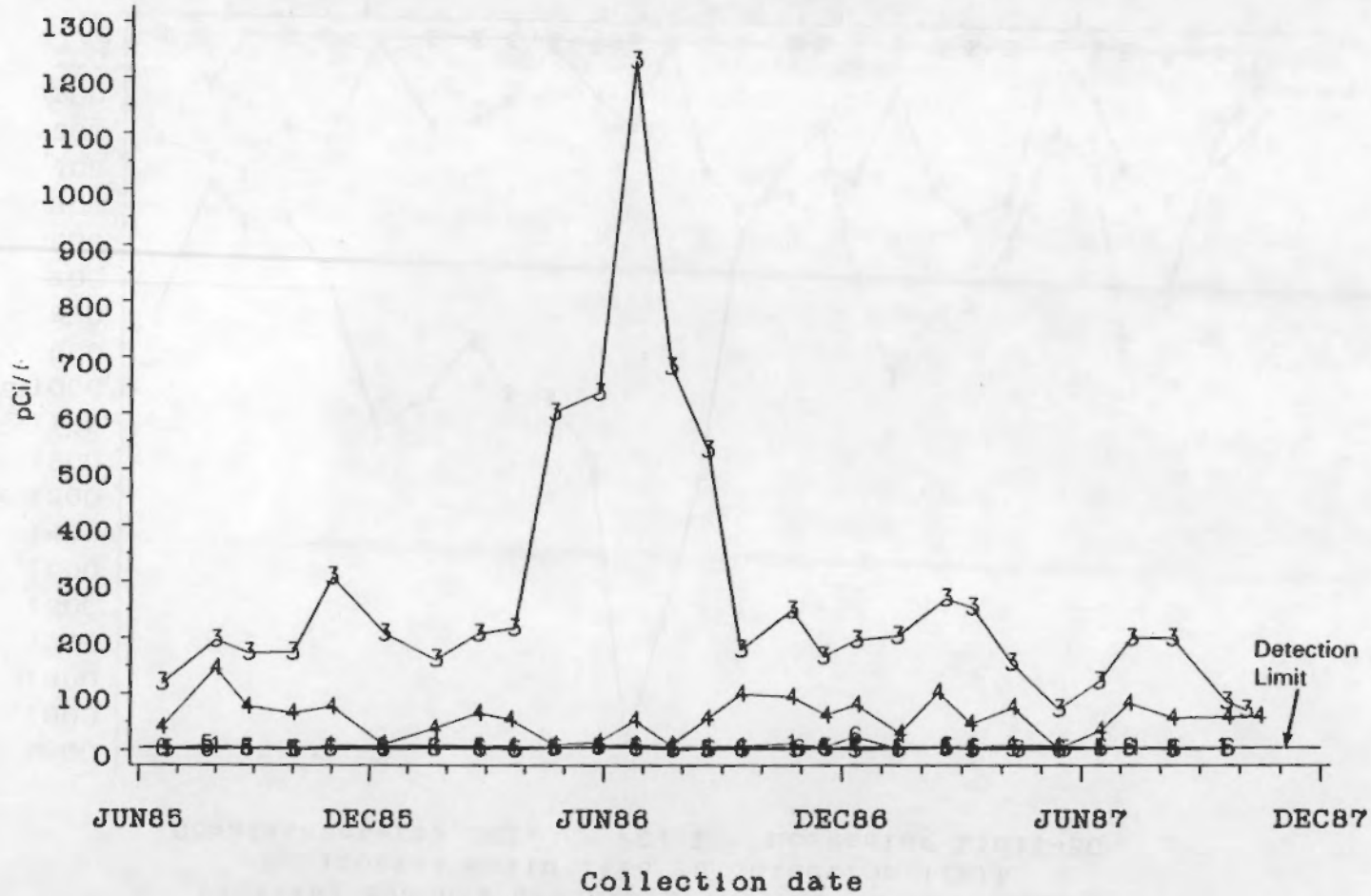


FIGURE 47. Gross Alpha Concentrations in the Original Monitoring Wells

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Phase I Wells, June 1985 to October 1987
 Plotting symbols are abbreviations of Well name
 Horizontal solid line is detection limit
 Constituent-111 BETA PCI/L Screening Limit-50

100

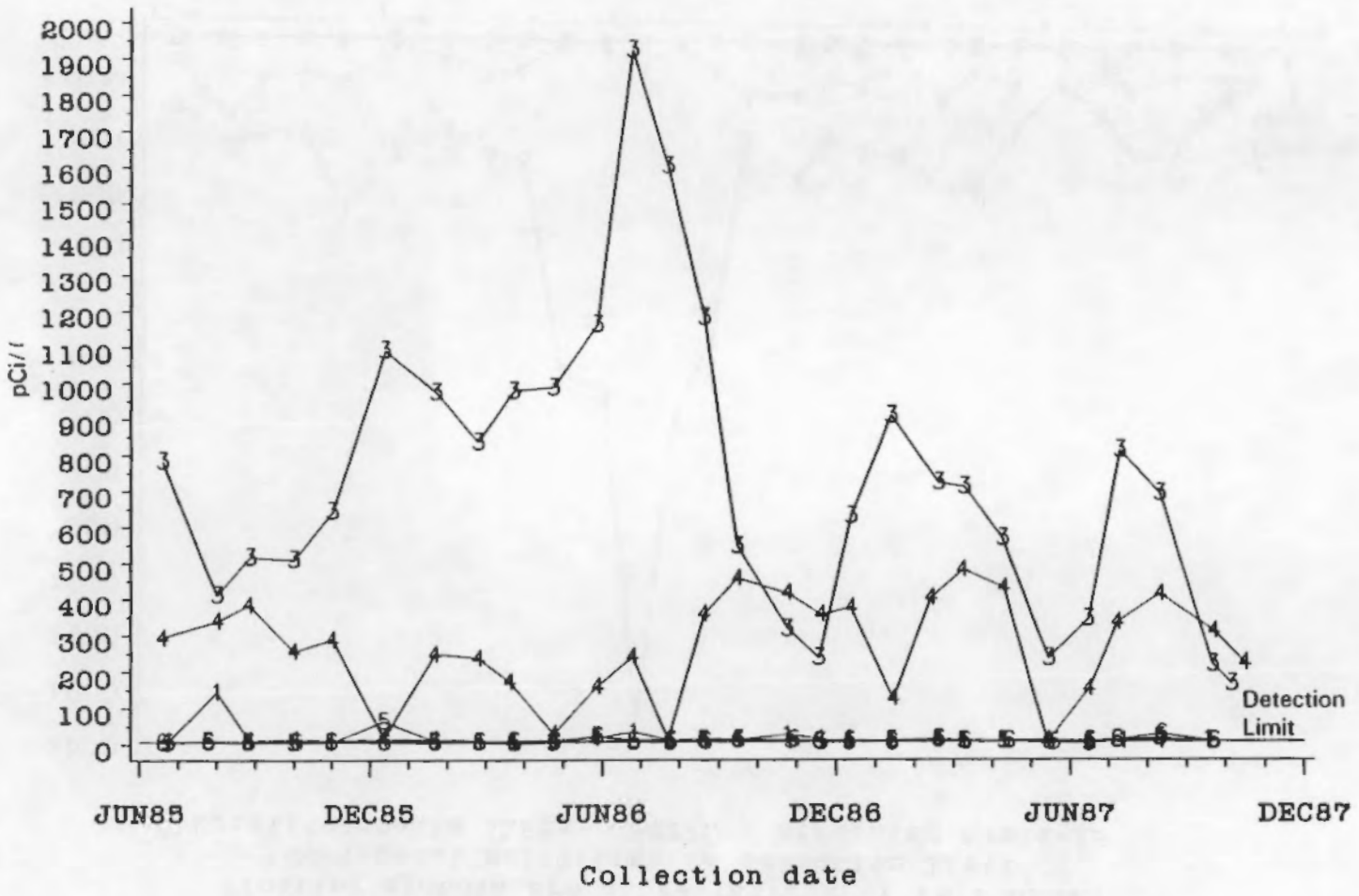


FIGURE 48. Gross Beta Concentrations in the Original Monitoring Wells

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Phase I Wells, June 1985 to October 1987
 Plotting symbols are abbreviations of Well name
 Horizontal solid line is detection limit
 Constituent-C72 NITRATE PPB EPA Limit-45000

101

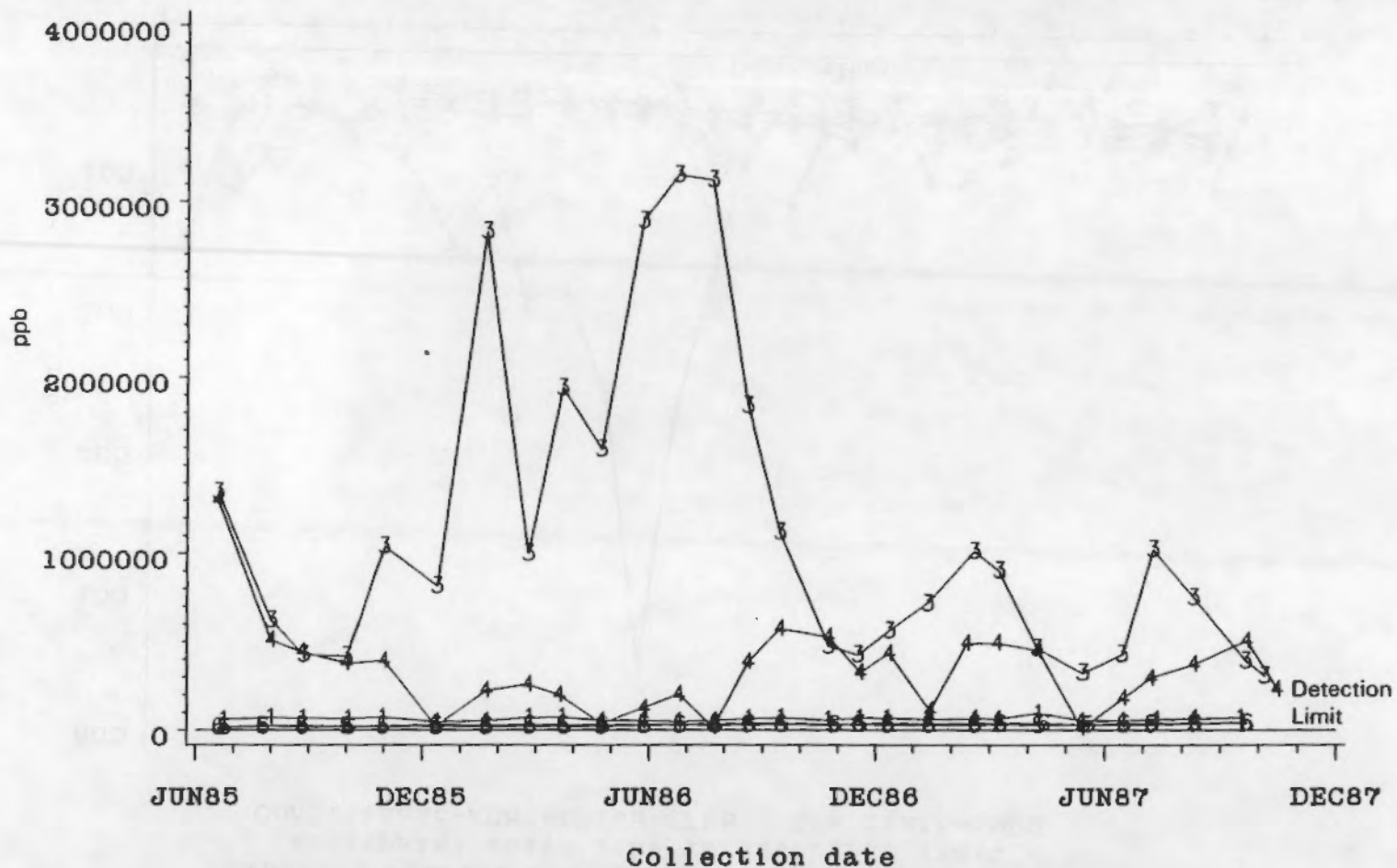


FIGURE 49. Nitrate Concentrations in the Original Monitoring Wells

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Phase I Wells, June 1985 to October 1987
 Plotting symbols are abbreviations of Well name
 Horizontal solid line is detection limit
 Constituent-A06 BARIUM PPB EPA Limit-1000

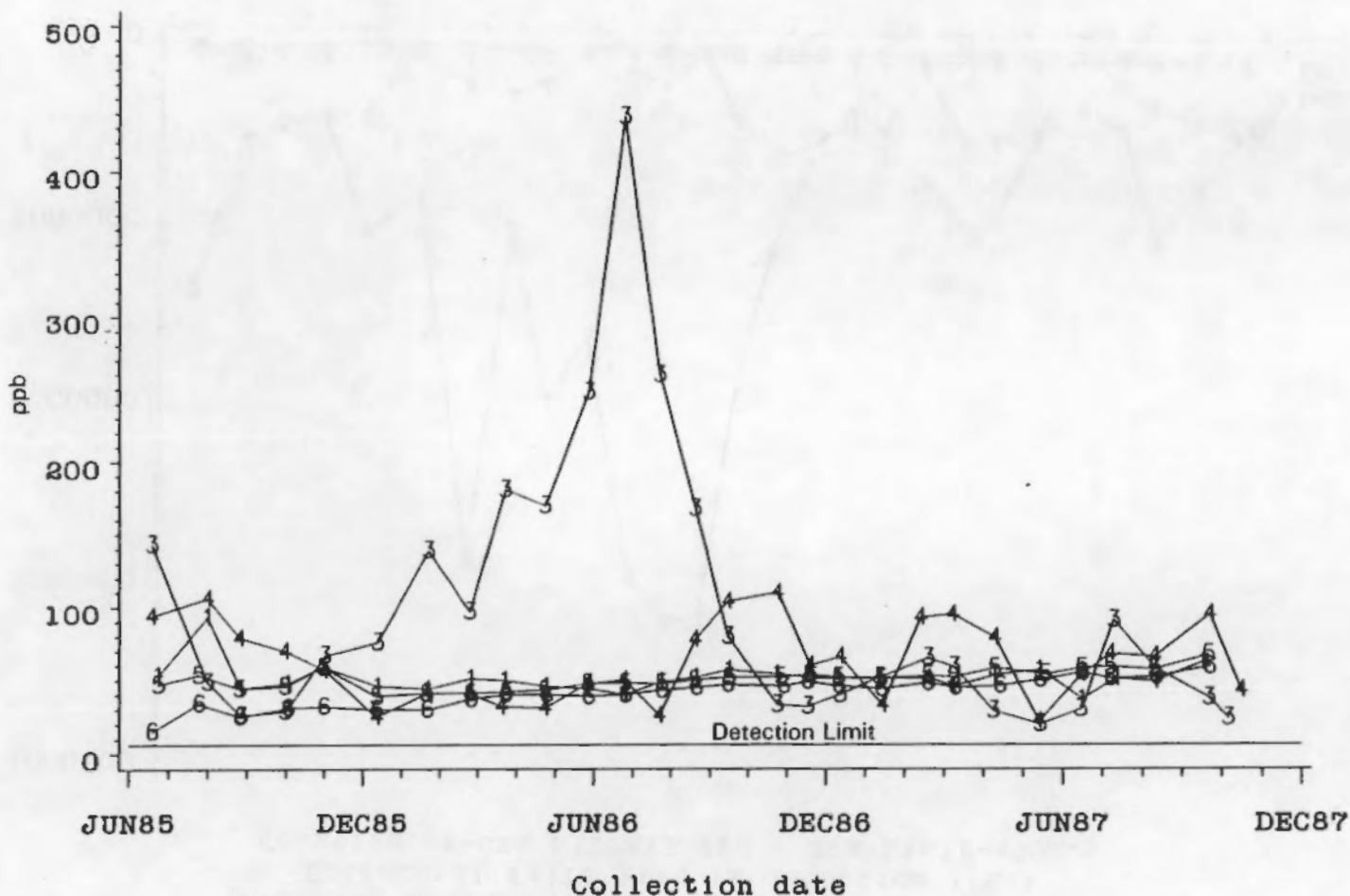


FIGURE 50. Barium Concentrations in the Original Monitoring Wells

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Phase I Wells, June 1985 to October 1987
 Plotting symbols are abbreviations of Well name
 Horizontal solid line is detection limit
 Constituent-C73 SULFATE PPB EPA Limit-None

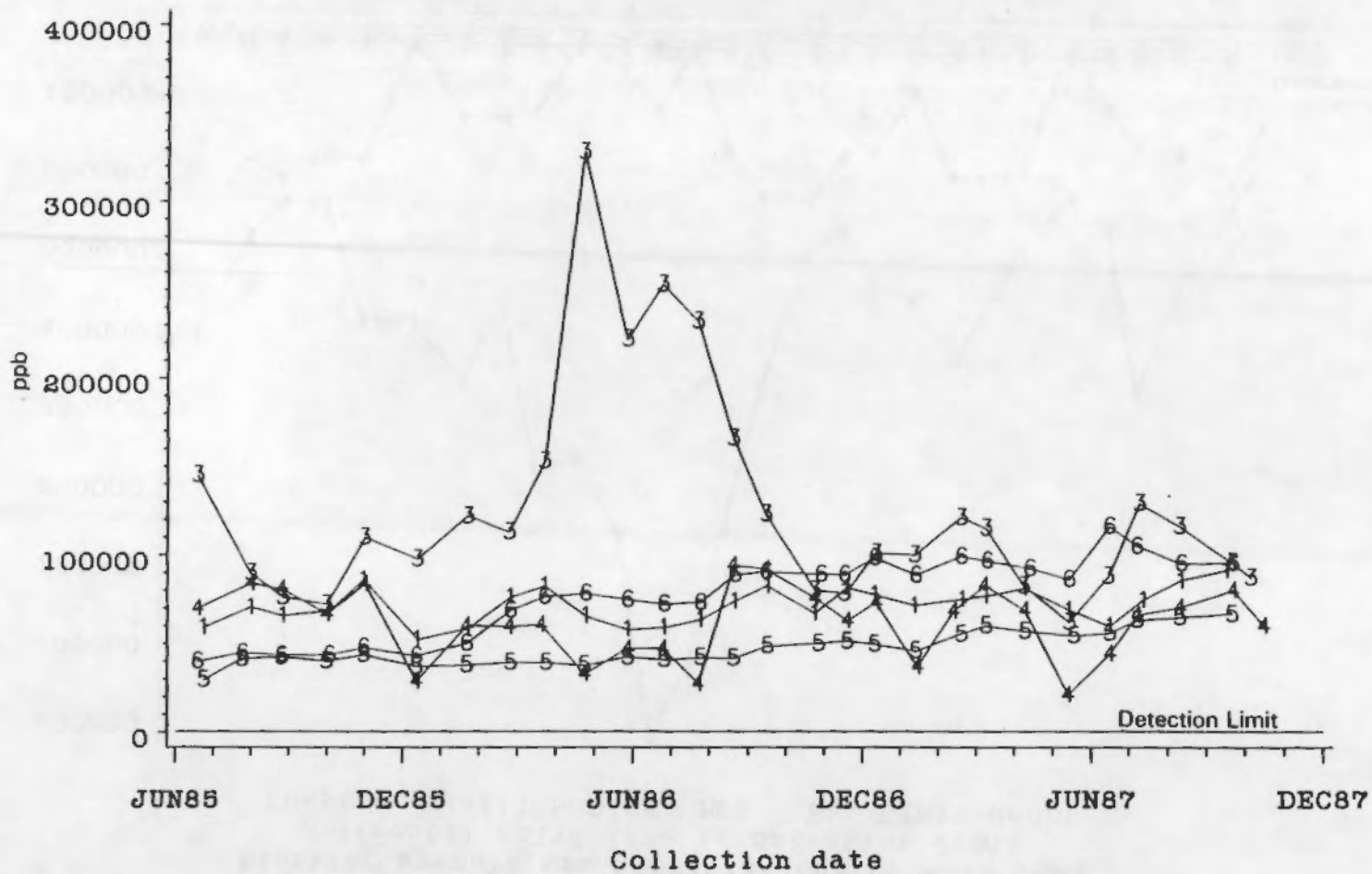


FIGURE 51. Sulfate Concentrations in the Original Monitoring Wells

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Phase I Wells, June 1985 to October 1987
 Plotting symbols are abbreviations of Well name
 Horizontal solid line is detection limit
 Constituent-All SODIUM PPB EPA Limit-None

104

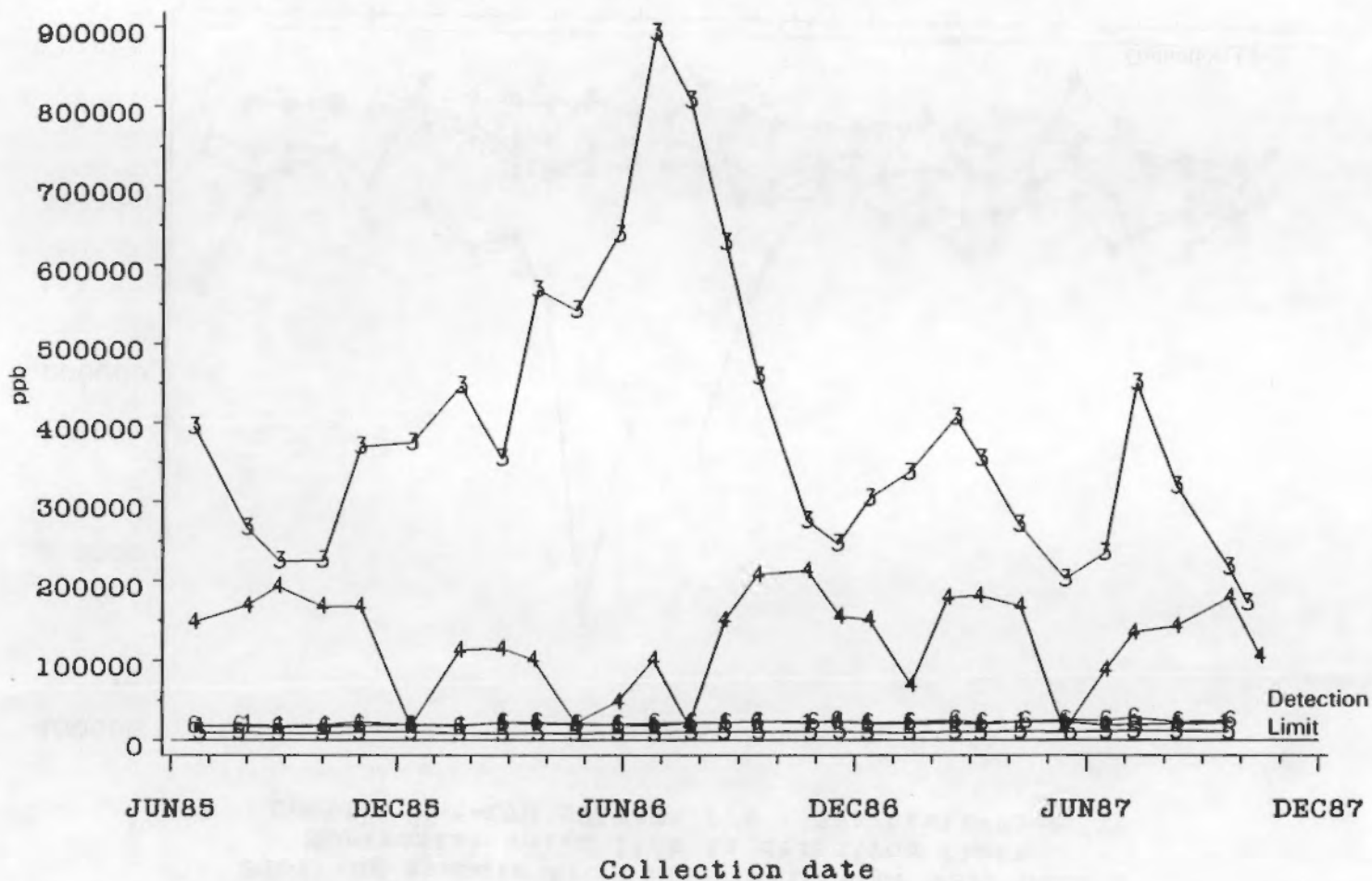


FIGURE 52. Sodium Concentrations in the Original Monitoring Wells

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Phase I Wells, June 1985 to October 1987
 Plotting symbols are abbreviations of Well name
 Horizontal solid line is detection limit
 Constituent-A03 STRONUM PPB EPA Limit-None

105

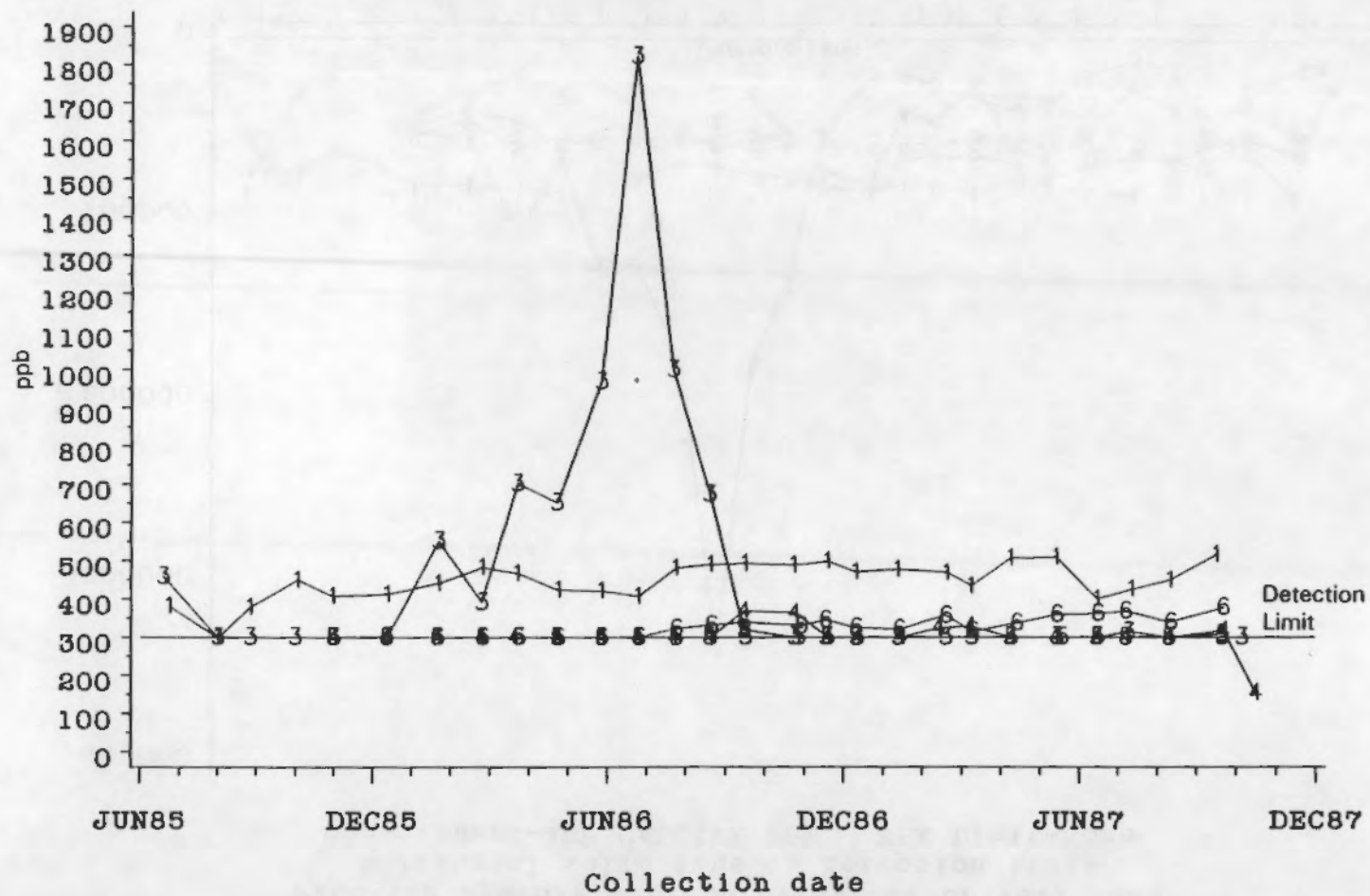


FIGURE 53. Strontium Concentrations in the Original Monitoring Wells

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Phase I Wells, June 1985 to October 1987
 Plotting symbols are abbreviations of Well name
 Horizontal solid line is detection limit
 Constituent-A05 CALCIUM PPB EPA Limit-None

106

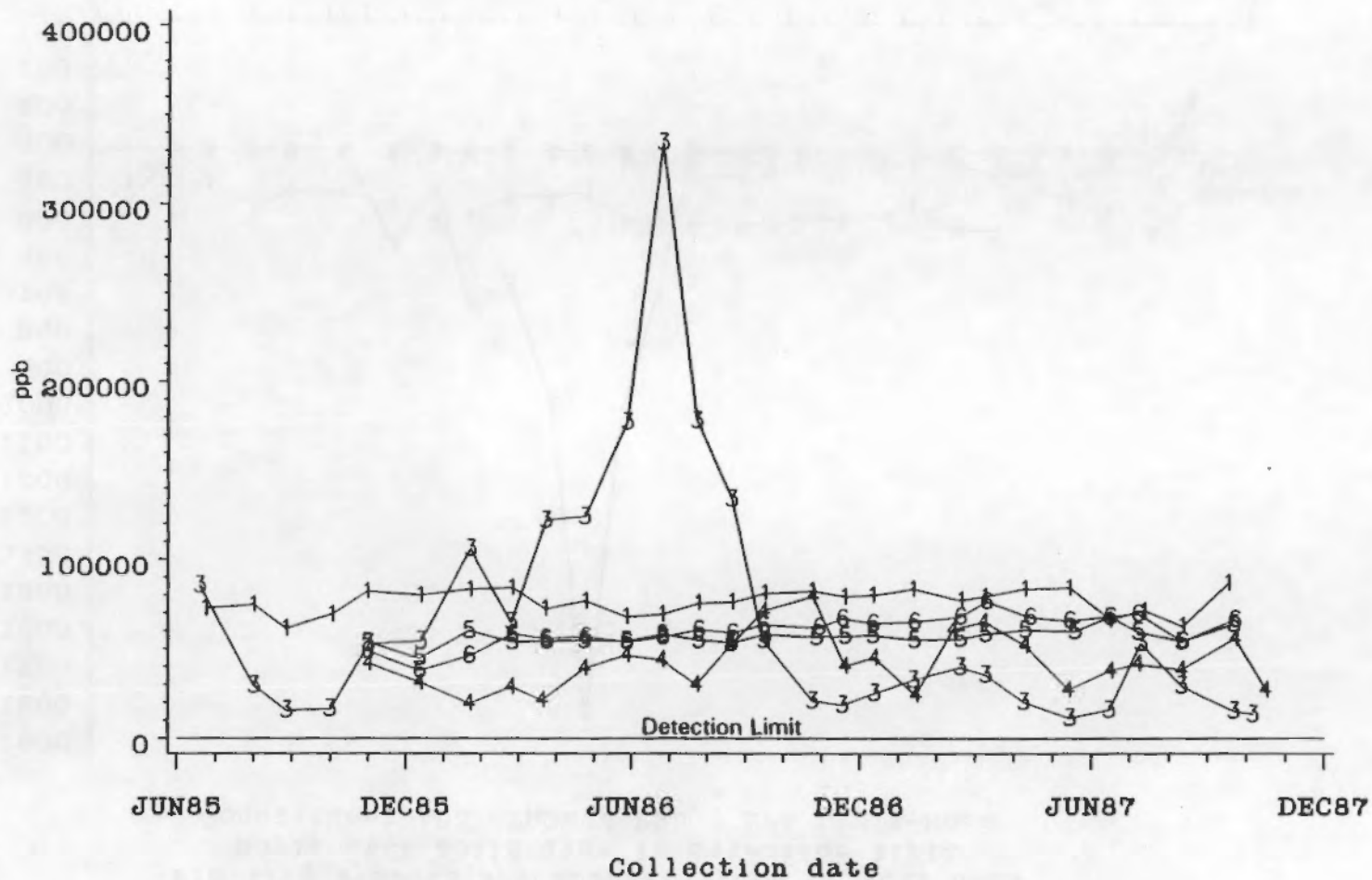


FIGURE 54. Calcium Concentrations in the Original Monitoring Wells

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Phase I Wells, June 1985 to October 1987
 Plotting symbols are abbreviations of Well name
 Horizontal solid line is detection limit
 Constituent-Al2 NICKEL PPB EPA Limit-None

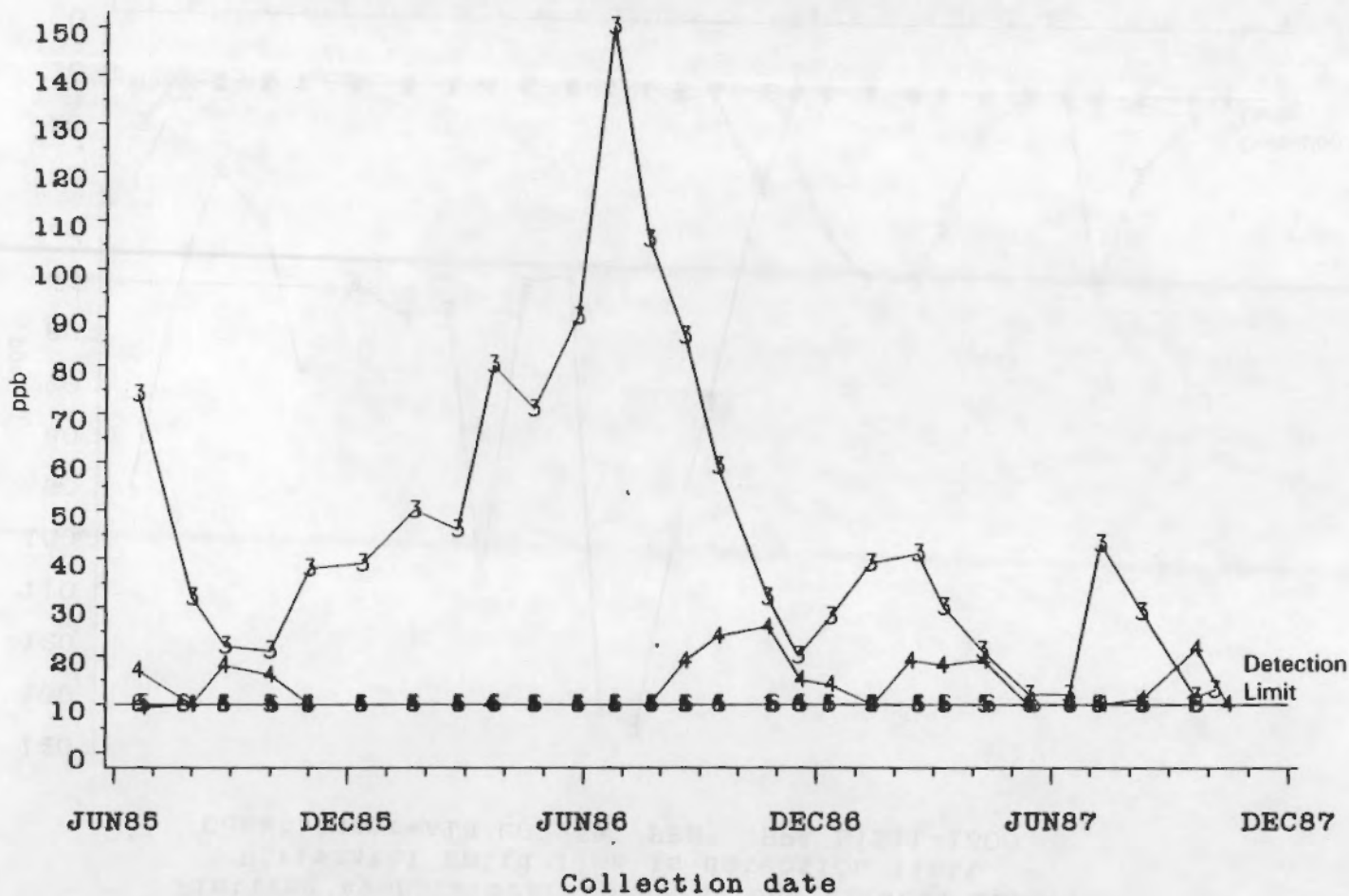


FIGURE 55. Nickel Concentrations in the Original Monitoring Wells

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Phase I Wells, June 1985 to October 1987
 Plotting symbols are abbreviations of Well name
 Horizontal solid line is detection limit
 Constituent-A13 COPPER PPB EPA Limit-1300

108

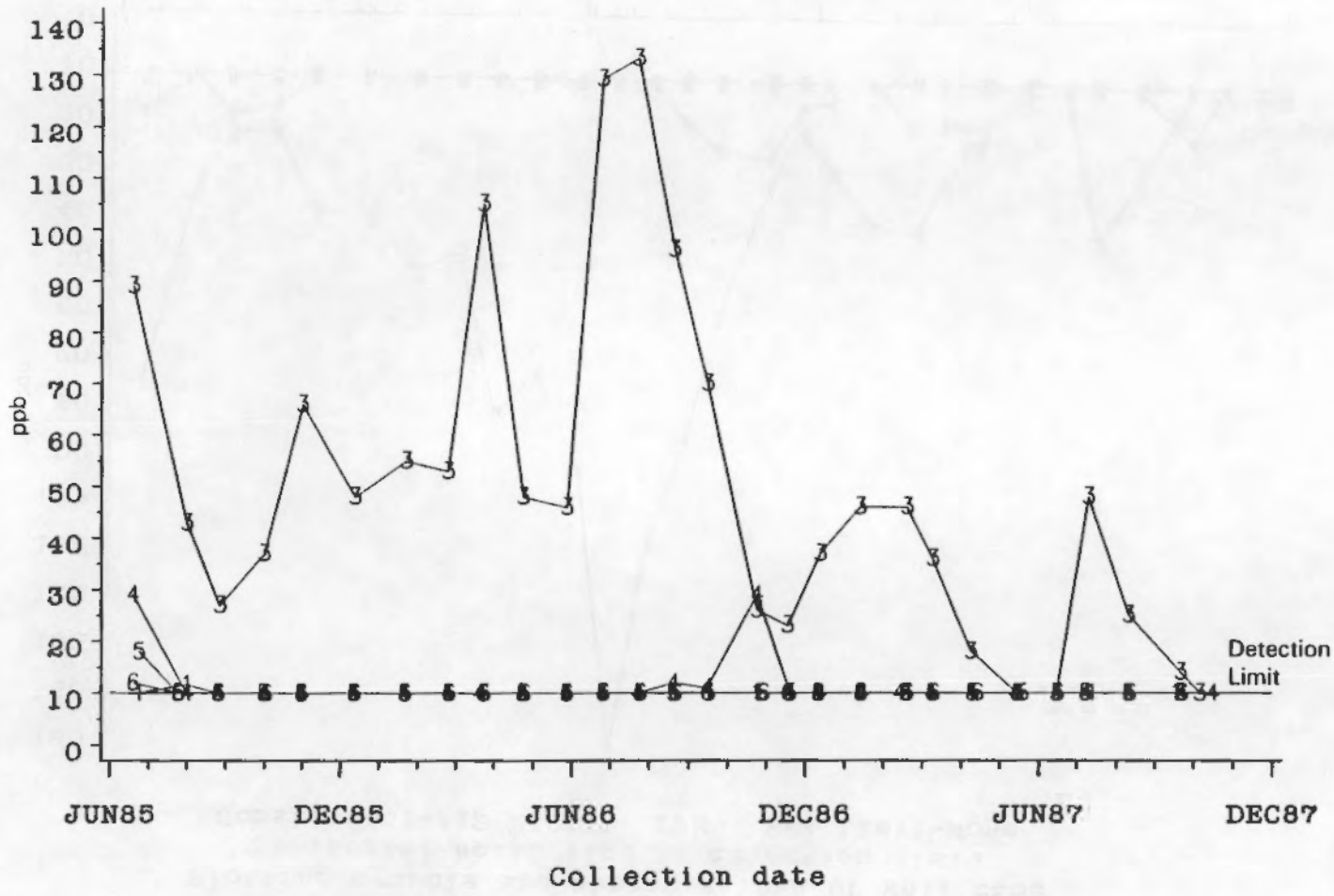


FIGURE 56. Copper Concentrations in the Original Monitoring Wells

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Phase I Wells, June 1985 to October 1987
 Plotting symbols are abbreviations of Well name
 Horizontal solid line is detection limit
 Constituent-A18 POTASUM PPB EPA Limit-None

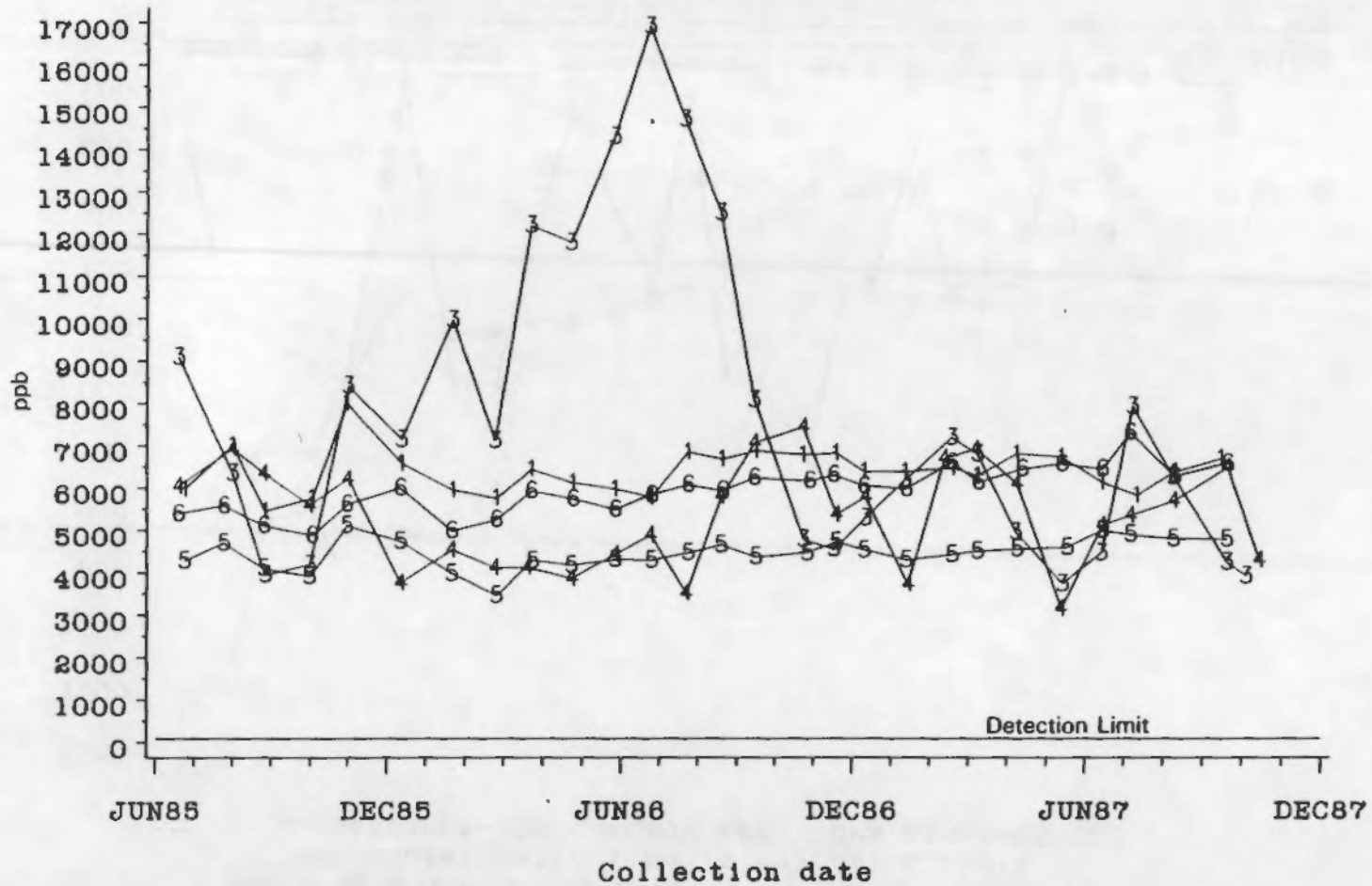


FIGURE 57. Potassium Concentrations in the Original Monitoring Wells

RCRA Compliance Groundwater Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Phase I Wells, June 1985 to October 1987
 Plotting symbols are abbreviations of Well name
 Horizontal solid line is detection limit
 Constituent-A08 CHROMIUM PPB EPA Limit-50

110

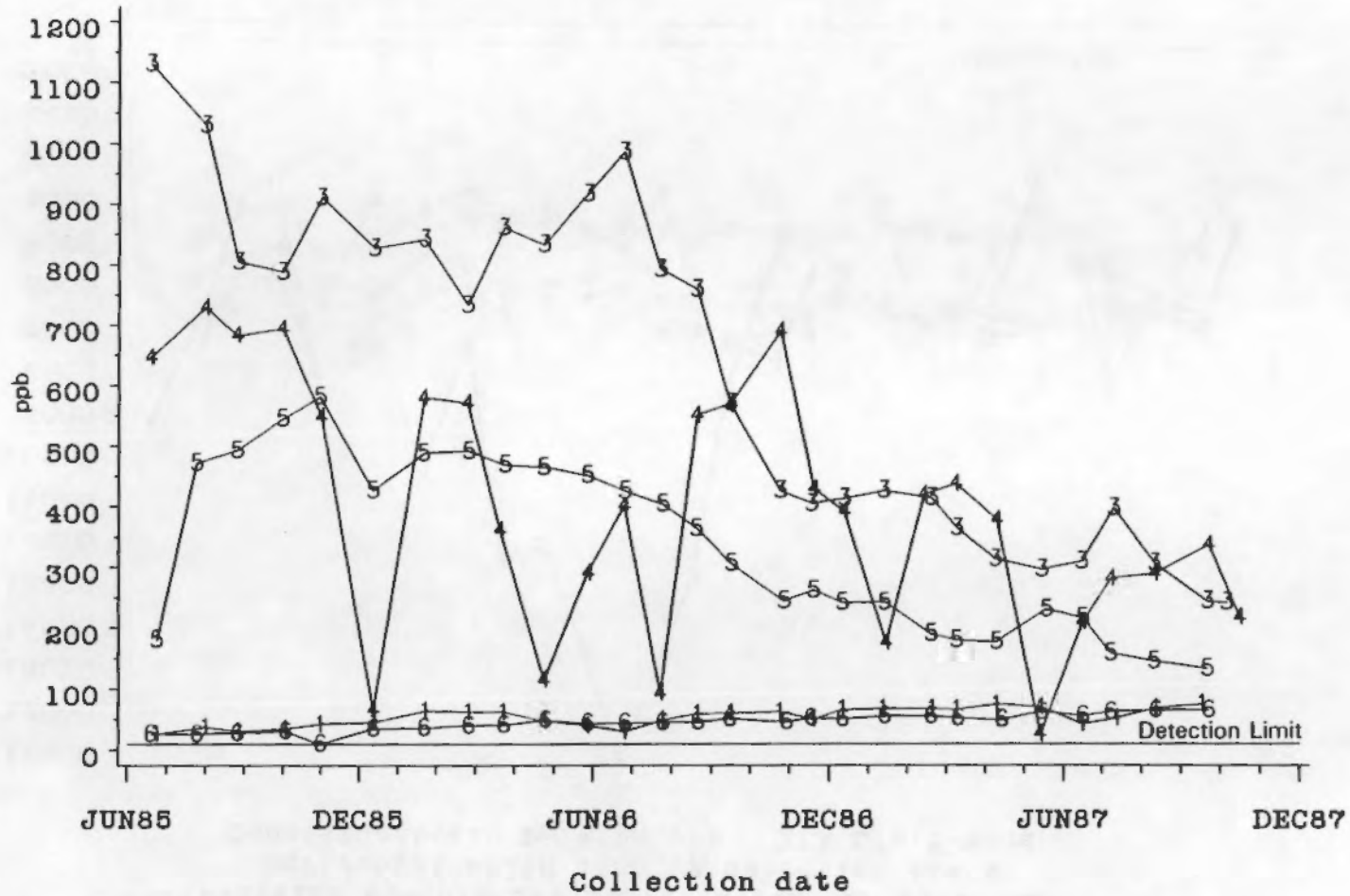


FIGURE 58. Chromium Concentrations in the Original Monitoring Wells

- Aluminum - concentrations are lower during the April to August 1986 peak
- Ammonium - concentrations are generally less than background.

A discussion of the clearest indicators of contamination attributable to the 183-H Basins appears in Section 9.0 "Contaminant Plume Description."

... concentrations are lower during the night to August 1968

1968

... concentrations are generally less than background

A discussion of the clearest indicators of contamination and their

in the 1968-69 season is given in section 3.0. Additional data are given

8.0 STATISTICAL EVALUATIONS

As discussed in Sections 1.0 "Introduction," and 7.0 "Analytical Results," a compliance monitoring program was established in June 1985 because hazardous waste constituents were known to have entered the ground water beneath the 183-H Basins. Based on these data and guidance provided in the WAC 173-303-645, the following statistical evaluations were performed.

8.1 DESCRIPTIVE STATISTICS

Basic descriptive statistics were calculated for the 68 constituents that had at least one value above the detection limit to determine the variability in the data for the sampling period June 1985 through October 1987 (Appendix B). These statistics include: the maximum (MAX), median, minimum (MIN), range (MAX-MIN), mean, standard deviation (STD), and coefficient of variation ($CV = STD/mean$). Appendix B gives the number of samples analyzed, the number of samples that were below the detection limit (or flagged by being reported with a "less than" value), and the number of days that samples were collected. The median values for the days (N) that had at least one value above the detection limit were used to calculate the descriptive statistics. A "." in Appendix B indicates that the statistic could not be calculated because of an insufficient number of values above the detection limit. The following observations were made with regard to these data.

Concentrations in filtered and unfiltered samples for the same constituent often do not appear similar in Wells 199-H3-1, 199-H4-3, 199-H4-4, 199-H4-5, and 199-H4-6. These differences arise primarily because samples collected during different time periods were used for concentration analyses: the unfiltered constituents for these wells have been collected since June 1985, while the filtered constituents have been collected only since September 1986.

The standard deviations and coefficients of variation are relatively large for a number of constituents and wells. Several of these constituents

are changing significantly with time (either increasing or decreasing). The concentrations are also changing significantly with the water levels in the wells.

8.2 CLUSTER WELL STATISTICS

Descriptive statistics for the three cluster well locations were reviewed individually to determine statistical differences in constituent concentrations with depth. The following observations were made from these data:

- Aluminum, ammonium, iron, and vanadium are generally detected only in the deep wells (199-H3-2C and 199-H4-12C).
- Barium concentrations are lowest in the deep wells and highest in the intermediate wells (199-H2-2B, 199-H4-12B, and 199-H4-15B).
- Calcium, chromium, strontium, and sulfate concentrations are lowest in the deep wells and the same in the shallow (199-H3-2A, 199-H4-12A, and 199-H4-15A) and intermediate wells.
- Chloride has the largest mean but lowest median in the deep wells. No differences occur in the shallow and intermediate wells.
- Chloroform is not often detected in the deep wells.
- Gross alpha and gross beta concentrations decrease with depth in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C. These constituents are below DWS at the other cluster well locations.
- Manganese is generally detected only in the intermediate and deep wells.
- Nitrate concentrations and specific conductance decrease with depth.
- Potassium and zinc concentrations increase with depth.
- Sodium concentrations are highly variable in the deep wells.

8.3 LINEAR REGRESSION ANALYSES

A series of simple and multiple linear regression analyses were performed to determine if the chemical constituents in the wells were changing with time and water table elevation. Analyses were performed for the period June 1985 through October 1987 using 18 chemical constituents (Table 14) in 20 wells (Table 15). These constituents were chosen because their concentrations (except those of chloroform and chromium) were routinely reported above detection limits in all the wells.

Wells 199-H3-1, 199-H4-3, 199-H4-4, 199-H4-5, and 199-H4-6 were divided into two time periods (pre- and post-September 1, 1986) because of the significant change in concentration trends in Well 199-H4-3 at this time. Prior to September 1, 1986, concentrations of all chemical constituents in this well were increasing with time and with increases in water table elevation (Figures 59 and 60). However, these concentrations have no statistically significant increases or decreases with time or water table elevation after September 1, 1986.

Several wells along the Columbia River are affected by changes in water table elevation. Most of the chemical constituents in Wells 199-H4-4 (pre- and post-) (Figures 61 and 62), 199-H4-10, 199-H4-12A, and 199-H4-12B significantly decreased with increases in water table elevation.

TABLE 14. Chemical Constituents Used for Linear Regression Trend Analyses

Gross Alpha	Specific Conductance
Gross Beta	Filtered Magnesium
Filtered Barium	Unfiltered Magnesium
Unfiltered Barium	Nitrate
Filtered Calcium	Filtered Potassium
Chloroform	Unfiltered Potassium
Chloride	Filtered Sodium
Filtered Chromium	Unfiltered Sodium
Unfiltered Chromium	Sulfate

TABLE 15. Wells Used for Linear Regression Trend Analyses

<u>Well No.</u>	<u>Period</u>
199-H3-1	(Pre-9-1-86)
199-H3-1	(Post-9-1-86)
199-H3-2A	
199-H4-2B	
199-H3-2C	
199-H4-3	(Pre-9-1-86)
199-H4-3	(Post-9-1-86)
199-H4-4	(Pre-9-1-86)
199-H4-4	(Post-9-1-86)
199-H4-5	(Pre-9-1-86)
199-H4-5	(Post-9-1-86)
199-H4-6	(Pre-9-1-86)
199-H4-6	(Post-9-1-86)
199-H4-7	
199-H4-8	
199-H4-9	
199-H4-10	
199-H4-11	
199-H4-12A	
199-H4-12B	
199-H4-12C	
199-H4-13	
199-H4-14	
199-H4-15A	
199-H4-15B	

Concentrations of chemical constituents in several upgradient wells were also significantly affected by changes in water table elevation. Concentrations in Well 199-H3-1 decreased significantly with increases in water table elevation. Most of the chemical constituents in Wells 199-H3-2A and 199-H3-2B significantly increased with increases in water table elevation. Well 199-H4-6 showed no consistent effects.

Well 199-H4-7 had significant increases in chemical concentrations when the water table elevation increased. Other wells located adjacent to the 183-H Basins [Wells 199-H4-3 (post-), 199-H4-5 (post-), 199-H4-8, 199-H4-9, and 199-H4-14] had almost no significant effects caused by changes in water table elevation.

Wells 199-H3-2C and 199-H4-12C had only a few chemical constituents that were affected by the water table elevation. However, most of the constituents in these wells are significantly decreasing over time.

All the chemical constituents in Well 199-H4-6 (pre-) were increasing significantly with time, except chloroform, which was significantly decreasing. Gross beta, chloroform, calcium, specific conductance, gross alpha, and sulfate were no longer significantly increasing after September 1, 1986.

Several of the wells had a number of chemical constituents that were either significantly increasing or significantly decreasing with time. Wells 199-H3-1 (pre-), 199-H3-2A, 199-H3-2B, 199-H4-5 (pre-), 199-H4-6 (pre-), 199-H4-7, 199-H4-8, and 199-H4-11 had increasing trends with time. Decreasing trends with time were noted for Wells 199-H3-1 (post-), 199-H4-12A, 199-H4-12B, and 199-H4-13. Wells 199-H4-3 (post-), 199-H4-4, 199-H4-14, 199-H4-15A, and 199-H4-15B do not show significant changes over time.

RCRA Compliance Ground-Water Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Plots of relationship between Water Level and Concentration
 Dashed line is water level, Solid line is constituent
 Well name=1-H4-3

118

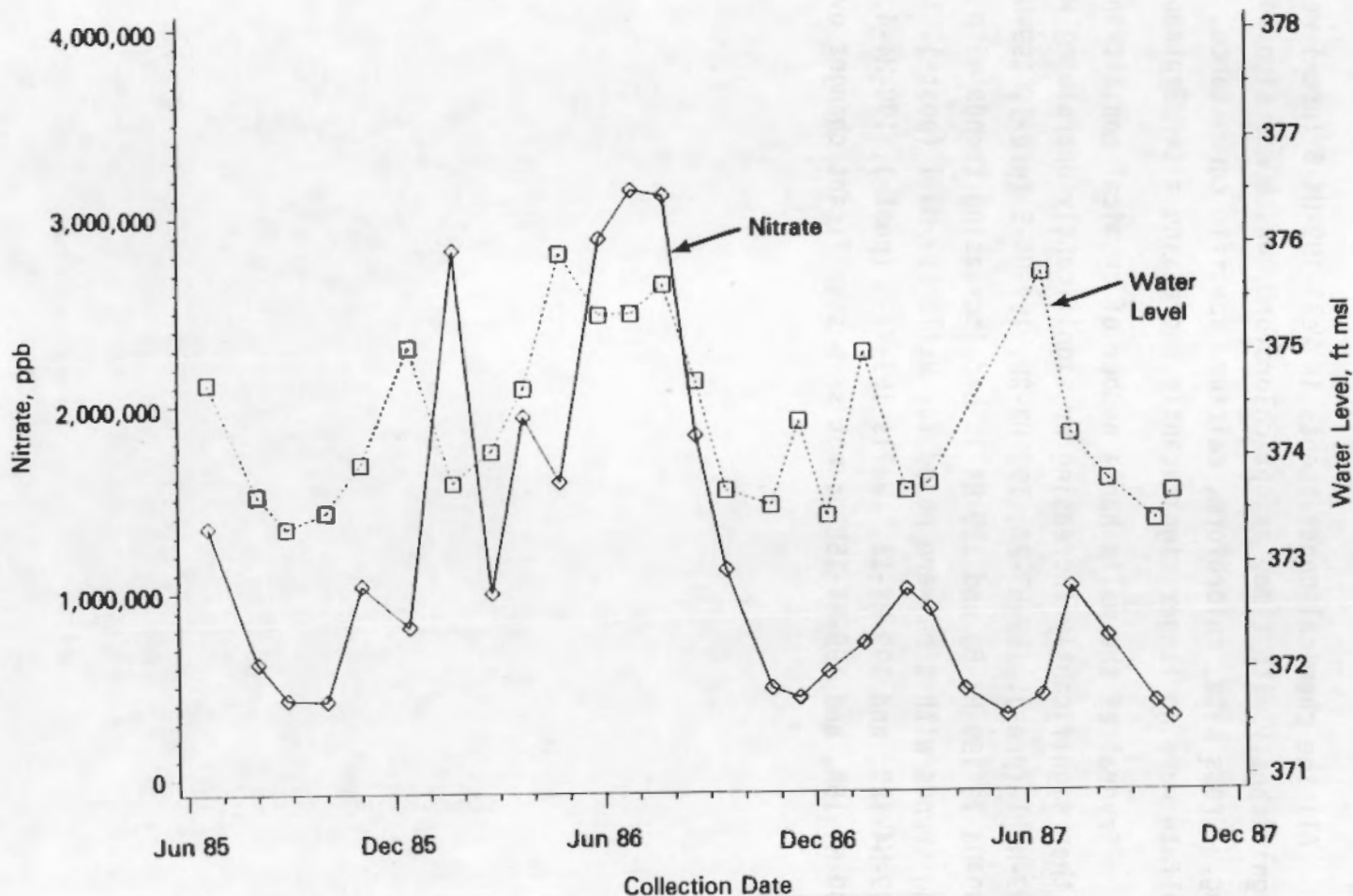
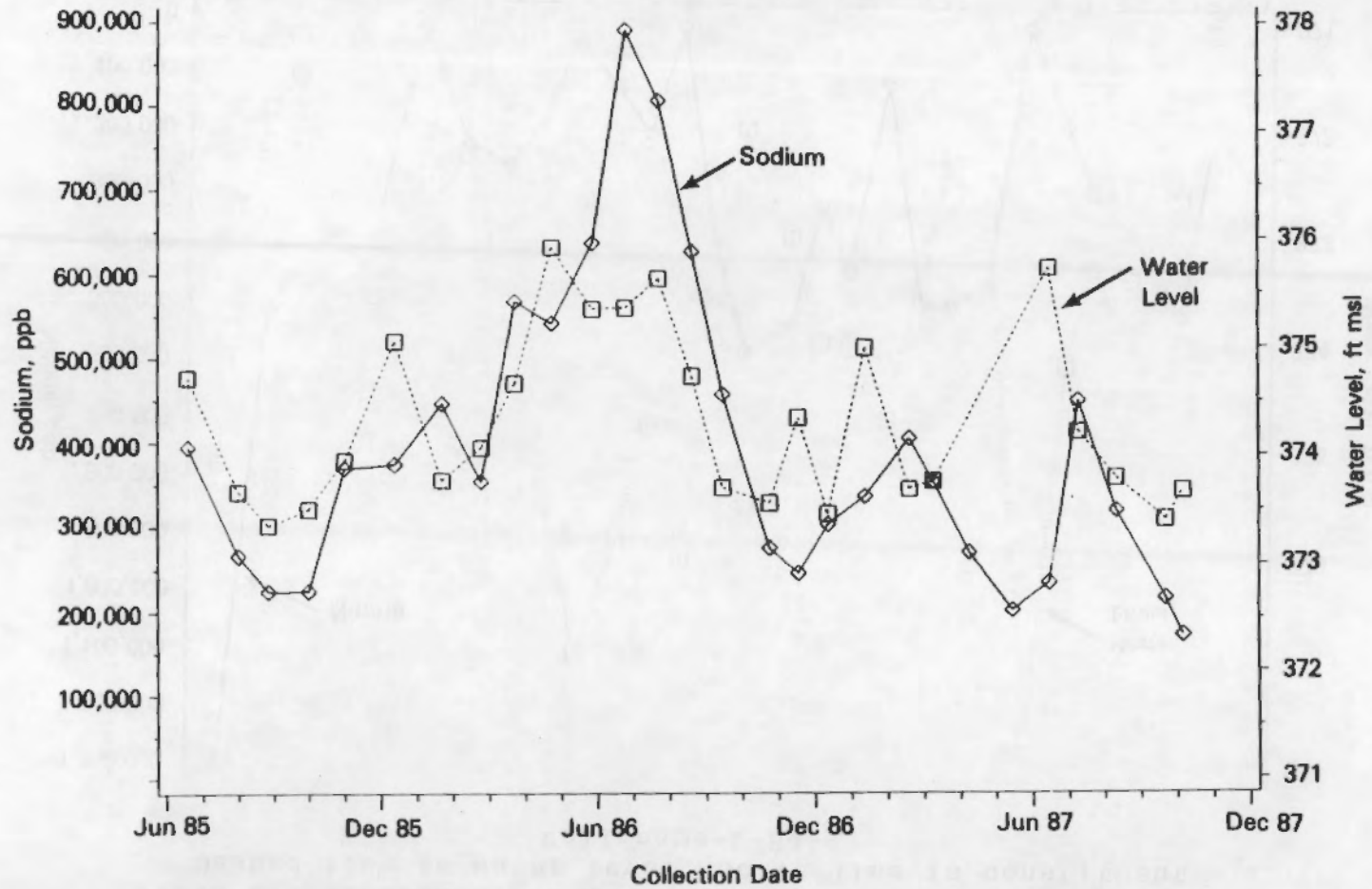


FIGURE 59. Nitrate Concentration Trends in Well 199-H4-3

RCRA Compliance Ground-Water Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Plots of relationship between Water Level and Concentration
 Dashed line is water level, Solid line is constituent
 Well name=1-H4-3



611

FIGURE 60. Sodium Concentration Trends in Well 199-H4-3

RCRA Compliance Ground-Water Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Plots of relationship between Water Level and Concentration
 Dashed line is water level, Solid line is constituent
 Well name-1-H4-4

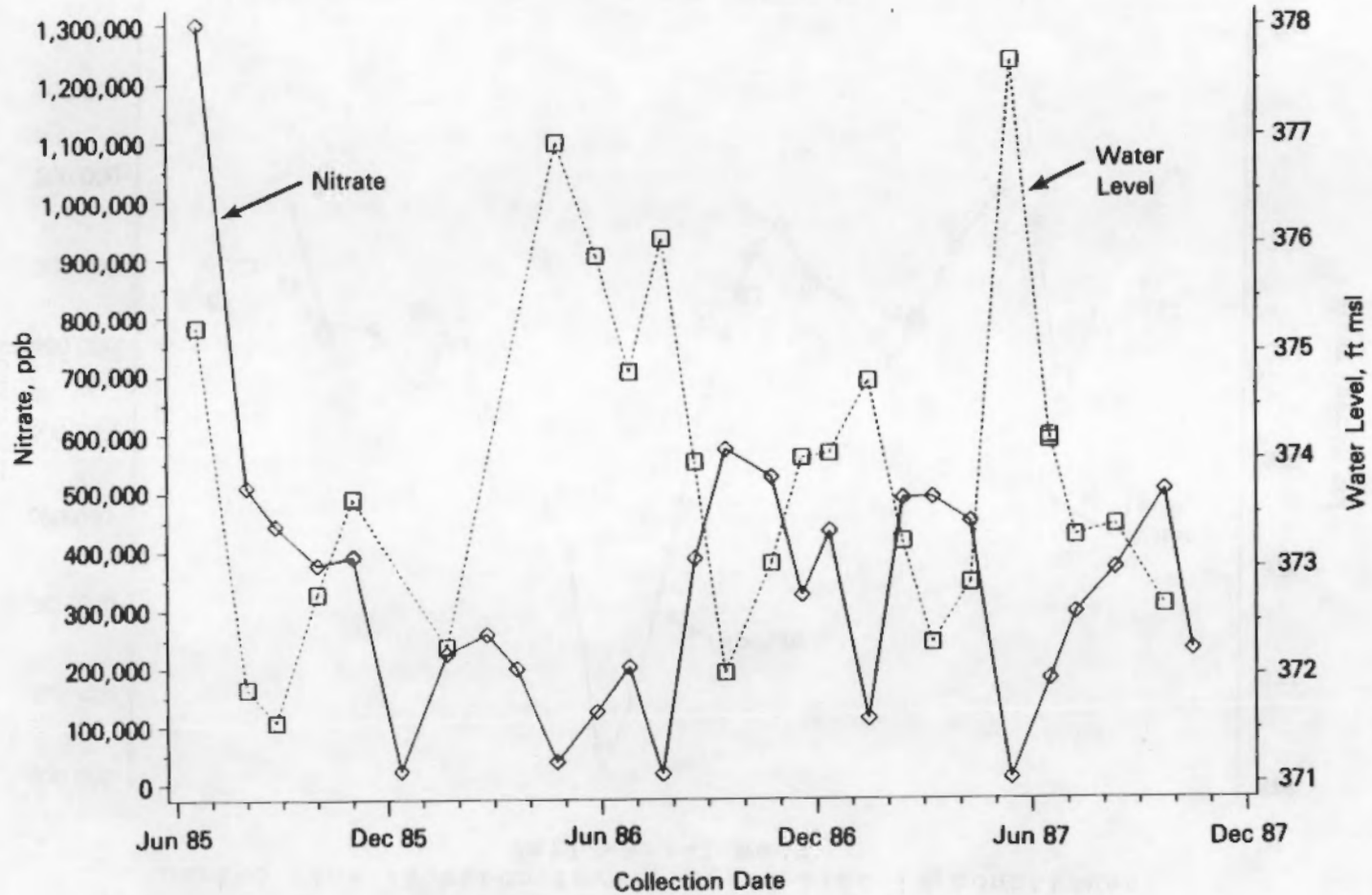


FIGURE 61. Nitrate Concentration Trends in Well 199-H4-4

RCRA Compliance Ground-Water Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Plots of relationship between Water Level and Concentration
 Dashed line is water level, Solid line is constituent
 Well name=1-H4-4

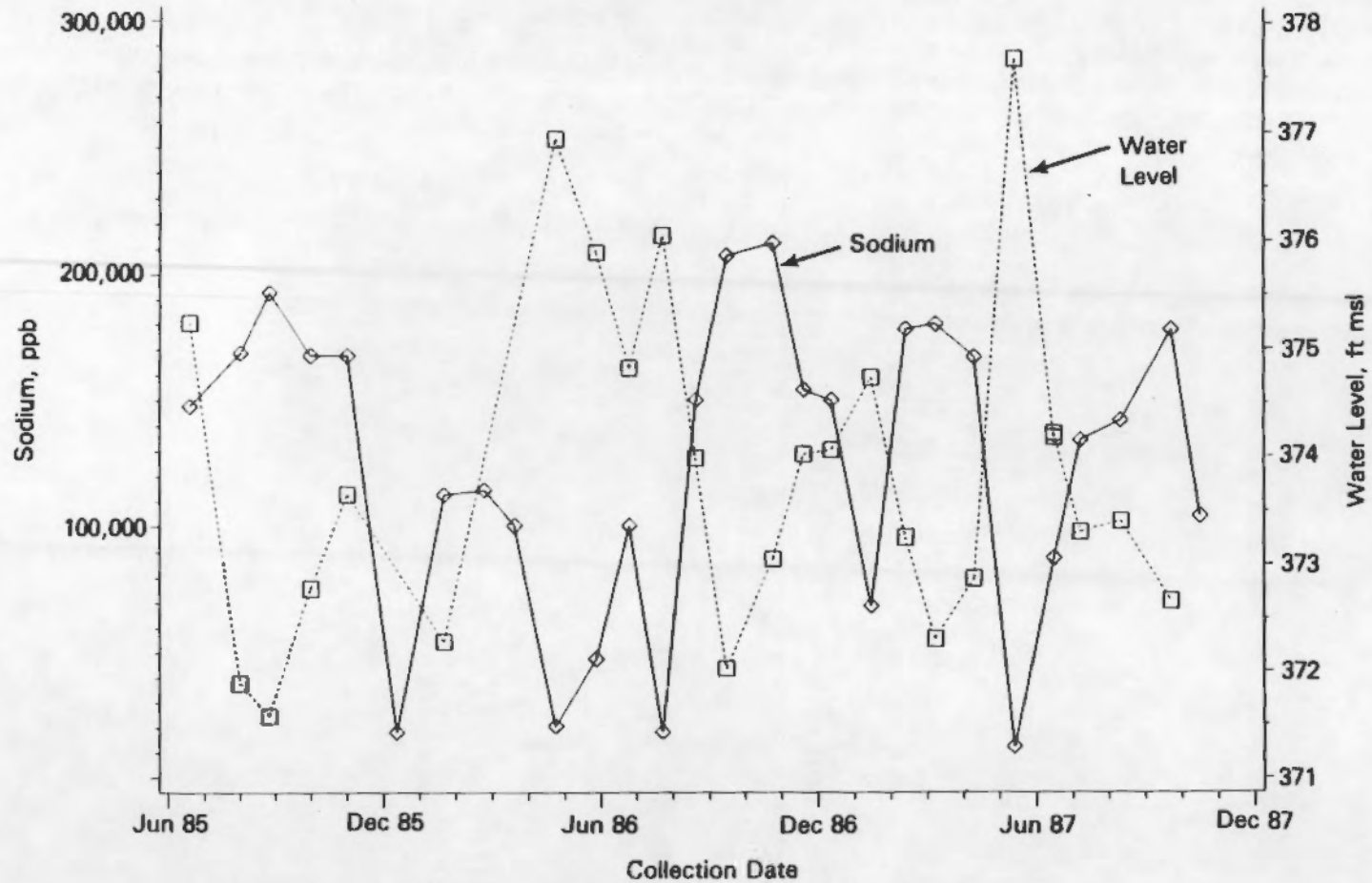
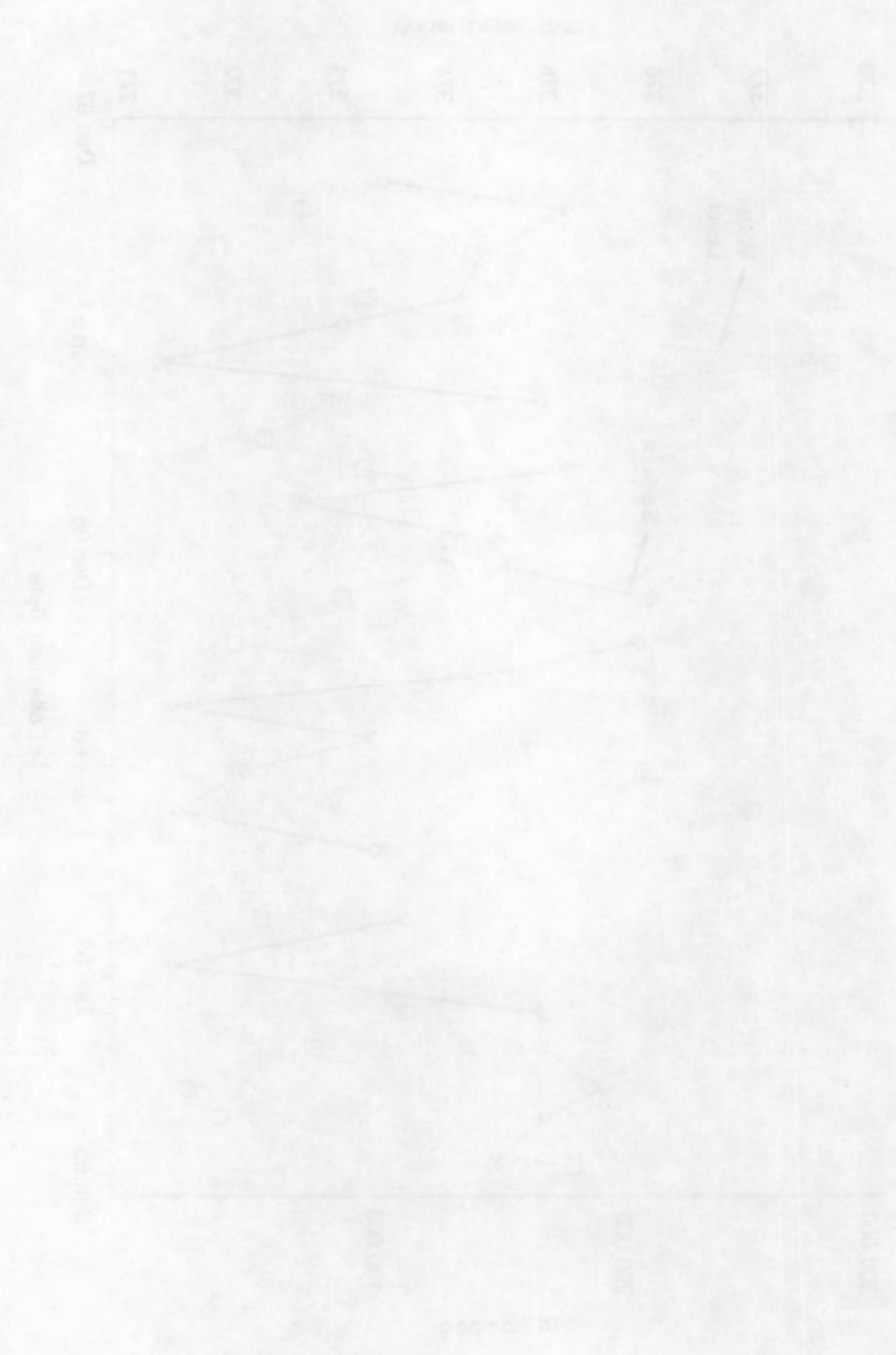


FIGURE 62. Sodium Concentration Trends in Well 199-H4-4

FIGURE 1. Seasonal variation in the abundance of *Chironomus tentans* in the Lake Ontario basin.



The seasonal variation in the abundance of *Chironomus tentans* in the Lake Ontario basin is shown in Figure 1. The abundance of this species is highest in late summer and early fall, and lowest in winter. This pattern is characteristic of many benthic invertebrates in temperate lakes.

9.0 CONTAMINANT PLUME DESCRIPTION

This section focuses on the ground-water contaminant plume attributable to the 183-H Basins. The extent of this plume was determined using data collected after January 1, 1987. Analytical data collected before this date were limited to the five wells in the original monitoring network, because sampling of the Phase II and III wells did not commence until 1987. This section includes information on background concentrations, horizontal and vertical extent of contamination, geochemical interaction of selected constituents, and ground-water modeling results.

9.1 BACKGROUND CONCENTRATIONS

Background concentrations in selected upgradient wells were calculated for the clearest indicators of contamination attributable to the 183-H Basins (Table 16). These constituents include nitrate, filtered sodium, gross alpha, and gross beta.

Background values were also calculated for pH (field) and TOX, which will be used for geochemical modeling. The background value for filtered chromium is shown in Table 16, although other potential sources of

TABLE 16. Background Concentrations

<u>Constituent</u>	<u>Units</u>	<u>No. of Samples</u>	<u>Average</u>	<u>Standard Deviation</u>	<u>Coefficient of Variation</u>
Nitrate	ppb	32	28,740	9,290	32.3
Filtered Sodium	ppb	32	15,940	5,872	36.8
Gross Alpha	pCi/L	32	2.35	1.23	52.5
Gross Beta	pCi/L	32	8.55	4.53	53.0
Filtered Chromium	ppb	32	71.3	44.2	62.0
pH (field)	--	31	7.542	0.4137	5.5
TOX	ppb	31	62.15	38.73	62.3

chromium have been identified in the 100-H Area. Monthly ground-water monitoring data for 1987 from Wells 199-H3-2A, 199-H4-6, and 199-H4-7 were used to calculate these values.

The statistics were calculated by pooling all available data as if each observation were a random sample. Seasonal variability was expected to be minimal because these wells are generally removed from the influence of the Columbia River, relative to the point of compliance, Well 199-H4-3. However, a high degree of spatial variability was noted in the data.

Constituents for which background values are not calculated are alkalinity, technetium-99, and uranium. Analysis for alkalinity began in May 1988 and will be used for geochemical modeling. Analyses for technetium-99 and uranium were initiated in March 1988. These constituents are thought to be the primary contributors to the gross beta and gross alpha concentrations, respectively. Background values for these constituents will be calculated similar to those shown in Table 16.

Table 17 compares background values for the clearest indicators of contamination attributable to the 183-H Basins and background values for the Hanford Site (Jacquish and Mitchell 1988). Chromium is also included in this table.

The background values for nitrate and filtered chromium in the upgradient wells near the 183-H Basins were higher than the background values for the Hanford Site, indicating other sources of these constituents located

TABLE 17. Comparison of Background Values from Selected Upgradient Wells Near the 183-H Basins with Background Values on the Hanford Site

<u>Constituent</u>	<u>Units</u>	<u>183-H Basins</u>	<u>Hanford Site</u>
Nitrate	ppb	28,740 ± 19,000	500 - 2,000
Filtered Sodium	ppb	15,940 ± 6,000	20,500 ± 6,700
Gross Alpha	pCi/L	2.35 ± 1.40	2.5 ± 1.4
Gross Beta	pCi/L	8.55 ± 1.70	19 ± 12
Filtered Chromium	ppb	71.3 ± 74	< 10

upgradient of the 1B3-H Basins. Background concentrations of filtered sodium, gross alpha, and gross beta were similar to the background concentrations on the Hanford Site.

9.2 HORIZONTAL EXTENT OF CONTAMINATION

As shown in the isoconcentration maps (Figures 63 through 74) and columnar diagrams (Figures 75 through 78), nitrate, sodium, gross alpha, and gross beta are the clearest indicators of contamination attributable to the 183-H Basins. Because of the proximity of the facility to the Columbia River and the demonstrated effect that the river has on many of the wells, isoconcentration maps data were plotted for low (September 1987), mean (December 1986), and high (May 1987) river stages.

In general, Wells 199-H4-3, 199-H4-4, 199-H4-9, and 199-H4-12A show the highest constituent concentrations for all three time periods. The basic shape and location of the plumes and columnar plots for a particular period were similar for most of the constituents found in these wells. As shown in Figures 63 through 74, concentrations of contaminants in the ground water are affected by variations in river stage. Generally, concentrations increase during periods of low river stage and decrease during periods of high river stage.

Gross beta contamination is also evident in Wells 199-H4-11 and 199-H4-13 and, to a lesser extent, in Wells 199-H4-16 and 199-H4-18. These concentrations do not correlate with the distribution of the other major contaminants attributable to the 183-H Basins (Figures 72 through 74) and may be a result of past operational practices at the 107-H Retention Basin (Figure 12). Further studies of gross beta distribution are warranted to discriminate the contaminant contributions of each facility.

Chromium concentrations have generally been found above the MCL in all but four wells in the network. These concentrations do not correlate with the distribution of the other major contaminants attributable to the 183-H Basins (Figures 79 through 82). Four other potential sources of chromium from inactive waste disposal facilities at the 100-H Area have been identified (Figure 12). These facilities, 116-H-1, 116-H-2, 116-H-3, and 116-H-4,

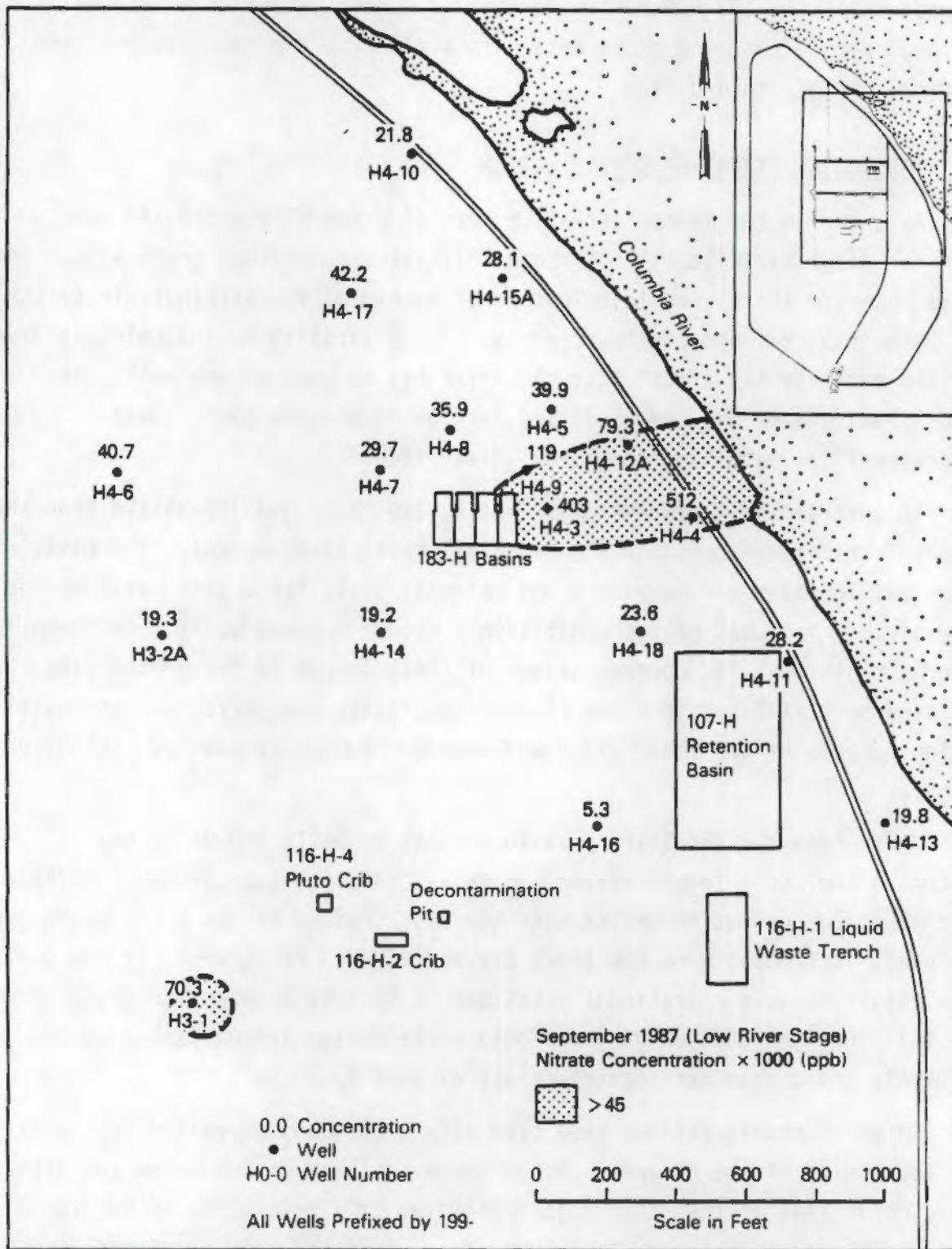
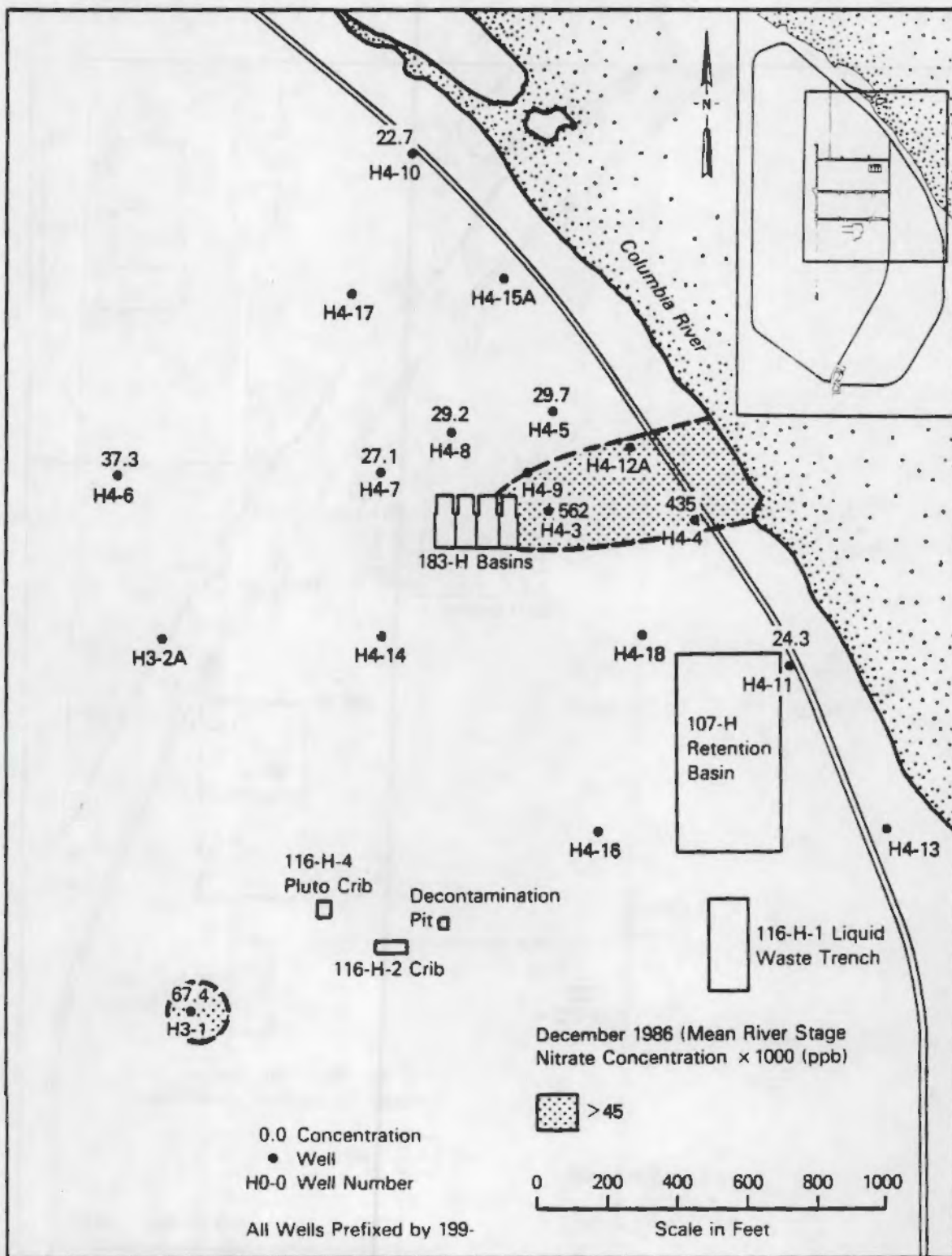


FIGURE 63. Nitrate Concentrations (low river stage), September 1987



*Concentration data is limited for December because not all of the wells had been completed

FIGURE 64. Nitrate Concentrations (mean river stage), December 1986

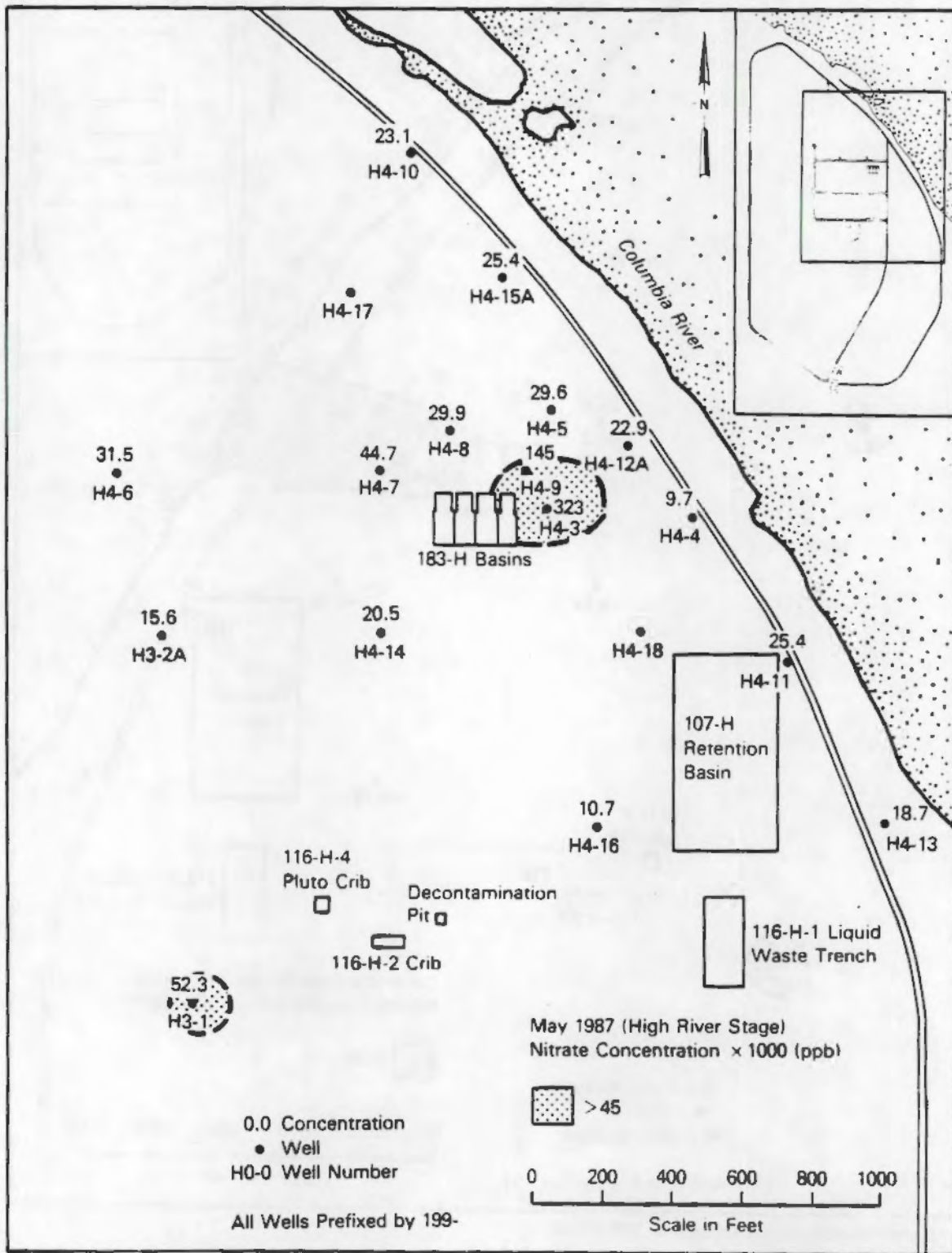


FIGURE 65. Nitrate Concentrations (high river stage), May 1987

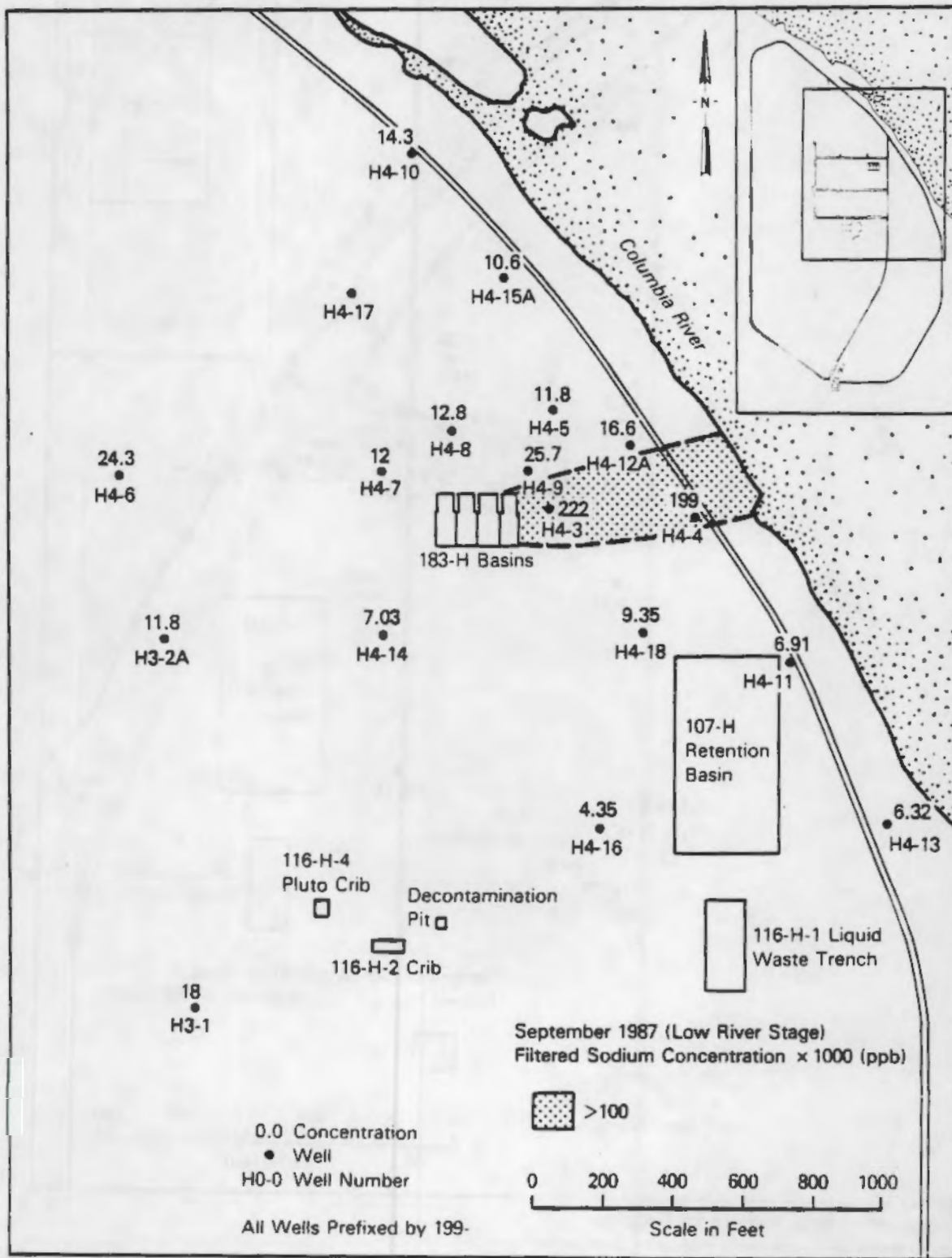
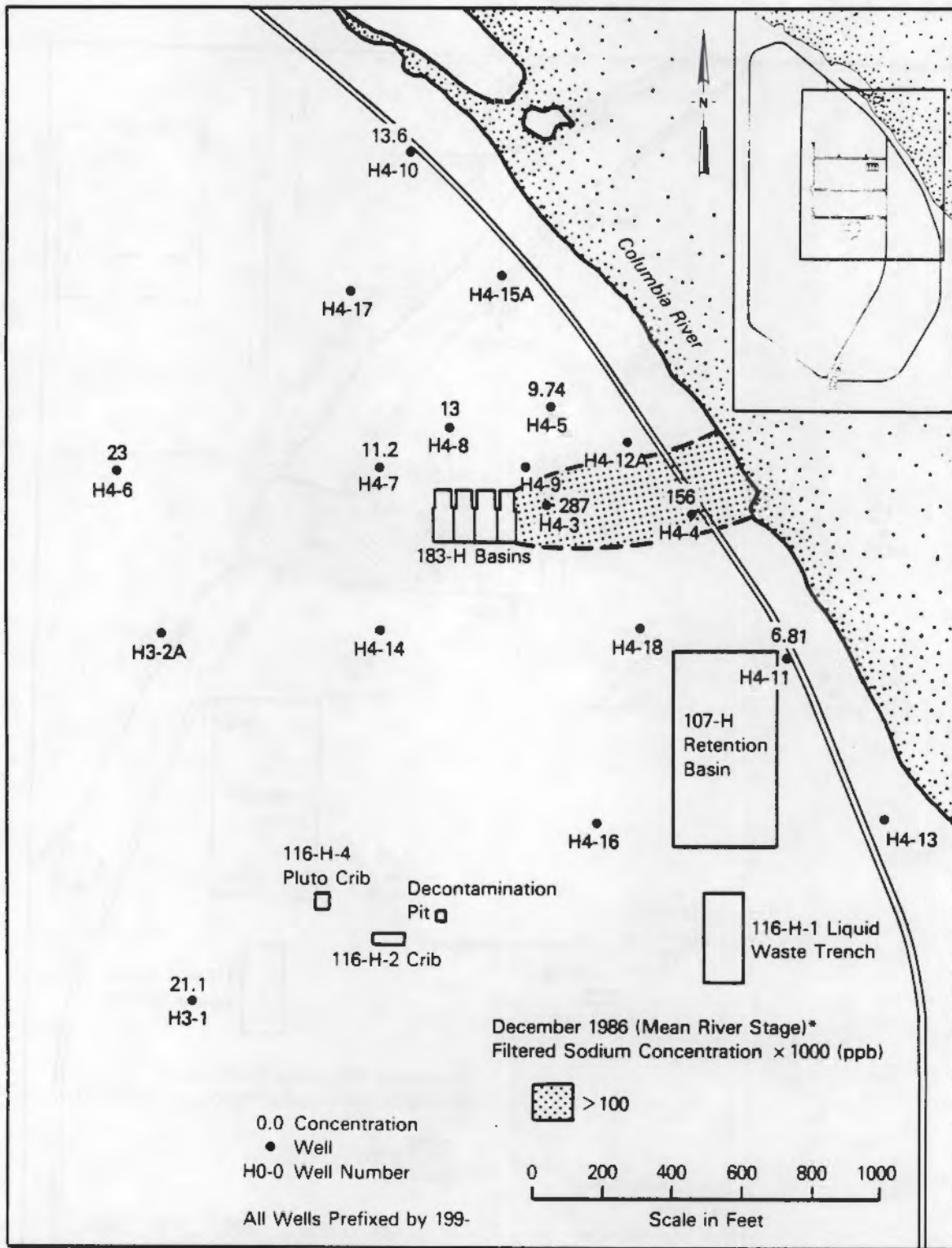


FIGURE 66. Filtered Sodium Concentrations (low river stage), September 1987



*Concentration data is limited for December because not all of the wells had been completed

FIGURE 67. Filtered Sodium Concentrations (mean river stage), December 1986

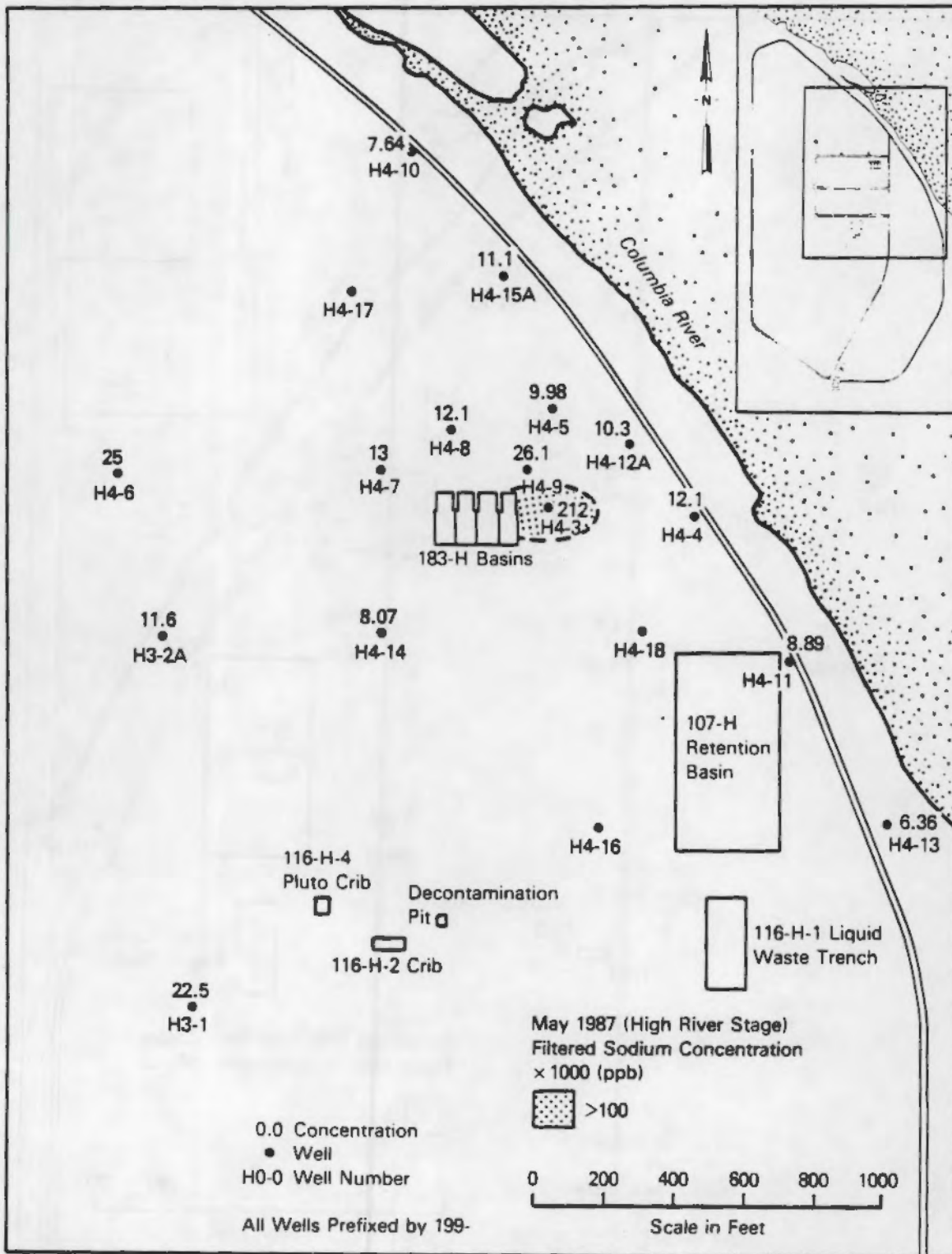


FIGURE 68. Filtered Sodium Concentrations (high river stage), May 1987

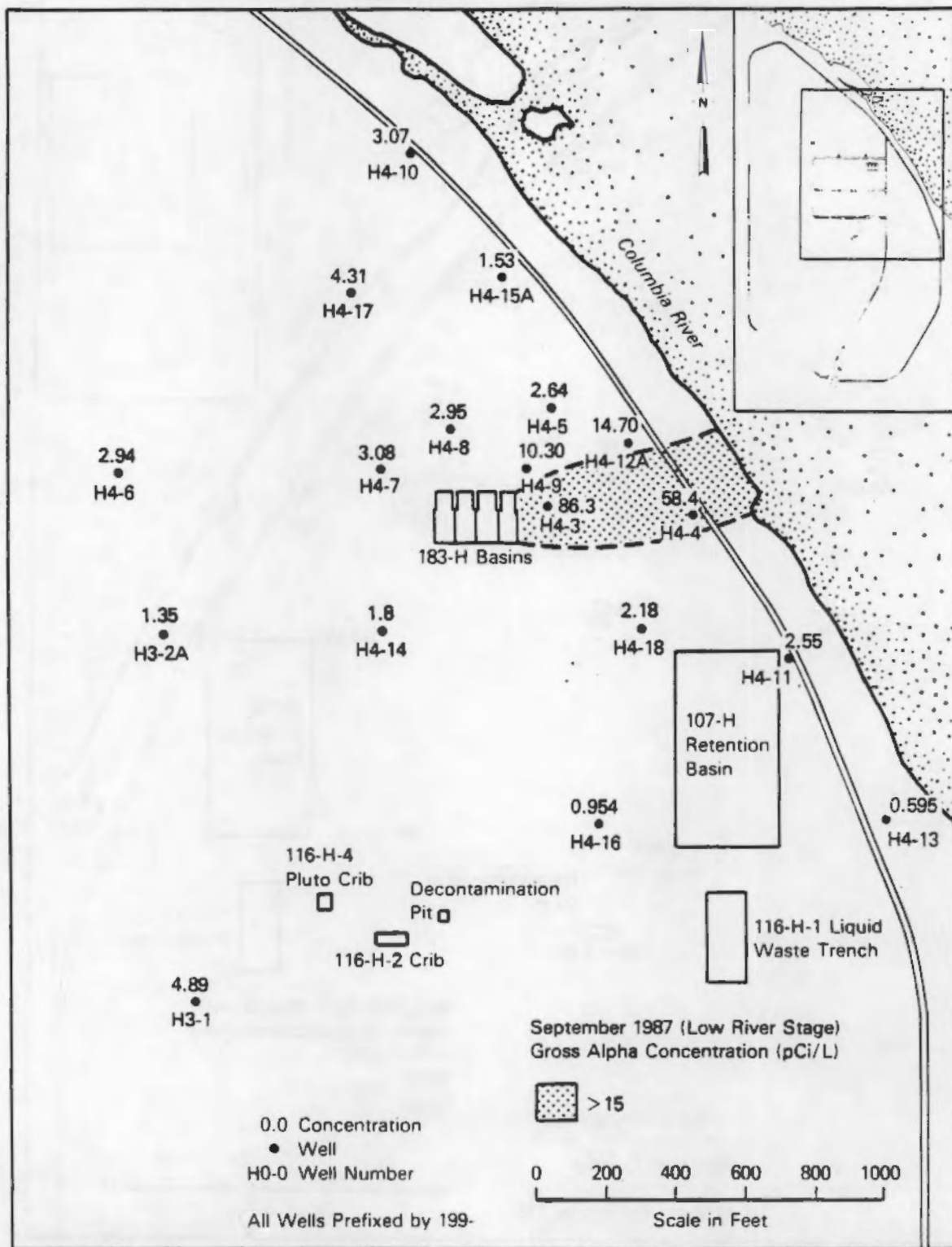


FIGURE 69. Gross Alpha Concentrations (low river stage), September 1987

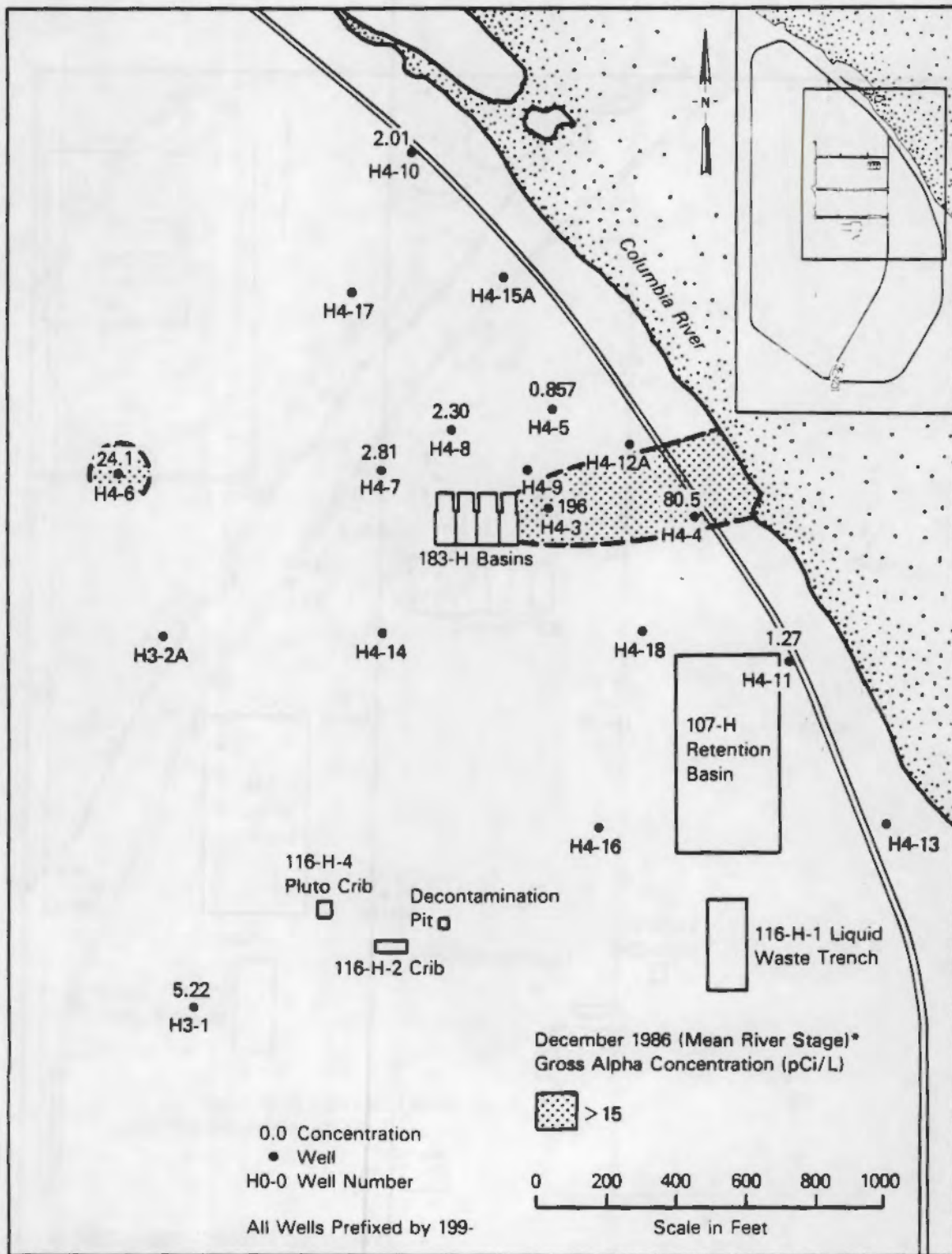


FIGURE 70. Gross Alpha Concentrations (mean river stage), December 1986

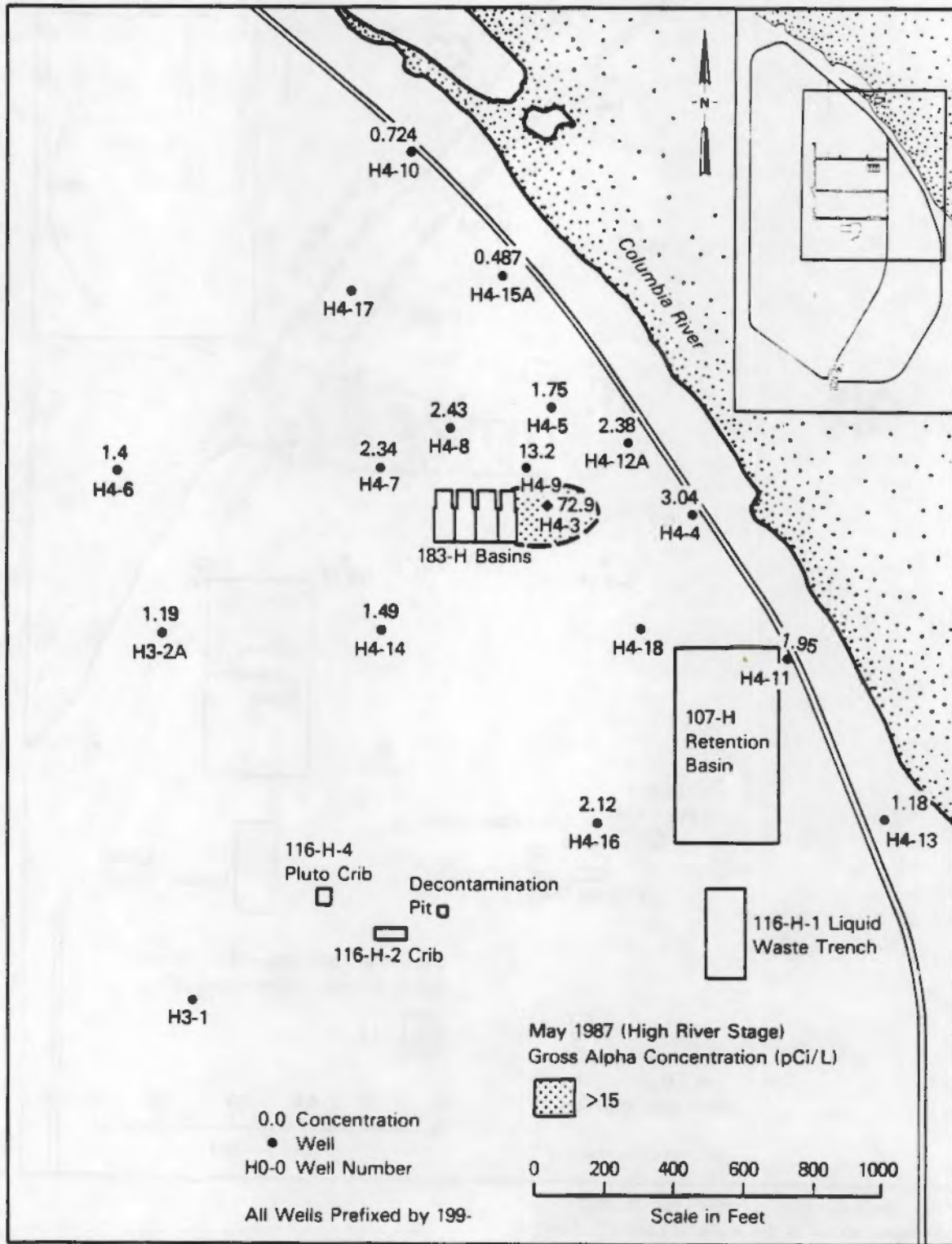


FIGURE 71. Gross Alpha Concentrations (high river stage), May 1987

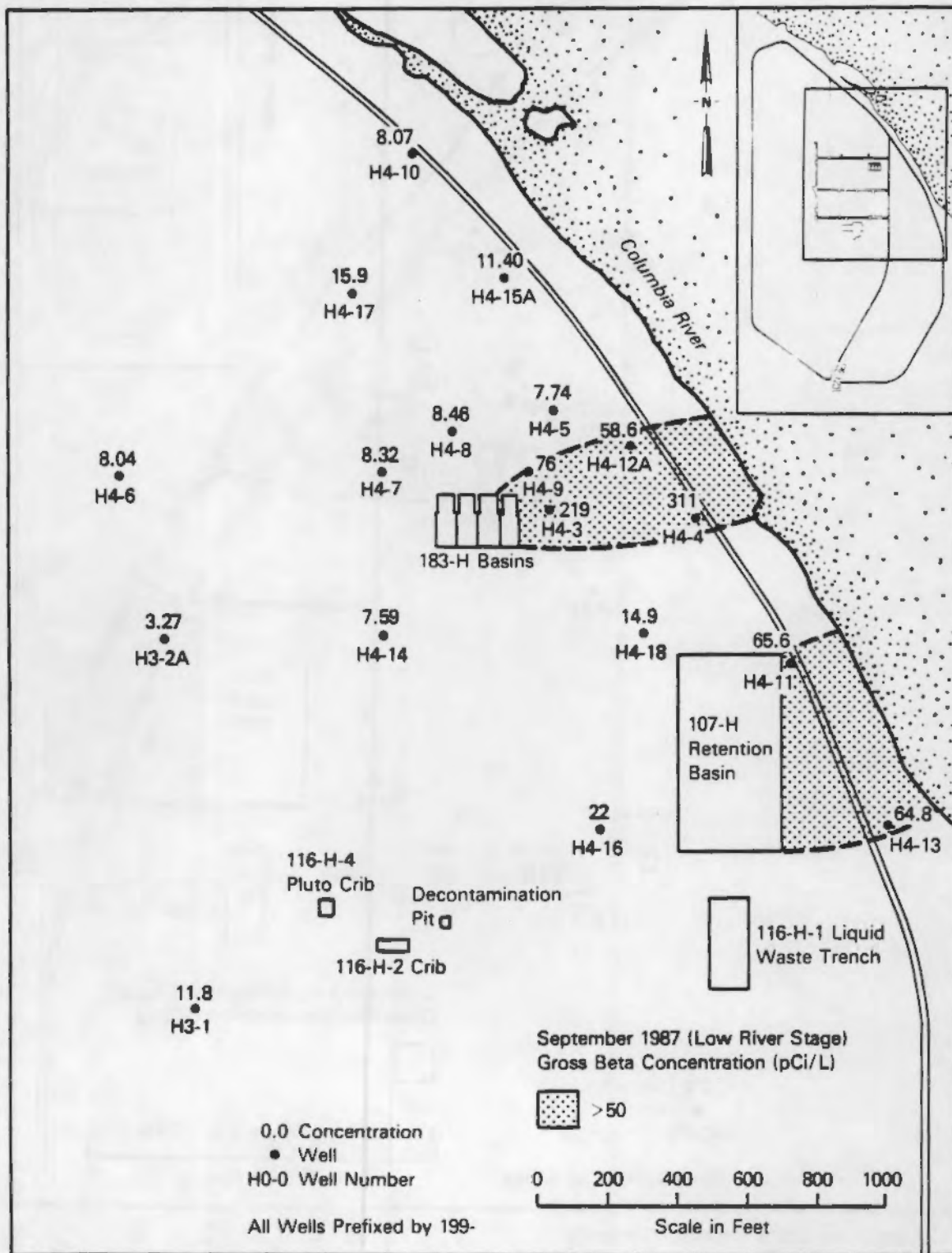
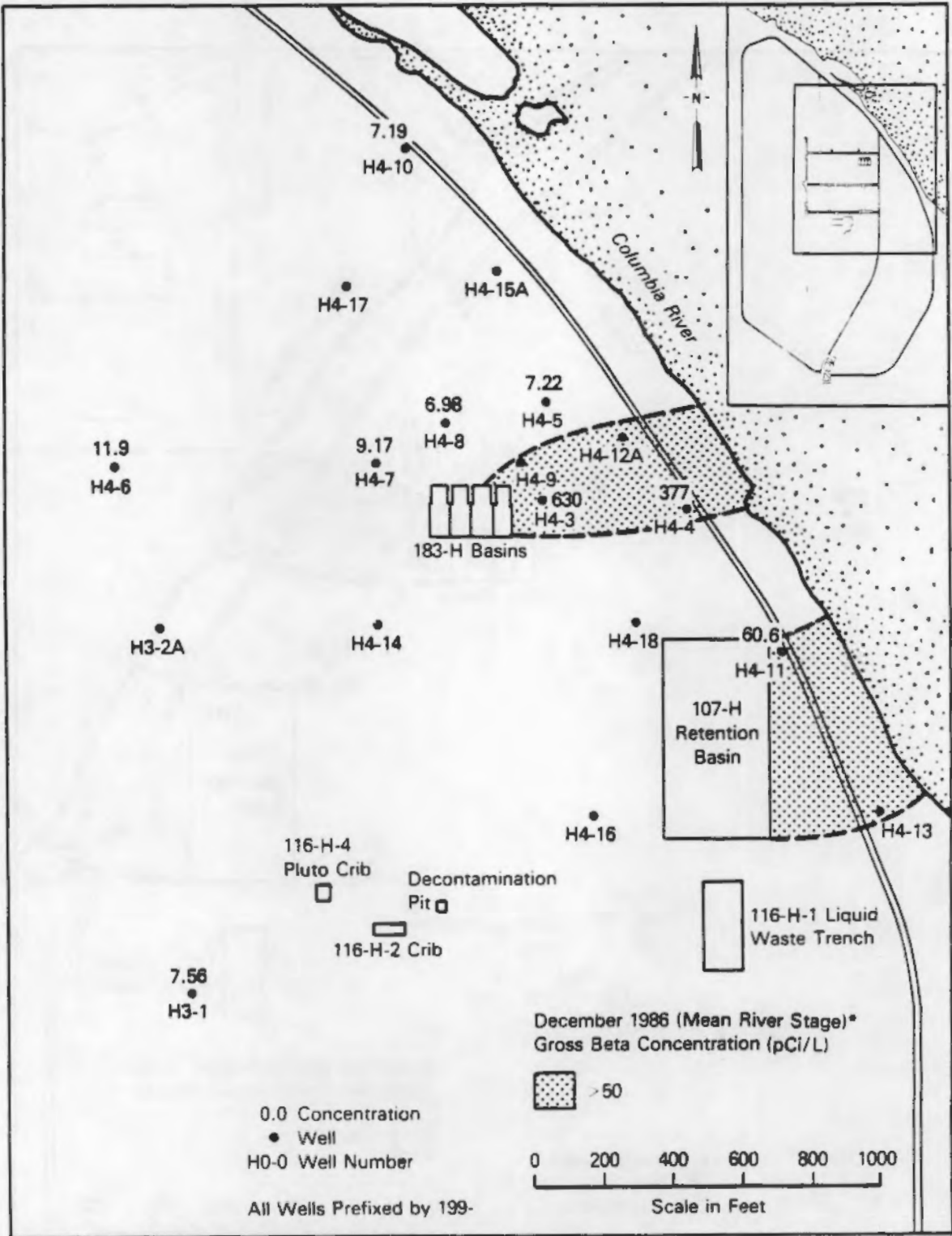


FIGURE 72. Gross Beta Concentrations (low river stage), September 1987



*Concentration data is limited for December because not all of the wells had been completed

FIGURE 73. Gross Beta Concentrations (mean river stage), December 1986

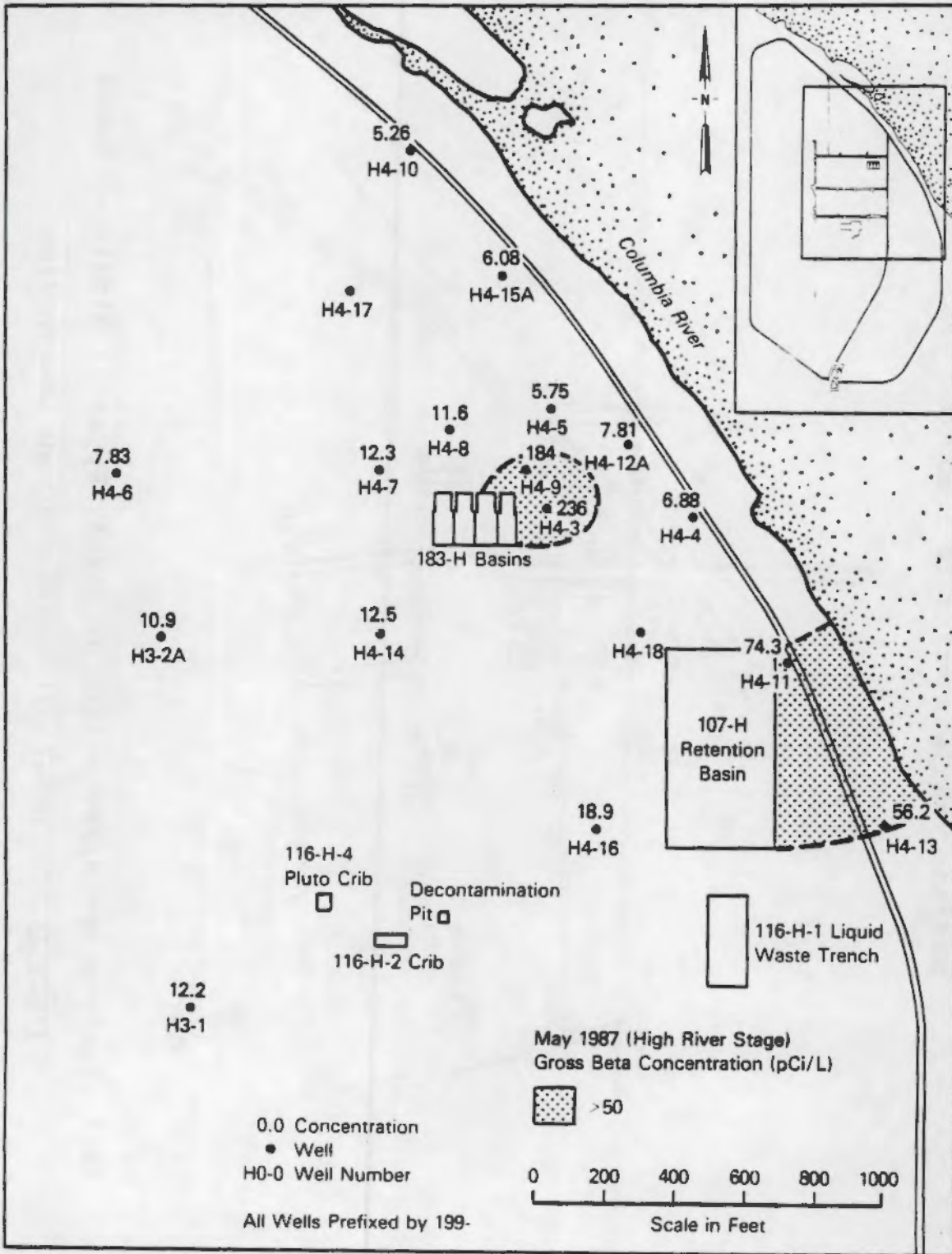
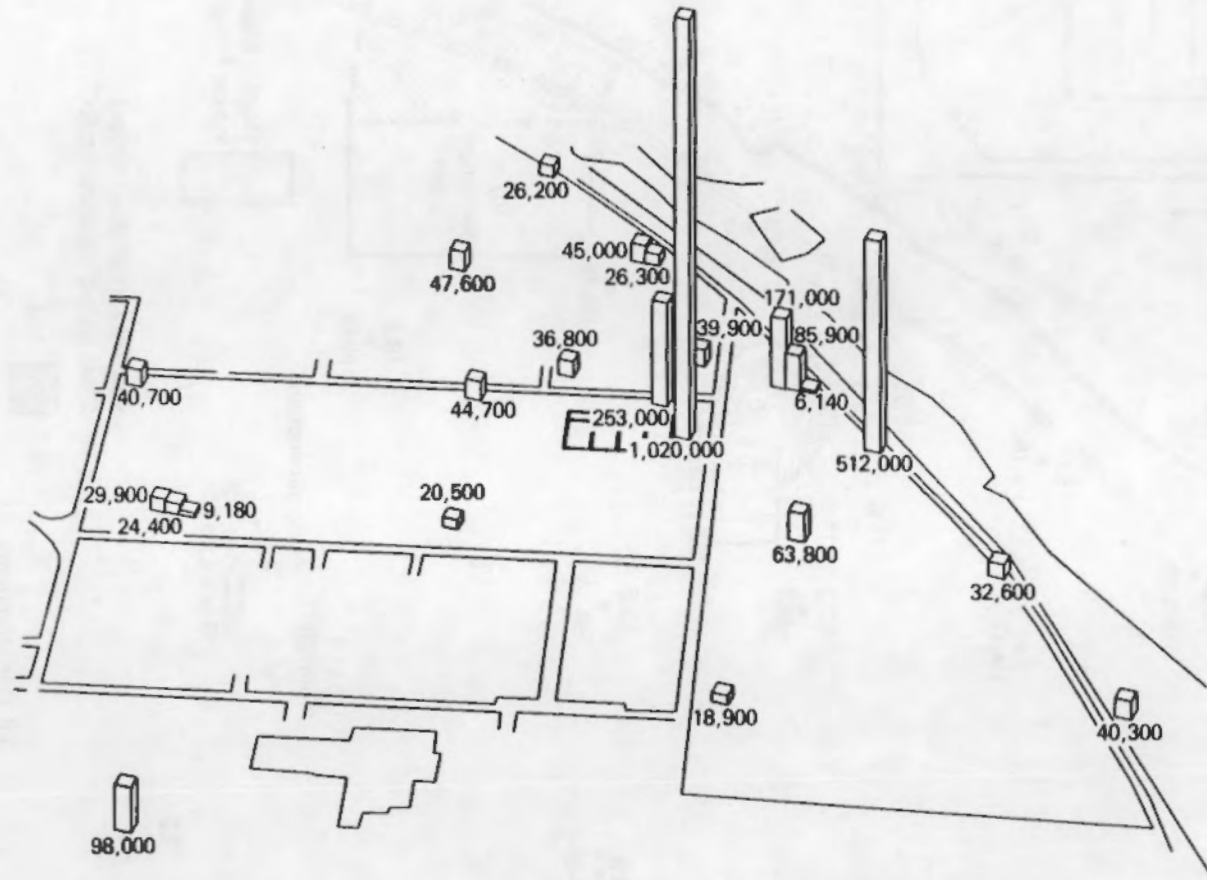


FIGURE 74. Gross Beta Concentrations (high river stage), May 1987

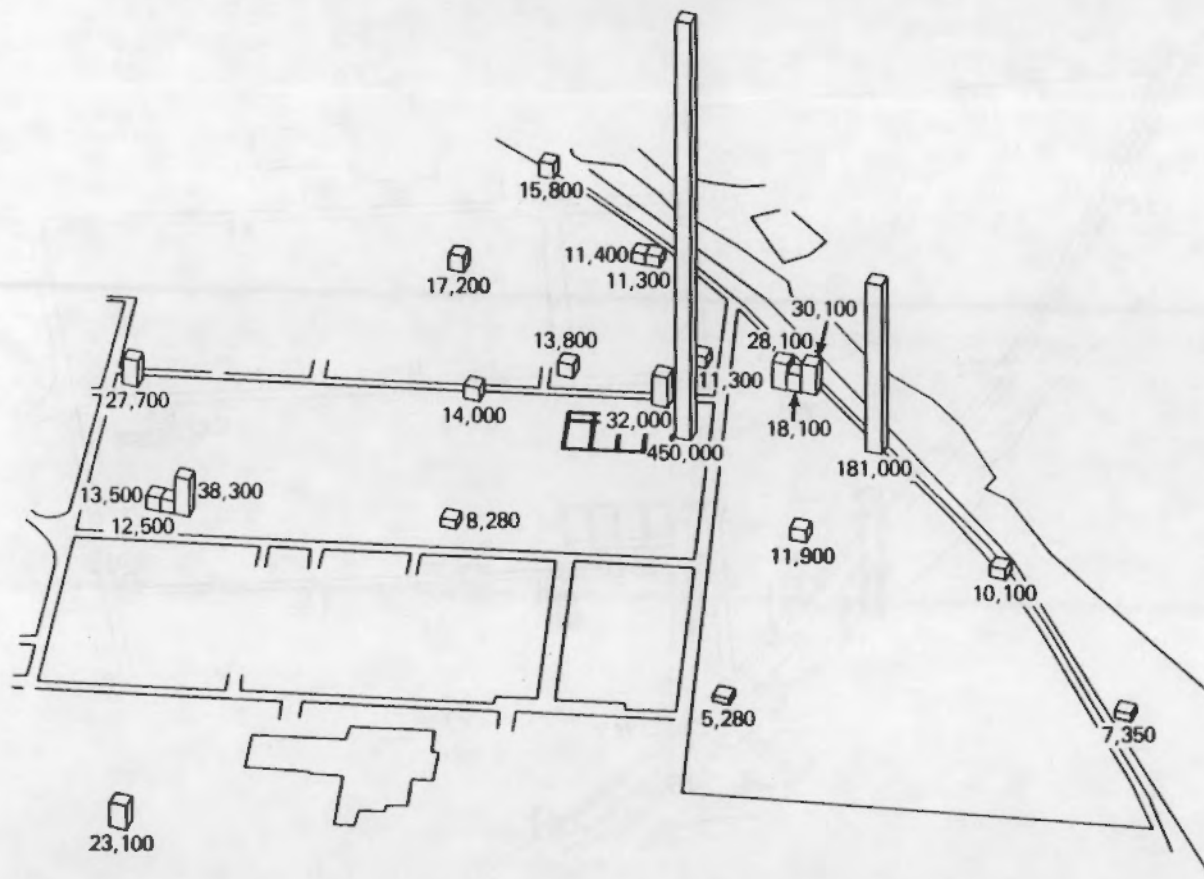
RCRA Compliance Ground-water Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Maximum Value Between January and October 1987
 Nitrate, maximum value is 1,020,000 ppb



Well clusters are ordered left to right, Upper -> Middle -> Lower

FIGURE 75. Horizontal Distribution of Nitrate Concentrations

RCRA Compliance Ground-water Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Maximum Value Between January and October 1987
 Sodium, maximum value is 450,000 ppb

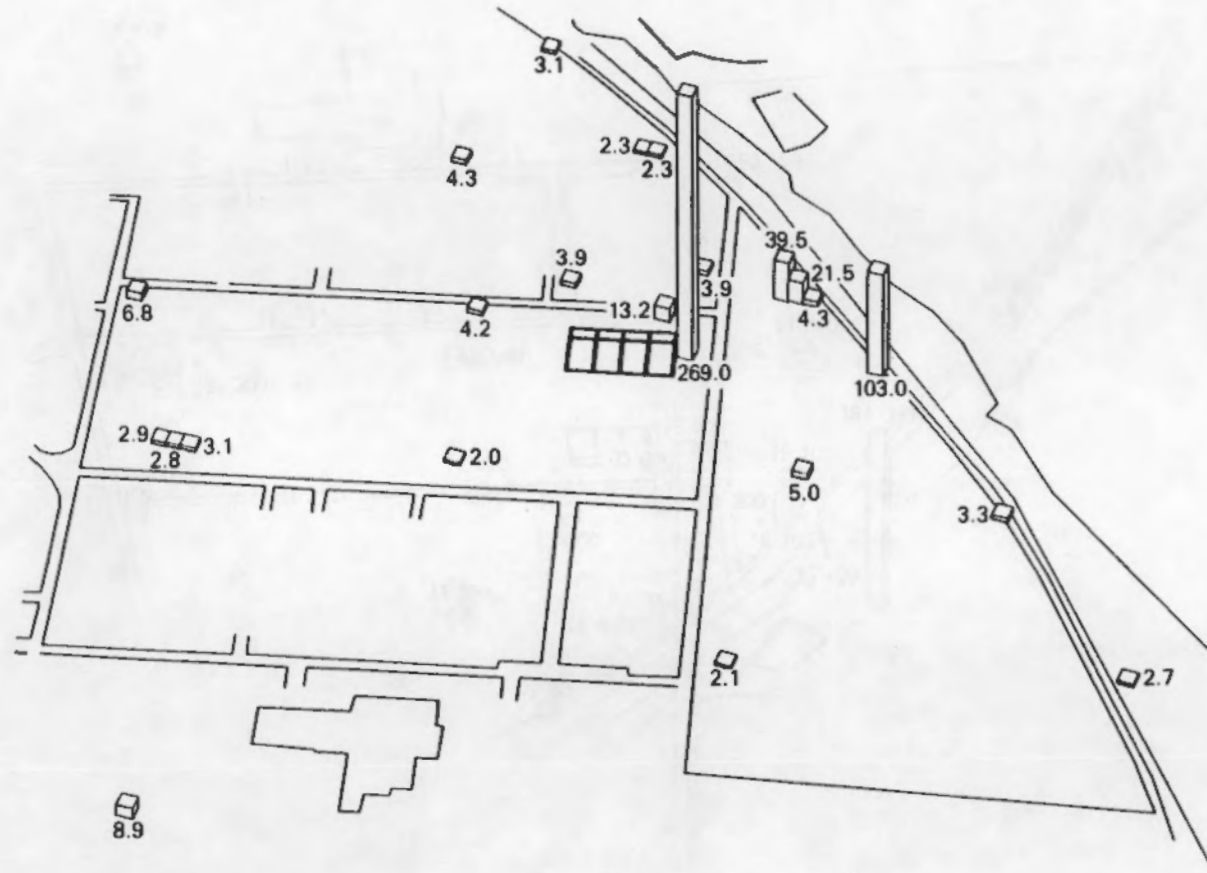


139

Well clusters are ordered left to right, Upper -> Middle -> Lower

FIGURE 76. Horizontal Distribution of Filtered Sodium Concentrations

RCRA Compliance Ground-water Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Maximum Value Between January and October 1987
 Gross Alpha, maximum value is 269 pCi/L



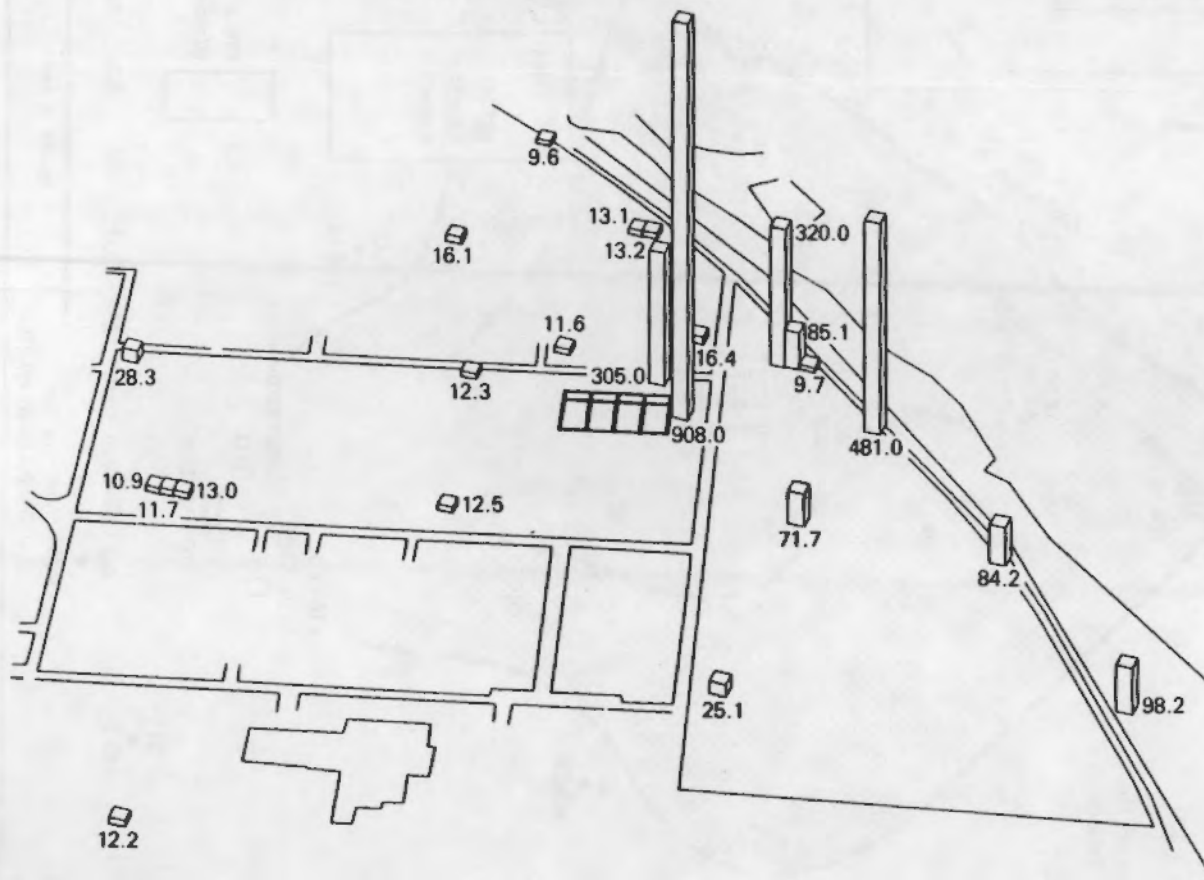
140

Well clusters are ordered left to right, Upper -> Middle -> Lower

FIGURE 77. Horizontal Distribution of Gross Alpha Concentrations

RCRA Compliance Ground-water Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Maximum Value Between January and October 1987
 Gross Beta, maximum value is 908 pCi/L

141



Well clusters are ordered left to right, Upper -> Middle -> Lower

FIGURE 78. Horizontal Distribution of Gross Beta Concentrations

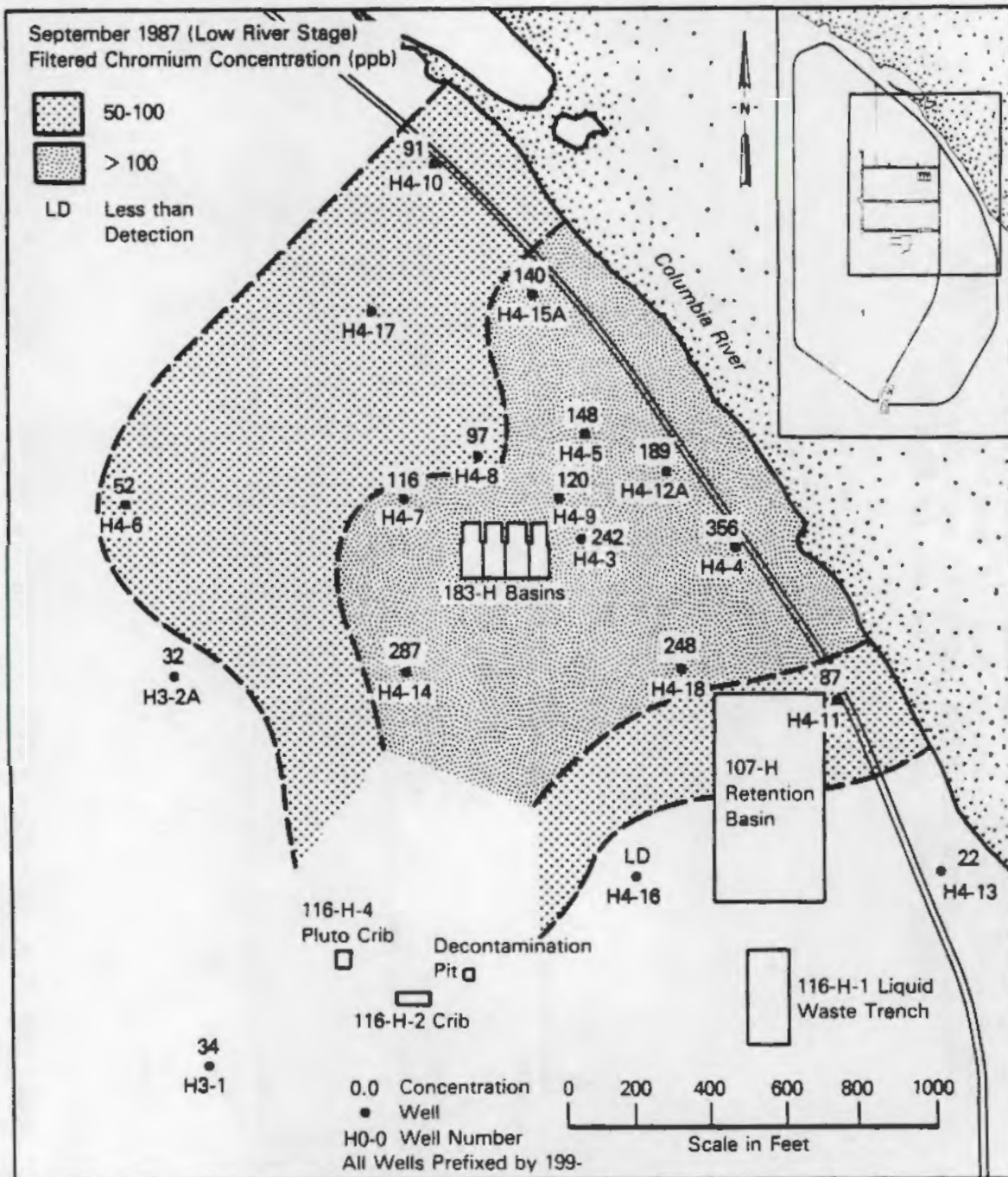
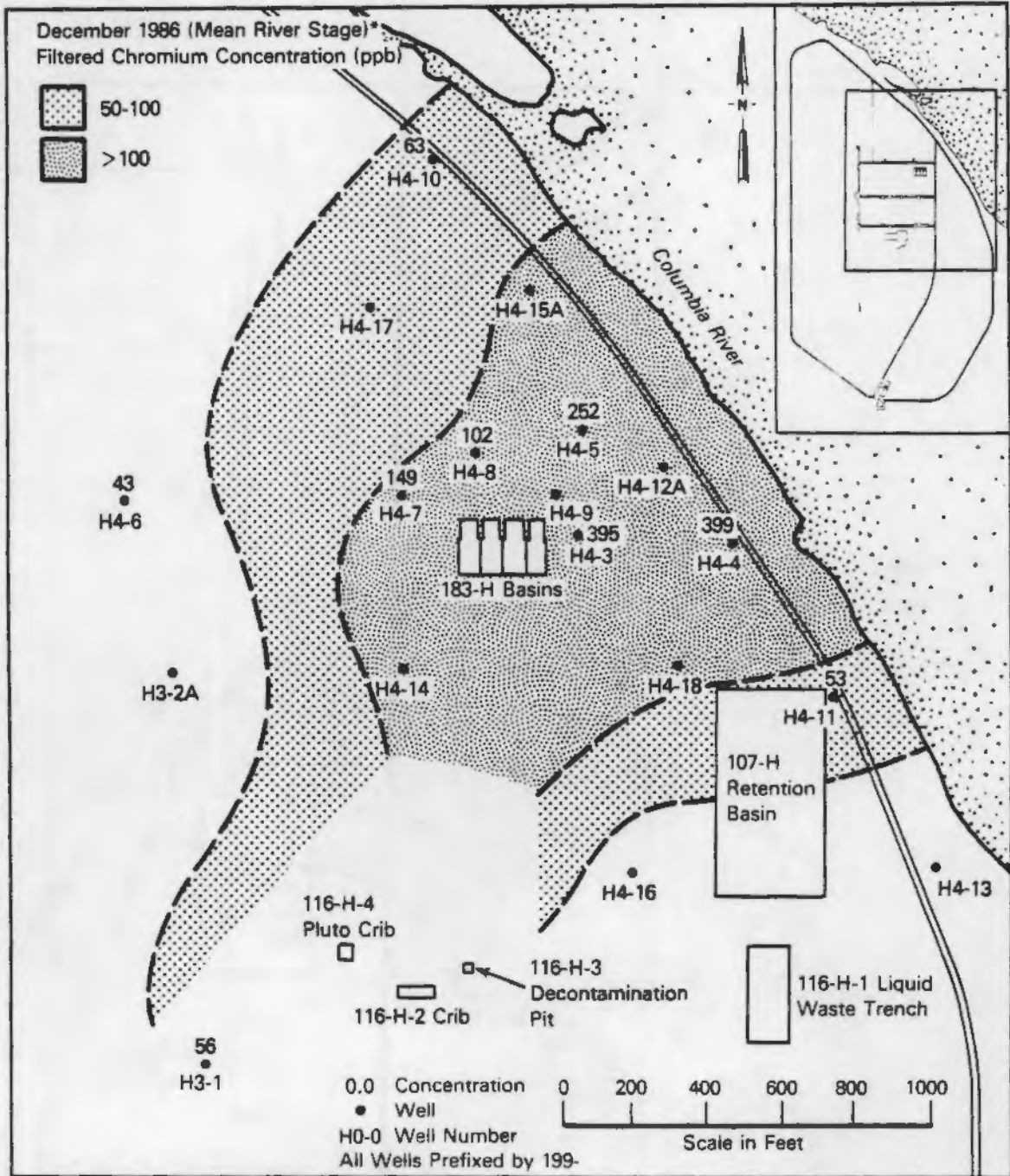


FIGURE 79. Filtered Chromium Concentrations (low river stage), September 1987



*Concentration data is limited for December because not all of the wells had been completed

FIGURE 80. Filtered Chromium Concentrations (mean river stage), December 1986

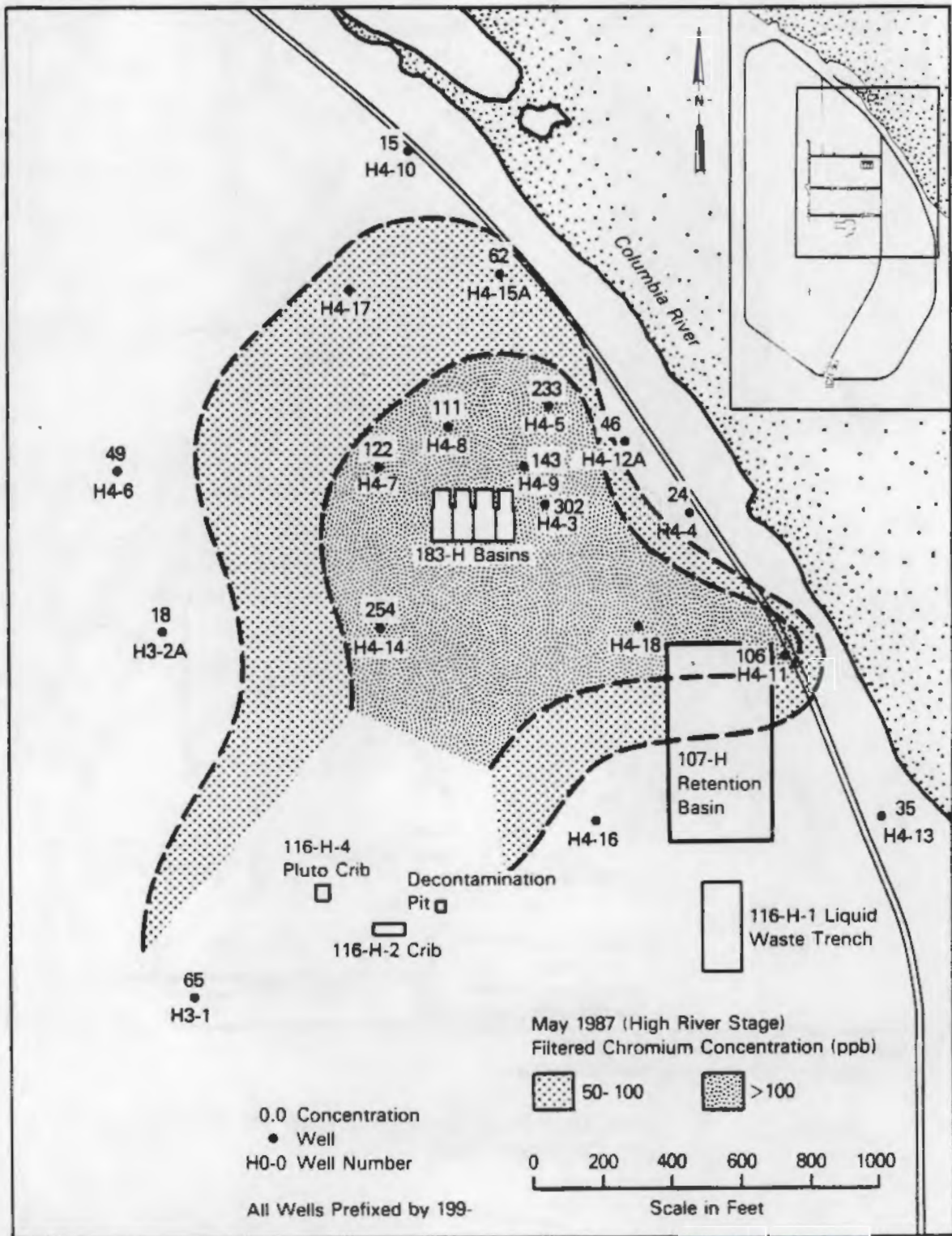
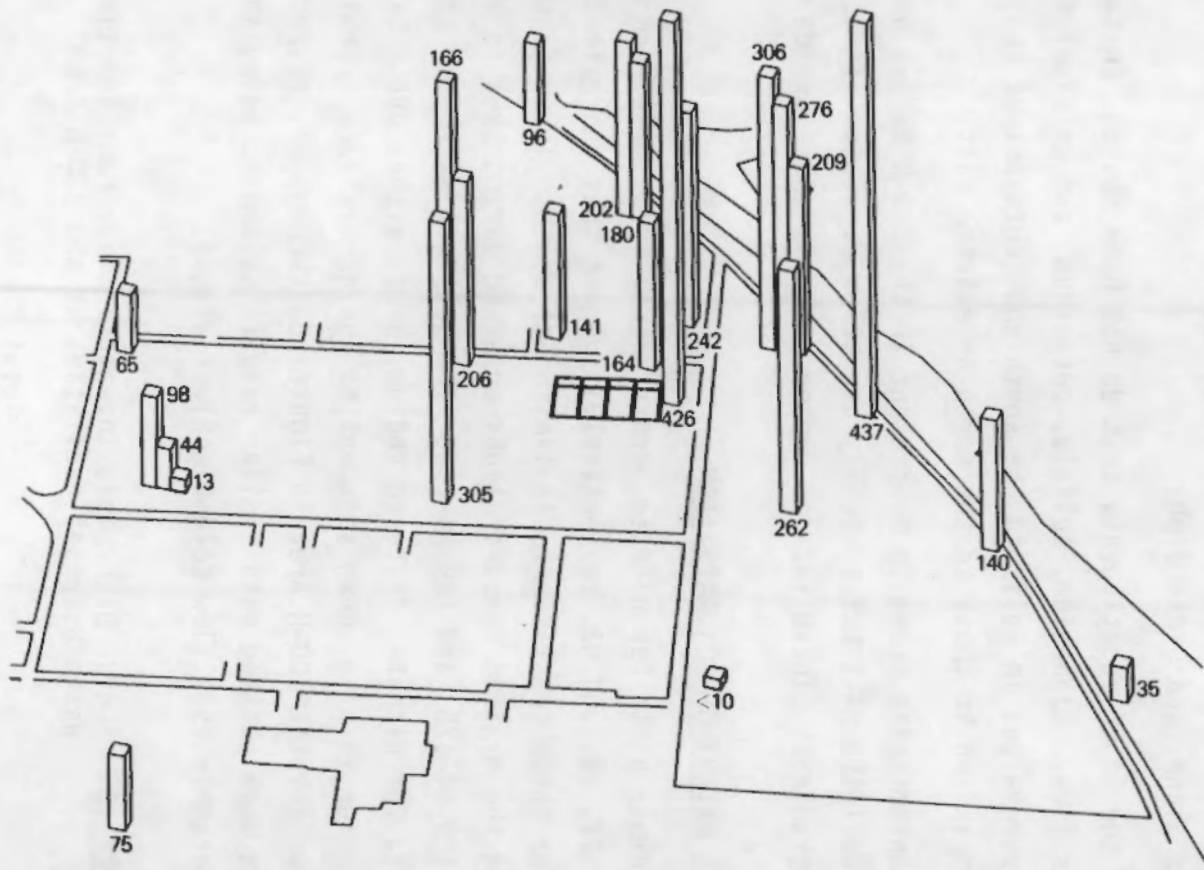


FIGURE 81. Filtered Chromium Concentrations (high river stage), May 1987

RCRA Compliance Ground-water Monitoring Project
 183-H Solar Evaporation Basins Assessment Program
 Maximum Value Between January and October 1987
 Chromium, maximum value is 437 ppb

145



Well clusters are ordered left to right, Upper -> Middle -> Lower

FIGURE 82. Horizontal Distribution of Filtered Chromium Concentrations

received high concentrations of sodium dichromate (Table 18). Further studies of chromium distribution are warranted to discriminate the contaminant contributions of each facility.

Specific conductance shows the same general distribution as nitrate, sodium, gross alpha, and gross alpha.

Most of the major constituents that do not have obvious contamination distributions (i.e., magnesium, sulfate, potassium, and calcium) show generally lower values in wells to the south and southeast of the 183-H Basins in comparison to those to the north or extreme east.

Other contaminants known to be present in the 183-H Basins have been detected in Well 199-H4-3 but typically are below detection limits in wells further downgradient. These include copper, nickel, and fluoride.

9.3 VERTICAL EXTENT OF CONTAMINATION

The columnar plots for nitrate, gross alpha, gross beta, and chromium (Figures 75, 77, 78, and 82, respectively) suggest that the extent of contamination for these constituents is limited at depth. These figures were plotted using the maximum concentrations observed during 1987 in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C. The vertical extent of contamination in these wells for nitrate, filtered sodium, gross alpha, gross beta, and filtered chromium is also shown adjacent to the generalized hydrostratigraphic column for the 100-H Area in Figures 83 through 87, respectively. These figures were plotted with similar results as above, using analytical data from September 1987 (low Columbia River stage).

TABLE 18. Sodium Dichromate Inventories for Four Inactive Waste Disposal Facilities at the 100-H Area

<u>Facility</u>	<u>Total Sodium Dichromate (kg)</u>
116-H-1	90.00
116-H-2	600.00
116-H-3	2000.00
116-H-4	1000.00

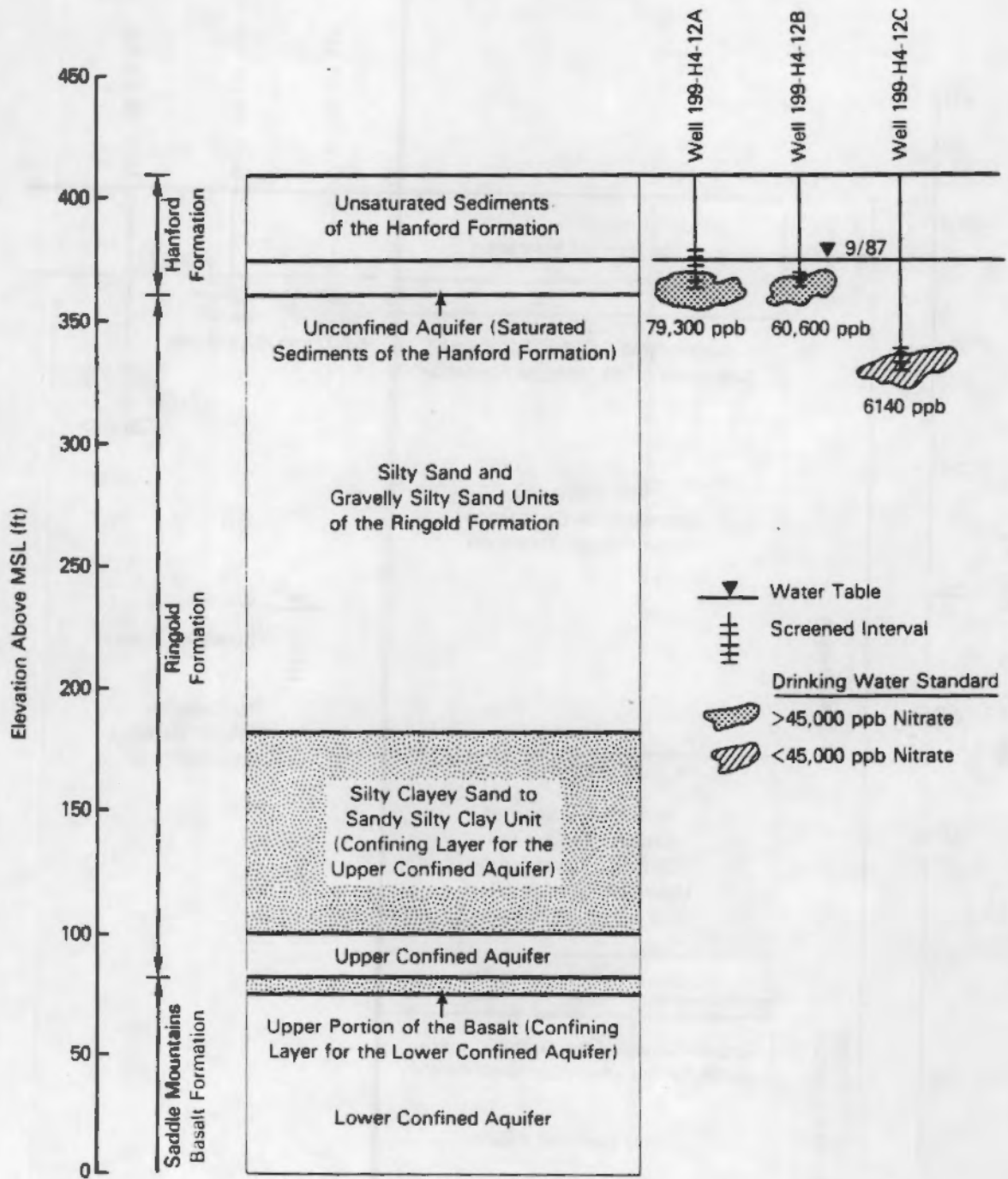


FIGURE 83. Nitrate Concentrations with Depth in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C

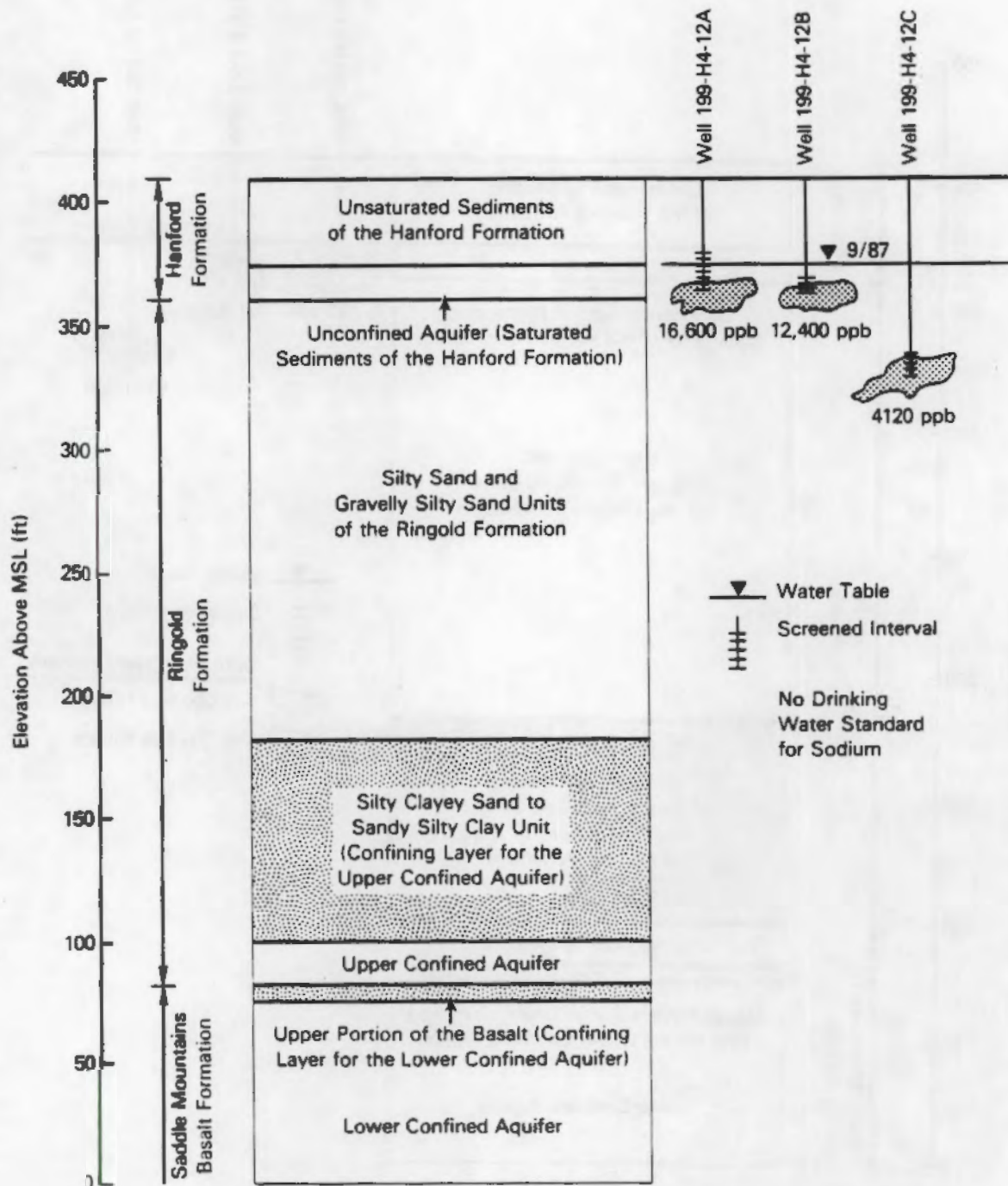


FIGURE 84. Filtered Sodium Concentrations with Depth in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C

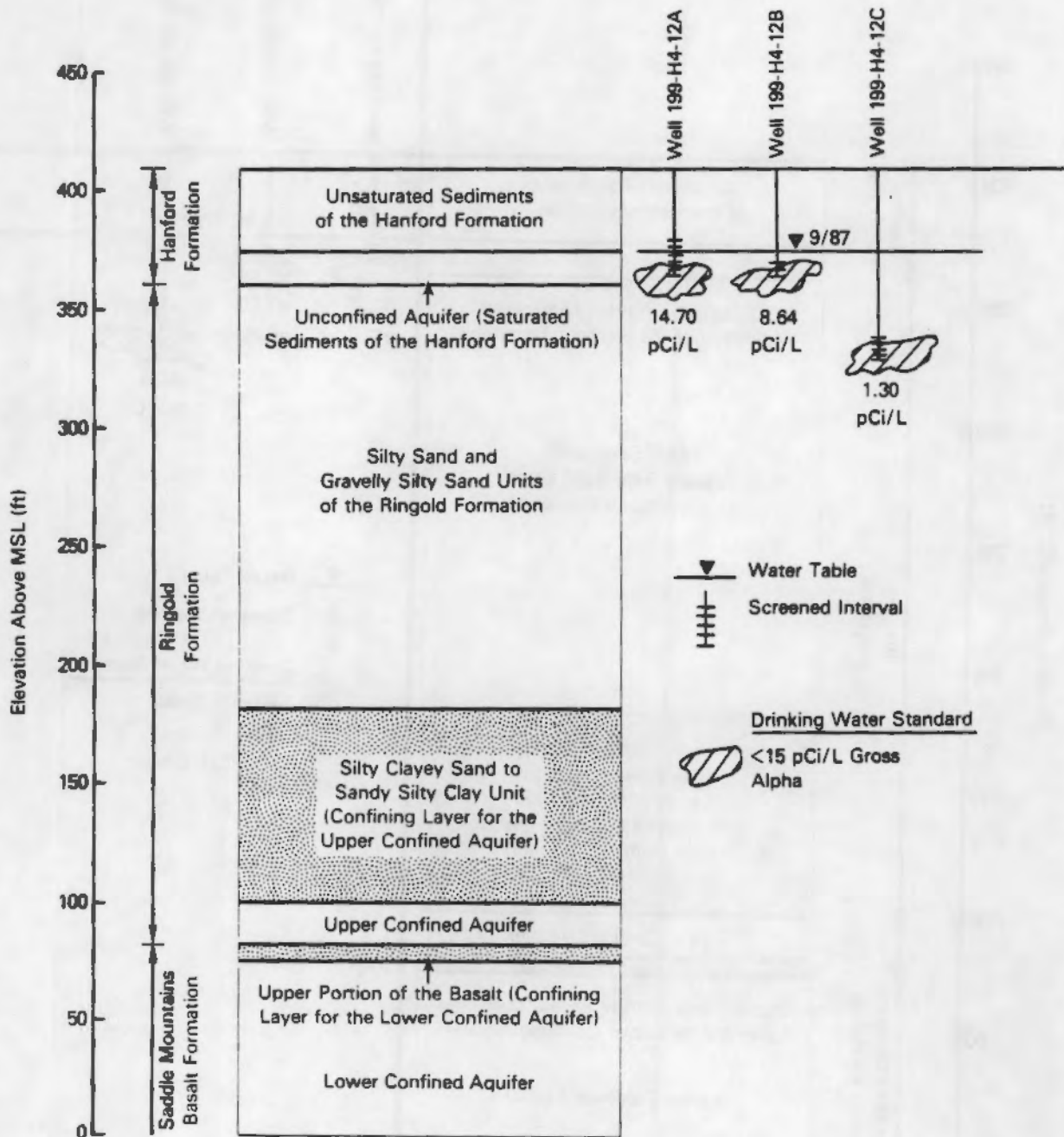


FIGURE 85. Gross Alpha Concentrations with Depth in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C

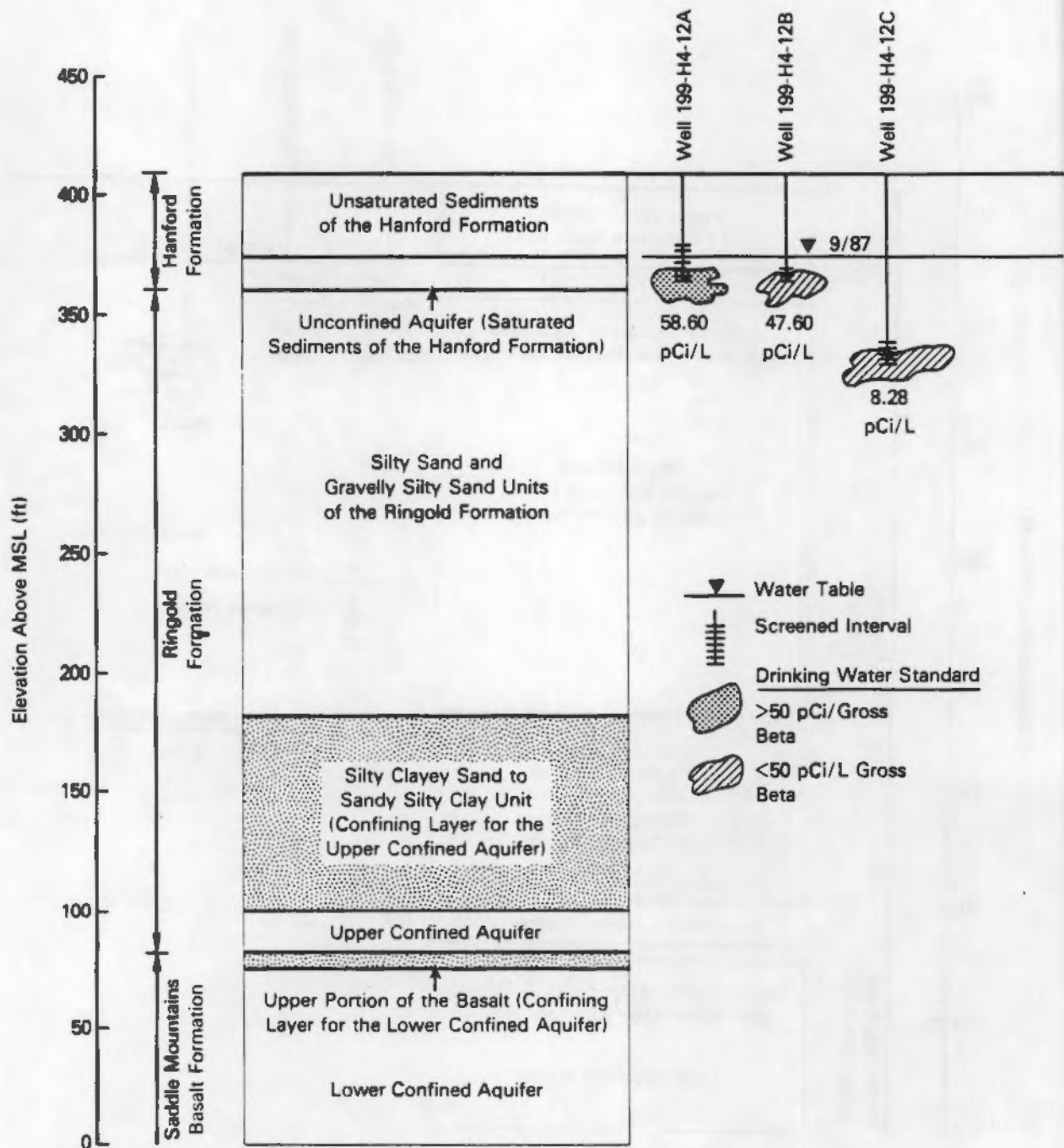


FIGURE 86. Gross Beta Concentrations with Depth in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C

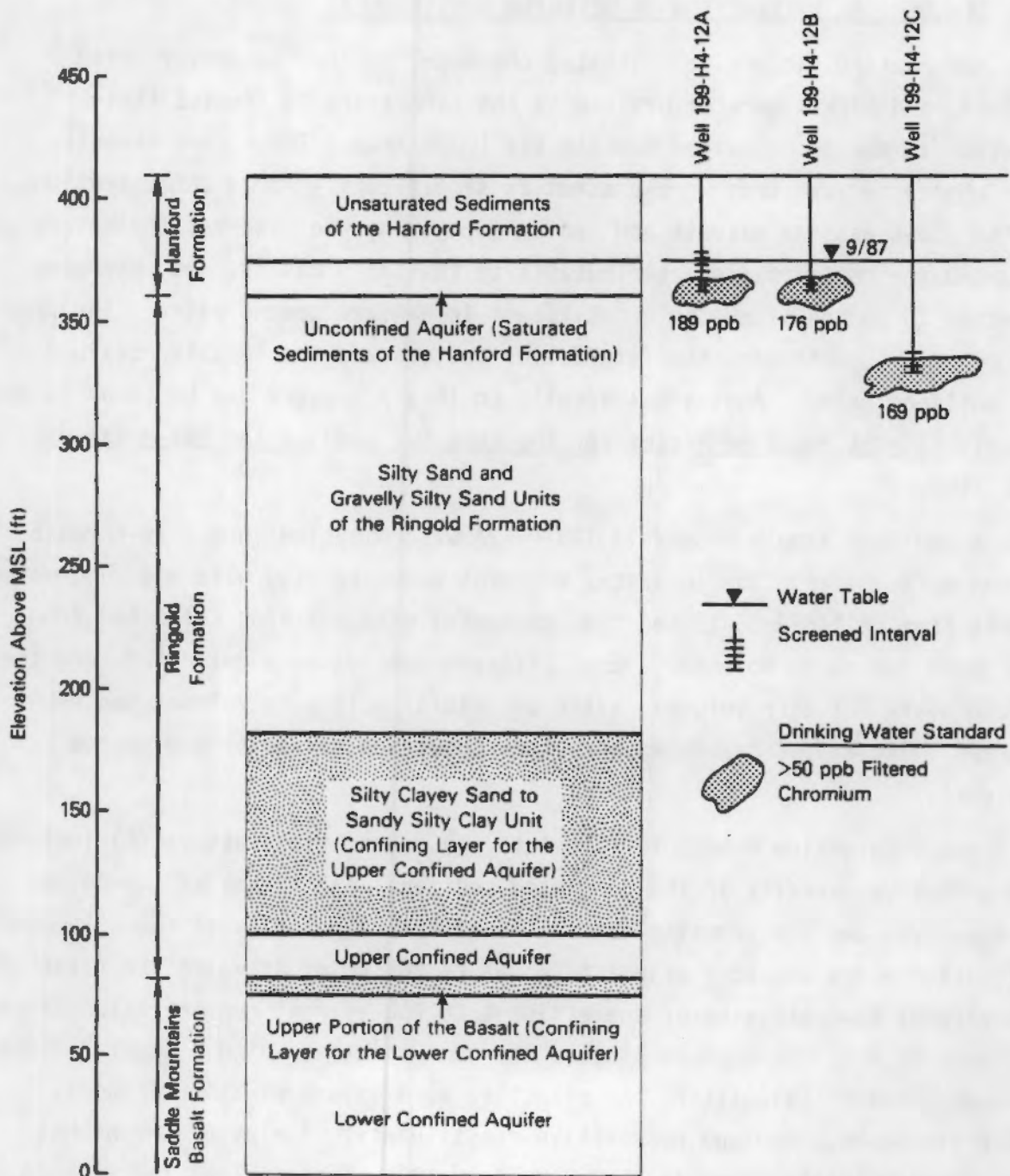


FIGURE 87. Filtered Chromium Concentrations with Depth in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C

9.4 GEOCHEMICAL INTERACTION OF SELECTED CONSTITUENTS

Retardation factors for nitrate, chromium, sodium, copper, fluoride, sulfate, and nickel were determined in the laboratory to predict their behavior in the ground water beneath the 100-H Area. These constituents were chosen because they were present in significantly large concentrations in the 183-H Basins; nitrate and sodium were among the clearest indicators of ground-water contamination attributable to the 183-H Basins; and they were expected to be nonattenuated constituents in Hanford ground water. The procedure used to determine the retardation factors and the results obtained are outlined below. Additional details on this procedure can be found in the Interim Characterization Report for the Area Surrounding the 183-H Basins (PNL 1987).

A sediment sample from Well 199-H3-2A was compacted in a flow-through column permeameter. The compacted sediment was saturated with a ground-water sample from Well 699-S3-25 and then contacted with solution collected from the 183-H Basins in November 1986. Effluent samples were collected from the column every 0.1 pore volumes, after an initial 0.17 pore volumes had been leached. The effluent samples were then submitted for anion and cation analyses.

The information needed to calculate the retardation factors (R) included the effective porosity of the compacted sediment, the volume of the column permeameter, and the leaching data. The effective porosity of the column was calculated where one pore volume is equal to the point at which the ratio of the element concentration of the effluent to the element concentration of the influent is 0.5. This ratio is also the same point at which elemental breakthrough occurs. Calculating the effective pore volume by this method is valid for nonretarded and nonreactive constituents. A plot of the nitrate and chromium breakthrough is shown in Figure 88. The R values for nitrate and chromium were 1.0 and 1.04, respectively. The breakthrough for sodium coincided with the nitrate breakthrough. The breakthroughs for copper, fluoride, sulfate, and nickel coincided with the chromium breakthrough.

The low R values indicate that nitrate, chromium, sodium, copper, fluoride, sulfate, and nickel are essentially nonattenuated when moving through

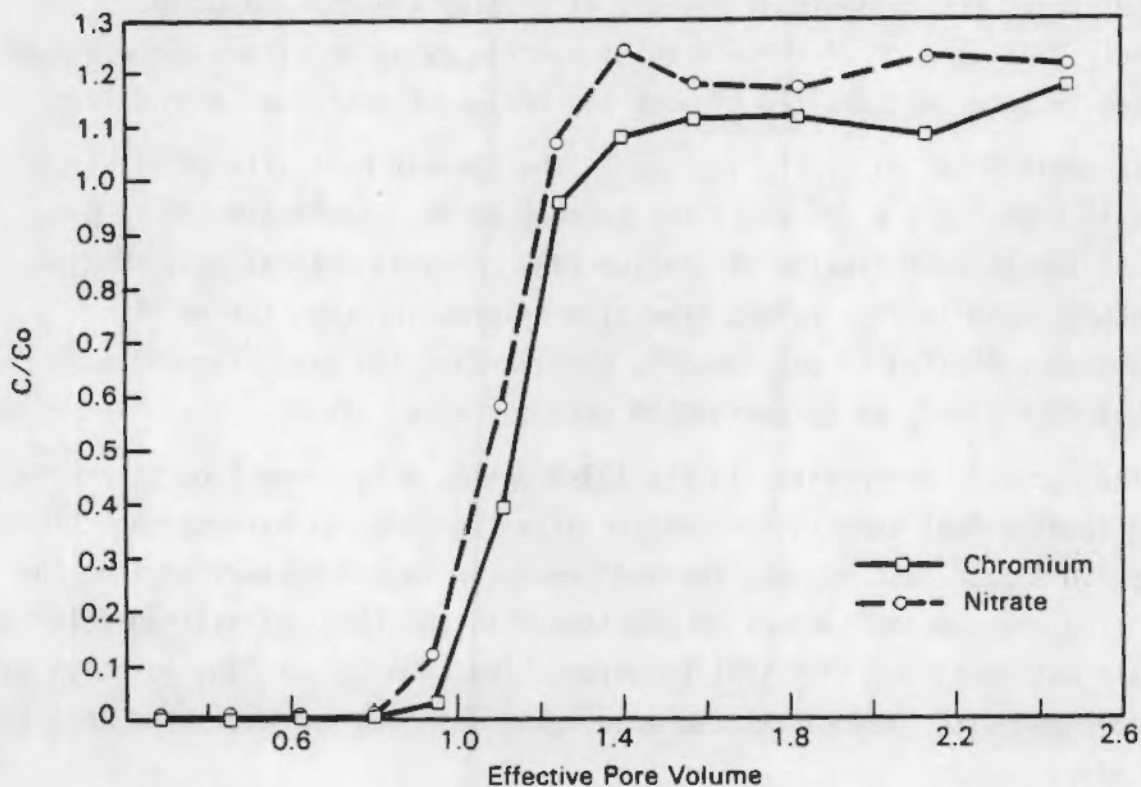


FIGURE 88. Breakthrough Curves for Nitrate and Chromium

the sediment tested. Several of these constituents are in their anionic form and would not be attracted to the typically anionic Hanford soils.

No laboratory studies were conducted to determine retardation factors for uranium or technetium in the sediments near the 183-H Basins. These constituents are thought to be the primary contributors to the gross alpha and gross beta concentrations, respectively. However, a significant amount of information exists where the behavior of uranium and technetium in the ground water can be predicted.

Uranium concentrations in the liquid phase of the waste material from basin #1 averaged 645,000 ppb. The expected uranium species present in the solution phase of basin #1 and #2 at a pH range of 9.32 to 10.5 would be $UO_2(CO_3)_3^{4-}$ (Langmuir 1978). As the basin solution percolates through the carbonate-rich Hanford soils, the pH would be expected to decrease and approach a range of 7 to 8, which is normal for Hanford ground water. At

this pH range, the predominant species of uranium would be $UO_2(CO_3)_2^{2-}$ (Langmuir 1978). Both of these uranium species exist as anions and would be expected to move unattenuated through the sediments near the 183-H Basins.

Technetium has no stable isotopes. The longest half-life of all technetium isotopes is 2×10^6 years for technetium-97. Technetium-99 is produced by spontaneous fission of uranium-238. A small natural contribution of technetium-99 is also formed from slow neutron-induced fission of uranium-235. Fission of uranium-233, thorium-232, and plutonium-239 also produces high yields of technetium-99 (Kotegov et al. 1968).

The technetium deposited in the 183-H Basins originated from the reprocessed uranium fuel used in conjunction with the chemical milling operations in the 300 Area. This process removed some uranium and technetium from the fuel. The uranium and technetium remained with the chemical milling solution and were not reclaimed from that solution. The chemical milling solution was then combined with the neutralized acid waste solution and deposited into the 183-H Basins.

The average concentration of technetium in basin #1 was 7.5×10^5 pCi/L. Because of the highly oxidative chemicals used during the fuels fabrication process, the technetium was oxidized to pertechnetate (TcO_4^-), a highly water-soluble anion. The technetium would be expected to remain as pertechnetate after neutralization. The pertechnetate ion has a tendency to migrate with ground water, unattenuated by Hanford soil (Brown 1967). The mobility of pertechnetate in the ground water would be similar to that of tritium and nitrate.

9.5 PATHLINE ANALYSIS

A pathline analysis was performed to estimate the flow paths and travel times of nonattenuated contaminants in the ground water beneath the 183-H Basins. These pathlines were estimated with a ground-water flow model of the area near the 183-H Basins. The analysis considered simulated ground-water flow in the unconfined aquifer under the effects of transient Columbia River stage.

The modeling, which provided the basis for the pathline analysis, was completed using the Coupled Fluid, Energy, and Solute Transport (CFEST) computer code (Gupta 1982). The model of the unconfined aquifer underlying the 100-H Area consisted of a two-dimensional area with varying thickness. The finite-element grid used for the simulations is shown in Figure 89. The bottom of the aquifer was assumed to be the top of the Ringold Formation and was defined by interpolating the elevations obtained from drilling logs. The thickness of the aquifer was defined as the vertical distance from the bottom of the aquifer to the water table.

The northern and southern boundaries for the model were assumed to be no-flow boundaries because they are parallel to streamlines defined by the direction of regional ground-water flow. The western boundary was outside the region estimated to be influenced by the river level fluctuations and was implemented as a fixed head boundary. The eastern boundary was the Columbia River and was implemented as a time-varying prescribed head boundary. This boundary was changed each time step to simulate the fluctuations in river stage. No areal recharge was assumed to enter the model; therefore, the water table fluctuations resulted entirely from changes in river level. Initial conditions assumed a steady-state water table surface, as calculated by CFEST, using the river level from the first week of September 1986.

A total of eight pathlines were simulated (Figure 90) starting at locations in the unconfined aquifer directly beneath the 183-H Basins. The pathlines were continued until they reached the Columbia River. The maximum travel time, based on previous modeling results reported in the Interim Characterization Report for the Area Surrounding the 183-H Basins (PNL 1987) was estimated to be approximately 5 years. Therefore, a transient simulation of ground-water flow spanning 6 years was used to allow all the pathlines to reach the river. A 6-year digitized record of Columbia River stages was not available for the 183-H Area; therefore, because of the time frame involved for the pathlines, ground-water flow was modeled using a yearly cycle of river level fluctuations. The river level data from September 1986 to September 1987 were assumed to represent a yearly cycle in river stage. These data were repeated to simulate a 6-year cycle.

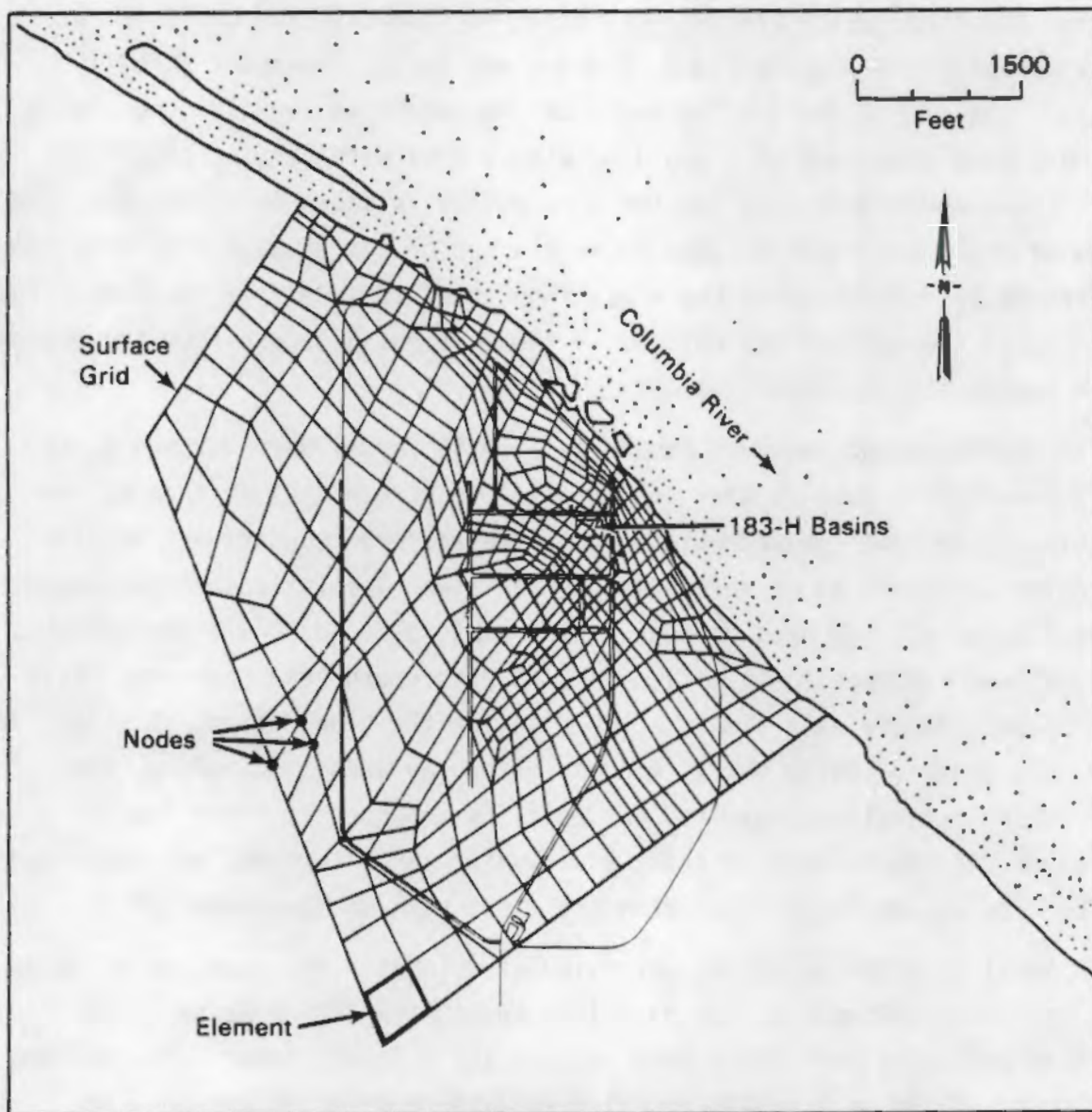


FIGURE 89. Finite-Element Grid Used for Simulations

The travel times and distances traveled by these simulated pathlines are shown in Table 19.

The travel times range from 1.2 to 4.1 years, while the distances traveled range from 607 to 1357 ft. The spread in times and distances traveled reflect the variable flow paths resulting from changes in the water table that, in turn, are caused by the fluctuating river stage. A spread of 173 ft was observed for the locations where the flow paths entered the river, and it

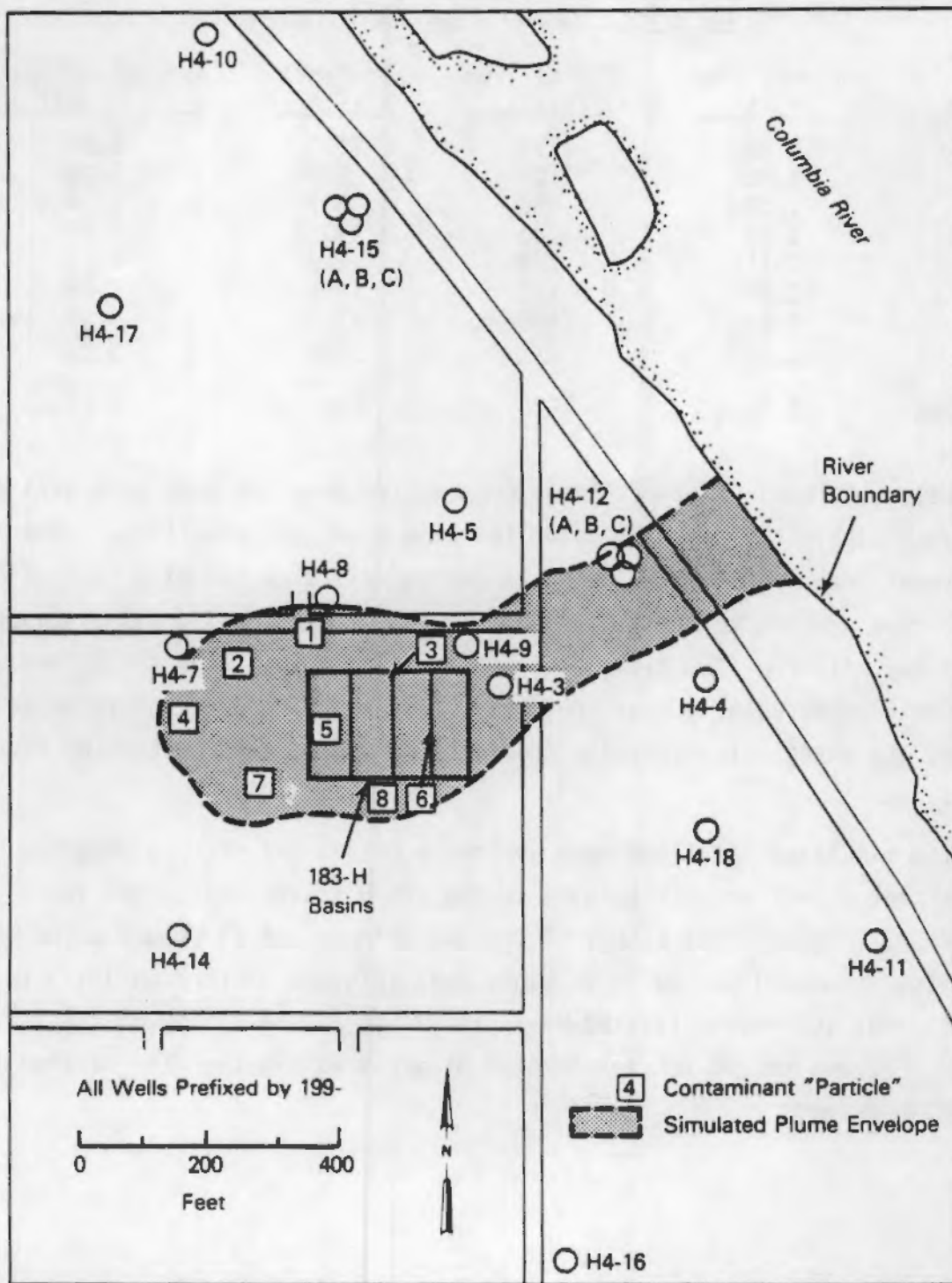


FIGURE 90. Simulated Contaminant Plume. Computer-derived flow paths for eight contaminant "particles" in the ground water near the 183-H Solar Evaporation Basins converge to form a plume that migrates toward the Columbia River and is contained within the shaded area.

TABLE 19. Travel Time and Distances

<u>Path</u>	<u>Travel Time (yr)</u>	<u>Travel Time (days)</u>	<u>Distance (ft)</u>	<u>Average Velocity (ft/day)</u>
1	4.09	1494	1291	0.86
2	3.02	1105	974	0.88
3	1.24	452	607	1.34
4	3.53	1289	1133	0.88
5	2.11	772	827	1.07
6	2.06	752	996	1.33
7	4.01	1465	1357	0.93
8	<u>2.40</u>	<u>877</u>	<u>842</u>	<u>0.96</u>
Averages	2.81	1026	1003	1.03

is likely that most other pathlines originating from the same area will reach the river within this spread, under the same transient conditions. The average travel time is 2.8 years, and the average distance traveled is 1003 ft. The average seepage velocity based on the travel times and total distances associated with the flow paths is 1 ft/day. The actual flow velocities vary considerably, especially near the river, because of changes in hydraulic properties and changes in hydraulic gradients caused by the fluctuating river level.

The simulated pathlines were generally consistent with 1) observed contaminant migration attributable to the 183-H Basins (discussed in Section 9.2, "Horizontal Extent of Contamination") and 2) ground-water flow direction indicated on the water table maps (Figures 39 through 41). The results indicate that Wells 199-H4-3, 199-H4-4, 199-H4-9, 199-H4-12A, 199-H4-12B, and 199-H4-12C are located directly within the flow related to the 183-H Basins.

point-of-compliance well, 199-H4-3, between April and August 1986. Concentrations of this magnitude have not been repeated since that time.

- Nitrate, sodium, gross alpha, and gross beta were identified as the clearest indicators of ground-water contamination attributable to the 183-H Basins.
- In general, Wells 199-H4-3, 199-H4-4, 199-H4-9, and 199-H4-12A show the highest constituent concentrations. These concentrations are affected by variations in Columbia River stage, increasing during periods of low river stage and decreasing during periods of high river stage.
- Gross beta concentrations near the 107-H Retention Basin do not correlate with the distribution of the other major contaminants attributable to the 183-H Basins, and may be a result of past operational practices at this facility.
- Chromium concentrations do not correlate with the distribution of the other major contaminants attributable to the 183-H Basins. Four other potential sources of chromium from inactive waste disposal facilities at the 100-H Area have been identified.
- Concentrations of nitrate, gross alpha, gross beta, and chromium in Wells 199-H4-12A, 199-H4-12B, and 199-H4-12C suggest that the extent of contamination for these constituents is limited at depth.
- Standard deviations and coefficients of variation are relatively large for a number of constituents and wells. Concentrations of several of these constituents are changing significantly with time and water table elevation.

Ground-Water Modeling

- Pathline analysis results estimated a range of travel times from 1.2 to 4.1 years and an average distance of 1003 ft from the 183-H Basins to the Columbia River. The average seepage velocity based on the travel times and total distances associated with the flow paths was 1 ft/day.

- The simulated pathlines were generally consistent with observed contaminant migration attributable to the 183-H Basins and ground-water flow direction.

11.0 RECOMMENDATIONS

The geohydrologic investigation of the area surrounding the 183-H Basins has resulted in the following recommendations:

- Soil samples within the unsaturated sediments of the Hanford formation should be collected adjacent to and directly beneath the 183-H Basins. These samples should be chemically analyzed to determine the types and extent of contamination present on the soil column.
- In addition to wells 199-H4-4 and 199-H4-5, continuous head data should be collected using data loggers and transducers in the selected wells proposed for continued sampling (199-H3-2A, 199-H4-3, 199-H4-6, 199-H4-9, 199-H4-12A, and 199-H4-18). These data will be correlated with 1) continuous Columbia River level data and 2) contaminant data collected from the wells to further define their relationships.
- Geochemical modeling should be conducted to assess the geochemical processes affecting transport of the waste constituents in the ground water.
- Beginning in FY 1989, ground-water sampling should be conducted on a quarterly basis until closure activities commence and during the post-closure period for Wells 199-H3-2A, 199-H4-3, 199-H4-4, 199-H4-5, 199-H4-6, 199-H4-9, 199-H4-12A, 199-H4-12B, 199-H4-12C, and 199-H4-18. Sampling of these wells should increase to a monthly frequency during closure activities. Sampling of the remaining 13 wells should be conducted on an annual basis.
- Sample analyses to be conducted on the 100-H Area ground-water samples for the period beyond FY 1988 should include nitrate, sodium, chromium, gross alpha, gross beta, uranium, technetium, TOX, alkalinity, and pH. In addition, analysis for those constituents listed in the WAC 173-303-9905 should be analyzed on an annual basis in the point-of-compliance well, 199-H4-3.

- Sampling of the Columbia River should be conducted at points upstream, adjacent to, and downstream of the 100-H Area to determine the impact of ground-water contamination on the river.
- Sampling of ground-water springs at the 100-H Area should be conducted to help determine the extent of contamination at the surface-water/ground-water interface.
- Additional studies are needed to discriminate the gross beta and chromium contributions from other potential sources within the 100-H Area.

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10.0 CONCLUSIONS

The geohydrologic investigation of the area surrounding the 183-H Basins has resulted in the following conclusions:

Geology

- The Elephant Mountain Member of the Saddle Mountains Basalt Formation is the topmost basalt flow in the 100-H Area.
- The sediments of the Ringold Formation beneath the 100-H Area were characterized as section type II, consisting of predominantly sands, silts, and clays. This formation was subdivided into three principal lithologic units, including the silty clayey sand to sandy silty clay, silty sand, and gravelly silty sand.
- The top of the Ringold Formation is an erosional unconformity, with peak elevations located to the east and northeast of the 183-H Basins.
- The Hanford formation at the 100-H Area has been severely modified by past operational and waste management activities. Backfill materials were often indistinguishable from the in situ gravels and sands, resulting in this formation being treated as a single silty sandy gravel unit.

Hydrology

- Five principal hydrostratigraphic units were defined beneath the 100-H Area, including the lower confined aquifer, upper confined aquifer, silty sand and gravelly silty sand units, saturated sediments of the Hanford formation, and unsaturated sediments of the Hanford formation.
- Testing of piezometer (Q) and (R) in Well 199-H4-15C may have altered the integrity of the bentonite seals adjacent to their screened intervals. Observation of the piezometer for several years may be necessary to determine if the annulus reseals.

- The unconfined aquifer occurs within the Hanford formation and ranges in thickness from 3 to 15 ft. This variation is a result of the erosional unconformity at the contact between the Hanford and Ringold Formations and the variation in the water table.
- Ground-water flow in the 100-H Area is generally northeast and east toward the Columbia River. Changes in water table elevation in all wells correspond to changes in river stage.
- Variability in aquifer testing results for the unconfined aquifer indicates that this aquifer is heterogeneous at the 100-H Area.

Geochemistry

- Sampling of waste material from Basin #1 indicate a wide variability in chemical composition among sampling locations, as a result of the formation of several solid and slurry-like layers.
- Sampling of waste material from Basin #2 indicate this material is predominantly a sodium nitrate solution.
- Analytical results from the wastes contained in basins #1 and #2 identified chromium, technetium, sodium, uranium, fluoride, nitrate, and sulfate as potential ground-water contaminants associated with the 183-H Basins.
- Retardation factors for nitrate, chromium, sodium, copper, fluoride, sulfate, and nickel indicate that these constituents are essentially nonattenuated.

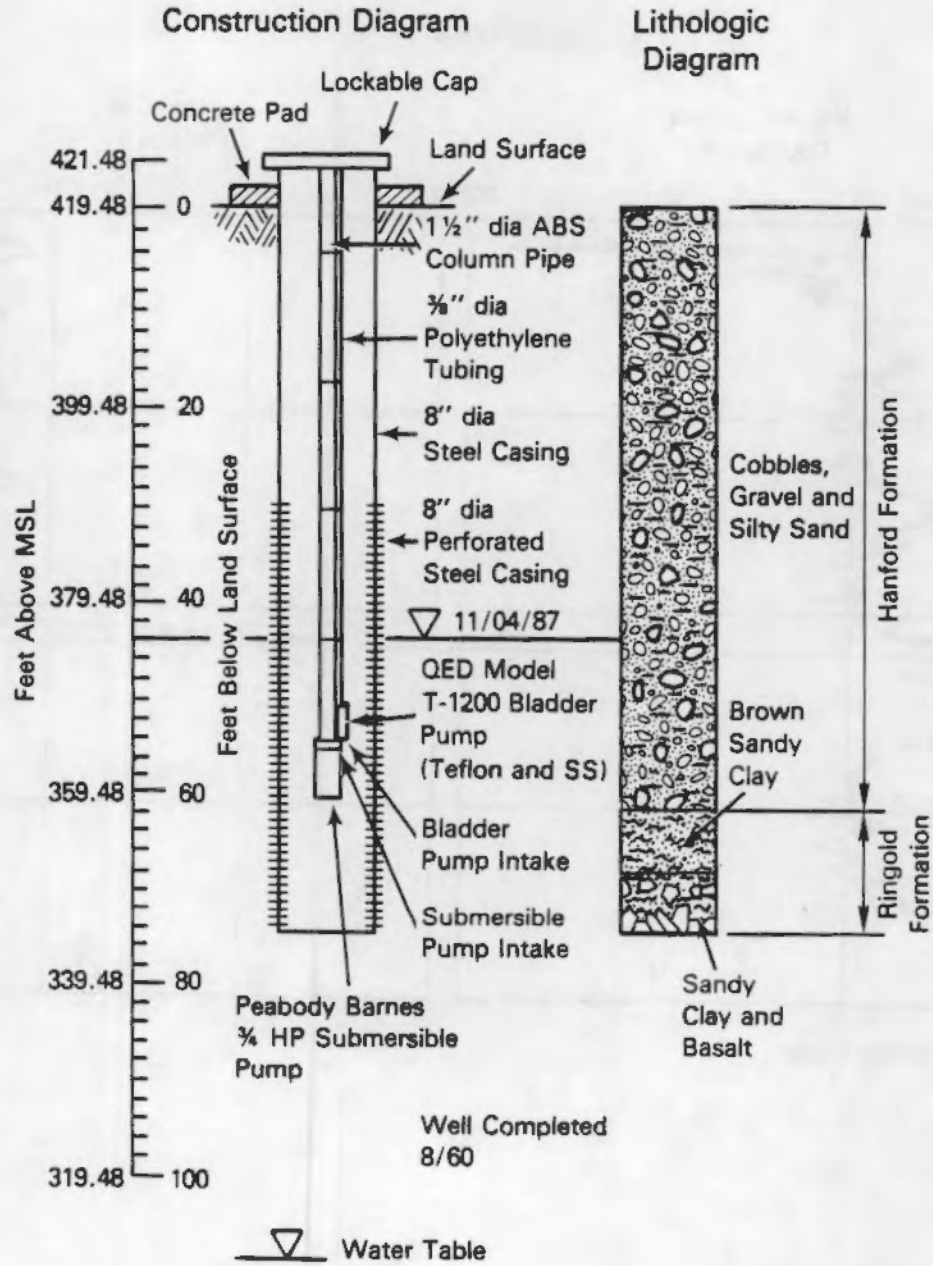
Ground-Water Monitoring

- Background values for nitrate and chromium in the upgradient wells near the 183-H Basins were higher than the background values for the Hanford Site, indicating other sources of these constituents located upgradient of the facility.
- Ground-water monitoring results revealed that concentrations of approximately 20 constituents showed very marked increases in the

APPENDIX A

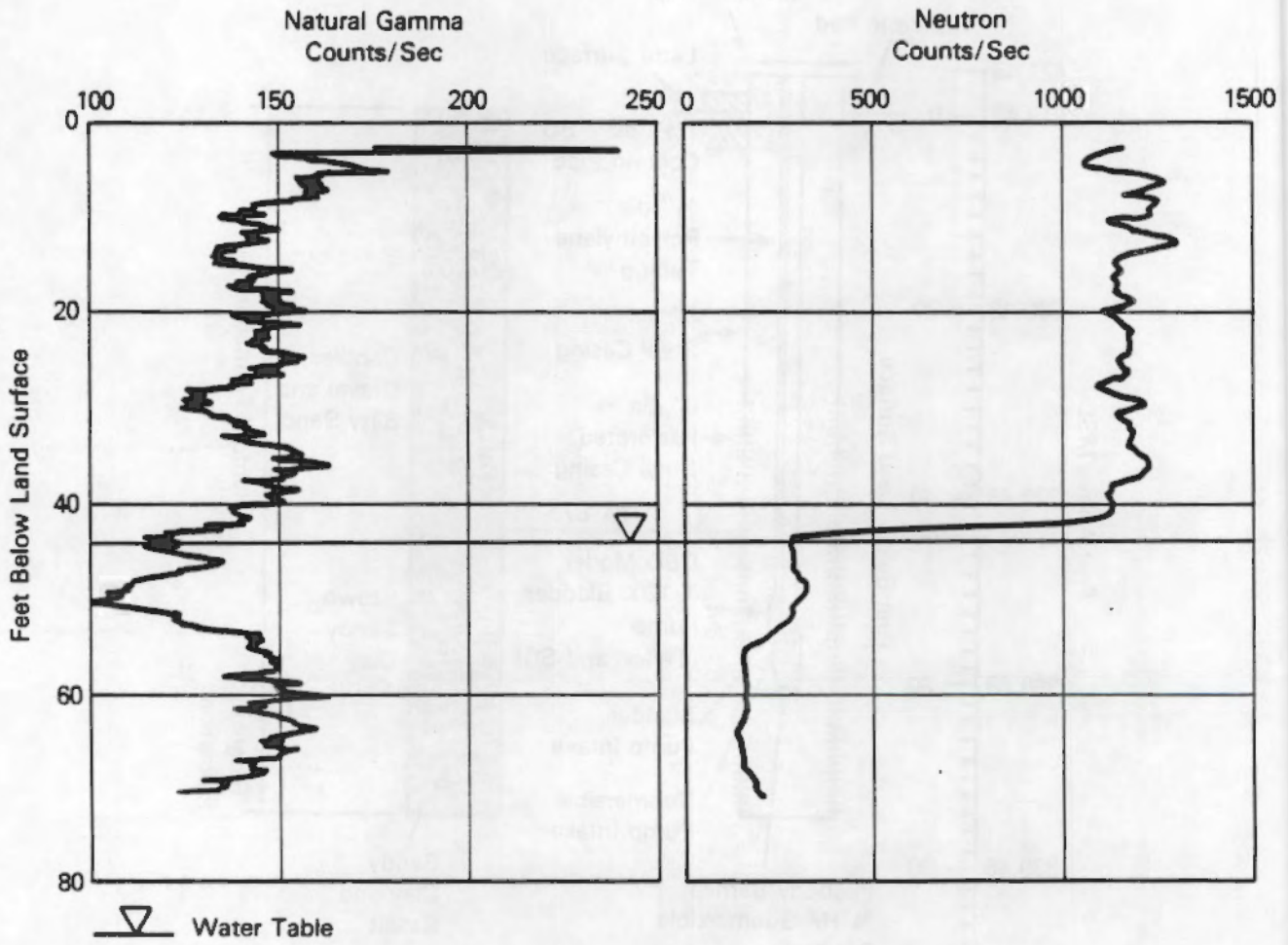
CONSTRUCTION DIAGRAMS, LITHOLOGIC DIAGRAMS,
AND GEOPHYSICAL LOGS FOR THE 100-H AREA WELLS

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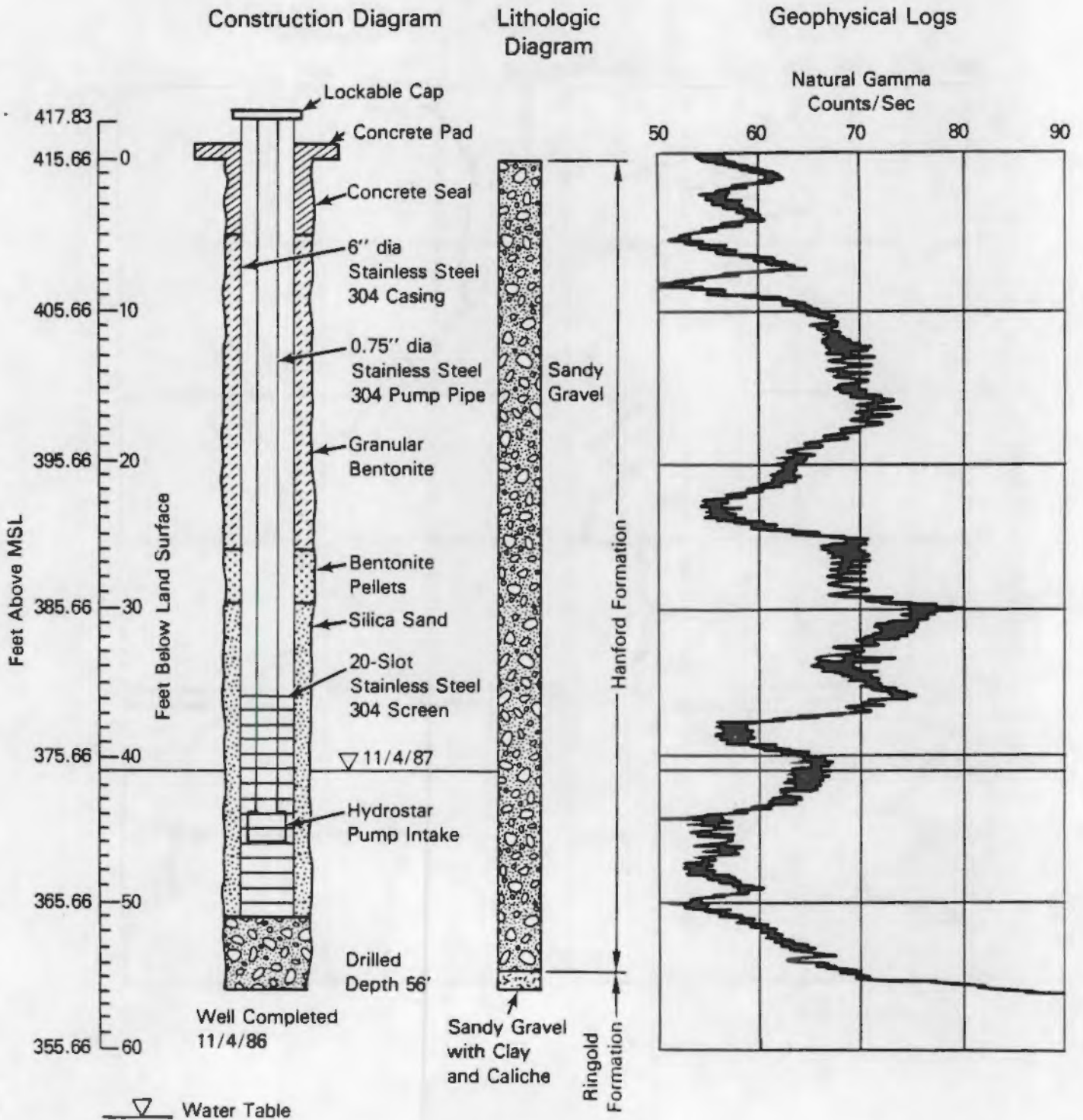


Well Number 199-H3-1

Geophysical Logs

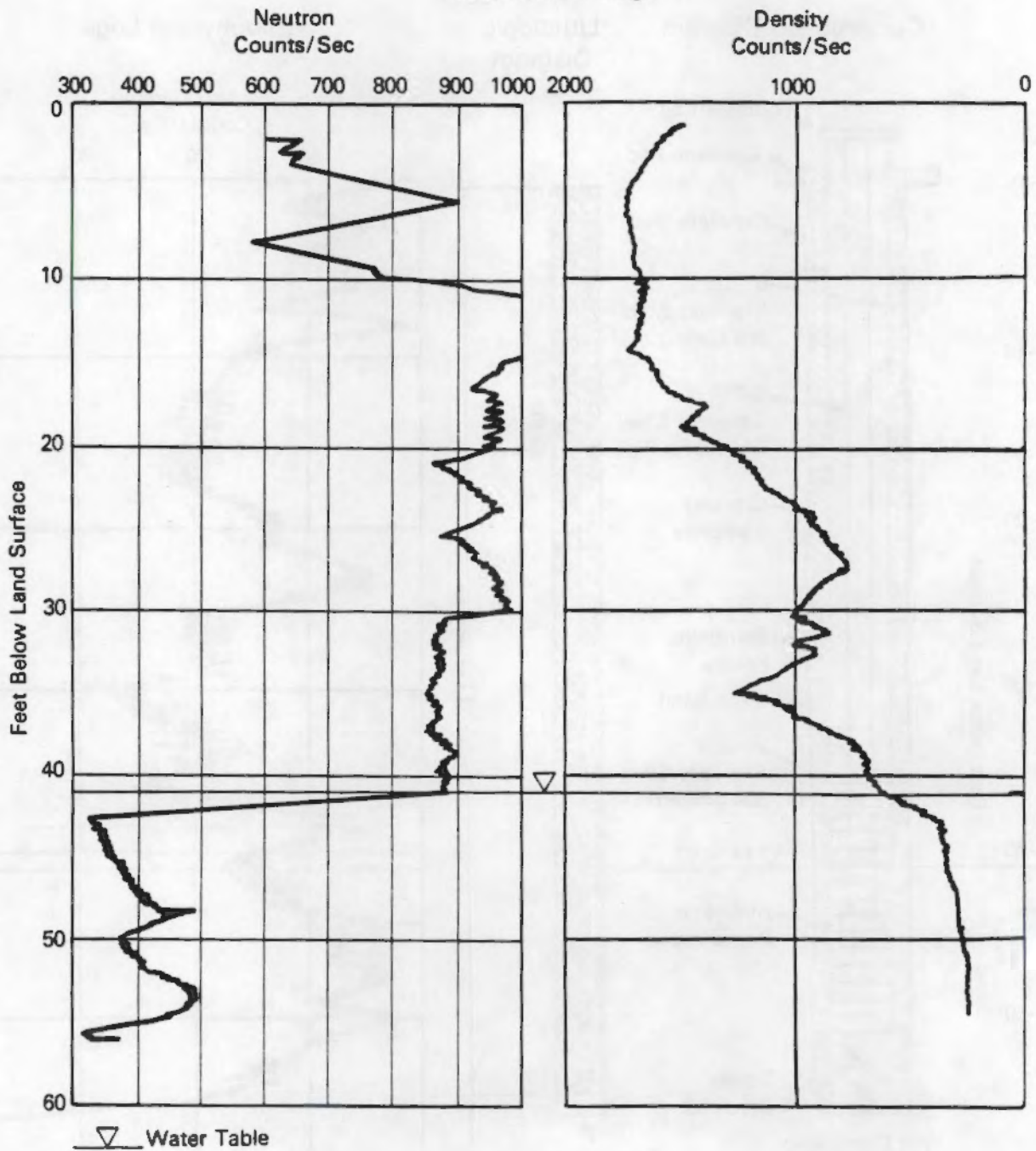


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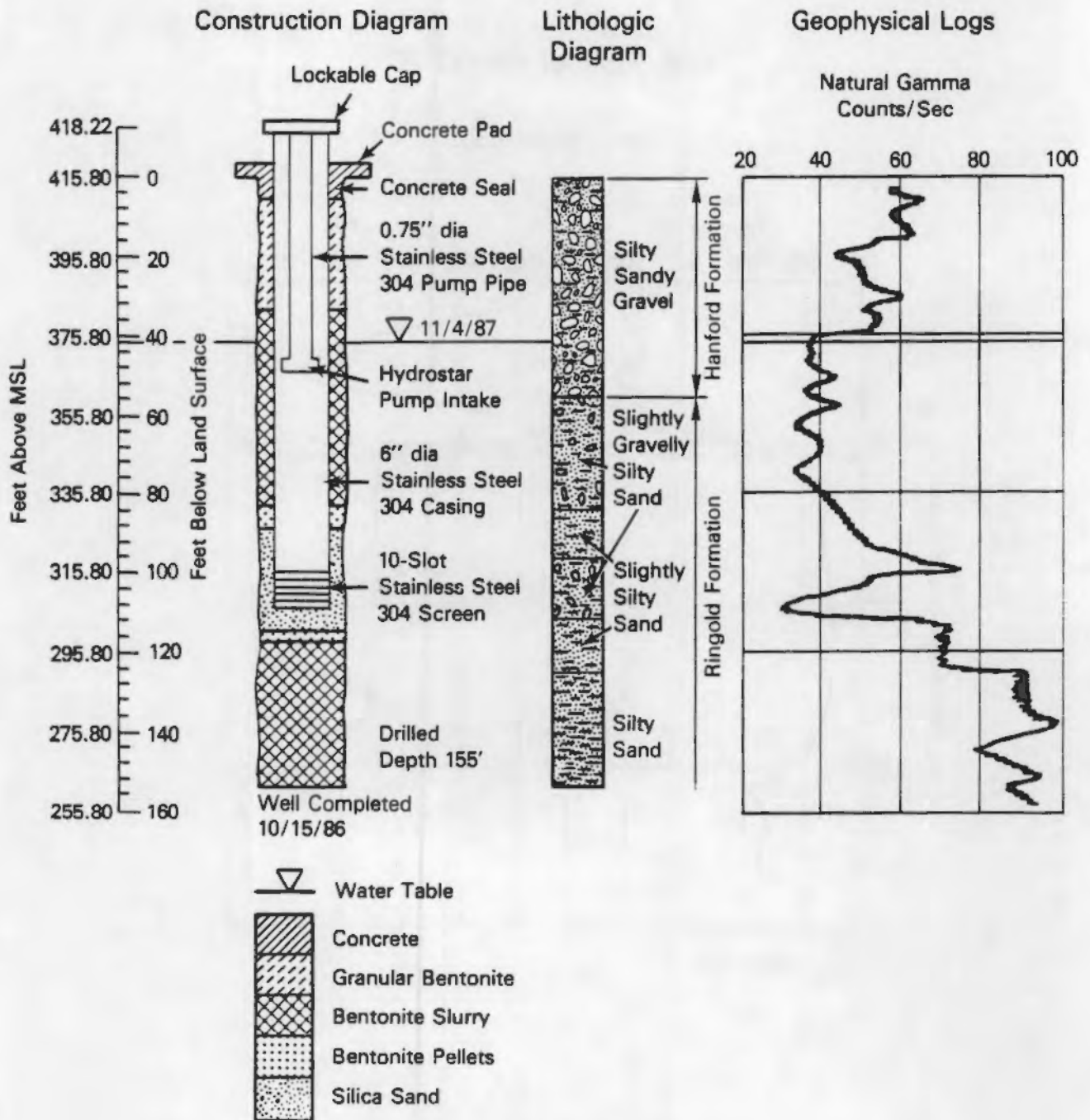


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Geophysical Logs

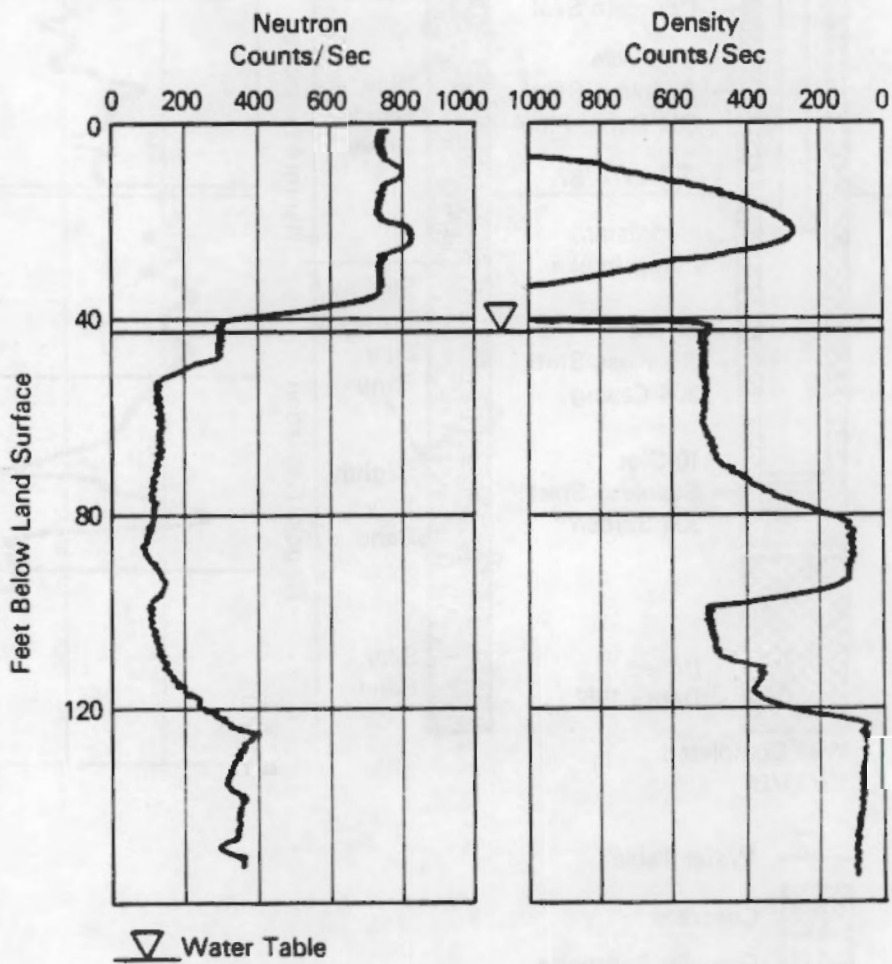


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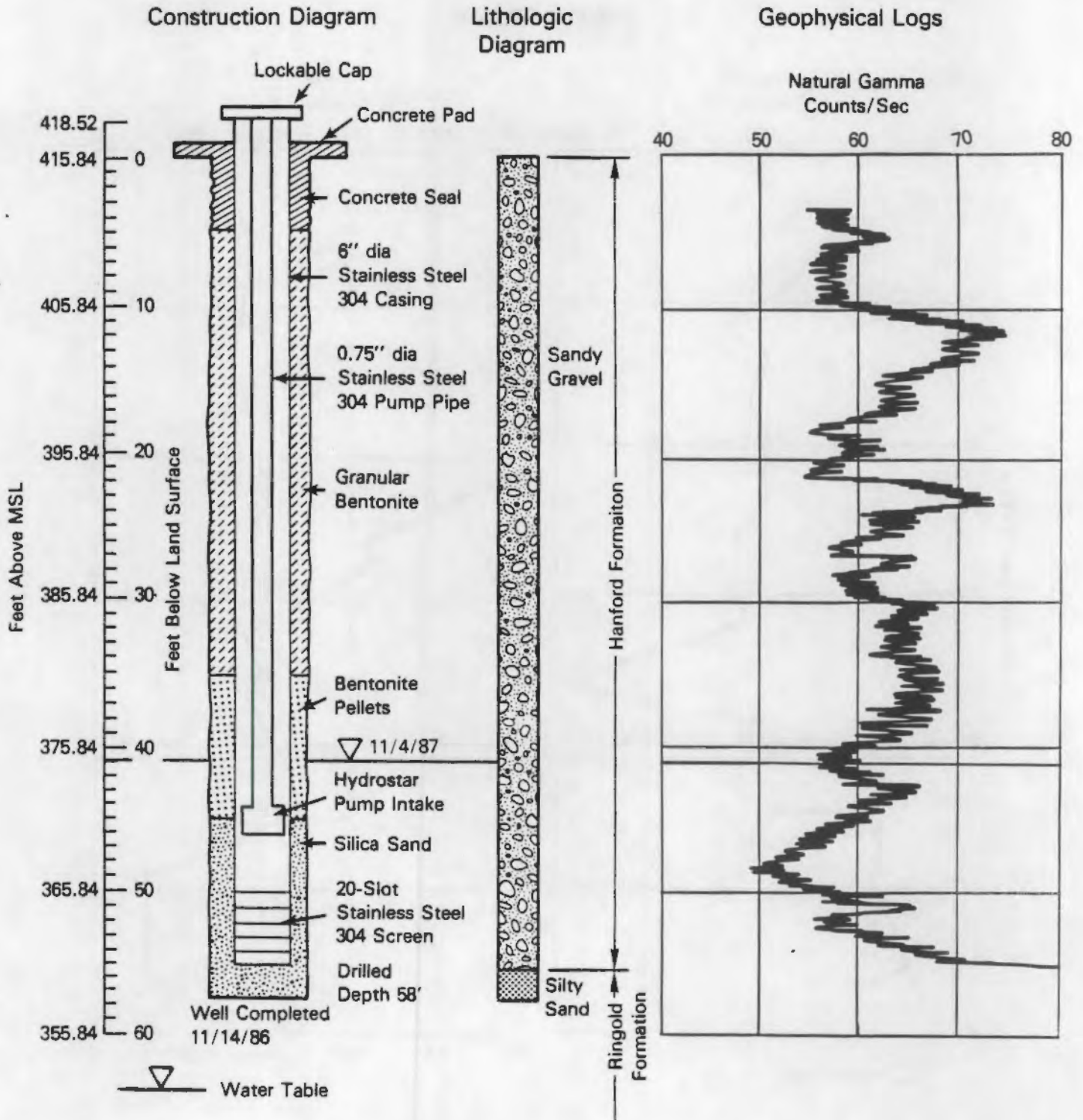


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Geophysical Logs

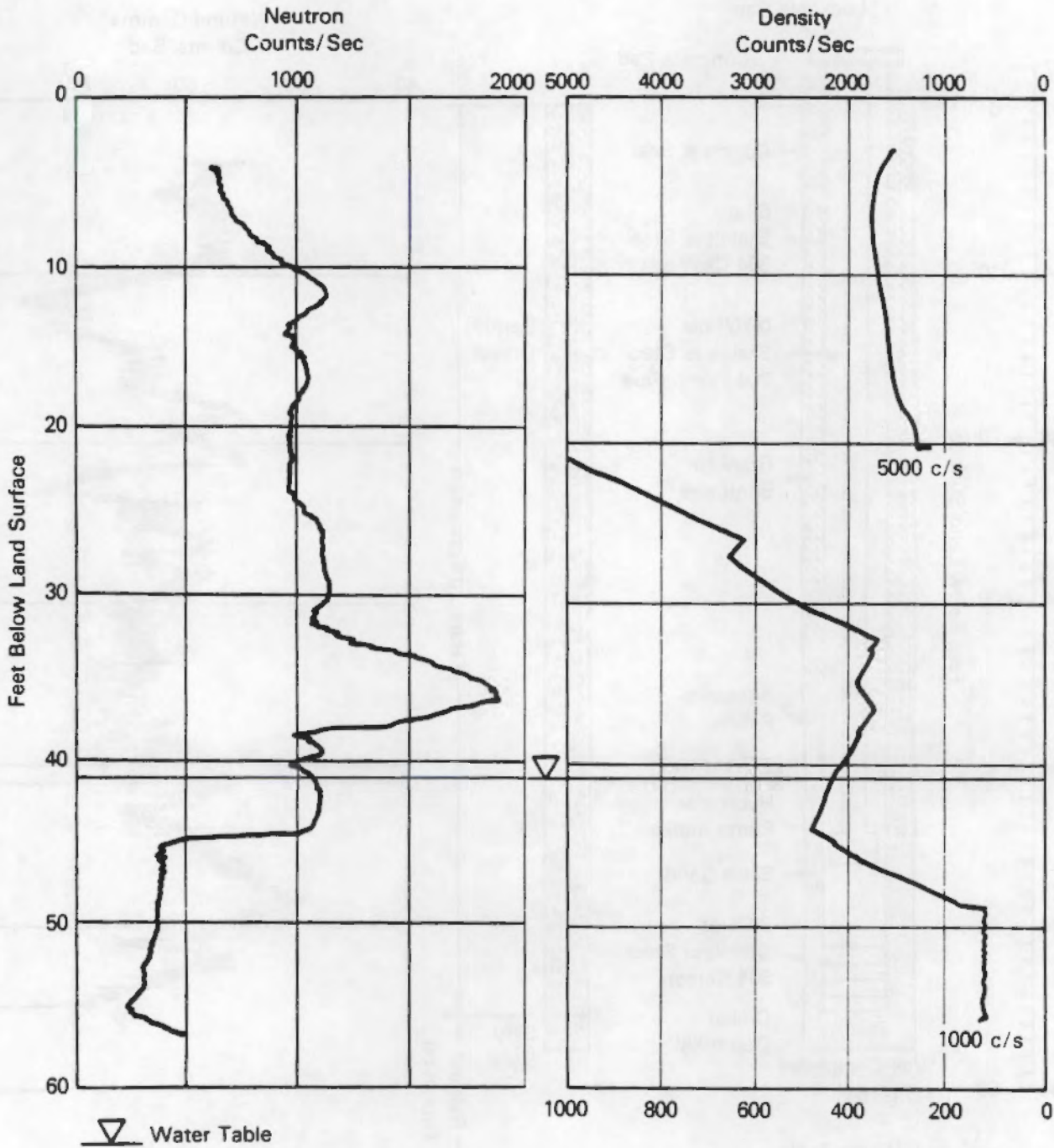


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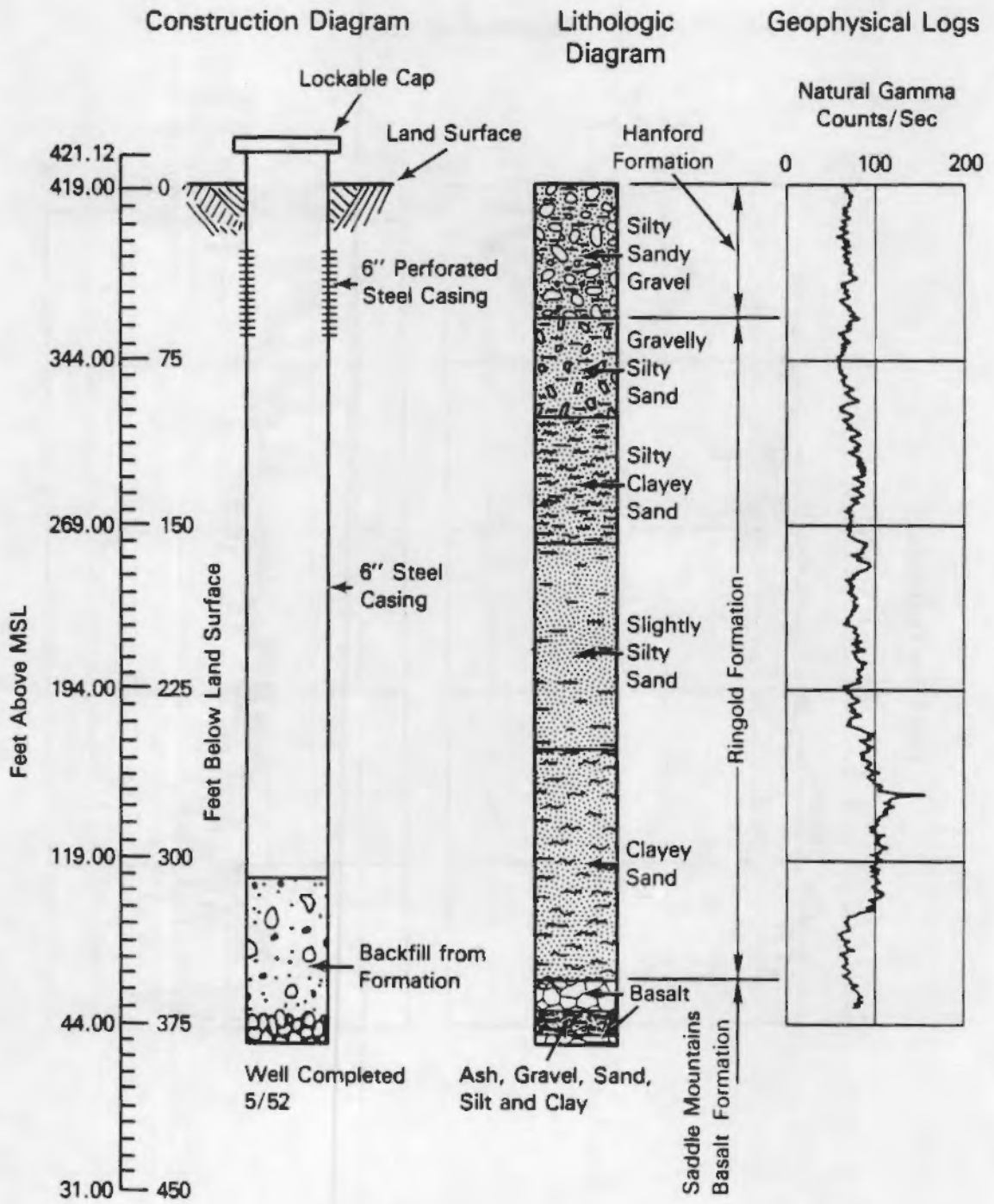


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Geophysical Logs

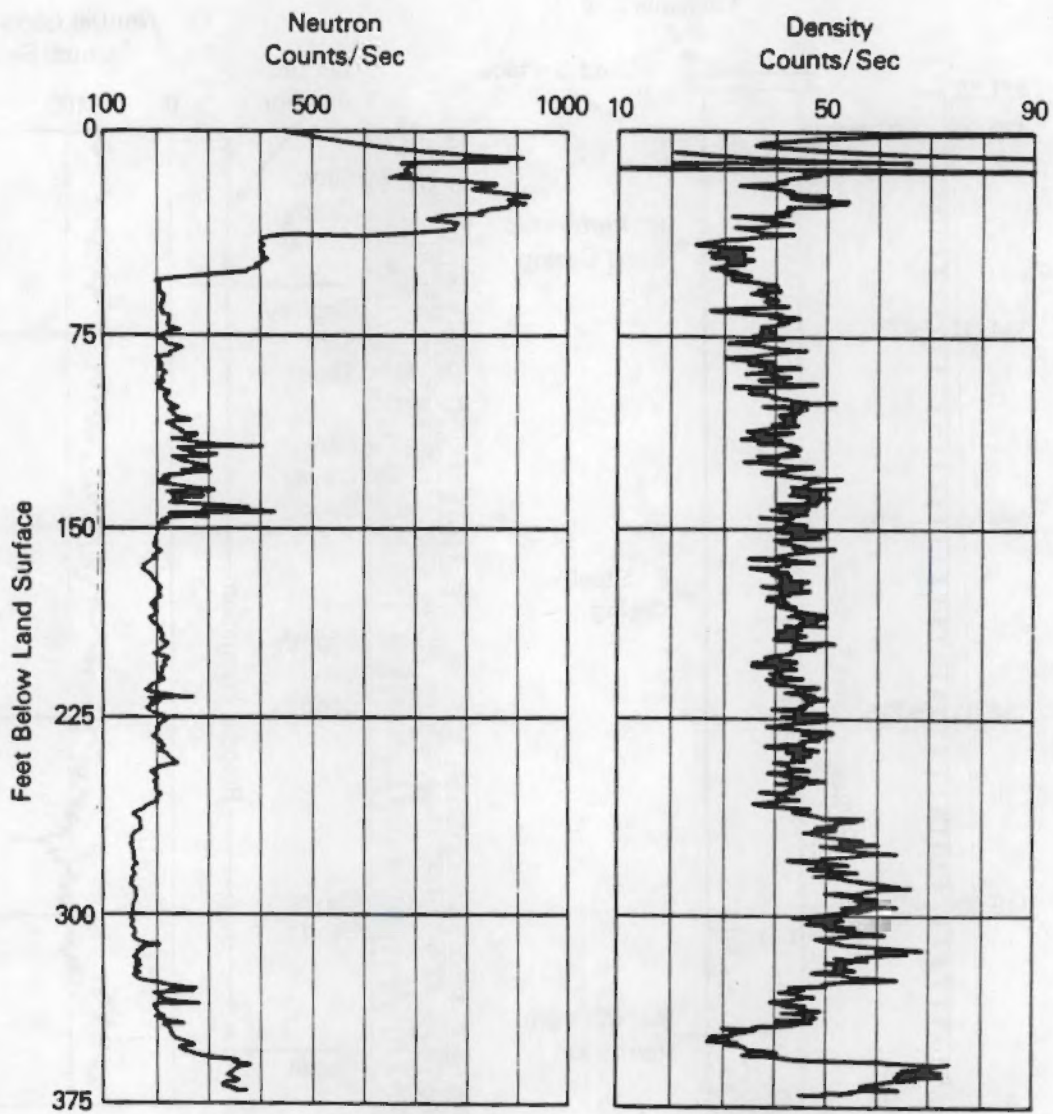


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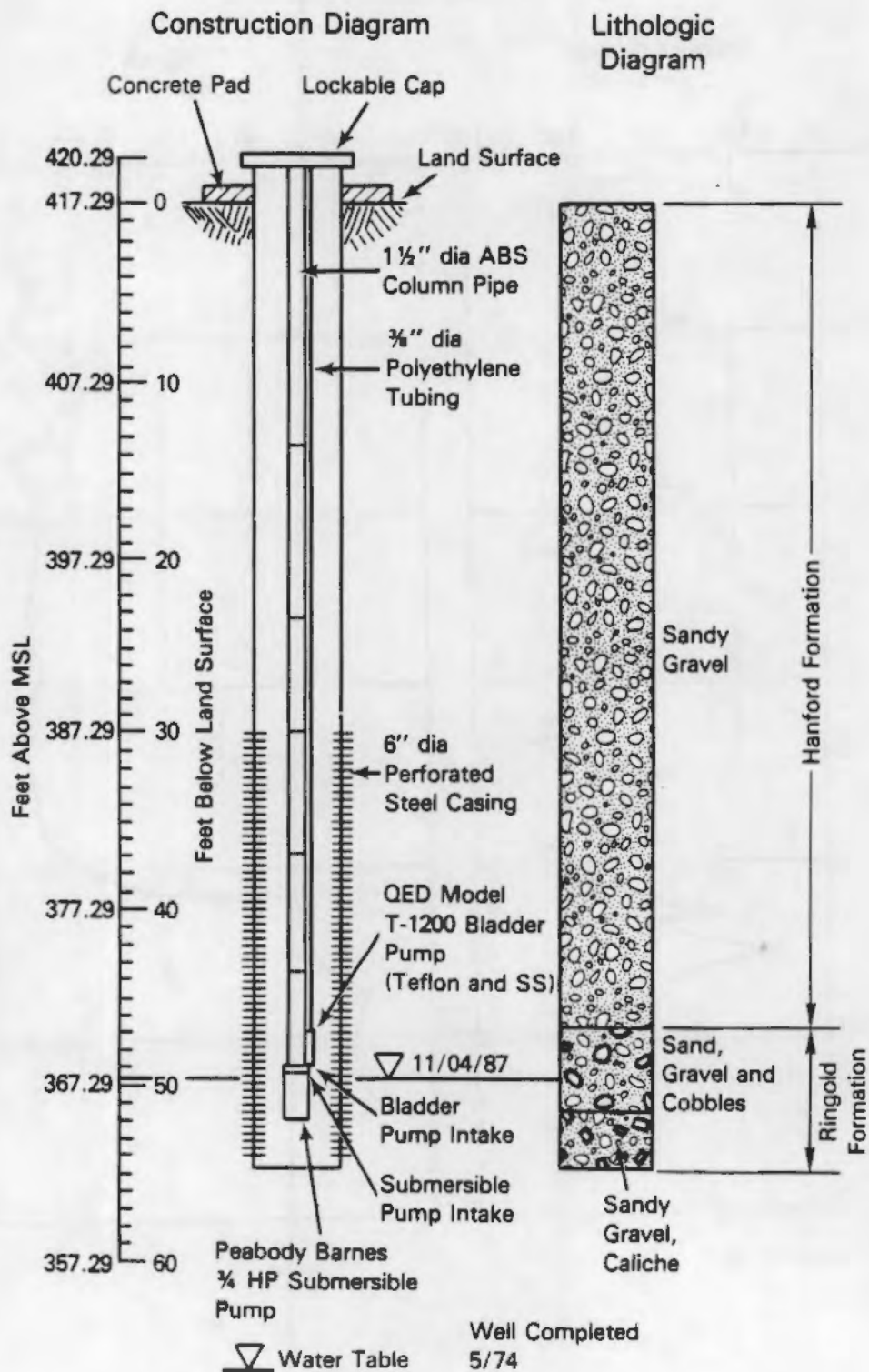


Well Number 199-H4-2

Geophysical Logs

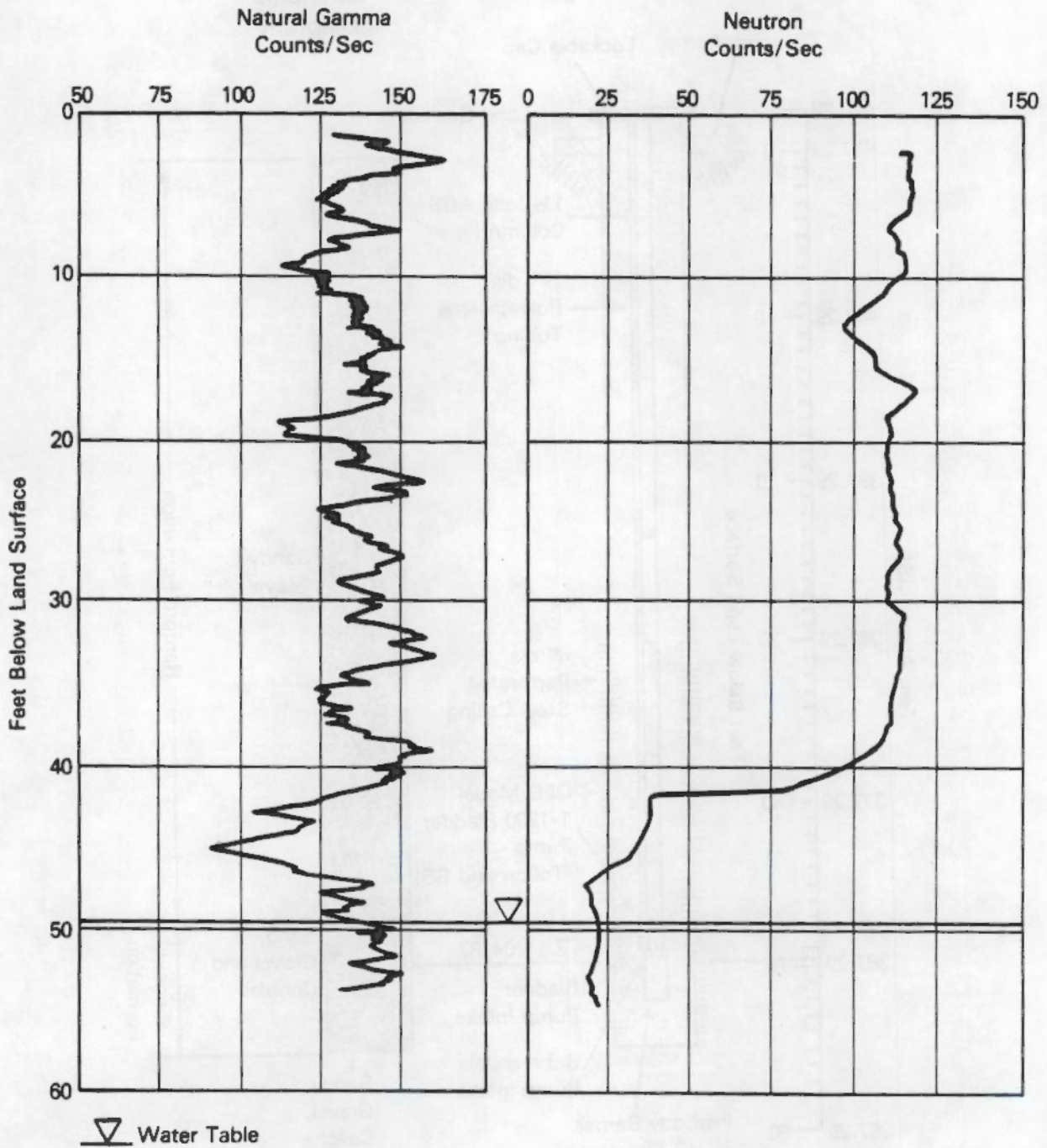


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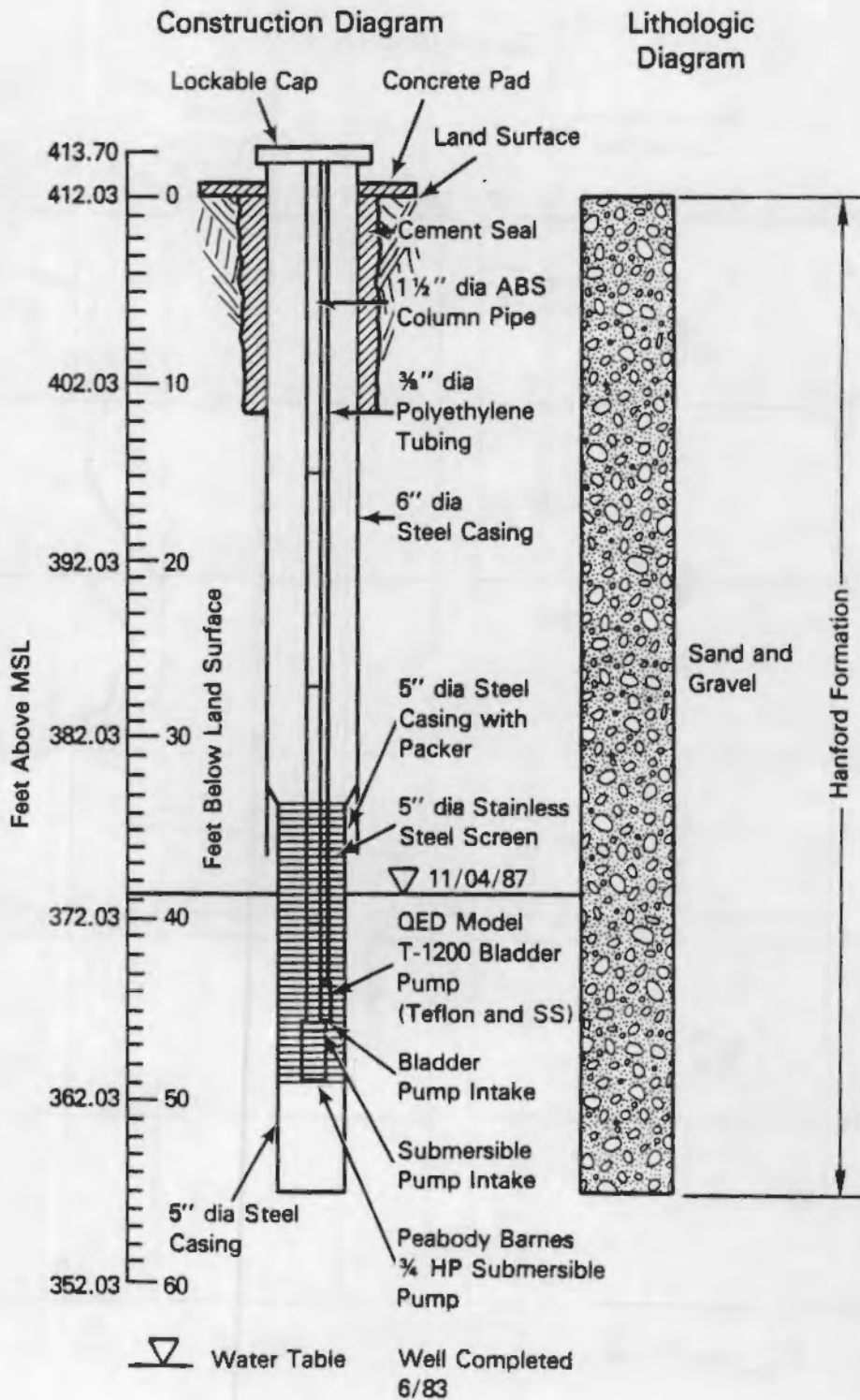


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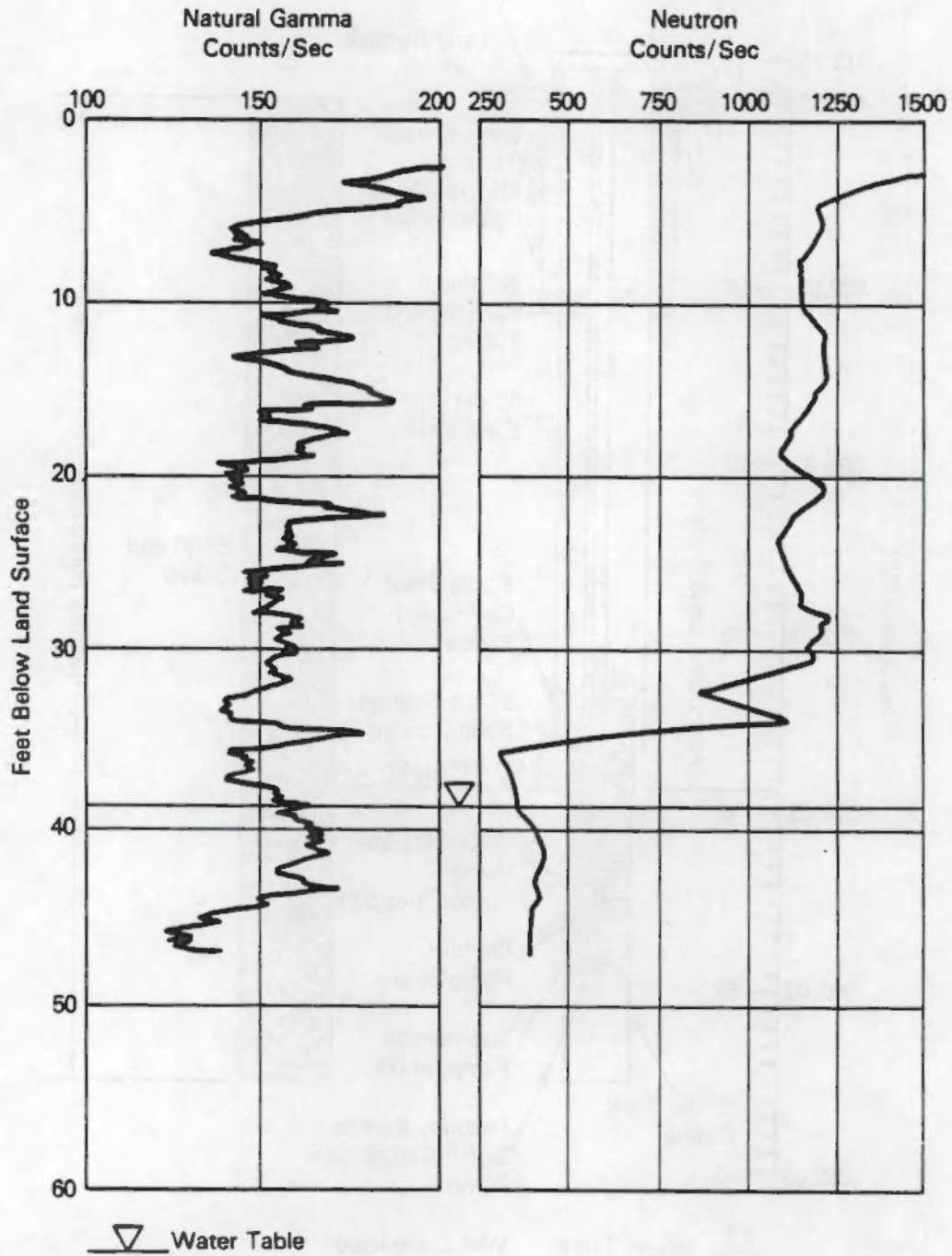


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Well Number 199-H4-4

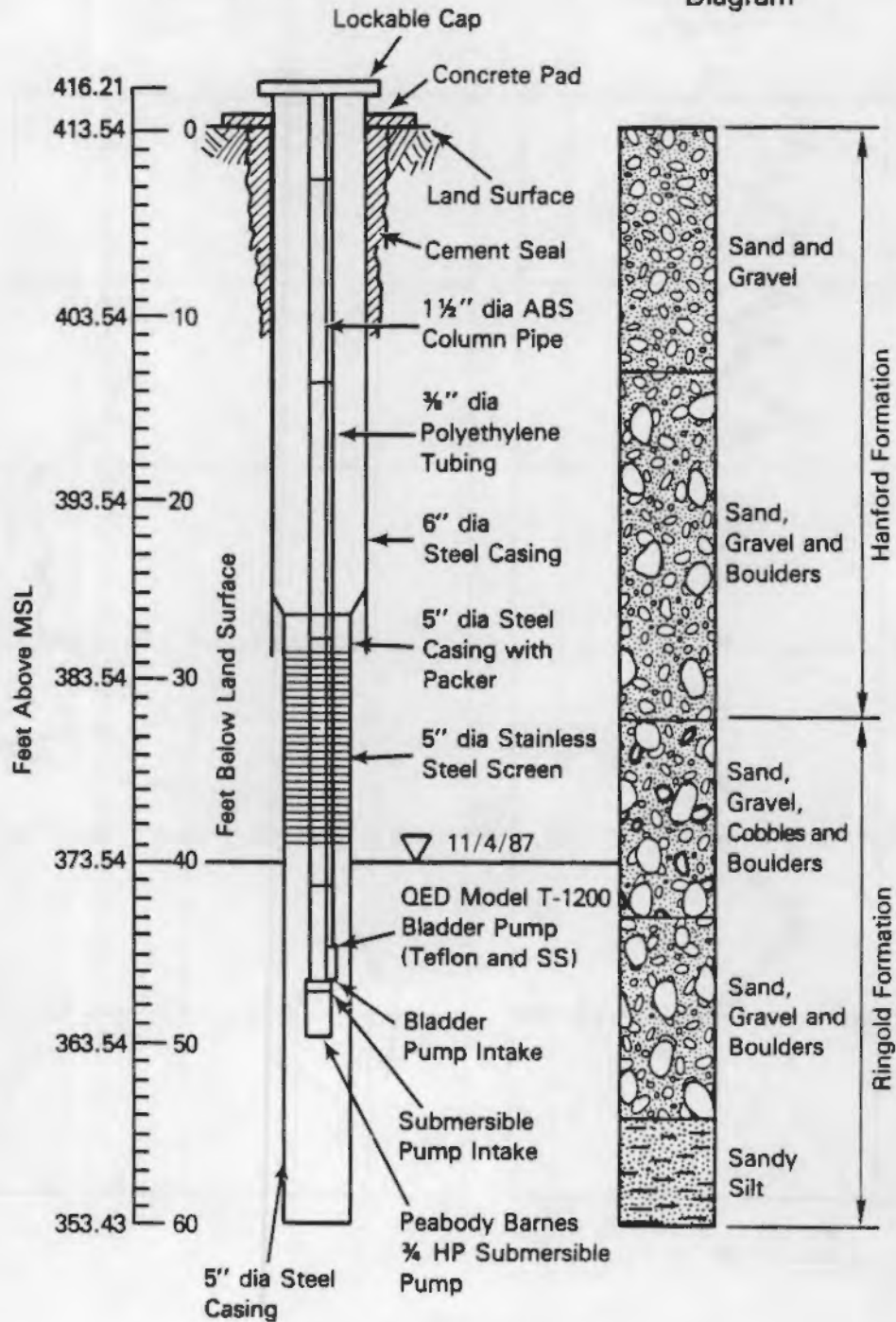
Geophysical Logs



Well Number 199-H4-5

Construction Diagram

Lithologic Diagram

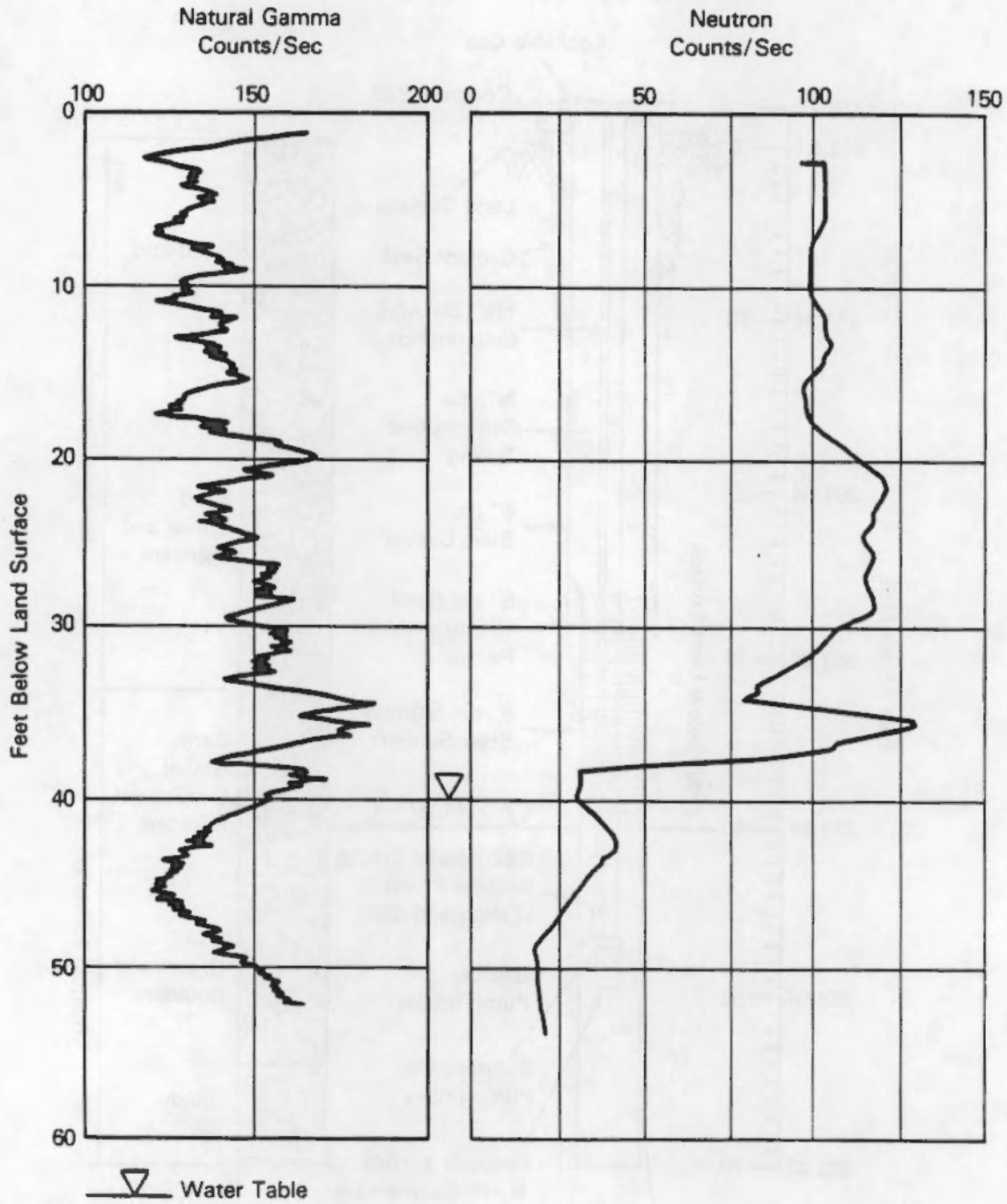


Well Completed
5/83

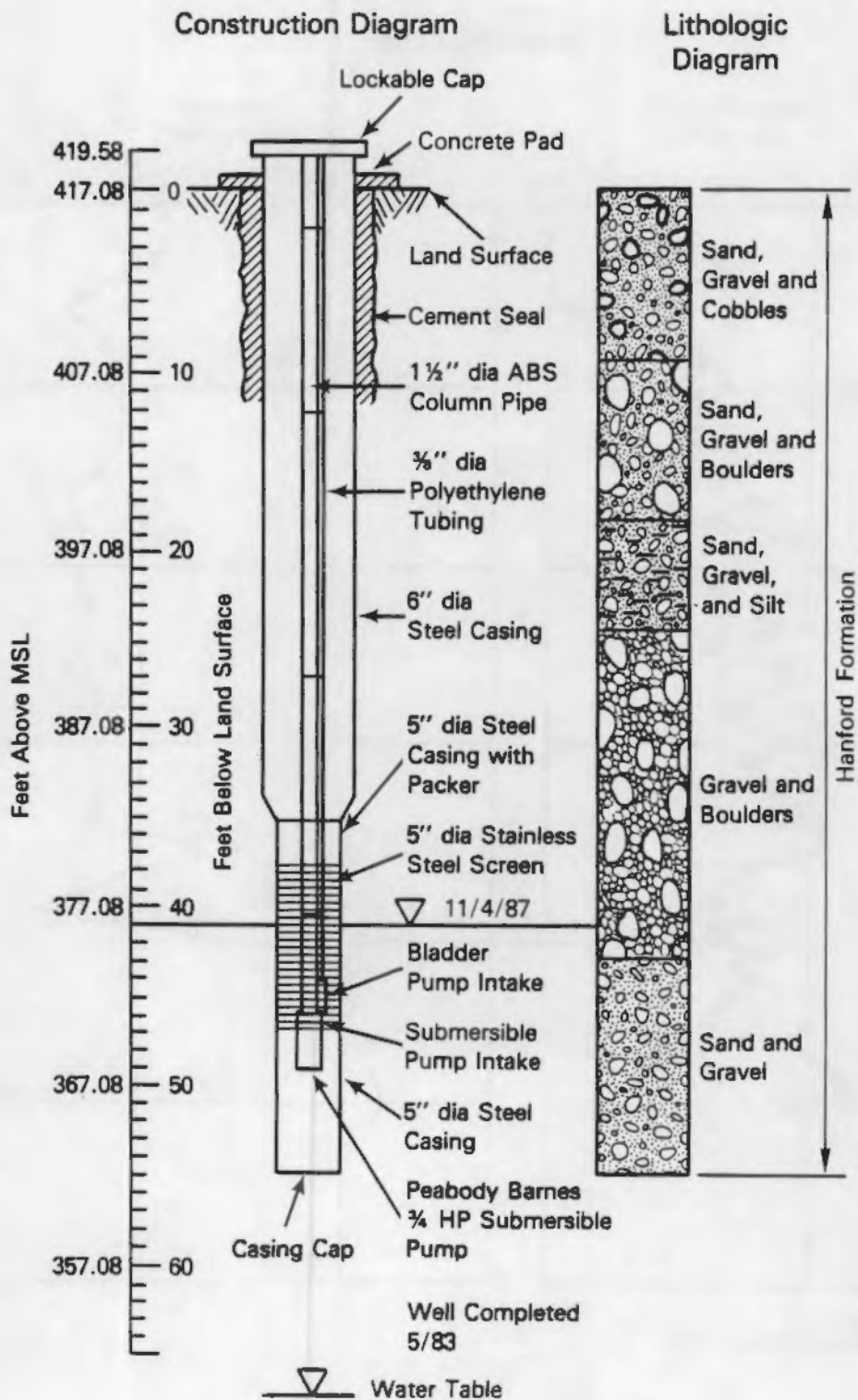
Water Table

Well Number 199-H4-5

Geophysical Logs

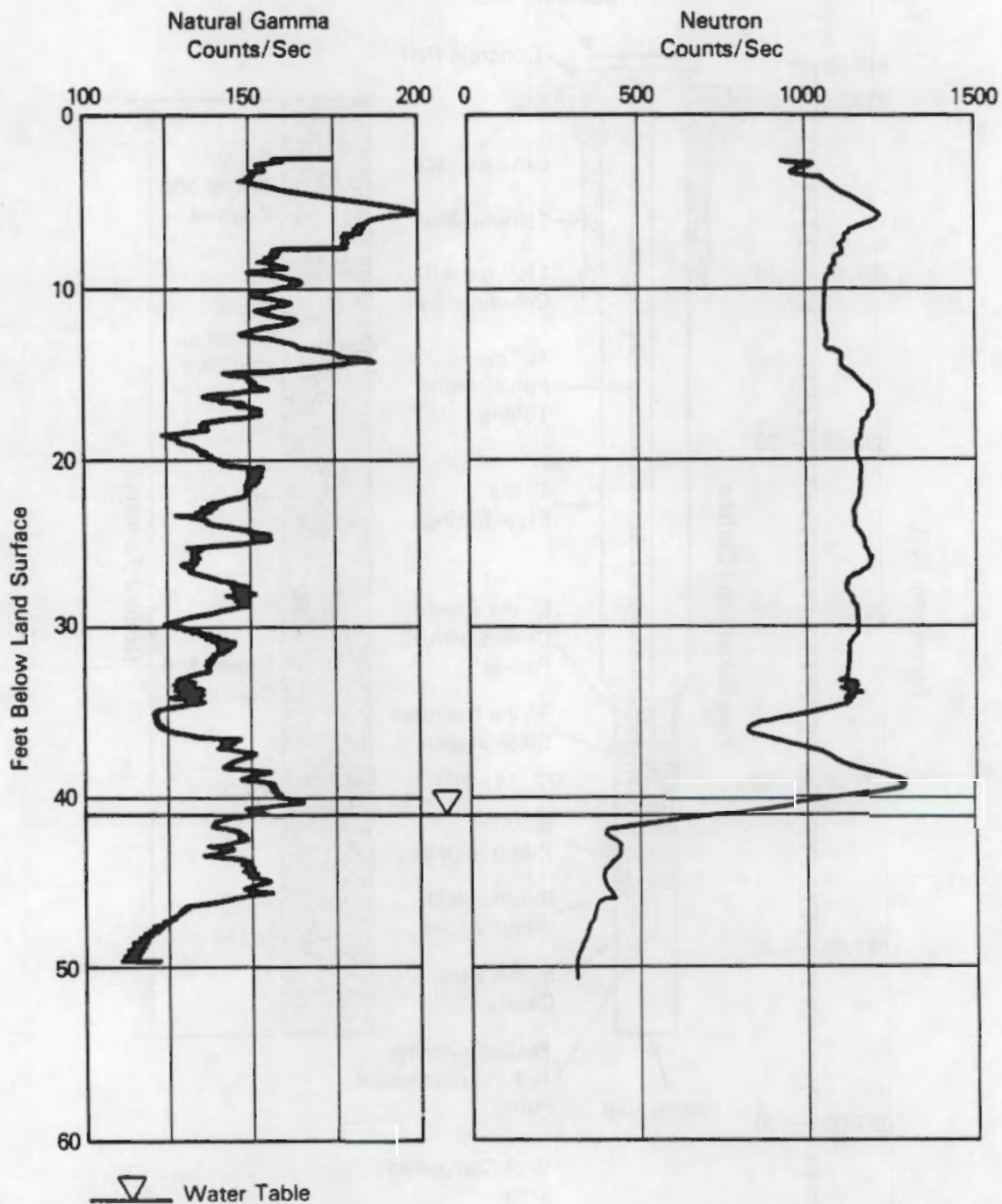


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Well Number 199-H4-6

Geophysical Logs

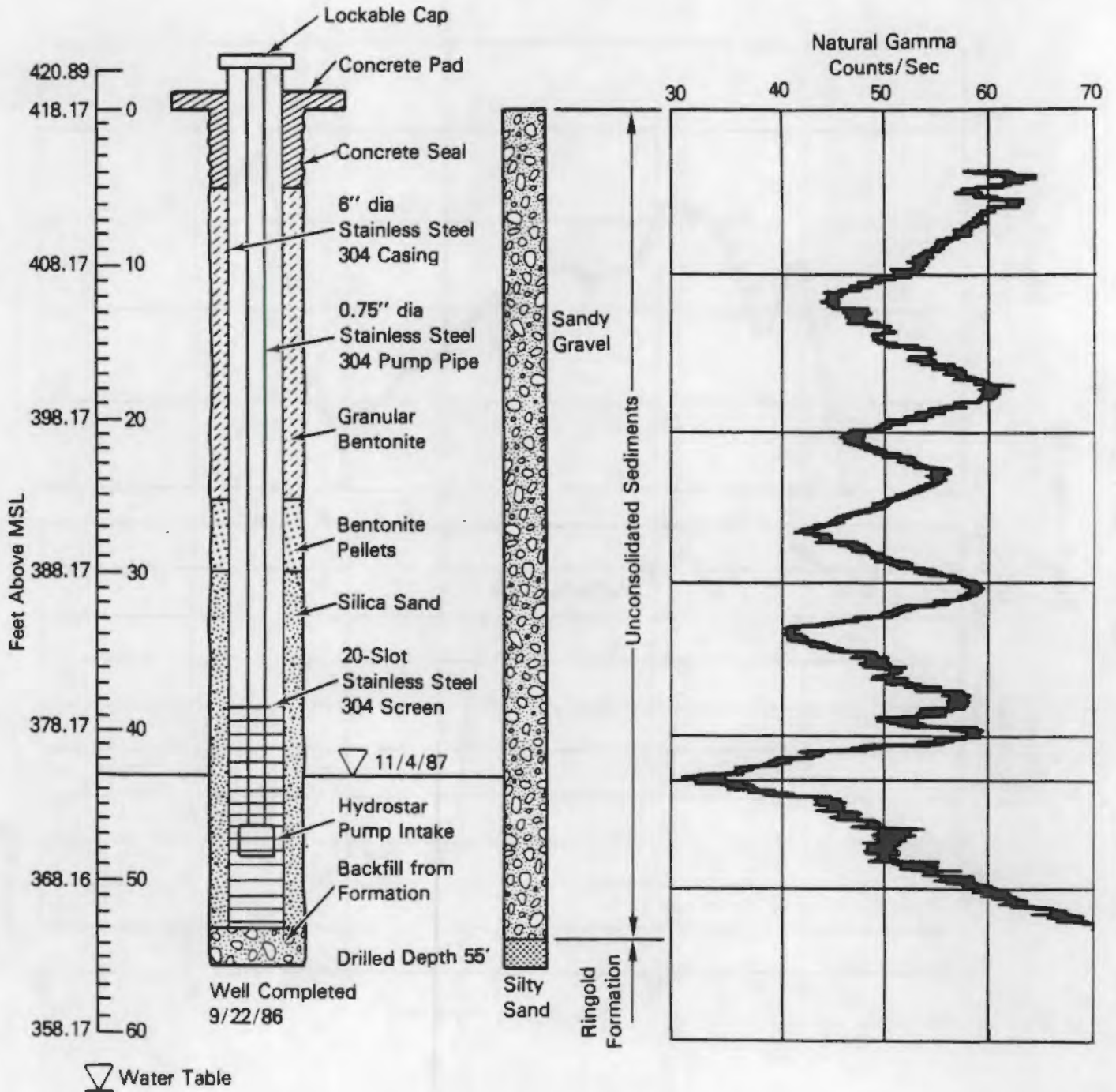


Well Number 199-H4-7

Construction Diagram

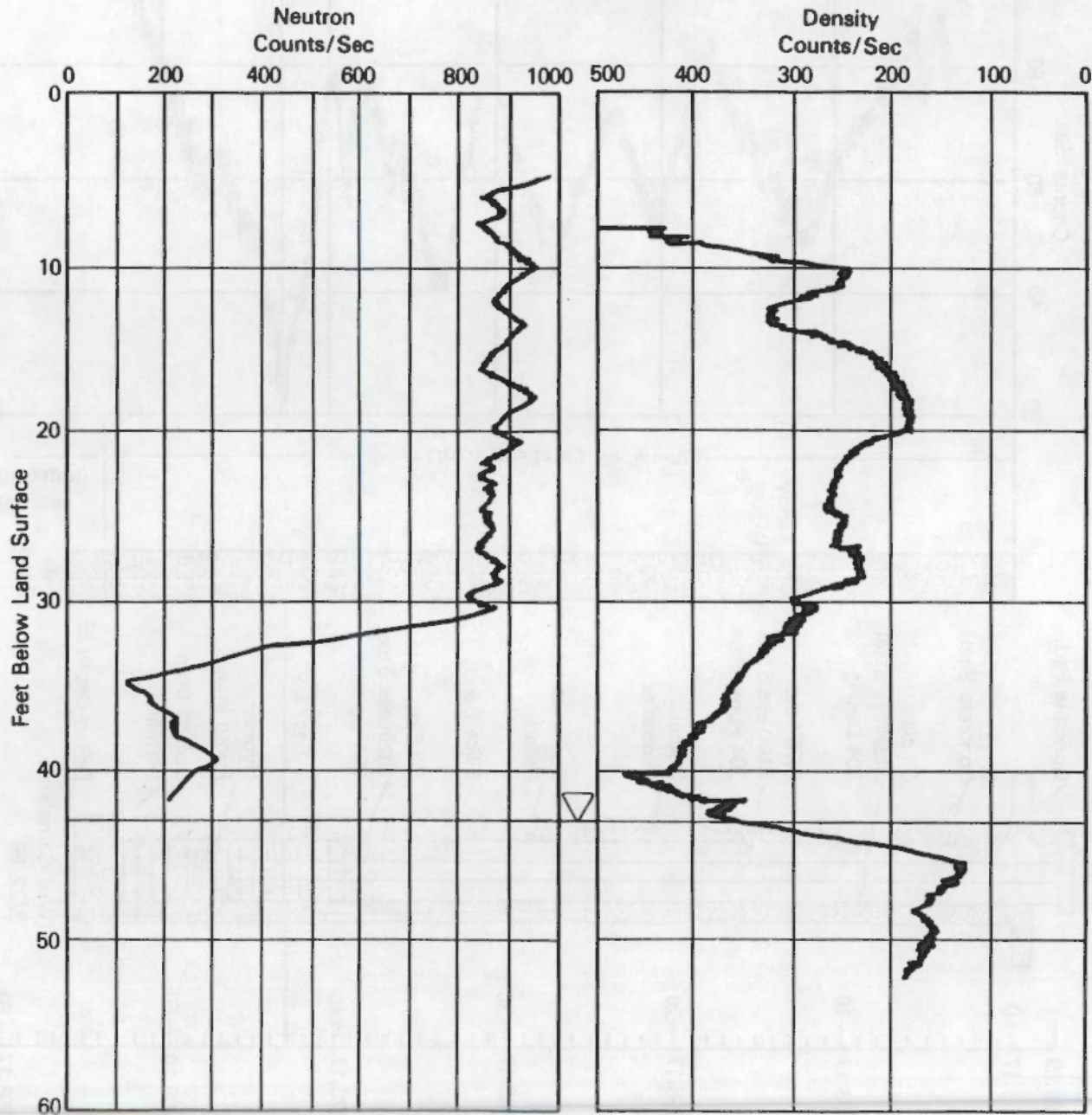
Lithologic Diagram

Geophysical Logs



Well Number 199-H4-7

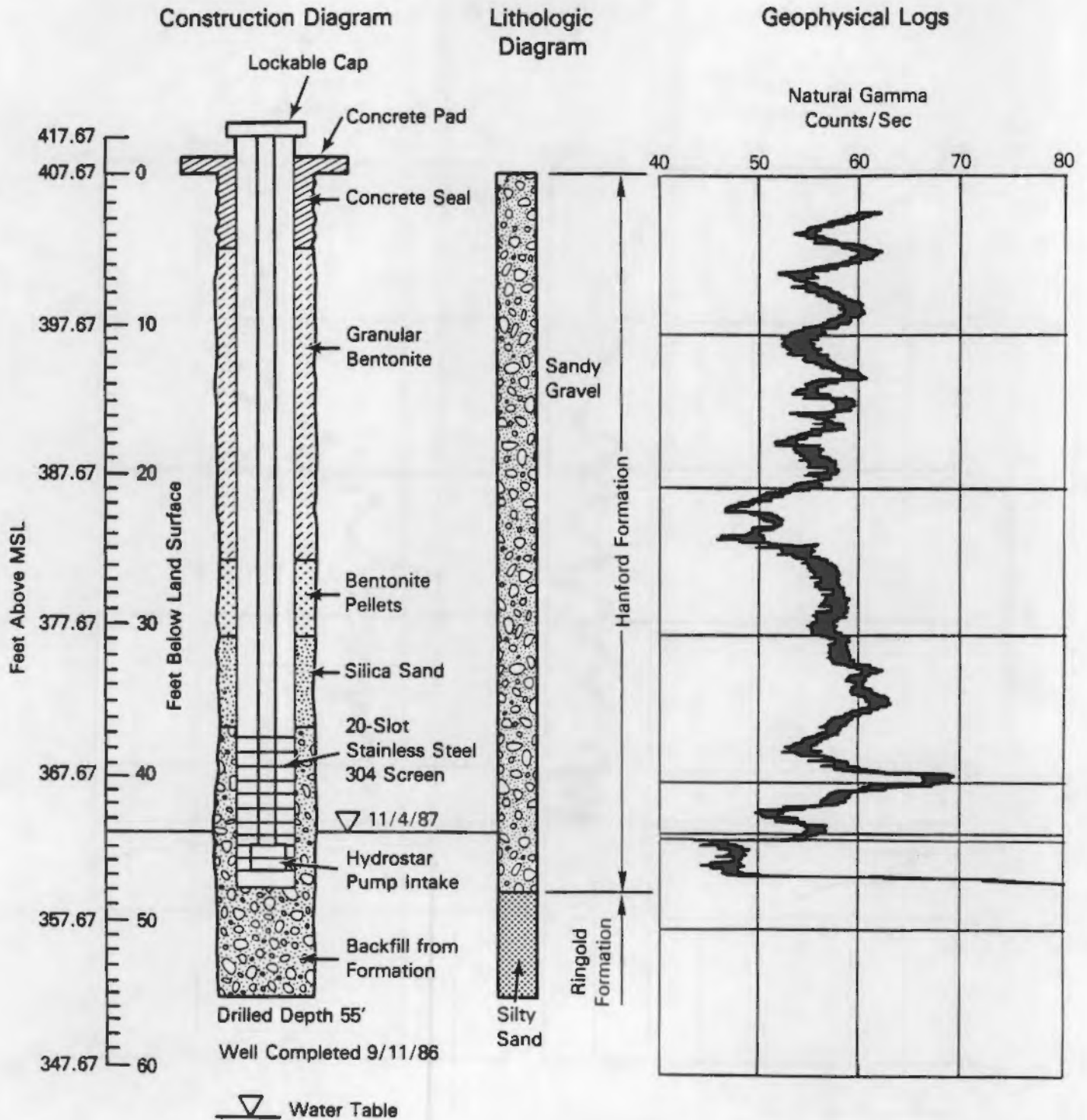
Geophysical Logs



A.20

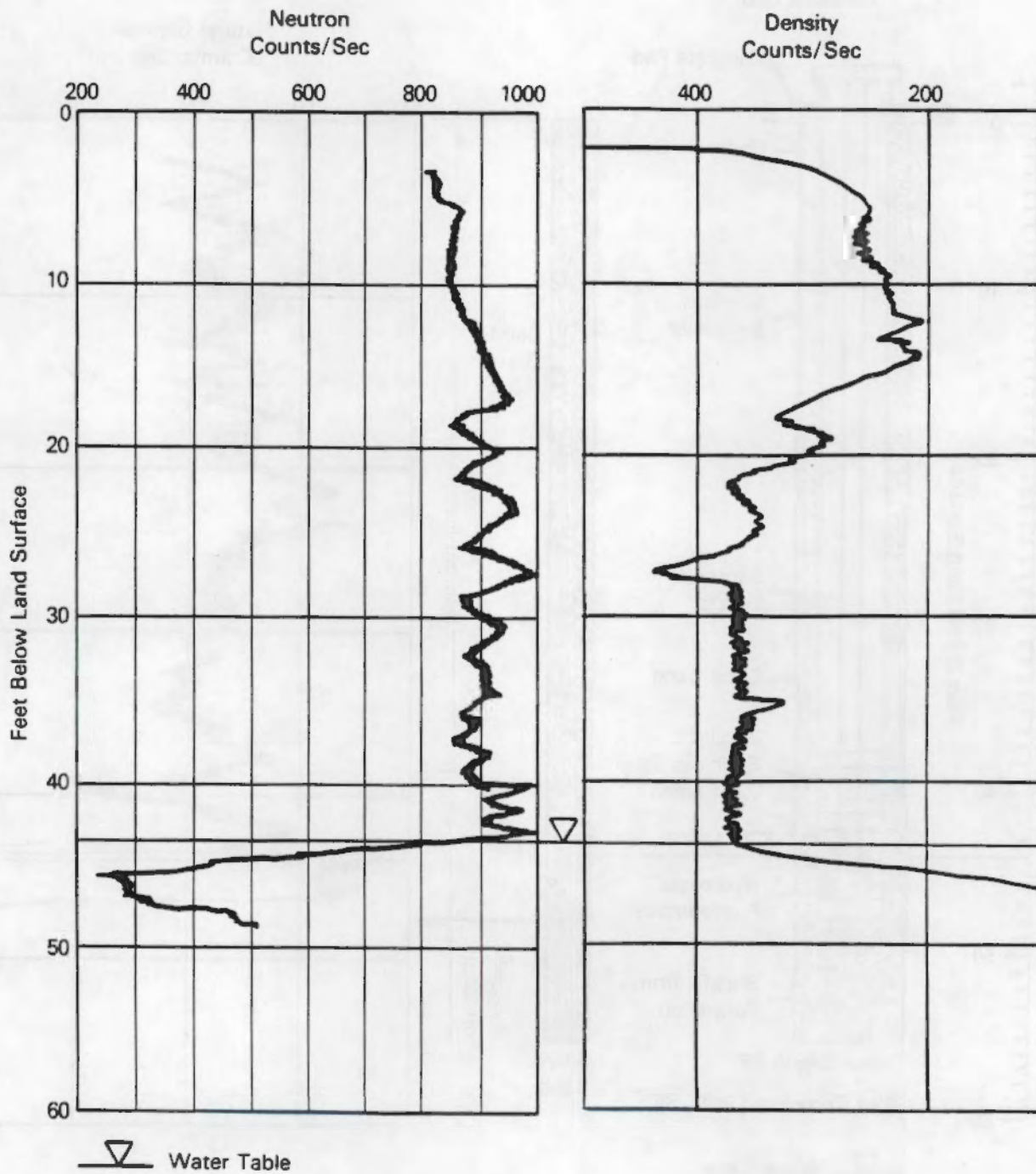
▽ Water Table

Well Number 199-H4-8

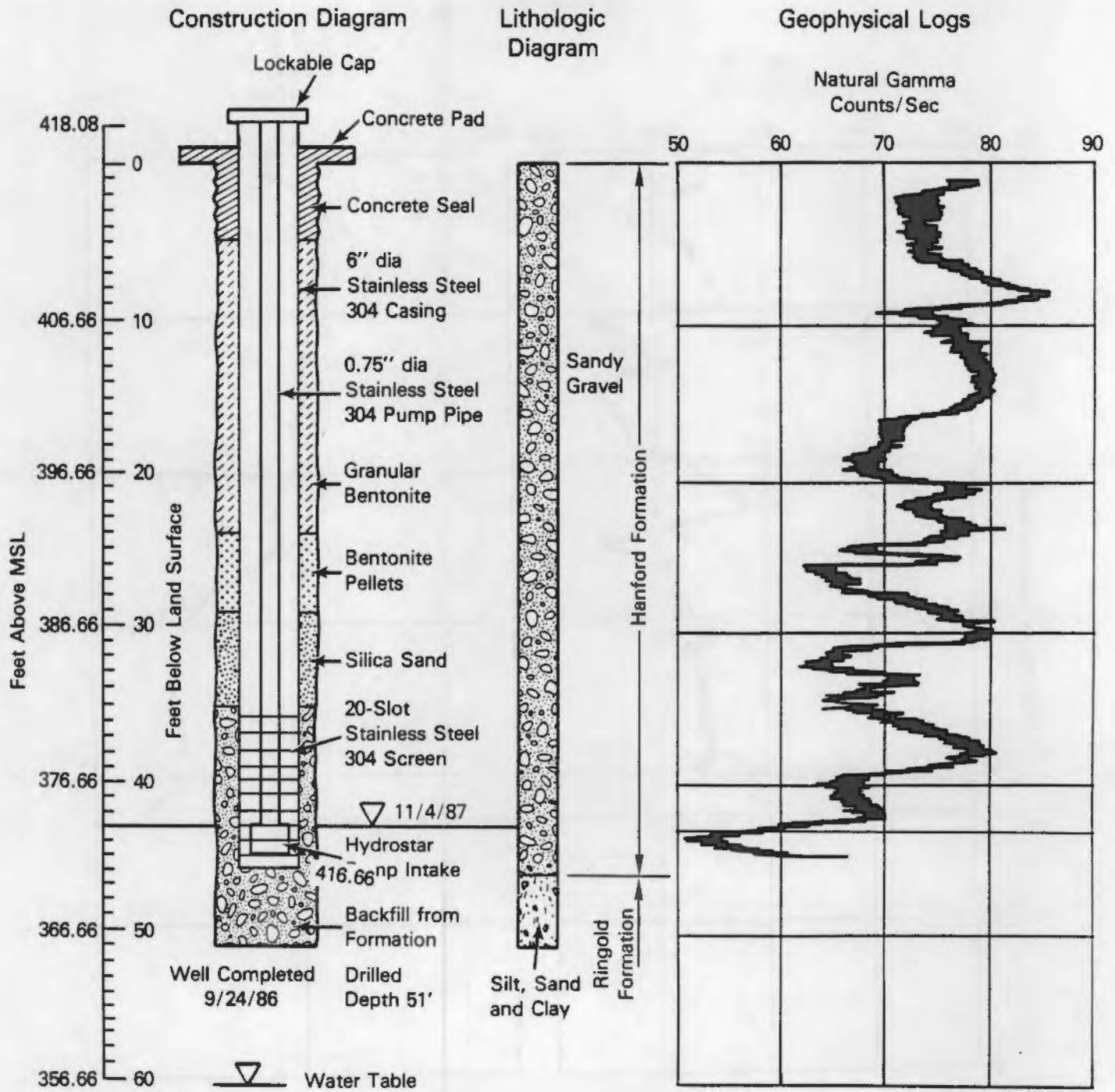


Well Number 199-H4-8

Geophysical Logs

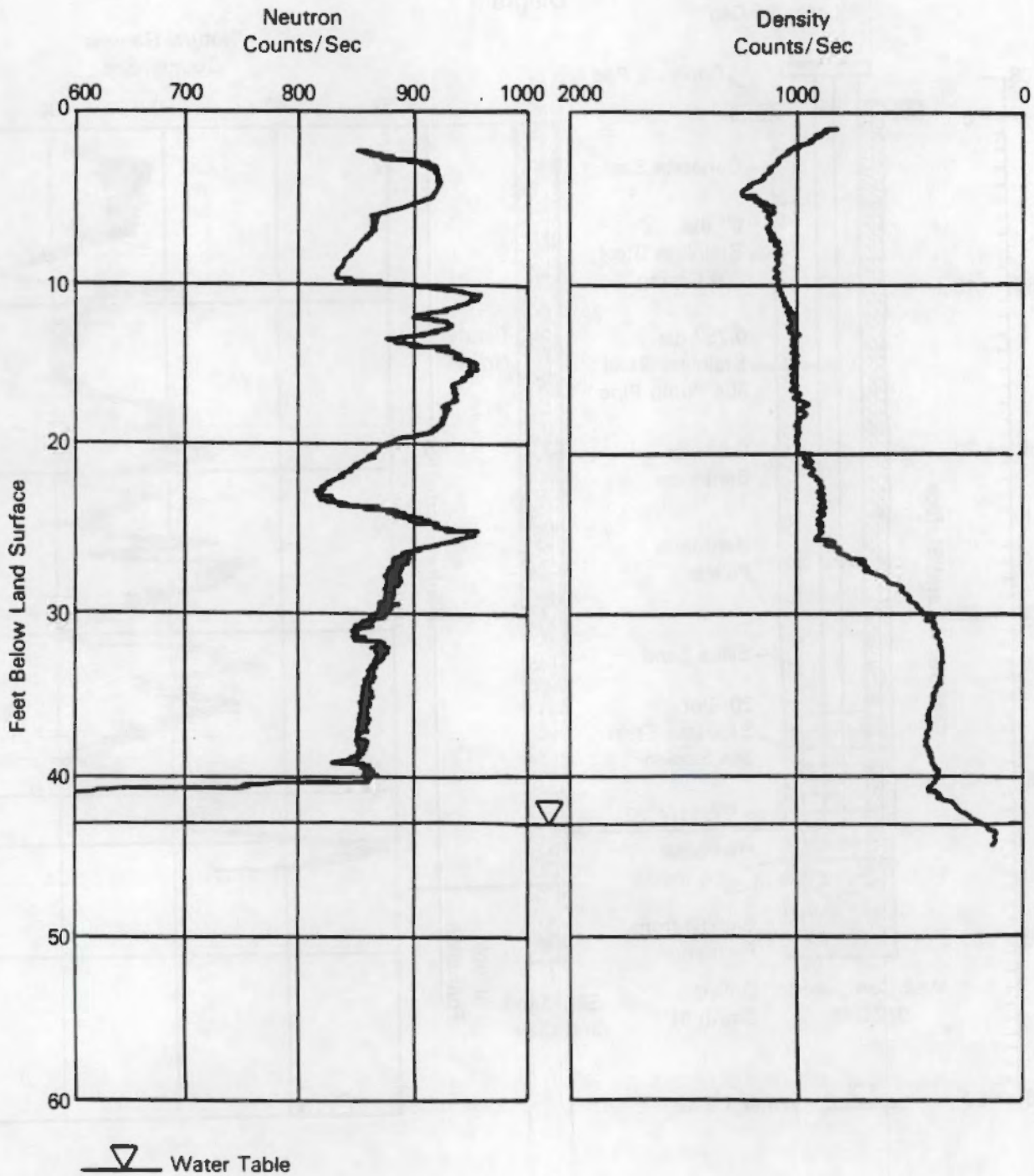


Well Number 199-H4-9

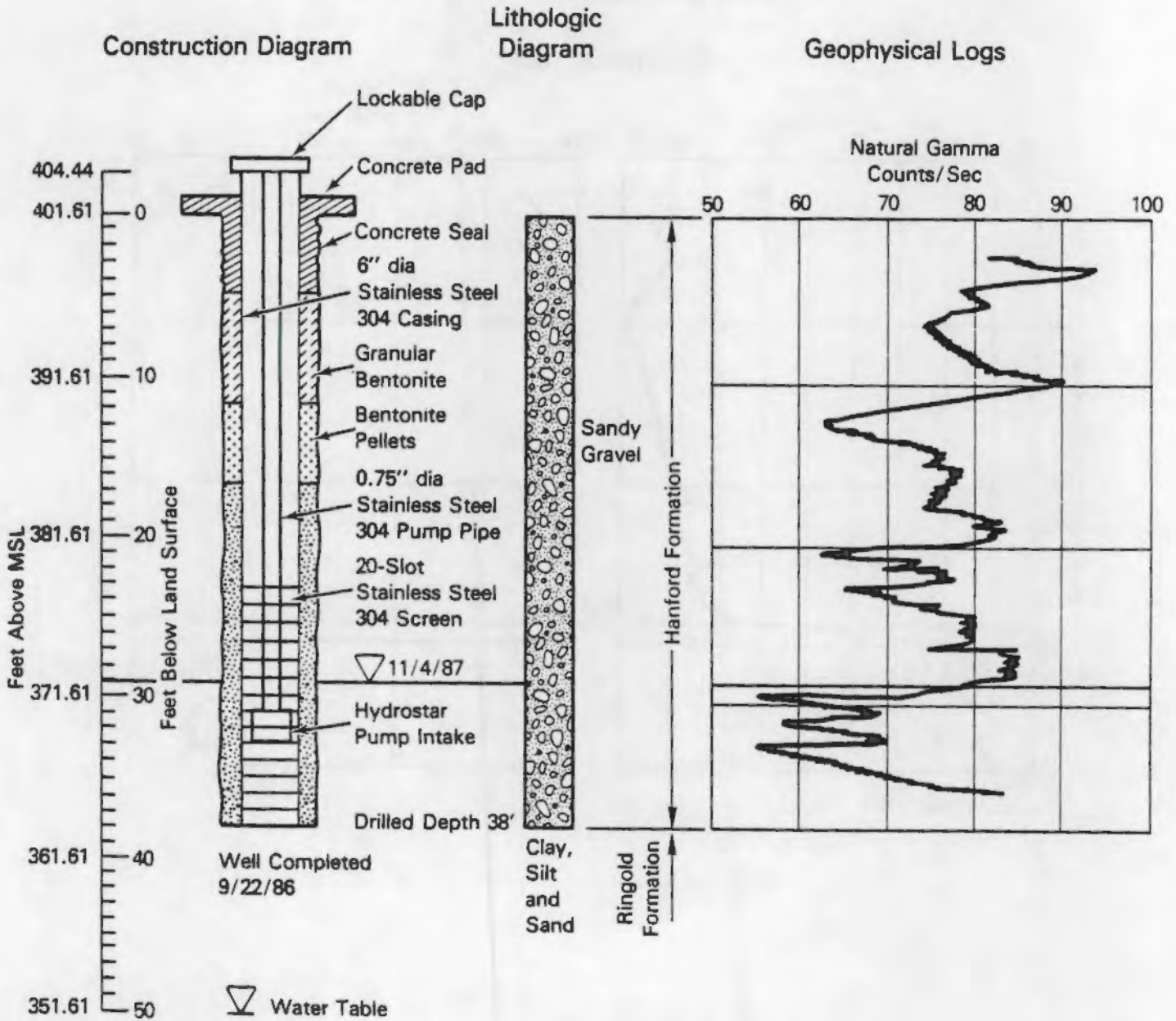


Well Number 199-H4-9

Geophysical Logs

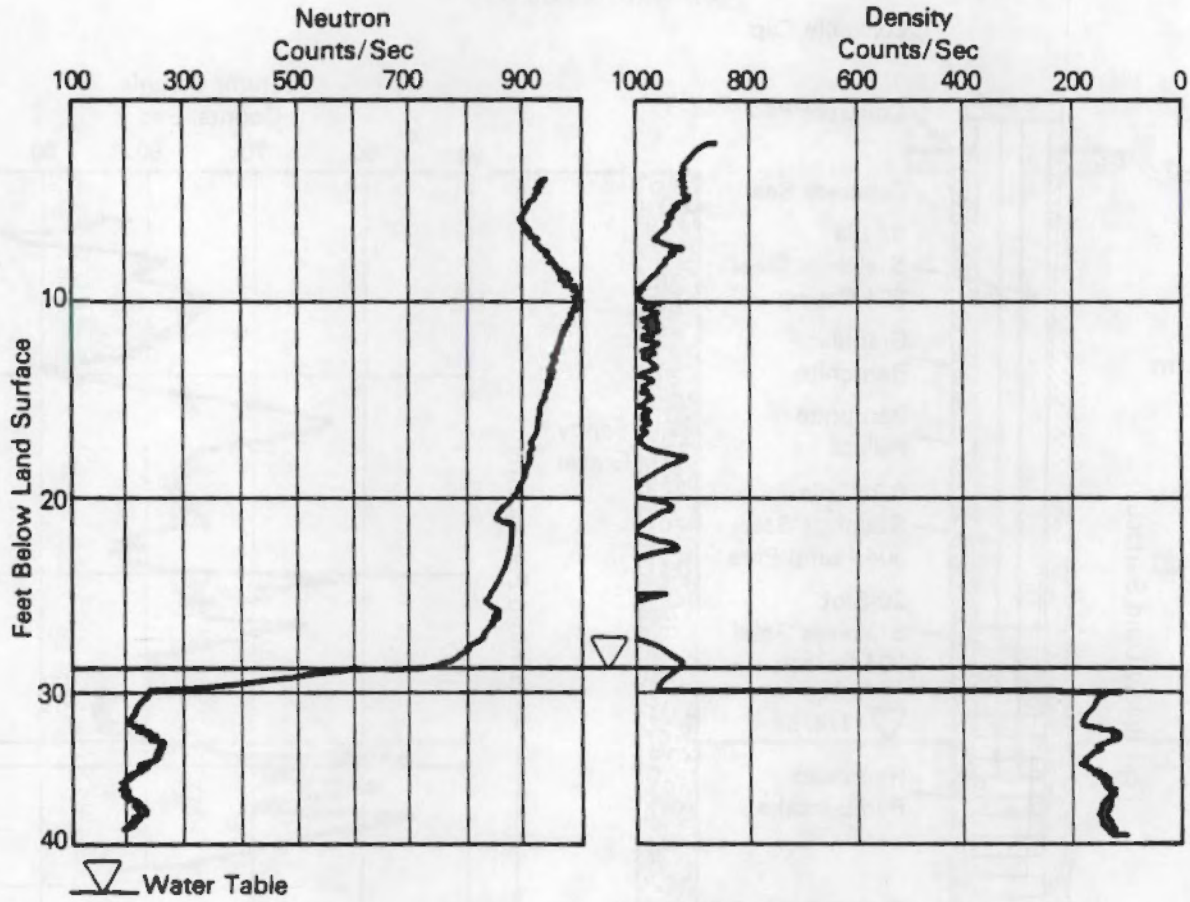


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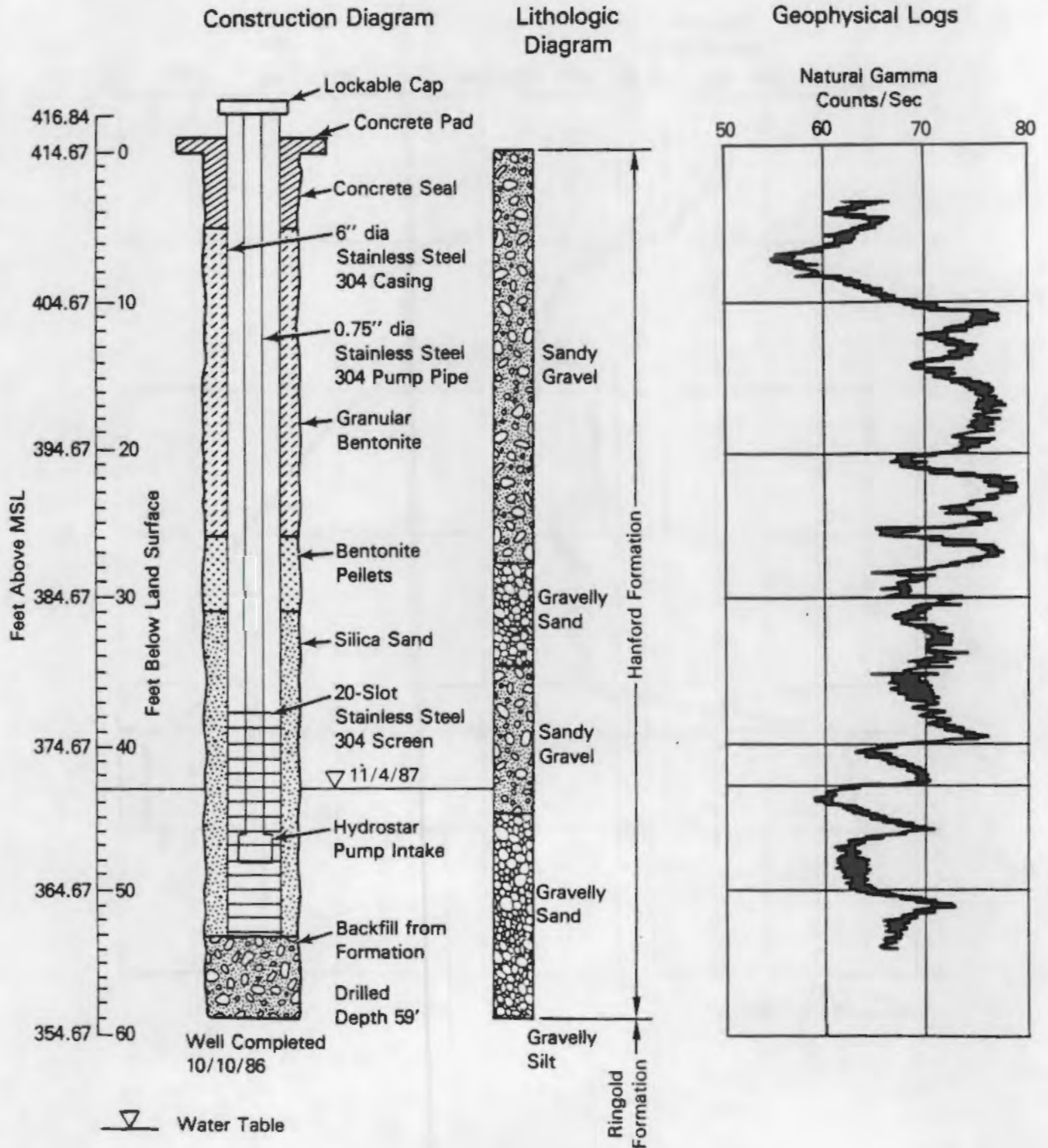


Well Number 199-H4-10

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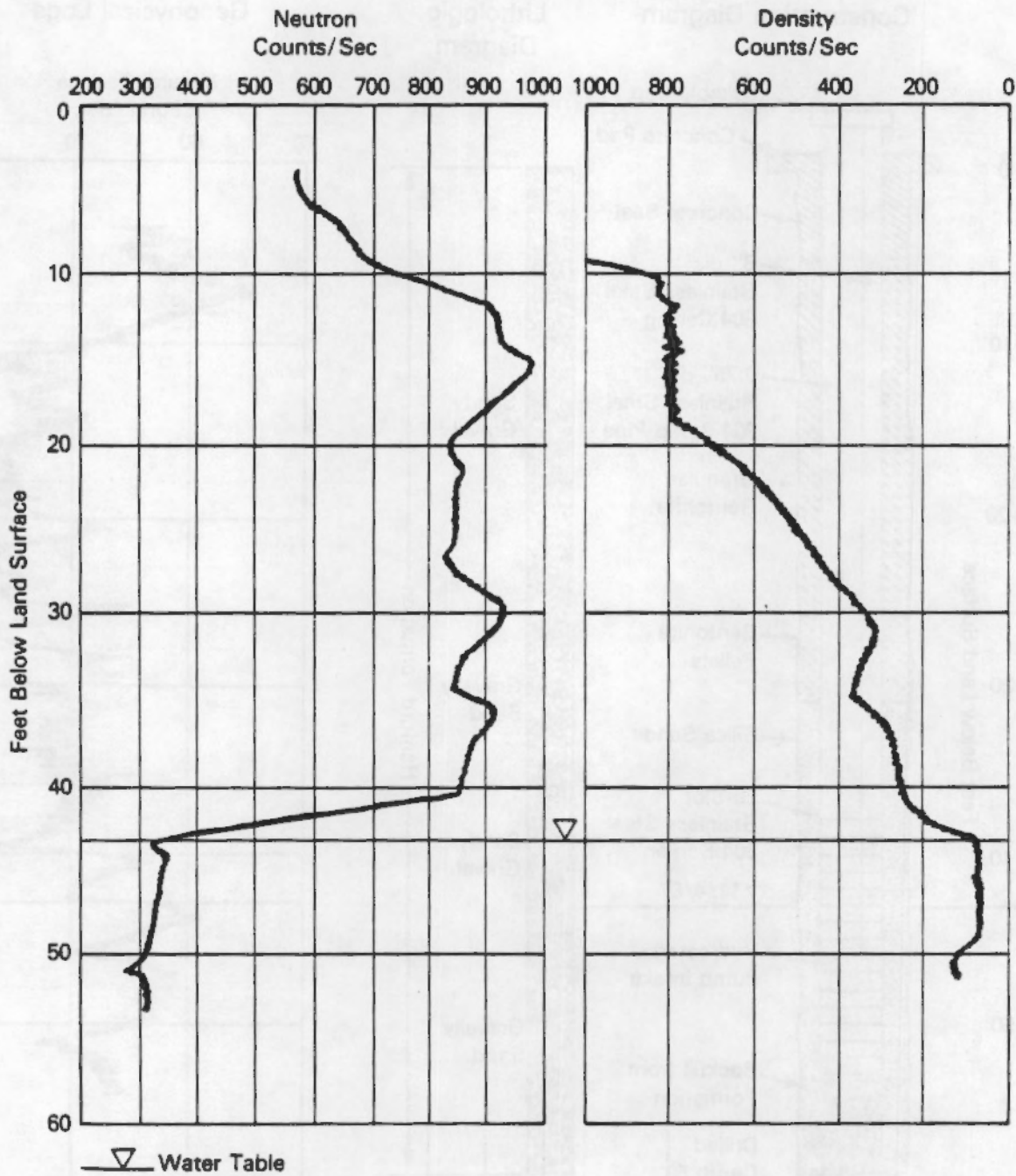


Well Number 199-H4-11

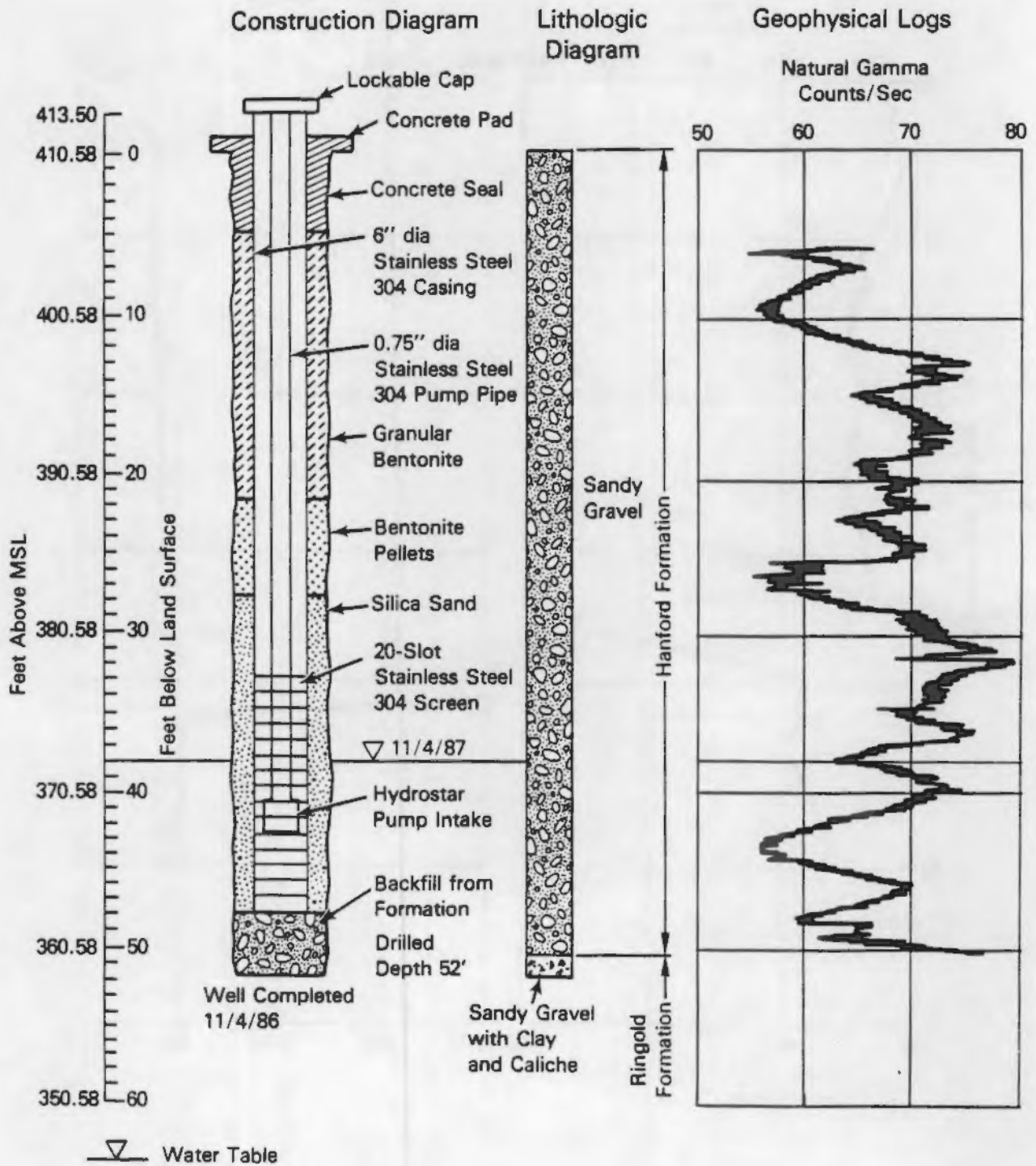


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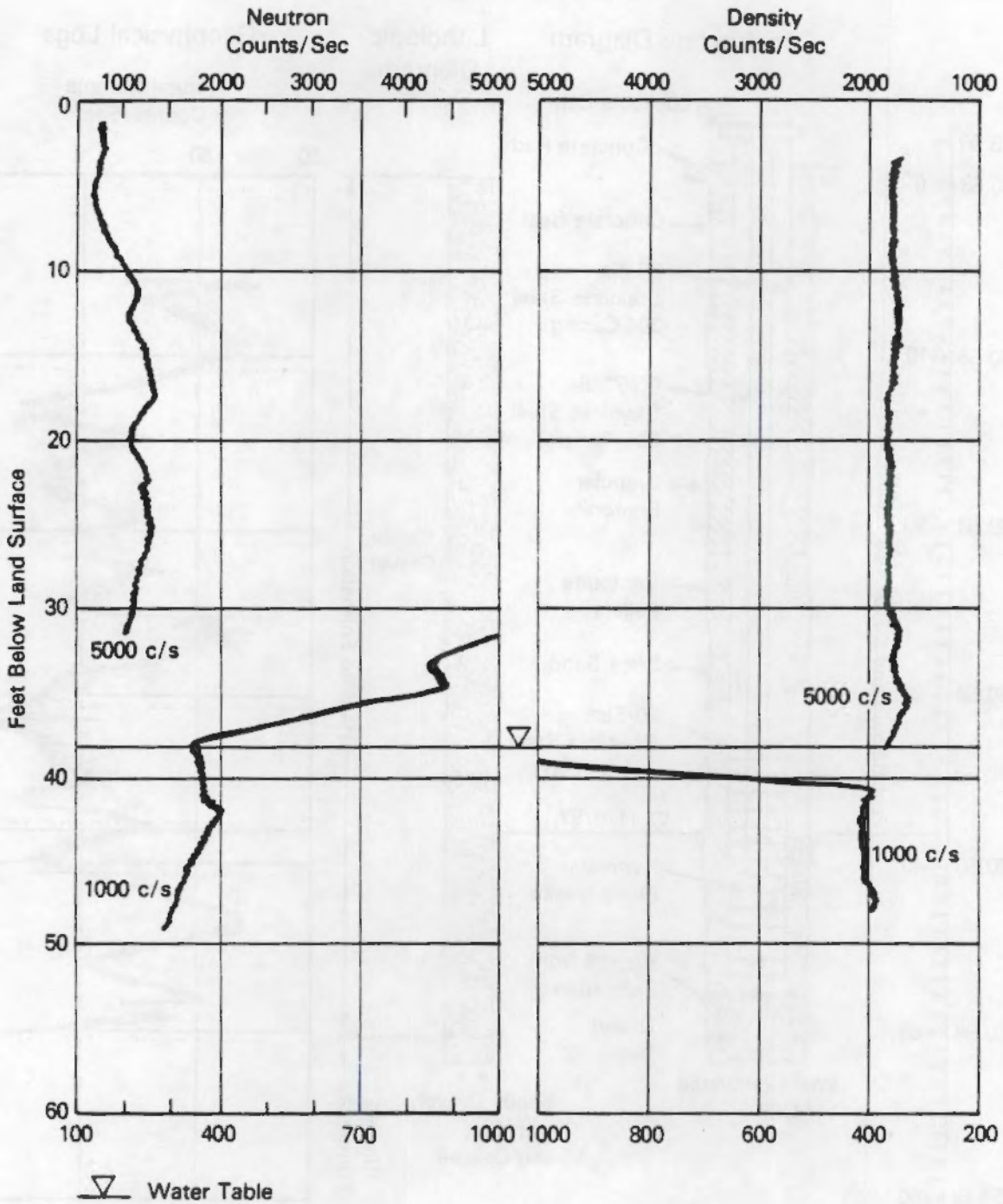


Well Number 199-H4-12A



Well Number 199-H4-12A

Geophysical Logs

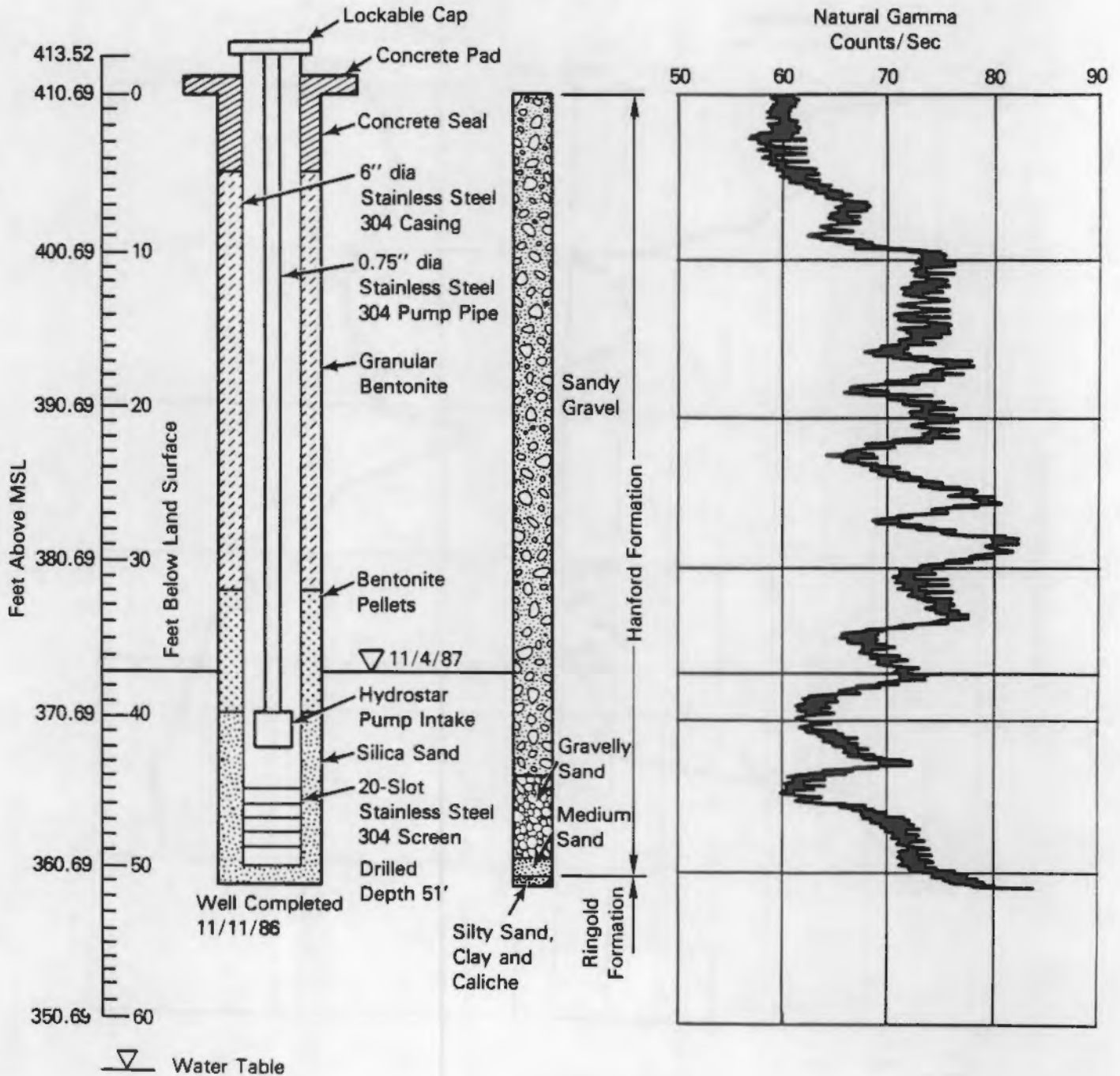


Well Number 199-H4-12B

Construction Diagram

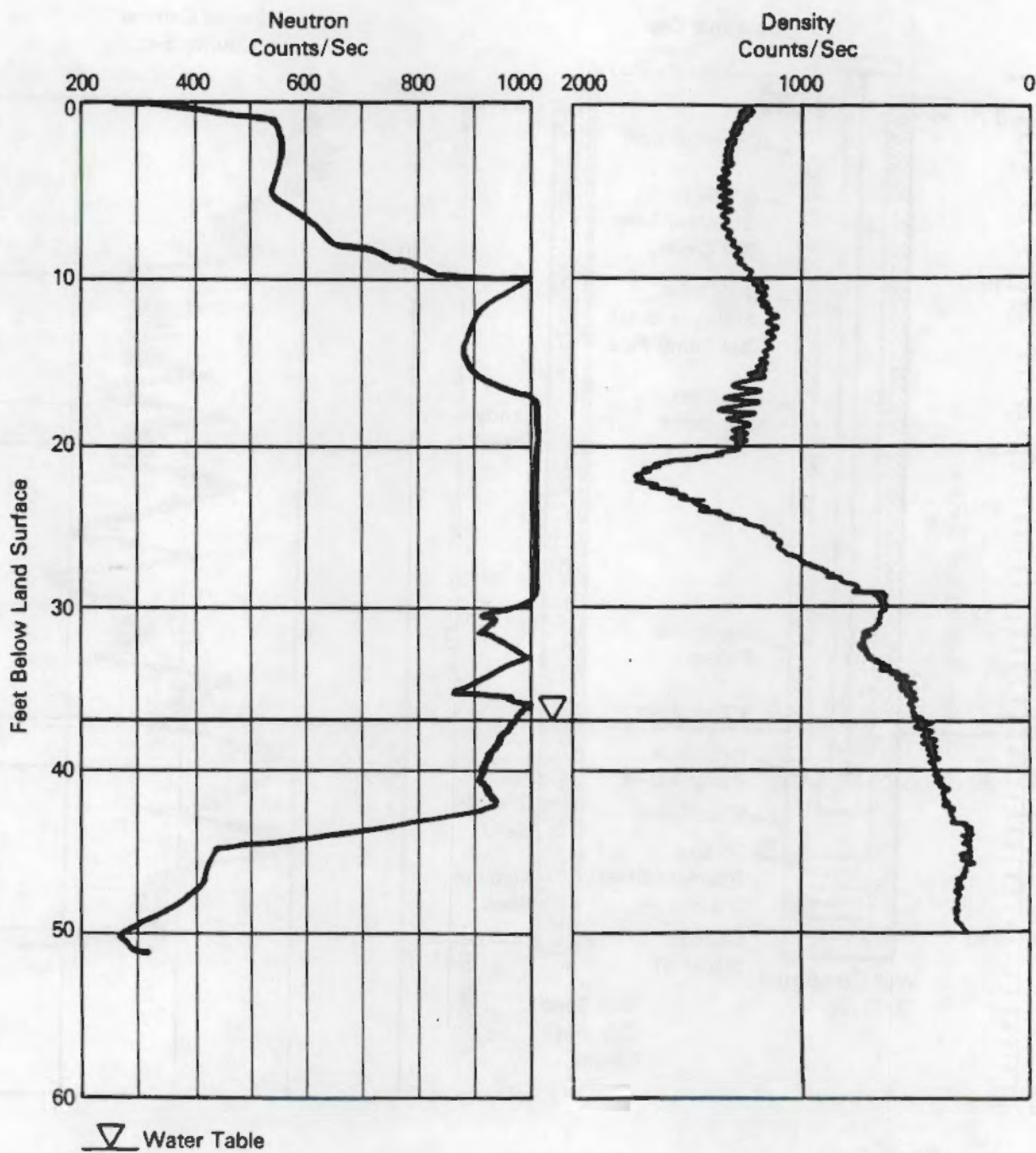
Lithologic Diagram

Geophysical Logs



Well Number 199-H4-12B

Geophysical Logs

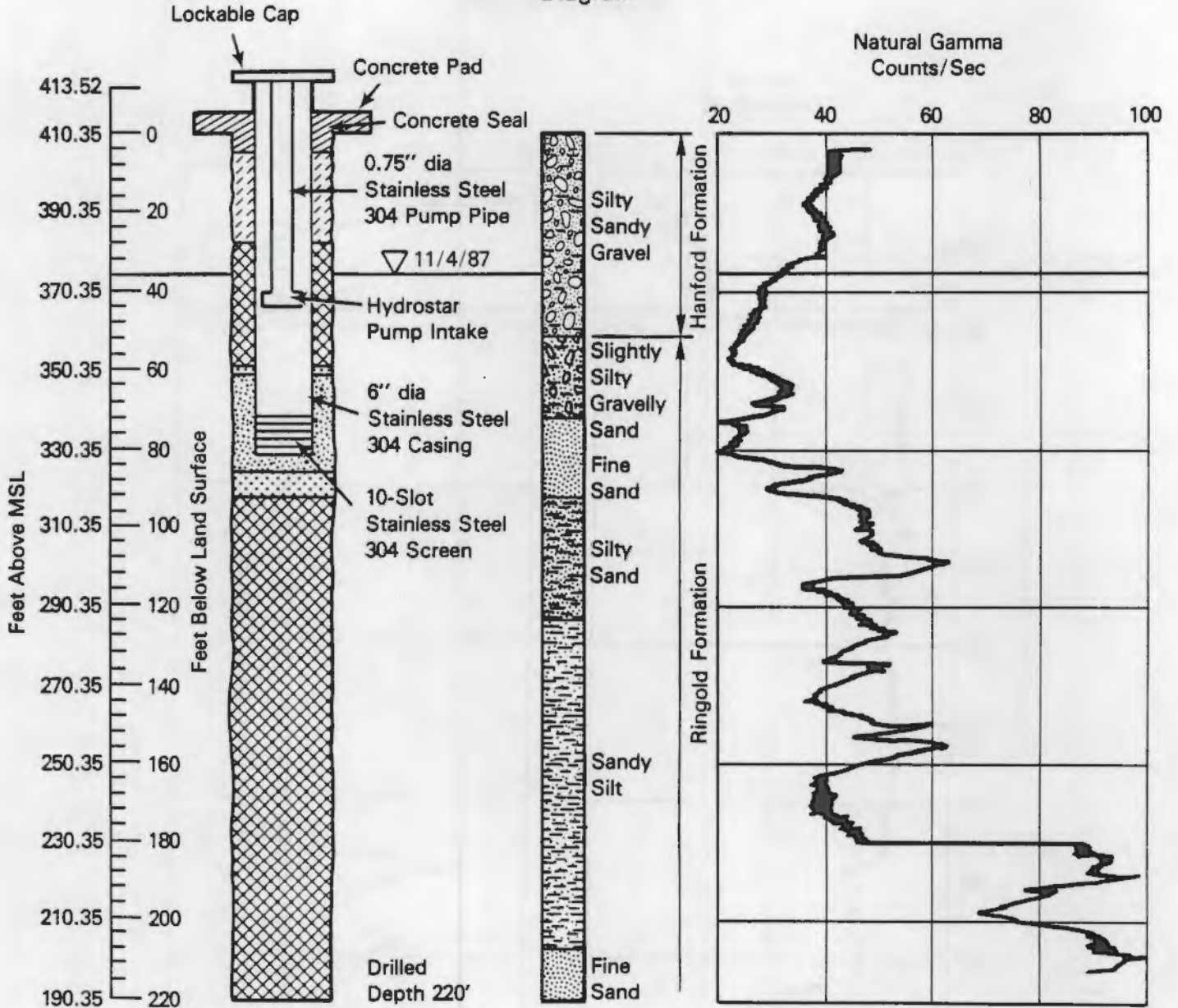


Well Number 199-H4-12C

Construction Diagram

Lithologic Diagram

Geophysical Logs

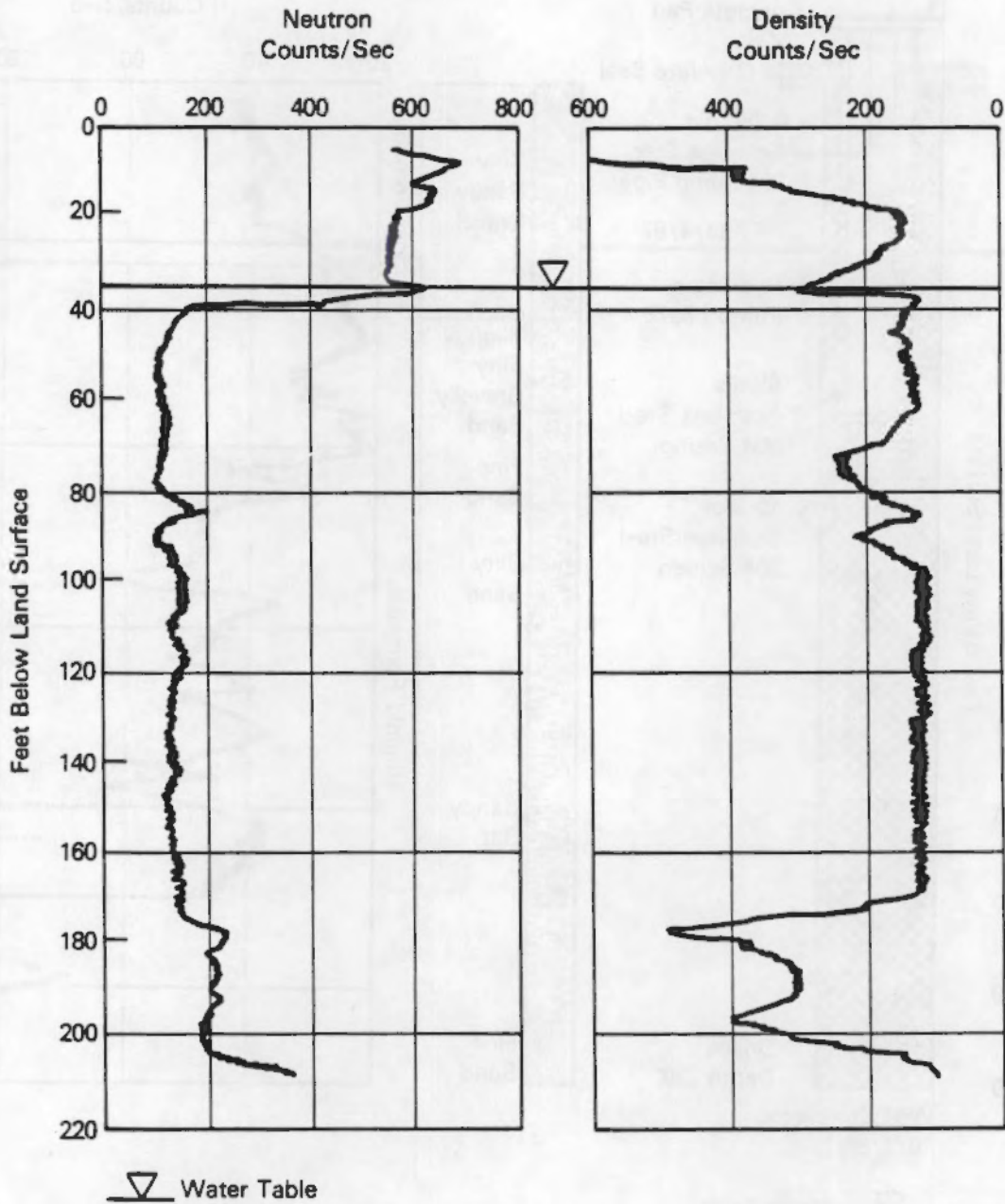


Well Completed
10/3/86

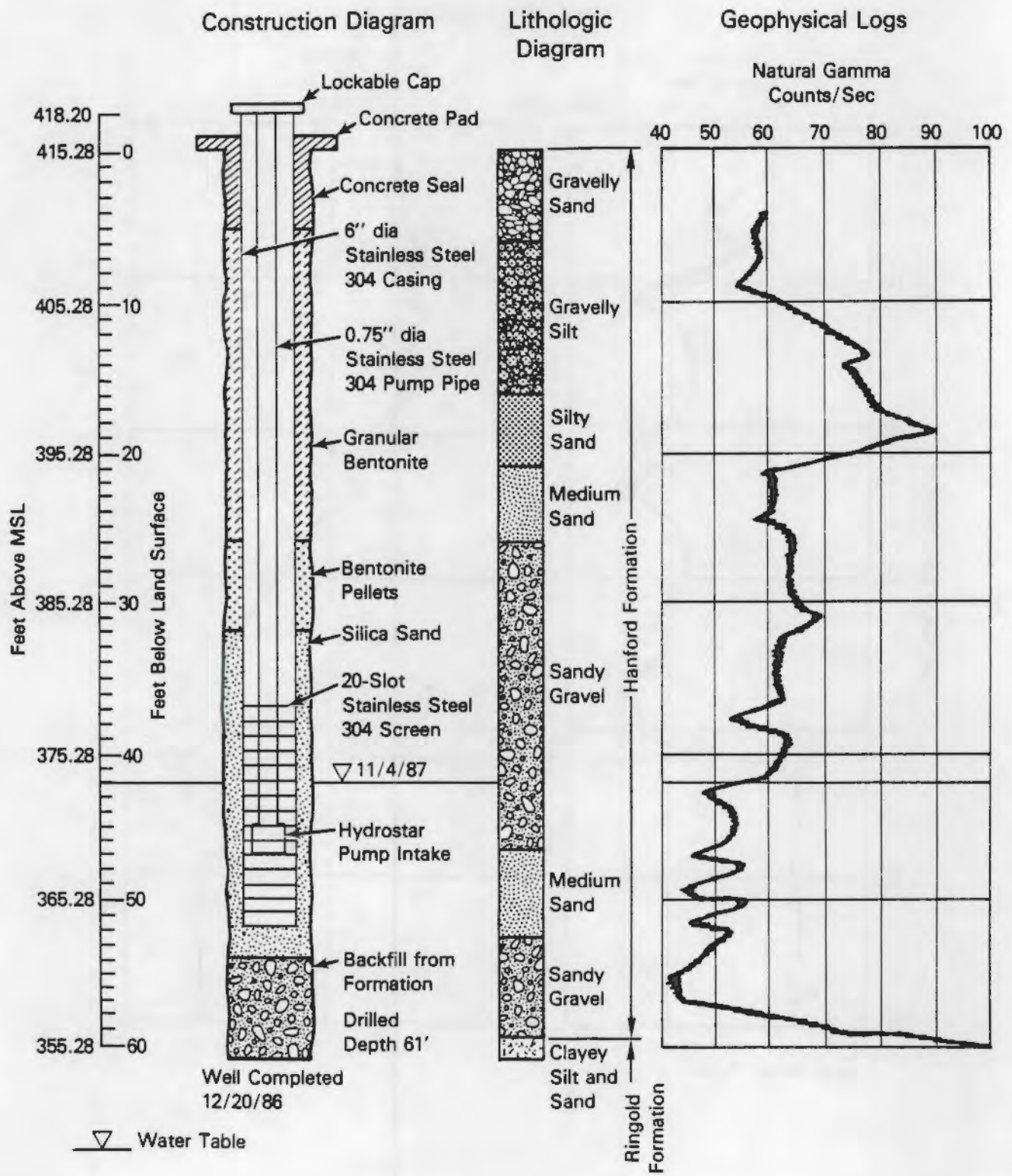
- Water Table
- Concrete
- Granular Bentonite
- Bentonite Slurry
- Bentonite Pellets
- Silica Sand

Well Number 199-H4-12C

Geophysical Logs

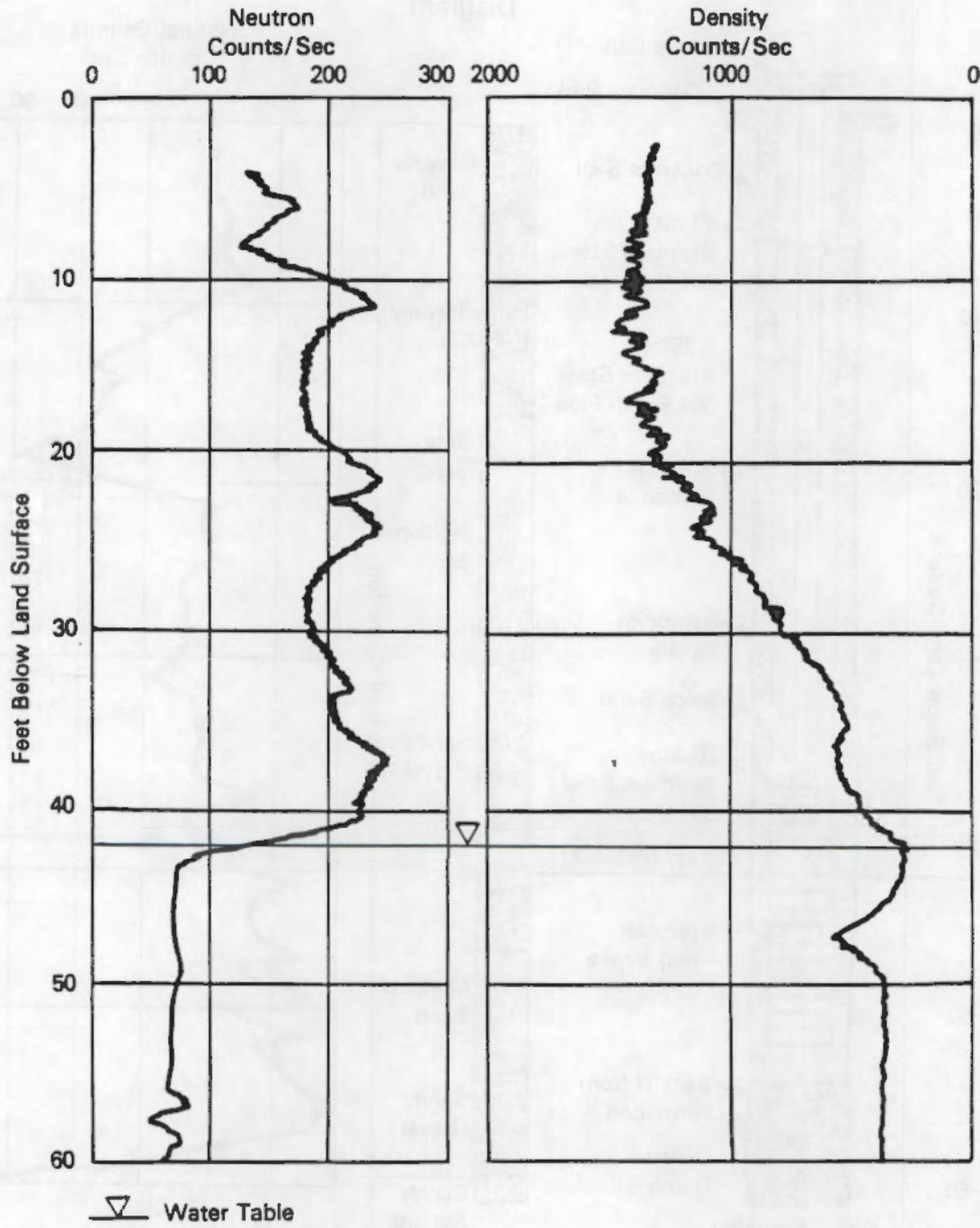


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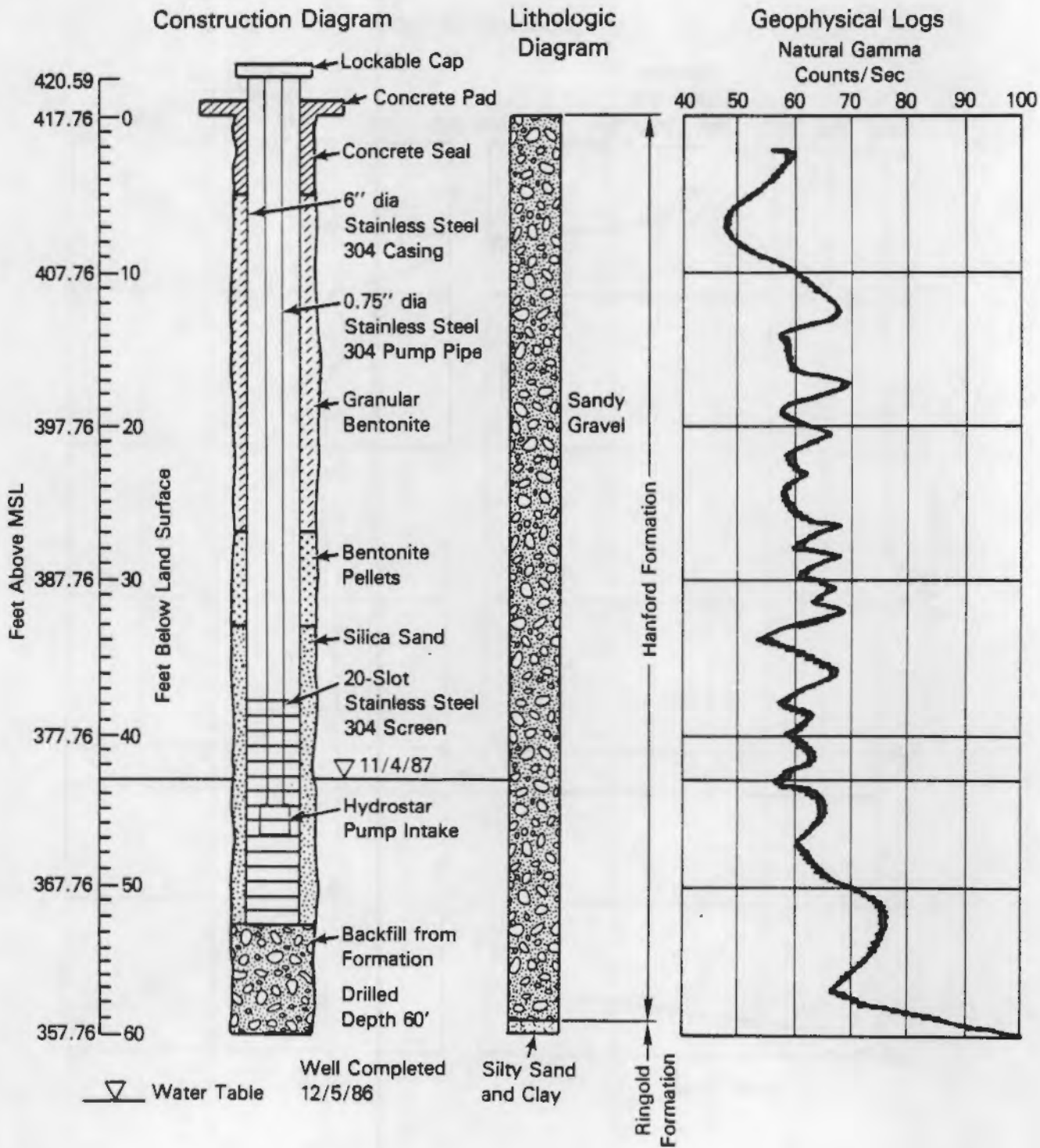


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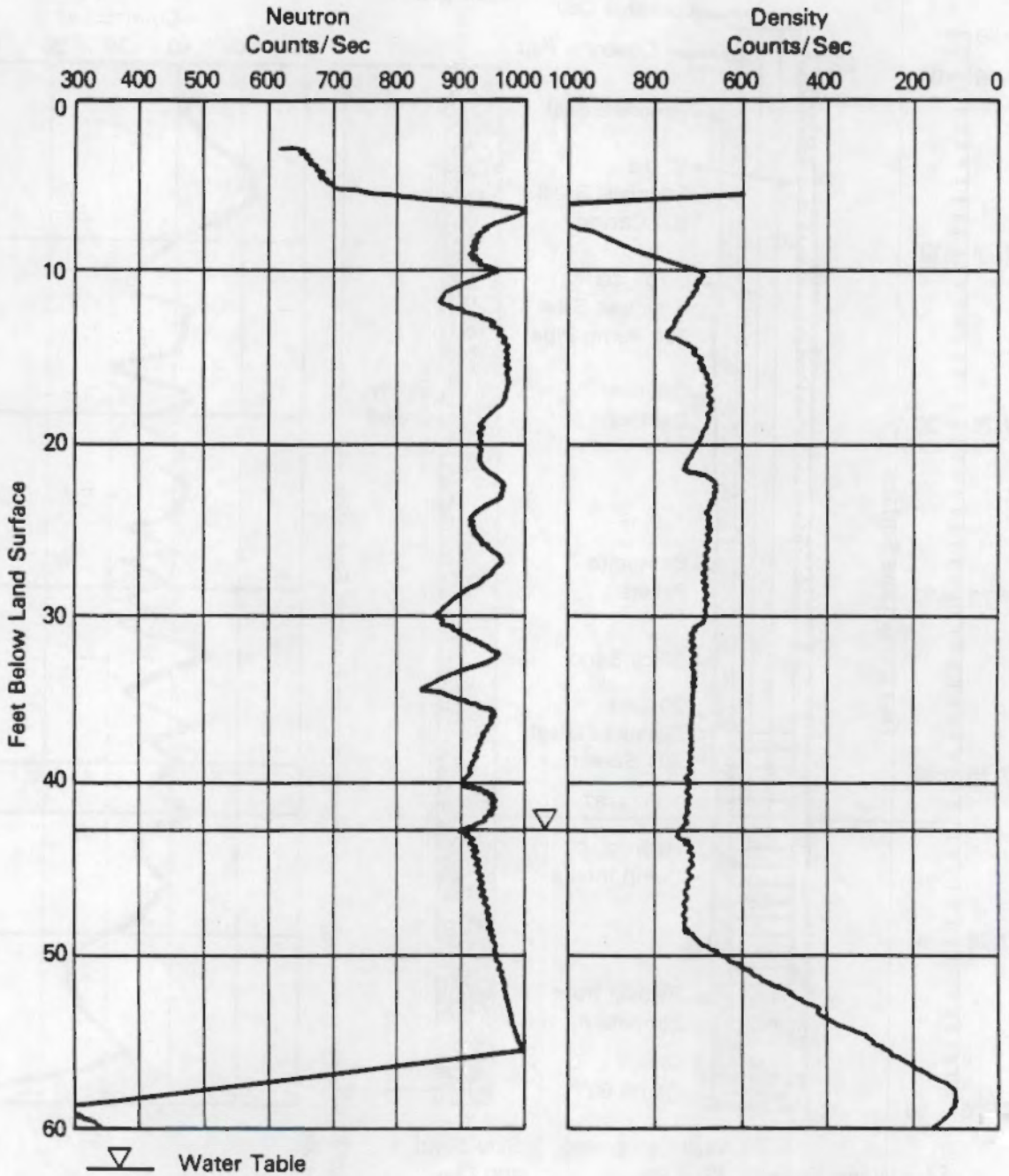


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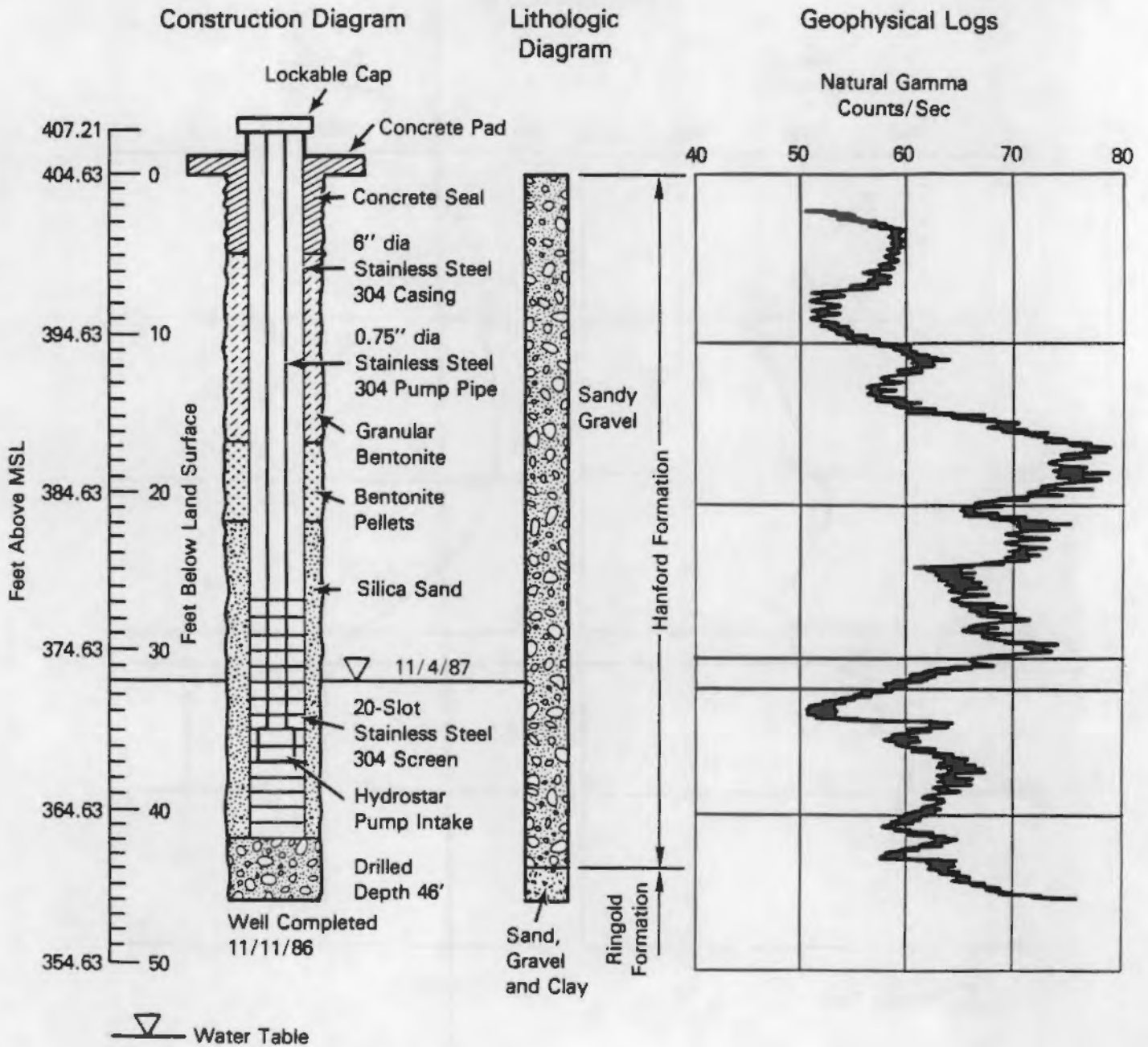


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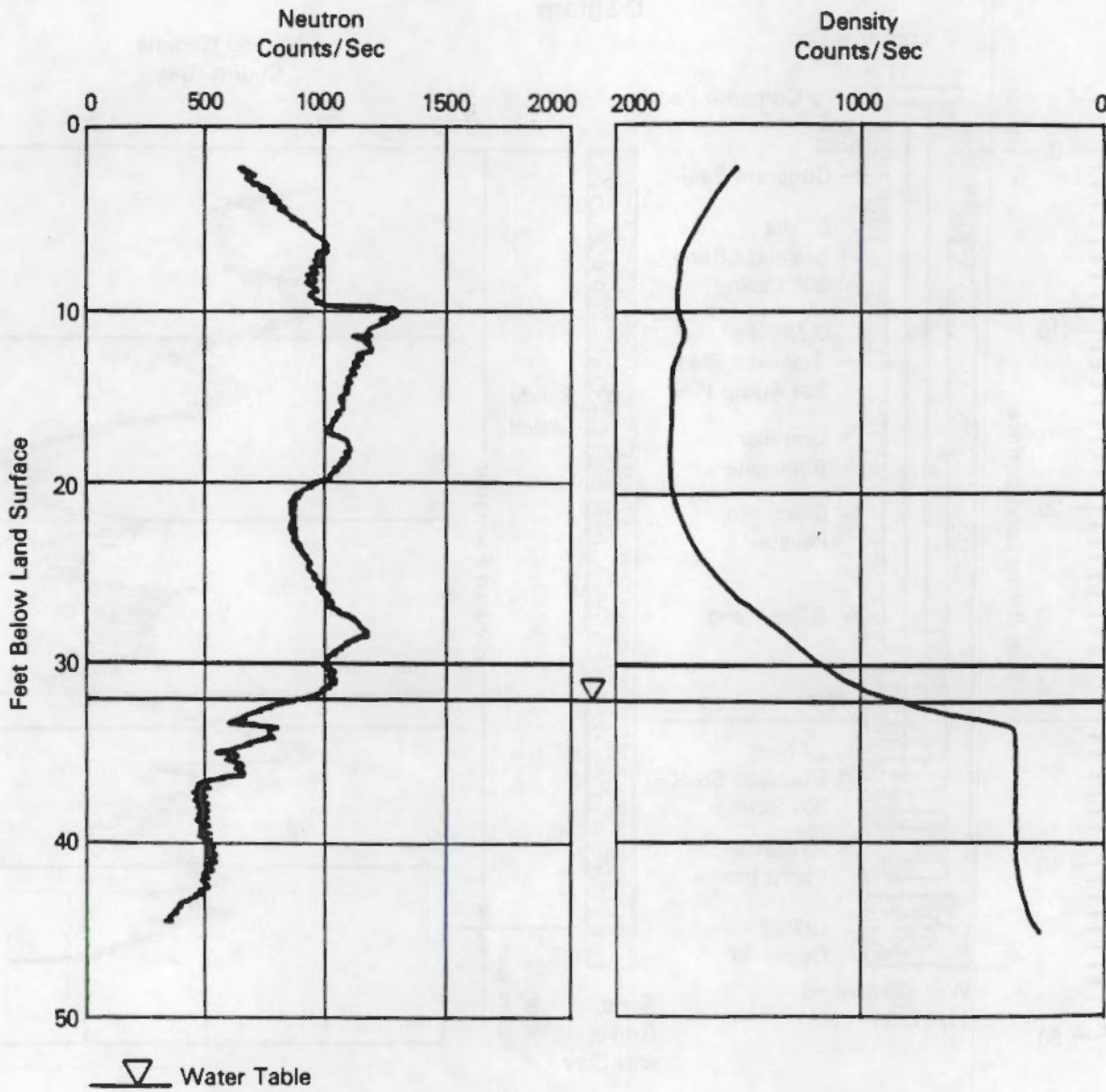


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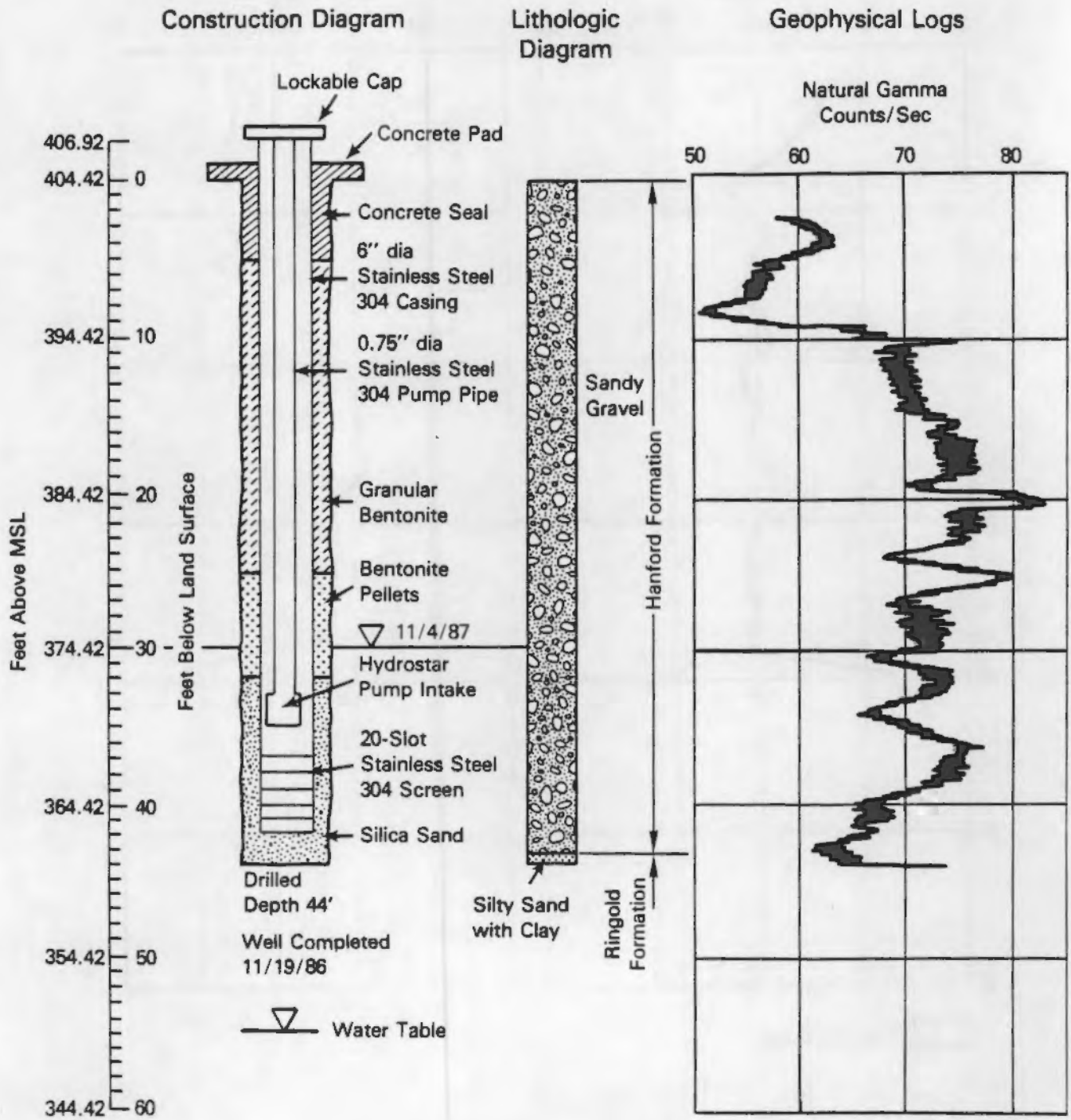


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Geophysical Logs

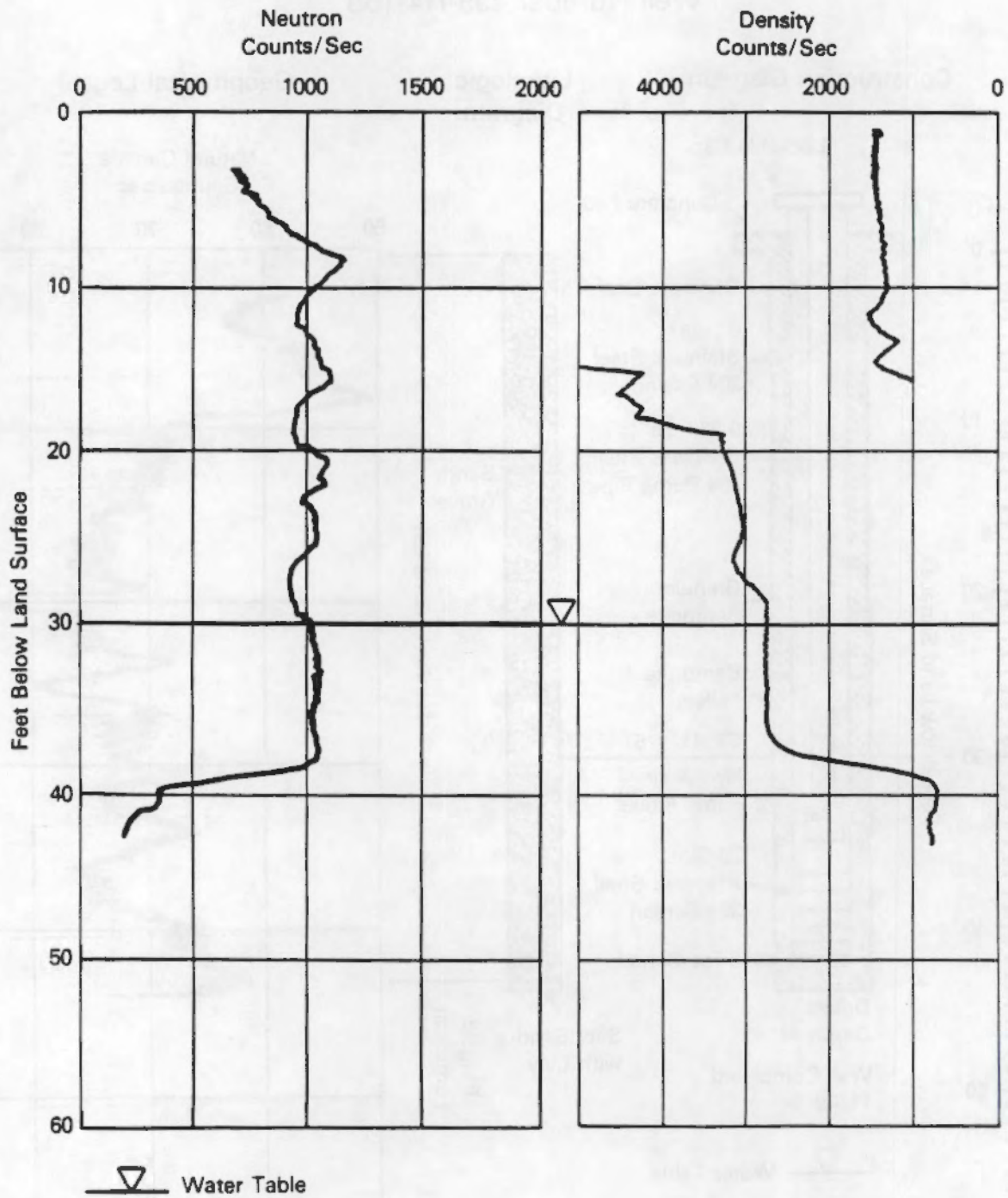


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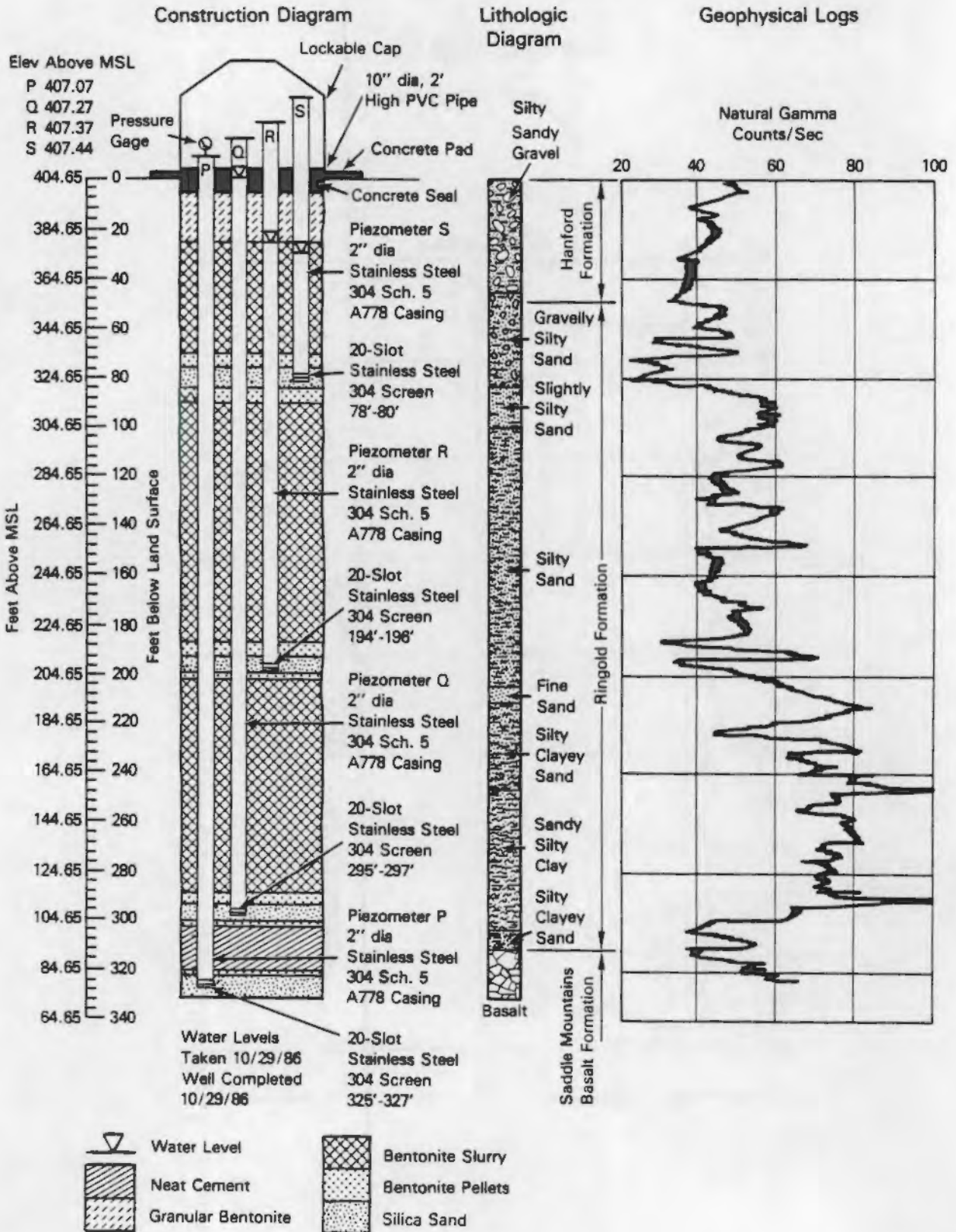


Well Number 199-H4-15B

Geophysical Logs

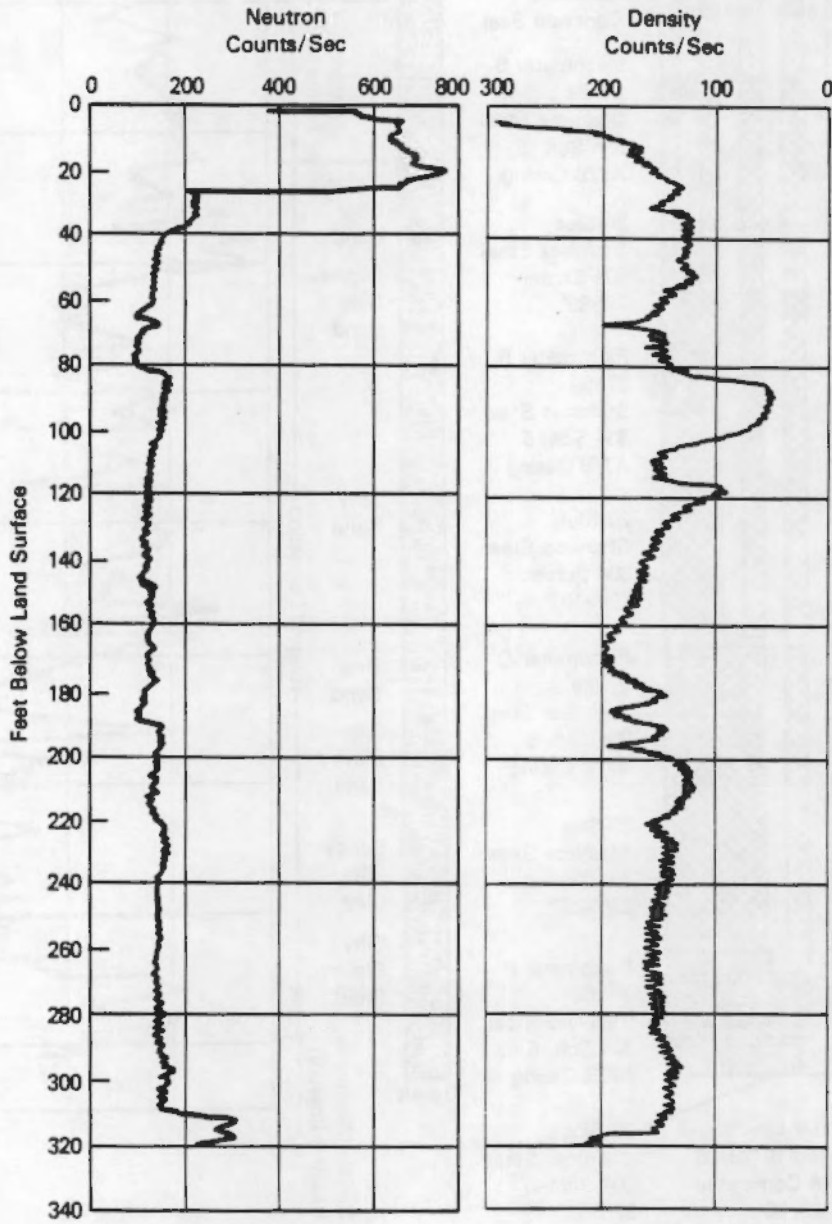


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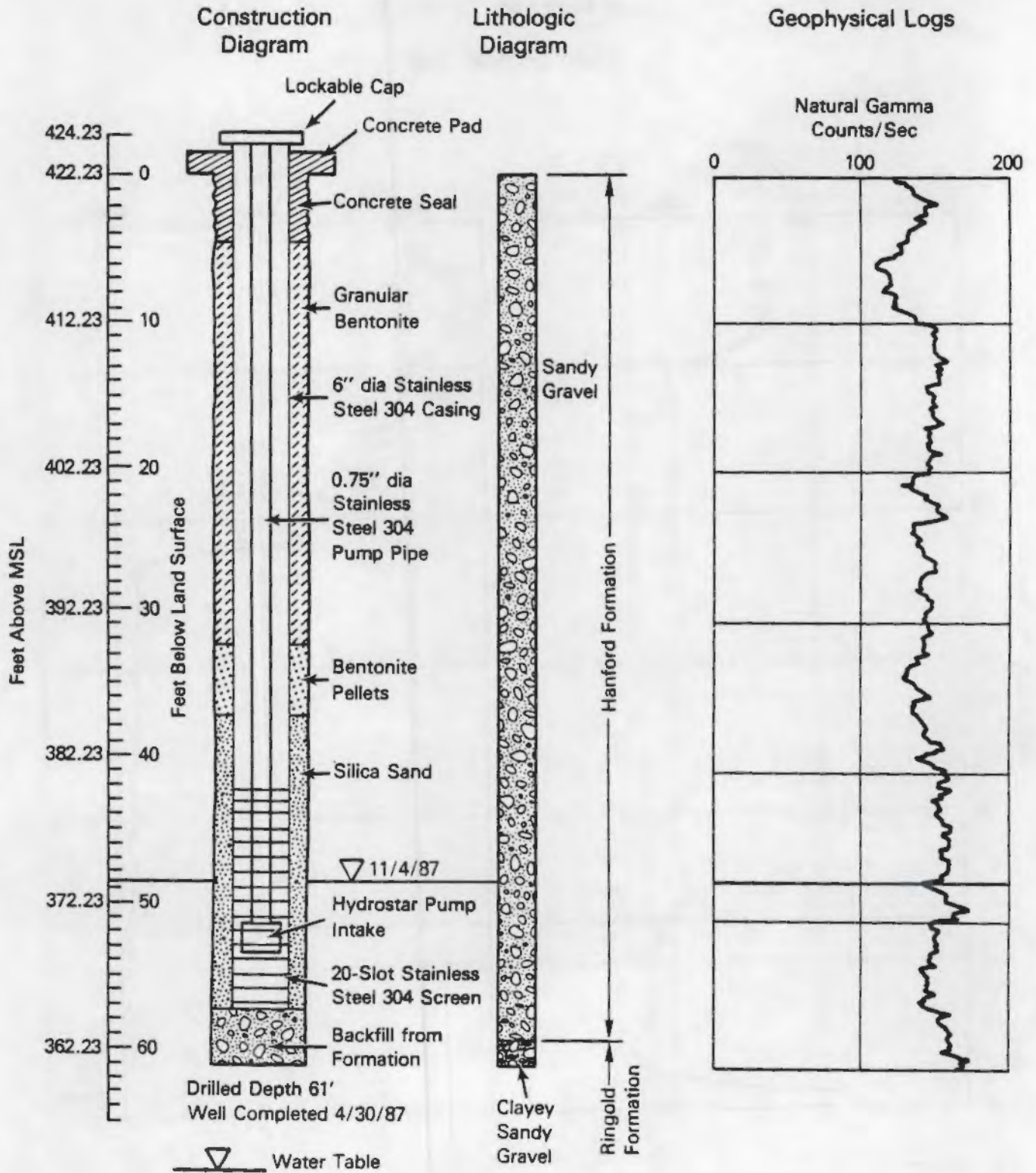


Well Number 199-H4-15C

Geophysical Logs

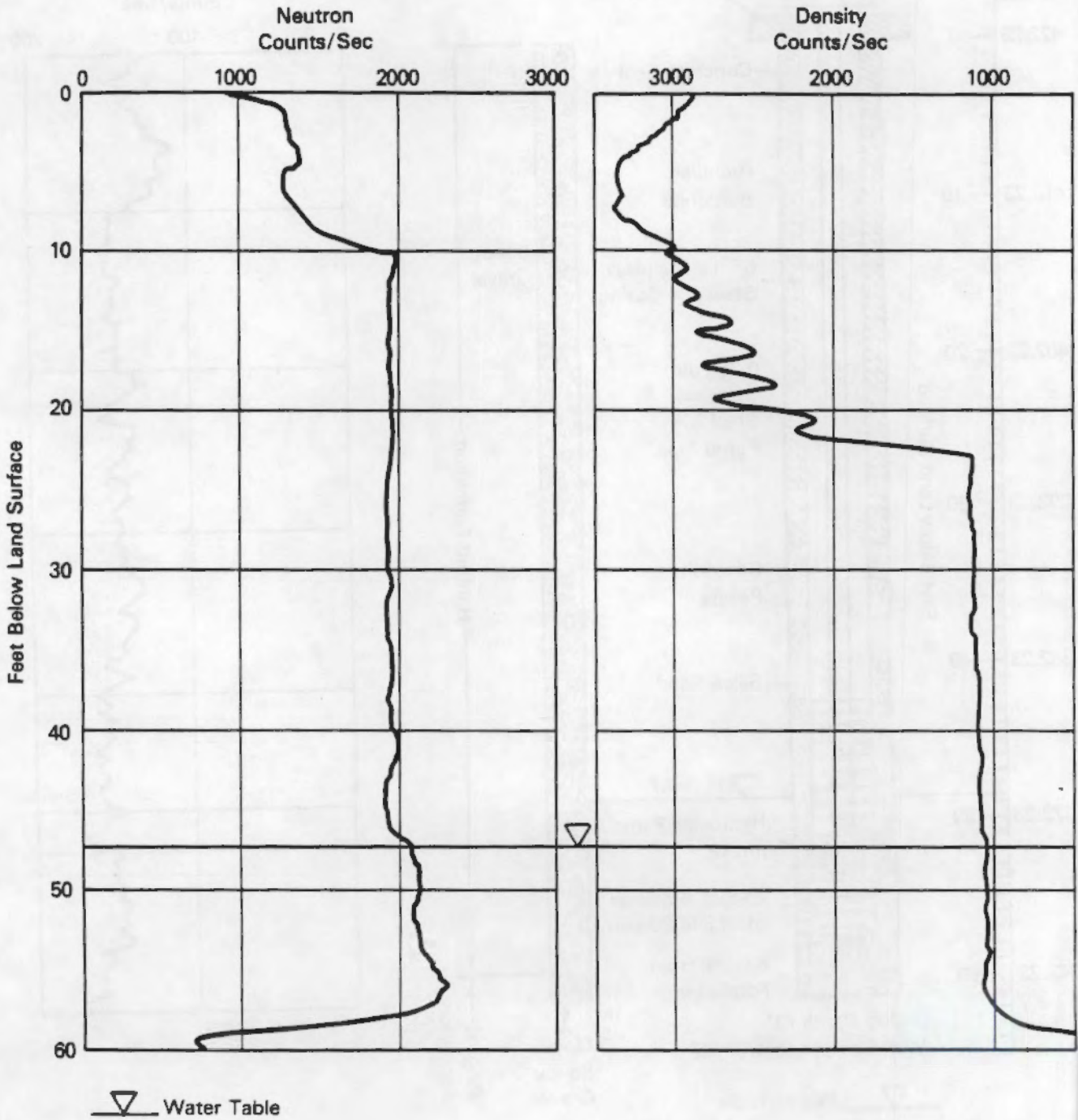


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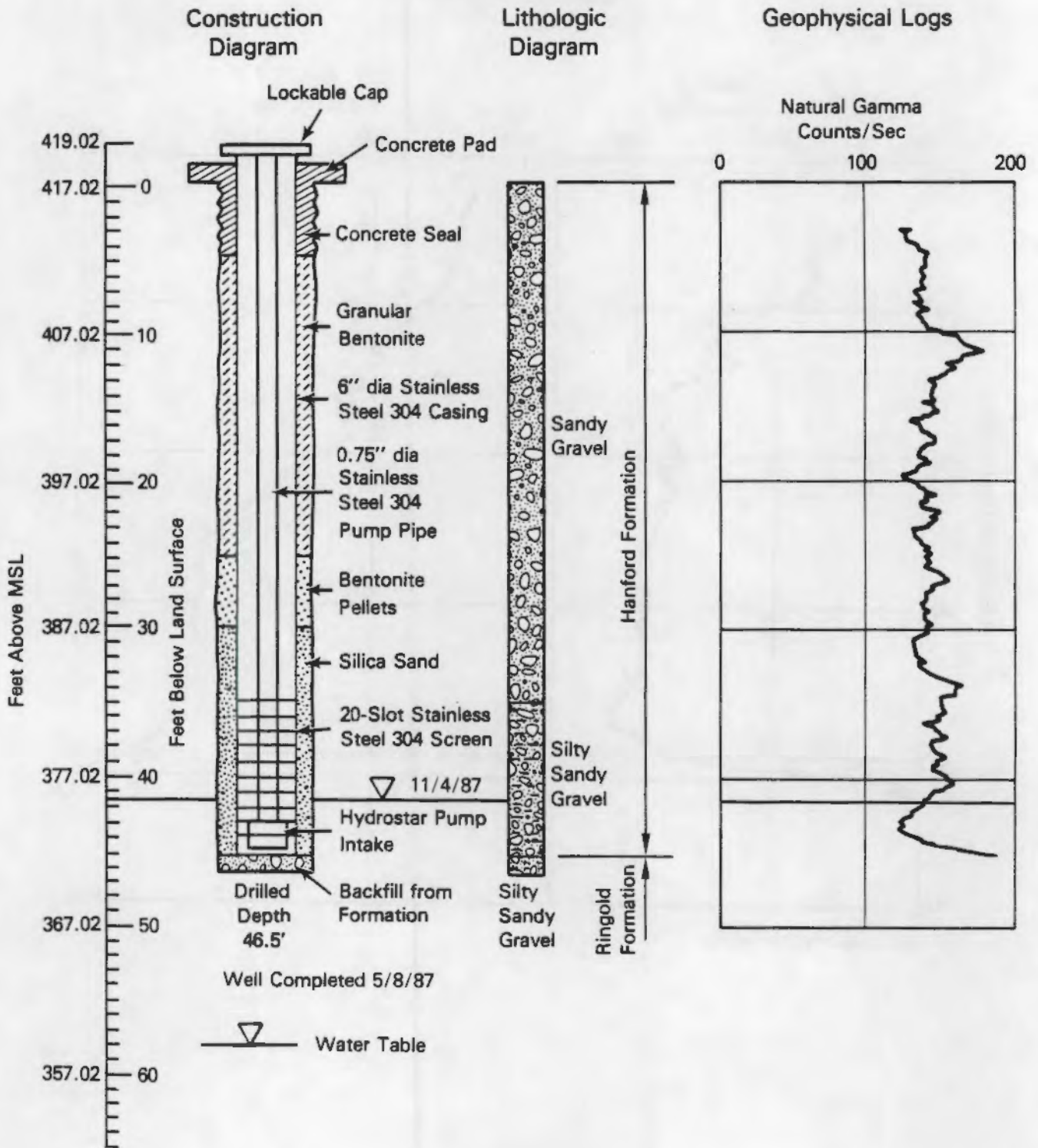


Well Number 199-H4-16

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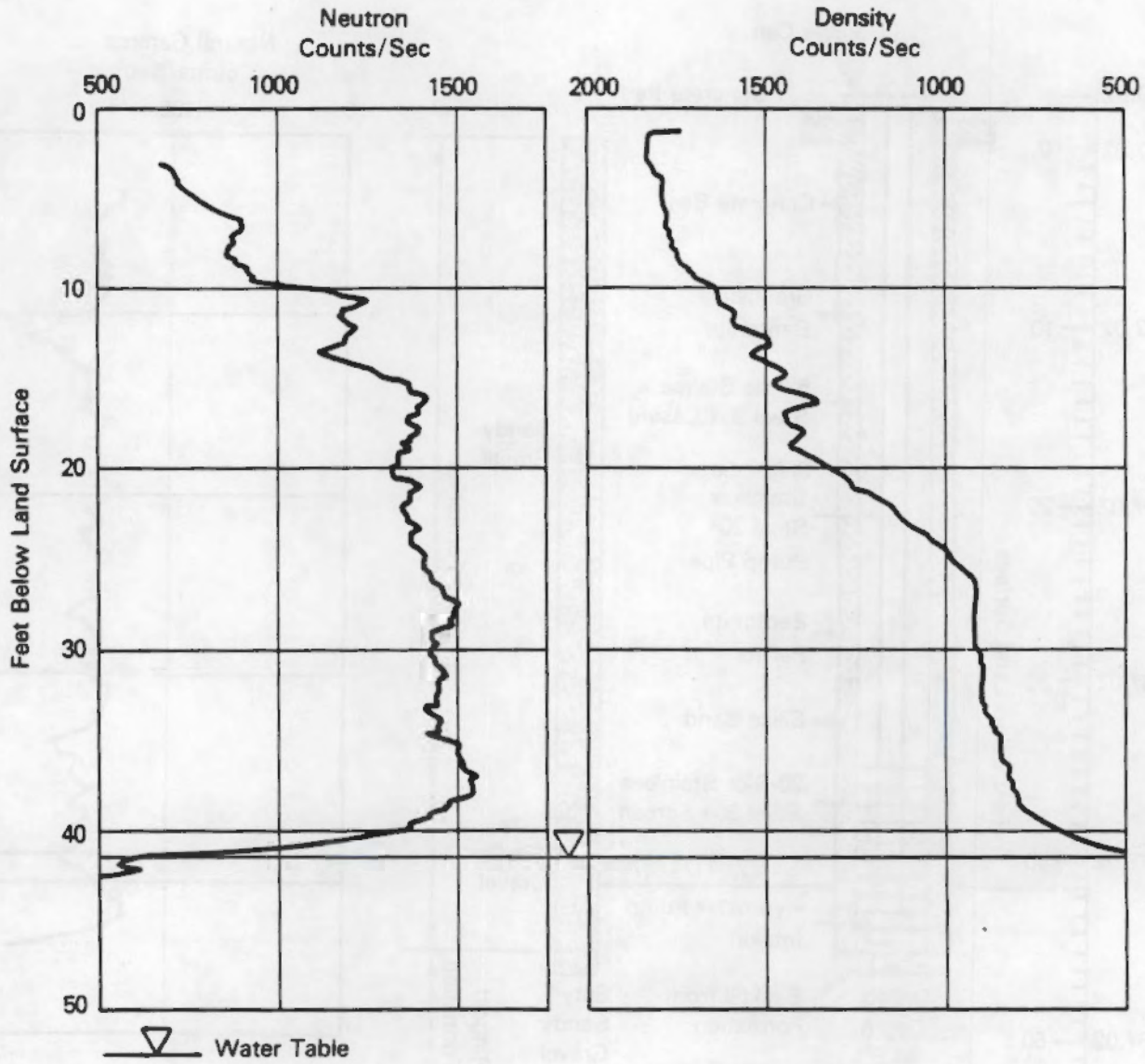


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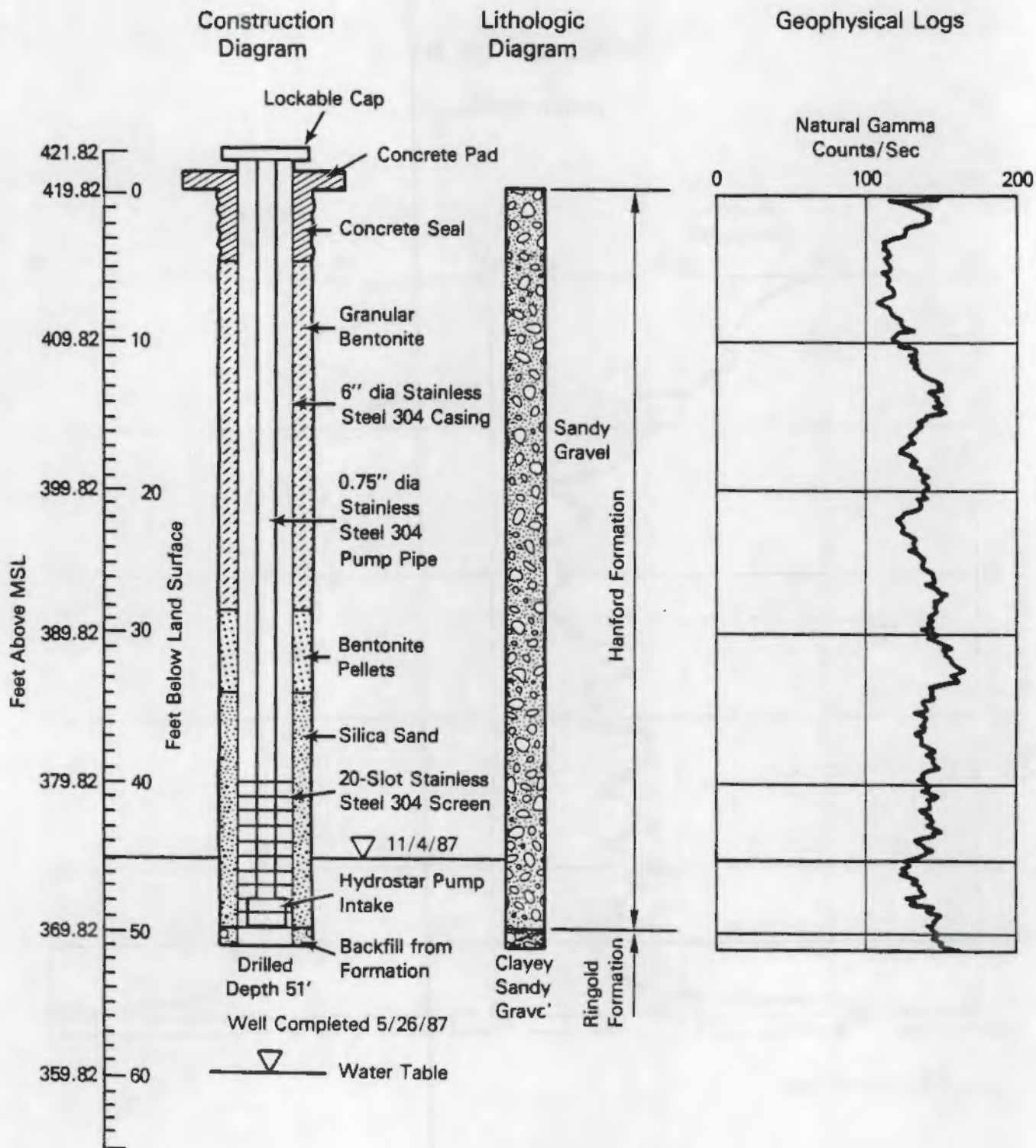


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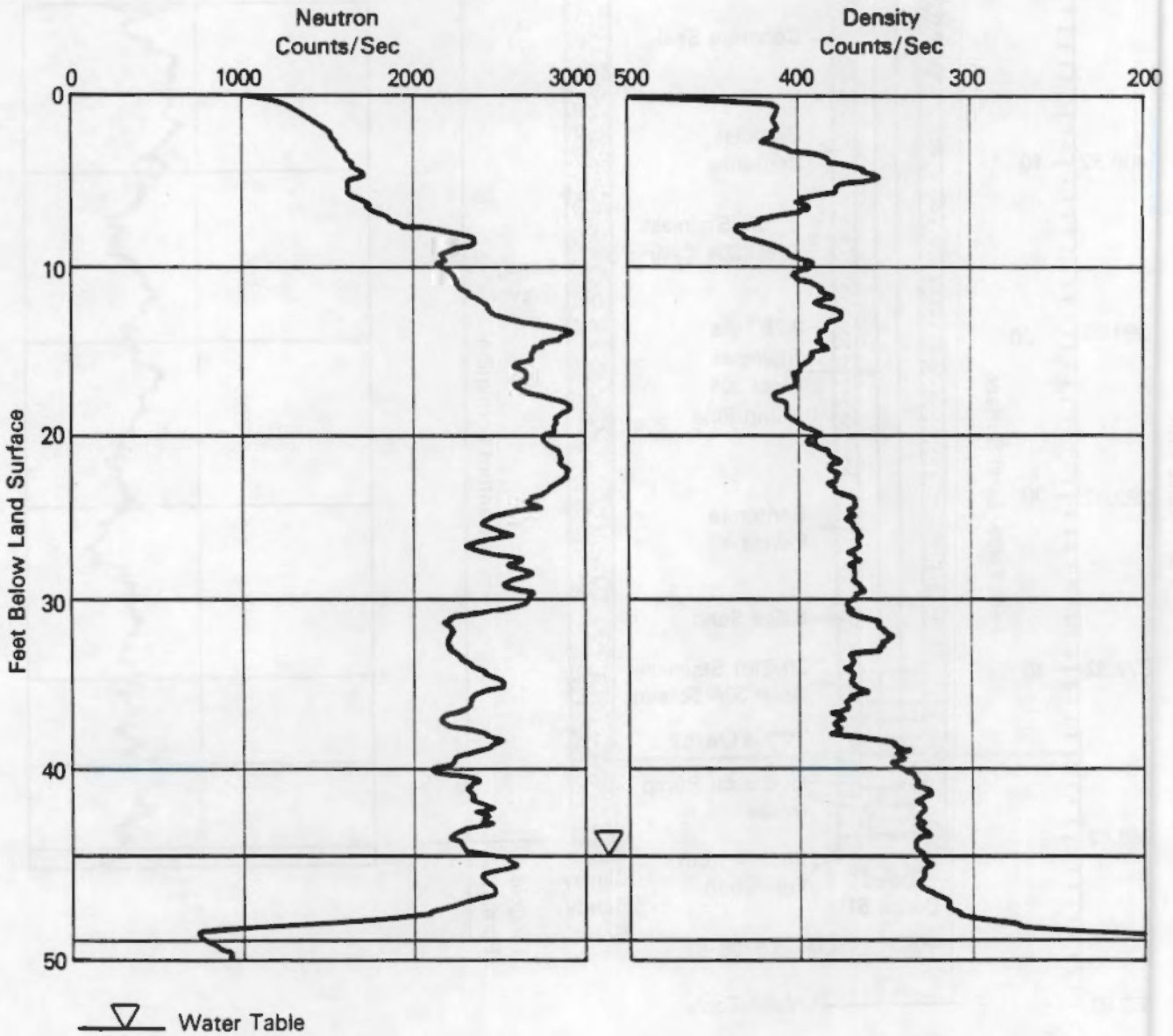


Well Number 199-H4-18



Well Number 199-H4-18

Geophysical Logs



APPENDIX B

BASIC DESCRIPTIVE STATISTICS FOR THE 68 CONSTITUENTS
THAT HAD AT LEAST ONE VALUE ABOVE THE DETECTION LIMIT

- Constituent=1,1,1-trichloroethane

(code=A87, name=1,1,1-T, units=PPB, dl=10, dws=200, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-4	30	28	28	1	115.00	115.00	115.00	0.00	115.00	.	.
1-H4-3	31	28	29	3	83.00	24.40	11.00	62.00	32.80	27.00	0.82
1-H3-1	36	33	28	1	22.00	22.00	22.00	0.00	22.00	.	.
1-H4-5	26	26	26	1	14.00	14.00	14.00	0.00	14.00	.	.
1-H4-8	26	23	25	2	14.00	14.00	14.00	0.00	14.00	0.00	0.00
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H3-2C	12	12	11	.	.	.	.	.	.	.	.
1-H4-7	12	12	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	12	12	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	11	11	.	.	.	.	.	.	.	.
1-H4-12C	12	12	12	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	6	6	6	.	.	.	.	.	.	.	.
1-H4-17	6	6	6	.	.	.	.	.	.	.	.
1-H4-18	6	6	6	.	.	.	.	.	.	.	.

- Constituent=Gross alpha

(code=212, name=ALPHA, units=PCI/L, dl=4, dws=15, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	30	0	29	29	1230.00	199.00	71.20	1158.80	275.22	245.87	0.89
1-H4-4	32	0	29	29	148.00	57.15	3.04	142.96	57.37	32.45	0.57
1-H4-12A	11	0	11	11	39.50	18.00	2.38	37.12	18.98	11.67	0.62
1-H4-12B	11	0	11	11	21.50	8.04	6.19	16.31	10.21	5.22	0.51
1-H4-9	12	0	11	11	13.20	8.94	3.45	9.75	7.63	2.97	0.39
1-H3-1	34	1	28	27	11.50	6.27	3.48	8.04	6.12	1.94	0.32
1-H4-8	26	2	29	26	8.78	2.81	1.15	5.63	3.10	1.52	0.49
1-H4-12C	12	1	12	11	6.60	1.69	0.89	5.71	2.38	1.70	0.72
1-H4-6	37	4	28	24	6.08	2.60	1.17	4.91	2.85	1.36	0.48
1-H4-18	6	0	6	6	5.03	2.47	1.58	3.45	2.92	1.27	0.43
1-H4-17	6	0	6	6	4.31	2.17	1.77	2.54	2.88	1.31	0.46
1-H4-7	12	0	11	11	4.20	2.34	1.38	2.84	2.48	0.73	0.30
1-H3-2C	11	4	11	7	3.88	1.68	1.10	2.78	2.19	1.08	0.48
1-H4-8	11	0	11	11	3.85	2.80	1.83	2.22	2.64	0.69	0.28
1-H4-11	12	0	12	12	3.34	2.38	1.27	2.07	2.38	0.72	0.31
1-H4-10	11	2	11	9	3.07	2.01	0.90	2.17	1.99	0.59	0.29
1-H3-2A	11	1	11	10	2.91	1.50	1.12	1.79	1.67	0.58	0.35
1-H3-2B	11	0	11	11	2.78	1.90	0.97	1.79	1.79	0.58	0.33
1-H4-13	11	3	11	8	2.70	1.11	0.88	1.82	1.34	0.60	0.45
1-H4-15B	11	0	11	11	2.32	1.60	1.14	1.18	1.68	0.41	0.24
1-H4-15A	11	1	11	10	2.28	1.58	1.02	1.26	1.57	0.49	0.31
1-H4-16	7	1	7	6	2.12	1.22	0.95	1.17	1.32	0.45	0.34
1-H4-14	11	3	11	8	1.97	1.60	0.98	0.99	1.57	0.31	0.20

- Constituent=Aluminum

(code=A18, name=ALUMINUM, units=PPB, dl=150, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-17	5	0	6	5	10100.00	1090.00	308.00	9792.00	2883.40	4085.80	1.43
1-H4-12C	12	7	12	5	5020.00	1180.00	308.00	4712.00	1719.80	1863.02	1.10
1-H3-2C	11	8	11	5	3780.00	1580.00	607.00	3163.00	1778.40	1233.08	0.89
1-H4-8	11	7	11	4	1600.00	1102.00	907.00	593.00	1152.75	288.38	0.26
1-H4-16	7	8	7	1	1180.00	1180.00	1180.00	0.00	1180.00	.	.
1-H4-3	30	12	29	17	1078.00	430.00	190.00	888.00	529.41	270.08	0.51
1-H4-11	12	11	12	1	908.00	908.00	908.00	0.00	908.00	.	.
1-H4-13	11	8	11	3	895.00	447.00	224.00	671.00	622.00	341.73	0.65
1-H4-18	8	6	8	1	822.00	822.00	822.00	0.00	822.00	.	.
1-H4-15A	11	10	11	1	549.00	549.00	549.00	0.00	549.00	.	.
1-H3-1	36	29	28	3	543.00	384.00	223.00	320.00	383.33	160.00	0.42
1-H4-5	38	29	28	3	364.00	219.00	163.00	201.00	248.87	103.73	0.42
1-H4-7	11	9	11	2	347.00	285.00	183.00	164.00	285.00	115.97	0.44
1-H4-8	28	28	28	2	332.00	278.50	225.00	107.00	278.50	75.86	0.27
1-H4-4	30	27	29	3	304.00	243.00	197.00	107.00	248.00	53.87	0.22
1-H4-12A	11	10	11	1	258.00	258.00	258.00	0.00	258.00	.	.
1-H4-9	11	8	11	3	248.00	178.00	177.00	71.00	201.00	40.71	0.20
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.

- Constituent=Aluminum, filtered

(code=H28, name=ALUMIN, units=PPB, dl=150, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-12C	12	7	12	5	2380.00	843.00	200.00	2180.00	1052.40	913.55	0.97
1-H3-2C	11	8	11	3	870.00	789.00	453.00	417.00	707.33	223.10	0.32
1-H4-16	6	6	6	1	602.00	602.00	602.00	0.00	602.00	.	.
1-H4-15B	11	10	11	1	454.00	454.00	454.00	0.00	454.00	.	.
1-H4-7	12	11	11	1	438.00	438.00	438.00	0.00	438.00	.	.
1-H4-11	12	11	12	1	341.00	341.00	341.00	0.00	341.00	.	.
1-H4-15A	11	10	11	1	202.00	202.00	202.00	0.00	202.00	.	.
1-H3-1	14	14	14	.	.	.	.	.	.	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H4-3	18	18	15	.	.	.	.	.	.	.	.
1-H4-4	17	17	14	.	.	.	.	.	.	.	.
1-H4-5	14	14	14	.	.	.	.	.	.	.	.
1-H4-8	14	14	14	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	11	11	10	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	10	10	10	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	6	6	6	.	.	.	.	.	.	.	.
1-H4-17	3	3	3	.	.	.	.	.	.	.	.

0.2

- Constituent=Arsenic, filtered

(code=H37, name=ARSENIC, units=PPB, dl=5, dws=60, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-9	10	4	10	8	15.00	7.60	7.00	8.00	8.83	3.13	0.35
1-H4-3	15	8	15	9	9.00	6.00	6.00	4.00	6.74	1.32	0.23
1-H4-6	14	10	14	4	7.00	5.50	5.00	2.00	5.75	0.98	0.17
1-H4-12C	12	5	12	7	7.00	6.00	5.00	2.00	6.29	0.76	0.12
1-H4-8	11	9	11	2	6.10	5.05	5.00	0.10	5.05	0.07	0.01
1-H3-2C	11	10	11	1	5.00	5.00	5.00	0.00	5.00	.	.
1-H4-4	15	11	14	4	6.00	6.00	5.00	0.00	5.00	0.00	0.00
1-H4-14	11	9	11	2	5.00	5.00	5.00	0.00	5.00	0.00	0.00
1-H4-15A	11	10	11	1	5.00	5.00	5.00	0.00	5.00	.	.
1-H3-1	14	14	14	.	.	.	.	.	.	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H4-6	14	14	14	.	.	.	.	.	.	.	.
1-H4-7	12	12	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	10	10	10	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.
1-H4-17	3	3	3	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.

- Constituent=Barium

(code=A08, name=BARIUM, units=PPB, dl=8, dws=1000, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	30	0	29	29	437.00	69.00	18.00	421.00	96.07	94.07	0.99
1-H4-17	6	0	5	5	153.00	81.00	69.00	84.00	93.20	33.90	0.36
1-H4-15B	11	0	11	11	117.00	107.00	92.00	25.00	105.84	8.06	0.08
1-H4-12B	11	0	11	11	113.00	101.00	73.00	40.00	98.91	11.82	0.12
1-H4-4	30	0	29	29	110.00	80.00	22.00	88.00	82.38	28.81	0.43
1-H4-15A	11	0	11	11	91.00	80.00	67.00	24.00	80.73	7.52	0.09
1-H4-12A	11	0	11	11	88.00	68.00	33.00	55.00	64.38	16.92	0.25
1-H4-9	11	0	11	11	83.00	69.00	45.00	38.00	67.38	12.91	0.19
1-H4-10	11	0	11	11	73.00	70.00	37.00	36.00	63.46	12.30	0.19
1-H4-5	38	0	28	28	69.00	61.75	39.00	30.00	51.23	7.41	0.14
1-H3-1	36	0	28	28	62.00	51.00	37.00	25.00	50.25	6.65	0.11
1-H4-8	28	0	28	28	69.00	44.50	15.00	44.00	41.79	9.81	0.23
1-H4-8	11	0	11	11	59.00	46.00	41.00	18.00	48.82	5.47	0.12
1-H4-18	8	0	8	8	48.00	35.50	32.00	18.00	37.83	8.01	0.18
1-H4-7	11	0	11	11	48.00	36.00	30.00	18.00	36.73	4.92	0.13
1-H4-11	12	0	12	12	45.00	30.50	26.00	19.00	32.75	5.38	0.18
1-H3-2B	11	0	11	11	42.00	35.00	24.00	18.00	35.00	5.35	0.15
1-H4-13	11	0	11	11	39.00	28.00	18.00	23.00	28.91	5.63	0.21
1-H4-18	7	0	7	7	39.00	26.00	20.00	19.00	28.43	8.35	0.24
1-H3-2C	11	0	11	11	38.00	22.00	17.00	21.00	22.73	5.55	0.24
1-H3-2A	11	0	11	11	33.00	27.00	22.00	11.00	28.91	3.75	0.14
1-H4-12C	12	0	12	12	30.00	10.00	7.00	23.00	11.17	6.26	0.56
1-H4-14	11	0	11	11	28.00	21.00	18.00	10.00	21.55	2.58	0.12

B.4

- Constituent=Barium, filtered

(code=H20, name=FBARIUM, units=PPB , dl=8 , dws=1000 , reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-15B	11	0	11	11	123.00	107.00	97.00	28.00	107.09	7.85	0.07
1-H4-12B	10	0	10	10	107.00	98.50	72.00	35.00	95.00	12.35	0.13
1-H4-4	17	0	14	14	95.00	67.00	27.00	68.00	64.07	24.09	0.38
1-H4-15A	11	0	11	11	94.00	80.00	82.00	32.00	80.55	9.09	0.11
1-H4-9	11	0	10	10	87.00	88.00	44.00	43.00	88.55	14.08	0.21
1-H4-9	16	0	15	15	88.00	29.00	14.00	72.00	38.87	22.17	0.57
1-H4-12A	11	0	11	11	82.00	67.00	33.00	49.00	64.84	18.28	0.25
1-H4-10	11	0	11	11	77.00	70.00	42.00	35.00	64.09	11.45	0.18
1-H4-17	3	0	3	3	74.00	73.00	68.00	6.00	71.67	3.21	0.04
1-H4-5	14	0	14	14	69.00	65.00	47.00	21.00	66.43	6.27	0.11
1-H3-1	14	0	14	14	60.00	50.50	40.00	20.00	50.00	4.87	0.09
1-H4-8	14	0	14	14	52.00	47.00	43.00	9.00	48.79	2.52	0.05
1-H4-8	11	0	11	11	49.00	40.00	38.00	13.00	41.38	3.88	0.09
1-H4-7	12	0	11	11	48.00	39.00	29.00	17.00	38.95	5.59	0.15
1-H3-2B	11	0	11	11	44.00	35.00	24.00	20.00	34.55	5.88	0.18
1-H4-18	8	0	8	8	44.00	36.00	29.00	15.00	36.33	5.05	0.14
1-H4-11	12	0	12	12	41.00	32.00	29.00	12.00	33.87	4.97	0.14
1-H3-2A	11	0	11	11	34.00	24.00	20.00	14.00	25.45	4.18	0.16
1-H4-18	8	0	8	8	33.00	23.50	21.00	12.00	24.50	4.32	0.18
1-H4-13	11	0	11	11	31.00	29.00	20.00	11.00	27.45	3.50	0.13
1-H3-2C	11	0	11	11	30.00	19.00	11.00	19.00	19.55	5.24	0.27
1-H4-14	11	0	11	11	27.00	23.00	19.00	8.00	23.19	2.84	0.11
1-H4-12C	12	0	12	12	18.00	10.00	7.00	9.00	10.42	2.81	0.25

- Constituent=Beryllium

(code=A01, name=BERYLUM, units=PPB , dl=5 , dws= , reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H3-1	33	32	28	1	5.00	5.00	5.00	0.00	5.00	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H3-2C	11	11	11	.	.	.	.	.	.	.	.
1-H4-3	28	28	27	.	.	.	.	.	.	.	.
1-H4-4	24	24	23	.	.	.	.	.	.	.	.
1-H4-5	23	23	22	.	.	.	.	.	.	.	.
1-H4-6	22	22	22	.	.	.	.	.	.	.	.
1-H4-7	11	11	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	11	11	.	.	.	.	.	.	.	.
1-H4-12C	12	12	12	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	8	8	8	.	.	.	.	.	.	.	.
1-H4-17	6	6	6	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.

B.5

- Constituent=Beryllium, filtered

(code=H33, name=FBERYLL, units=PPB, di=5, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-8	11	10	11	1	5.00	5.00	5.00	0.00	5.00	.	.
1-H3-1	12	12	12	.	.	.	.	.	.	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H3-2C	11	11	11	.	.	.	.	.	.	.	.
1-H4-3	14	14	13	.	.	.	.	.	.	.	.
1-H4-4	16	16	12	.	.	.	.	.	.	.	.
1-H4-5	11	11	11	.	.	.	.	.	.	.	.
1-H4-7	12	12	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	11	11	10	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	10	10	10	.	.	.	.	.	.	.	.
1-H4-12C	12	12	12	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	8	8	8	.	.	.	.	.	.	.	.
1-H4-17	3	3	3	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.

- Constituent=Gross beta

(code=111, name=BETA, units=PCI/L, di=8, dws=50, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	30	0	29	29	1920.00	891.50	186.00	1754.00	720.57	416.99	0.58
1-H4-4	32	0	29	29	481.00	289.00	6.88	474.12	266.14	139.11	0.52
1-H4-12A	11	0	11	11	320.00	59.80	7.91	312.09	82.13	65.80	1.04
1-H4-9	12	0	11	11	306.00	148.00	37.20	287.80	141.12	82.70	0.59
1-H4-13	11	0	11	11	98.20	73.20	66.20	42.00	71.65	11.75	0.16
1-H4-12B	11	0	11	11	85.10	45.80	18.50	66.60	49.76	20.83	0.43
1-H4-11	12	0	12	12	84.20	65.90	58.80	25.40	67.86	7.87	0.12
1-H4-18	8	0	8	8	71.70	19.25	14.90	56.80	27.60	21.96	0.80
1-H3-1	34	0	28	28	34.40	11.80	7.58	26.84	13.01	5.57	0.43
1-H4-8	28	0	28	28	28.30	9.05	5.90	22.40	10.58	4.79	0.45
1-H4-16	7	0	7	7	25.10	17.50	8.99	16.11	18.00	6.03	0.28
1-H4-5	37	1	28	28	23.40	8.05	4.59	16.81	9.55	4.08	0.43
1-H4-17	5	0	5	5	18.10	15.30	5.95	10.15	12.53	4.80	0.37
1-H4-15B	11	0	11	11	13.20	9.54	4.27	8.93	9.24	2.37	0.26
1-H4-15A	11	0	11	11	13.10	9.66	5.54	7.58	9.30	2.24	0.24
1-H3-2C	11	0	11	11	13.00	8.44	3.88	9.24	8.39	3.57	0.43
1-H4-14	11	0	11	11	12.50	7.87	4.55	7.95	7.88	2.17	0.28
1-H4-7	12	1	11	10	12.30	7.81	4.05	8.25	7.83	2.59	0.33
1-H3-2B	11	2	11	9	11.70	7.65	5.10	6.60	7.84	2.14	0.27
1-H4-8	11	0	11	11	11.80	8.47	5.49	6.11	8.45	1.92	0.23
1-H3-2A	11	1	11	10	10.90	8.89	3.39	7.51	7.41	2.17	0.29
1-H4-12C	12	0	12	12	9.72	8.08	4.08	5.54	7.53	2.06	0.27
1-H4-10	11	0	11	11	9.62	7.71	5.28	4.36	7.35	1.36	0.19

B-5

- Constituent=Bis(2-ethylhexyl) phthalate (code=B40, name=BIS2EPH, units=PPB , dl=10 , dws= , reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	13	11	13	1	13.00	13.00	13.00	0.00	13.00	.	.
1-H3-1	18	18	12	.	.	.	.	.	.	.	.

- Constituent=Cadmium (code=A07, name=CADMIUM, units=PPB , dl=2 , dws=10 , reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-8	28	28	28	2	13.00	7.50	2.00	11.00	7.50	7.78	1.04
1-H4-3	30	28	29	2	5.00	3.50	2.00	3.00	3.50	2.12	0.61
1-H4-4	30	28	29	2	4.00	3.50	3.00	1.00	3.50	0.71	0.20
1-H4-5	38	34	28	3	3.50	3.20	3.00	0.50	3.23	0.25	0.08
1-H4-11	12	11	12	1	3.00	3.00	3.00	0.00	3.00	.	.
1-H4-17	5	4	5	1	3.00	3.00	3.00	0.00	3.00	.	.
1-H3-1	25	34	28	1	2.10	2.10	2.10	0.00	2.10	.	.
1-H4-9	11	9	11	2	2.00	2.00	2.00	0.00	2.00	0.00	0.00
1-H4-12A	11	10	11	1	2.00	2.00	2.00	0.00	2.00	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H3-2C	11	11	11	.	.	.	.	.	.	.	.
1-H4-7	11	11	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	11	11	.	.	.	.	.	.	.	.
1-H4-12C	12	12	12	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-16A	11	11	11	.	.	.	.	.	.	.	.
1-H4-16B	11	11	11	.	.	.	.	.	.	.	.
1-H4-18	7	7	7	.	.	.	.	.	.	.	.
1-H4-18	6	6	6	.	.	.	.	.	.	.	.

- Constituent=Cadmium, filtered (code=H21, name=FCADMIU, units=PPB , dl=2 , dws=10 , reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-5	14	13	14	1	3.00	3.00	3.00	0.00	3.00	.	.
1-H3-2A	11	10	11	1	2.00	2.00	2.00	0.00	2.00	.	.
1-H3-2B	11	10	11	1	2.00	2.00	2.00	0.00	2.00	.	.
1-H4-9	11	10	10	1	2.00	2.00	2.00	0.00	2.00	.	.
1-H4-12C	12	11	12	1	2.00	2.00	2.00	0.00	2.00	.	.
1-H3-1	14	14	14	.	.	.	.	.	.	.	.
1-H3-2C	11	11	11	.	.	.	.	.	.	.	.
1-H4-3	18	18	15	.	.	.	.	.	.	.	.
1-H4-4	17	17	14	.	.	.	.	.	.	.	.
1-H4-8	14	14	14	.	.	.	.	.	.	.	.
1-H4-7	12	12	11	.	.	.	.	.	.	.	.
1-H4-9	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	10	10	10	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-16B	11	11	11	.	.	.	.	.	.	.	.
1-H4-18	6	6	6	.	.	.	.	.	.	.	.
1-H4-17	3	3	3	.	.	.	.	.	.	.	.
1-H4-18	6	6	6	.	.	.	.	.	.	.	.

B.7

- Constituent=Calcium

(code=A06, name=CALCIUM, units=PPB , dl=60 , dws= , reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	30	0	29	29	334000.00	35500.00	11300.00	322700.00	85189.88	71371.03	1.09
1-H4-9	11	0	11	11	113000.00	85600.00	85100.00	47900.00	88181.82	14789.01	0.17
1-H4-17	5	0	5	5	90100.00	71300.00	59300.00	30800.00	72780.00	11089.33	0.16
1-H3-1	35	0	28	28	90000.00	77850.00	60900.00	29100.00	78689.29	7330.72	0.10
1-H4-12A	11	0	11	11	82400.00	73100.00	40100.00	42300.00	68581.82	14411.51	0.22
1-H4-12B	11	0	11	11	79400.00	70200.00	50300.00	29100.00	65883.64	9443.55	0.14
1-H4-4	28	0	25	25	79300.00	41200.00	19500.00	59800.00	42436.00	16384.82	0.38
1-H4-8	24	0	24	24	76300.00	62450.00	37900.00	38400.00	60729.17	8875.93	0.14
1-H4-5	25	0	24	24	76000.00	56650.00	44900.00	30100.00	57341.67	6858.85	0.10
1-H4-7	11	0	11	11	72100.00	54300.00	47200.00	24900.00	57200.00	7981.12	0.14
1-H4-8	11	0	11	11	70300.00	63700.00	56300.00	14000.00	63581.82	4437.53	0.07
1-H3-2A	11	0	11	11	62400.00	40400.00	35900.00	28500.00	43027.27	7177.20	0.17
1-H4-18	8	0	8	8	68500.00	48450.00	38200.00	20300.00	48000.00	6889.64	0.14
1-H4-16A	11	0	11	11	67700.00	49200.00	42100.00	15800.00	49409.09	4398.51	0.09
1-H4-11	12	0	12	12	66800.00	48200.00	41800.00	16200.00	48408.33	4021.88	0.08
1-H3-2B	11	0	11	11	62400.00	43400.00	38500.00	13900.00	44418.18	4484.28	0.10
1-H4-15B	11	0	11	11	62100.00	49000.00	41800.00	10500.00	47863.64	3043.11	0.08
1-H4-13	11	0	11	11	47000.00	40700.00	31400.00	15800.00	39954.55	4417.32	0.11
1-H4-10	11	0	11	11	46400.00	43800.00	27400.00	19000.00	40454.55	6268.55	0.16
1-H4-18	7	0	7	7	48300.00	41600.00	34700.00	11800.00	41100.00	3944.62	0.10
1-H4-14	11	0	11	11	44500.00	42400.00	34100.00	10700.00	41000.00	3253.92	0.08
1-H4-12C	12	0	12	12	34000.00	28100.00	23300.00	10700.00	27333.33	3106.89	0.11
1-H3-2C	11	0	11	11	28200.00	25600.00	20300.00	5900.00	24745.45	1748.08	0.07

- Constituent=Calcium, filtered

(code=H18, name=FCALCIU, units=PPB , dl=60 , dws= , reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-9	11	0	10	10	113000.00	91150.00	65300.00	47700.00	91180.00	13933.00	0.16
1-H3-1	14	0	14	14	87400.00	78850.00	55300.00	32100.00	75871.43	9251.48	0.12
1-H4-12A	11	0	11	11	81100.00	69400.00	40700.00	40400.00	64838.38	13842.89	0.21
1-H4-17	3	0	3	3	78500.00	77700.00	57900.00	20600.00	71368.87	11669.33	0.18
1-H4-6	14	0	14	14	78200.00	66700.00	57700.00	18500.00	68178.57	4915.62	0.07
1-H4-8	11	0	11	11	74100.00	65200.00	57100.00	17000.00	65883.64	5682.91	0.09
1-H4-7	12	0	11	11	73400.00	56700.00	49900.00	23500.00	58522.73	7304.43	0.12
1-H4-5	14	0	14	14	73300.00	58250.00	54800.00	19500.00	60435.71	5544.73	0.09
1-H4-12B	10	0	10	10	72900.00	67450.00	51500.00	21400.00	64140.00	7717.97	0.12
1-H4-4	17	0	14	14	72000.00	41250.00	23900.00	48100.00	45114.29	18843.89	0.37
1-H3-2A	11	0	11	11	65000.00	40700.00	38500.00	28500.00	43454.55	7999.92	0.18
1-H4-18	8	0	8	8	61100.00	47700.00	39400.00	21700.00	47983.33	7507.97	0.16
1-H4-16A	11	0	11	11	68700.00	51100.00	43500.00	16200.00	50418.18	4181.59	0.08
1-H4-15B	11	0	11	11	66000.00	48300.00	41200.00	13800.00	48472.73	3853.52	0.08
1-H4-3	18	0	15	16	64100.00	19900.00	11200.00	42900.00	25988.67	13797.98	0.53
1-H4-11	12	0	12	12	59800.00	48750.00	43300.00	10500.00	48841.67	2471.48	0.05
1-H3-2B	11	0	11	11	51800.00	41800.00	40300.00	11500.00	43818.18	4610.44	0.09
1-H4-18	8	0	8	8	49500.00	40300.00	37200.00	12300.00	41318.67	4359.55	0.11
1-H4-13	11	0	11	11	47500.00	39900.00	33700.00	13800.00	39990.91	4259.92	0.11
1-H4-10	11	0	11	11	47000.00	42800.00	29700.00	17300.00	40400.00	6138.08	0.15
1-H4-14	11	0	11	11	44700.00	40800.00	38300.00	8400.00	40972.73	2524.71	0.06
1-H4-12C	12	0	12	12	33900.00	27200.00	23700.00	10200.00	27525.00	3274.73	0.12
1-H3-2C	11	0	11	11	28800.00	23700.00	20000.00	8800.00	23927.27	2354.61	0.10

- Constituent=Chromium (code=A08, name=CHROMIUM, units=PPB, dl=10, dws=50, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	30	0	29	29	1130.00	571.00	241.00	889.00	608.02	279.89	0.46
1-H4-4	30	0	29	29	729.00	392.00	26.00	703.00	393.47	204.75	0.52
1-H4-5	38	0	28	28	551.50	284.00	133.00	448.50	327.21	142.49	0.44
1-H4-14	11	0	11	11	331.00	287.00	148.00	183.00	248.27	62.68	0.25
1-H4-12A	11	0	11	11	308.00	207.00	57.00	249.00	208.64	80.10	0.39
1-H4-18	8	0	8	8	288.00	254.50	237.00	48.00	257.17	16.97	0.08
1-H4-12B	11	0	11	11	278.00	184.00	152.00	124.00	202.48	43.41	0.21
1-H4-12C	12	0	12	12	268.00	177.50	58.00	200.00	181.42	58.12	0.38
1-H4-7	11	0	11	11	204.00	128.00	112.00	94.00	140.55	30.39	0.22
1-H4-15A	11	0	11	11	202.00	155.00	80.00	142.00	146.55	43.17	0.30
1-H4-15B	11	0	11	11	180.00	154.00	107.00	73.00	148.45	22.57	0.15
1-H4-11	12	0	12	12	187.00	98.50	81.00	108.00	101.58	32.40	0.32
1-H4-17	5	0	5	5	168.00	82.00	53.00	113.00	83.40	47.36	0.57
1-H4-9	11	0	11	11	184.00	137.00	108.00	56.00	138.84	17.00	0.12
1-H4-8	11	0	11	11	141.00	113.00	95.00	46.00	113.18	14.18	0.13
1-H3-2A	11	0	11	11	98.00	37.00	27.00	71.00	48.27	20.27	0.44
1-H4-10	11	0	11	11	96.00	77.00	17.00	79.00	69.46	27.19	0.39
1-H3-1	36	0	28	28	79.00	59.50	24.00	55.00	54.27	18.48	0.29
1-H4-8	28	1	28	27	79.00	49.00	26.00	53.00	47.78	12.82	0.27
1-H4-13	11	0	11	11	48.00	25.00	17.00	31.00	28.00	9.03	0.32
1-H3-2B	11	0	11	11	44.00	27.00	14.00	30.00	29.45	9.97	0.34
1-H3-2C	11	7	11	4	23.00	12.50	11.00	12.00	14.75	6.58	0.38
1-H4-18	7	5	7	2	18.00	13.00	10.00	8.00	13.00	4.24	0.33

- Constituent=Chromium, filtered (code=H22, name=FCHROMI, units=PPB, dl=10, dws=50, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	18	0	15	15	581.00	348.00	210.00	351.00	345.80	90.36	0.28
1-H4-4	17	0	14	14	522.00	338.75	24.00	498.00	308.88	134.23	0.44
1-H4-14	11	1	11	10	304.00	288.00	154.00	150.00	251.20	50.36	0.20
1-H4-5	14	0	14	14	303.00	194.00	142.00	181.00	205.79	50.18	0.24
1-H4-12A	11	0	11	11	302.00	197.00	48.00	258.00	201.91	80.34	0.40
1-H4-18	8	0	8	8	282.00	252.50	242.00	40.00	258.33	14.73	0.06
1-H4-12C	12	1	12	11	272.00	188.00	54.00	218.00	158.84	68.87	0.43
1-H4-12B	10	0	10	10	250.00	187.50	137.00	113.00	191.50	36.54	0.19
1-H4-15A	11	0	11	11	205.00	147.00	82.00	143.00	148.55	44.84	0.31
1-H4-15B	11	0	11	11	171.00	153.00	99.00	72.00	149.91	22.32	0.15
1-H4-9	11	0	10	10	184.00	129.00	107.00	67.00	131.00	18.83	0.13
1-H4-11	12	0	12	12	155.00	89.50	53.00	102.00	96.17	31.41	0.33
1-H4-7	12	0	11	11	153.00	125.50	98.00	55.00	129.88	18.80	0.13
1-H4-8	11	0	11	11	112.00	102.00	94.00	18.00	102.82	8.29	0.08
1-H4-10	11	0	11	11	92.00	82.00	15.00	77.00	87.55	28.88	0.43
1-H4-8	14	0	14	14	82.00	43.00	38.00	53.00	47.07	13.18	0.28
1-H3-1	14	0	14	14	70.00	51.00	31.00	39.00	52.88	11.93	0.23
1-H3-2A	11	0	11	11	69.00	32.00	18.00	51.00	35.82	14.42	0.40
1-H4-17	3	0	3	3	67.00	50.00	33.00	34.00	50.00	17.00	0.34
1-H4-13	11	1	11	10	48.00	25.50	13.00	35.00	27.50	10.31	0.37
1-H3-2B	11	1	11	10	40.00	30.50	14.00	26.00	27.80	9.88	0.35
1-H3-2C	11	9	11	2	11.00	10.50	10.00	1.00	10.50	0.71	0.07
1-H4-18	8	5	8	1	11.00	11.00	11.00	0.00	11.00	.	.

- Constituent=Cobalt-60 (code=010, name=CO 60, units=PCI/L, dl=22.5, dws=100, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H3-1	8	4	8	2	5.88	5.88	5.83	0.45	5.88	0.32	0.05
1-H4-3	8	5	8	1	5.63	5.63	5.63	0.00	5.63	.	.

0.10

- Constituent=Coliform bacteria

(code=109, name=COLIFRM, units=MPN , dl=2.2 , dws=1 , reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	29	26	29	4	23.00	10.05	2.20	20.80	11.32	9.52	0.84
1-H4-7	11	4	11	7	16.00	16.00	2.20	13.80	10.50	6.93	0.66
1-H4-8	11	10	11	1	16.00	16.00	16.00	0.00	16.00	.	.
1-H4-12A	11	10	11	1	16.00	16.00	16.00	0.00	16.00	.	.
1-H3-2C	11	10	11	1	6.10	5.10	5.10	0.00	5.10	.	.
1-H4-4	29	26	29	3	4.00	2.20	2.20	1.80	2.60	1.04	0.37
1-H3-1	34	33	29	1	2.20	2.20	2.20	0.00	2.20	.	.
1-H4-11	12	11	12	1	2.20	2.20	2.20	0.00	2.20	.	.
1-H4-12C	12	10	12	2	2.20	2.20	2.20	0.00	2.20	0.00	0.00
1-H4-13	11	10	11	1	2.20	2.20	2.20	0.00	2.20	.	.
1-H4-17	6	4	6	1	2.20	2.20	2.20	0.00	2.20	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H4-5	37	37	29	.	.	.	.	.	.	.	.
1-H4-6	29	29	29	.	.	.	.	.	.	.	.
1-H4-9	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	6	6	6	.	.	.	.	.	.	.	.
1-H4-18	6	6	6	.	.	.	.	.	.	.	.

- Constituent=Specific conductance, field

(code=121, name=CONDFLD, units=UMHO , dl=1 , dws=700 , reg=WDOE)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	29	0	29	27	5790.00	1654.00	910.00	4880.00	2101.41	1175.25	0.56
1-H4-4	29	0	29	27	1357.00	692.00	215.00	1142.00	626.56	349.10	0.42
1-H4-9	11	0	11	11	865.00	639.00	476.00	389.00	673.82	119.37	0.16
1-H3-1	29	0	29	27	725.00	595.00	459.00	266.00	593.04	68.54	0.12
1-H4-12A	11	0	11	11	670.00	516.00	272.00	398.00	466.64	125.44	0.26
1-H4-6	29	0	29	29	569.00	461.00	293.00	276.00	450.54	79.15	0.18
1-H4-17	6	0	6	4	566.00	504.50	471.00	84.00	506.75	37.79	0.07
1-H4-12B	11	0	11	11	539.00	491.00	331.00	208.00	451.73	79.47	0.18
1-H4-8	11	0	11	11	529.00	417.00	356.00	173.00	426.64	49.10	0.11
1-H4-7	11	0	11	11	506.00	423.00	329.00	177.00	424.00	54.83	0.13
1-H4-5	29	0	29	27	475.00	401.00	302.00	173.00	392.52	46.00	0.12
1-H3-2A	11	0	11	11	466.00	314.00	252.00	203.00	326.91	52.53	0.16
1-H4-15B	11	0	11	11	416.00	367.00	296.00	118.00	359.18	33.54	0.09
1-H4-15A	11	0	11	11	414.00	372.00	310.00	104.00	367.73	39.56	0.10
1-H4-19	6	0	6	6	396.00	316.00	239.00	157.00	319.83	63.03	0.17
1-H4-10	11	0	11	11	395.00	316.00	207.00	189.00	306.91	60.47	0.20
1-H3-2B	11	0	11	11	363.00	319.00	268.00	115.00	320.00	35.69	0.11
1-H3-2C	11	0	11	11	376.00	261.00	167.00	209.00	267.55	75.57	0.26
1-H4-12C	12	0	12	12	371.00	272.00	221.00	150.00	263.17	48.92	0.17
1-H4-11	12	0	12	12	364.00	302.00	245.00	119.00	312.67	37.19	0.12
1-H4-13	11	0	11	11	352.00	295.00	185.00	166.00	272.91	53.52	0.20
1-H4-14	11	0	11	11	315.00	304.00	208.00	109.00	289.19	32.24	0.11
1-H4-16	6	0	6	6	295.00	251.50	190.00	105.00	243.00	41.57	0.17

- Constituent=Copper

(code=A13, name=COPPER, units=PPB, dl=10, dwe=1300, reg=EPAP)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-11	12	0	12	3	274.00	19.00	13.00	261.00	102.00	148.99	1.48
1-H4-3	30	0	29	29	193.00	46.00	10.00	123.00	48.45	33.89	0.70
1-H4-15A	11	0	11	3	103.00	12.00	11.00	92.00	42.00	52.83	1.28
1-H4-13	11	9	11	2	88.00	39.00	10.00	58.00	39.00	41.01	1.06
1-H4-17	6	2	6	3	30.00	11.00	10.00	20.00	17.00	11.27	0.66
1-H3-2A	11	9	11	2	29.00	23.50	18.00	11.00	23.50	7.78	0.33
1-H4-4	30	28	29	4	29.00	20.50	11.00	18.00	20.25	10.11	0.50
1-H3-2C	11	6	11	6	28.00	22.50	10.00	18.00	20.60	7.45	0.36
1-H4-14	11	7	11	4	28.00	16.00	10.00	18.00	17.50	7.69	0.43
1-H4-12C	12	10	12	2	28.00	18.00	10.00	18.00	18.00	11.31	0.63
1-H4-5	36	33	28	2	20.00	18.25	18.50	3.50	18.25	2.47	0.14
1-H4-7	11	9	11	2	17.00	16.50	18.00	1.00	16.50	0.71	0.04
1-H4-9	11	8	11	5	16.00	13.00	10.00	6.00	12.60	2.39	0.19
1-H3-1	36	33	28	2	15.00	12.50	10.00	5.00	12.50	3.54	0.28
1-H4-10	11	7	11	4	14.00	11.00	10.00	4.00	11.50	1.73	0.15
1-H4-8	28	28	28	2	12.00	11.50	11.00	1.00	11.50	0.71	0.06
1-H4-18	7	6	7	2	12.00	11.50	11.00	1.00	11.60	0.71	0.06
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	11	11	11	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.

- Constituent=Copper, filtered

(code=H28, name=FCOPPER, units=PPB, dl=10, dwe=1300, reg=EPAP)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	18	5	15	10	88.00	34.50	23.00	45.00	37.60	13.84	0.36
1-H4-12C	12	10	12	2	33.00	24.00	15.00	18.00	24.00	12.73	0.53
1-H3-2C	11	9	11	2	22.00	18.00	14.00	8.00	18.00	5.68	0.31
1-H4-15B	11	10	11	1	19.00	19.00	19.00	0.00	19.00	.	.
1-H4-10	11	10	11	1	11.00	11.00	11.00	0.00	11.00	.	.
1-H4-11	12	11	12	1	11.00	11.00	11.00	0.00	11.00	.	.
1-H3-1	14	14	14	.	.	.	.	.	.	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H4-4	17	17	14	.	.	.	.	.	.	.	.
1-H4-5	14	14	14	.	.	.	.	.	.	.	.
1-H4-6	14	14	14	.	.	.	.	.	.	.	.
1-H4-7	12	12	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	11	11	10	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	10	10	10	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	8	8	8	.	.	.	.	.	.	.	.
1-H4-17	3	3	3	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.

0.12

- Constituent=Fluoride

(code=C74, name=FLUORID, unit=PPB, di=600, dws=4000, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	31	19	29	12	1980.00	944.00	500.00	1480.00	1007.75	484.11	0.48
1-H4-4	33	20	29	10	817.50	683.50	500.00	317.50	641.95	106.89	0.17
1-H4-5	37	33	28	1	770.00	770.00	770.00	0.00	770.00	.	.
1-H4-6	28	25	29	8	730.00	594.00	507.00	223.00	610.33	112.39	0.18
1-H3-1	34	28	29	8	702.00	588.50	591.00	171.00	601.17	84.68	0.11
1-H4-9	12	9	11	2	828.50	571.25	514.00	114.50	571.25	90.98	0.14
1-H3-2C	11	6	11	3	628.00	628.00	500.00	28.00	518.87	18.17	0.03
1-H4-17	5	4	5	1	507.00	507.00	507.00	0.00	507.00	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H4-7	12	12	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	11	11	.	.	.	.	.	.	.	.
1-H4-12C	12	12	12	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	8	8	8	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.

- Constituent=Iron

(code=A19, name=IRON, units=PPB, di=50, dws=300, reg=EPAS)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-17	5	0	5	5	15000.00	1740.00	528.00	14472.00	4365.80	8006.33	1.38
1-H4-12C	12	1	12	11	4950.00	141.00	79.00	4871.00	932.73	1452.48	1.58
1-H3-2C	11	5	11	8	4690.00	1346.00	186.00	4504.00	1816.83	1810.94	0.99
1-H4-5	38	10	29	19	4450.00	79.00	51.00	4399.00	383.47	1028.96	2.89
1-H4-18	7	3	7	4	2870.00	91.00	33.00	2837.00	788.25	1402.75	1.83
1-H4-8	11	0	11	11	2550.00	100.00	35.00	2515.00	781.19	977.70	1.25
1-H4-13	11	4	11	7	2380.00	210.00	64.00	2316.00	599.88	829.41	1.41
1-H4-4	30	5	29	24	2300.00	138.00	50.00	2250.00	459.87	608.13	1.32
1-H4-11	12	3	12	9	1800.00	111.00	52.00	1748.00	324.67	560.02	1.72
1-H4-3	30	1	29	28	1420.00	490.00	59.00	1361.00	558.48	358.80	0.64
1-H4-19	8	1	8	5	1320.00	127.00	59.00	1261.00	409.20	529.12	1.29
1-H4-15A	11	4	11	7	939.00	137.00	33.00	906.00	298.00	304.00	1.08
1-H4-6	28	0	28	28	820.00	288.50	184.00	436.00	309.19	105.95	0.34
1-H4-12A	11	9	11	3	499.00	81.00	59.00	431.00	202.87	247.98	1.22
1-H3-1	35	15	28	16	473.00	110.00	50.00	423.00	181.89	127.30	0.79
1-H4-9	11	1	11	10	452.00	105.50	63.00	389.00	180.80	131.84	0.73
1-H4-7	11	3	11	9	392.00	190.50	100.00	292.00	201.88	102.63	0.51
1-H4-14	11	5	11	5	221.00	52.00	31.00	190.00	83.00	77.88	0.94
1-H3-2A	11	2	11	9	213.00	82.00	50.00	163.00	92.33	48.11	0.52
1-H4-15B	11	6	11	5	124.00	98.00	31.00	93.00	77.60	42.20	0.54
1-H4-10	11	9	11	2	74.00	70.00	66.00	8.00	70.00	5.88	0.08
1-H3-2B	11	7	11	4	73.00	55.00	52.00	21.00	58.75	9.84	0.16
1-H4-12B	11	9	11	2	52.00	49.50	37.00	25.00	49.50	17.68	0.38

B.13

- Constituent=Iron, filtered

(code=H81, name=FIRON, units=PPB, dl=60, dwe=300, reg=EPAS)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-16B	11	9	11	2	3220.00	1869.00	98.00	3122.00	1869.00	2207.69	1.33
1-H4-12C	12	5	12	7	2380.00	512.00	48.00	2332.00	927.88	988.60	1.07
1-H4-18	8	5	8	1	1100.00	1100.00	1100.00	0.00	1100.00	.	.
1-H3-2C	11	5	11	8	919.00	392.50	69.00	880.00	468.17	399.49	0.98
1-H4-11	12	11	12	1	830.00	830.00	830.00	0.00	830.00	.	.
1-H4-7	12	10	11	2	664.00	310.50	67.00	507.00	310.60	358.50	1.16
1-H4-15A	11	8	11	3	307.00	124.00	78.00	231.00	189.00	121.90	0.72
1-H4-13	11	9	11	2	243.00	168.50	70.00	173.00	168.50	122.33	0.79
1-H4-17	3	1	3	2	200.00	148.50	97.00	103.00	148.50	72.83	0.49
1-H4-8	11	8	11	3	190.00	172.00	107.00	73.00	169.00	40.04	0.26
1-H4-5	14	13	14	1	169.00	169.00	169.00	0.00	169.00	.	.
1-H4-14	11	10	11	1	98.00	98.00	98.00	0.00	98.00	.	.
1-H3-2A	11	10	11	1	83.00	83.00	83.00	0.00	83.00	.	.
1-H4-12B	10	9	10	1	80.00	80.00	80.00	0.00	80.00	.	.
1-H4-6	14	11	14	3	58.00	55.00	34.00	24.00	49.00	13.08	0.27
1-H4-3	18	16	18	1	40.00	40.00	40.00	0.00	40.00	.	.
1-H3-1	14	14	14	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H4-4	17	17	14	.	.	.	.	.	.	.	.
1-H4-9	11	11	10	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.

- Constituent=Lead (graphite furnace)

(code=A51, name=LEADGF, units=PPB, dl=6, dwe=50, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-5	38	36	28	2	88.00	48.51	5.01	82.99	48.51	58.88	1.28
1-H4-17	5	3	6	2	18.00	14.50	13.00	3.00	14.50	2.12	0.16
1-H4-11	12	11	12	1	11.80	11.80	11.80	0.00	11.80	.	.
1-H4-4	30	27	29	3	11.20	8.21	6.91	5.39	7.74	3.00	0.39
1-H4-12C	12	11	12	1	8.20	8.20	8.20	0.00	8.20	.	.
1-H3-1	36	34	28	1	8.00	8.00	8.00	0.00	8.00	.	.
1-H4-3	30	27	29	3	8.00	8.00	5.10	0.90	5.70	0.52	0.09
1-H3-2C	11	10	11	1	5.10	5.10	5.10	0.00	5.10	.	.
1-H4-12A	11	10	11	1	6.00	5.00	5.00	0.00	5.00	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H4-8	28	28	28	.	.	.	.	.	.	.	.
1-H4-7	11	11	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	11	11	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-16B	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	8	8	8	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.

B.14

- Constituent=Lead, filtered

(code=H41, name=FLEAD, units=PPB, dl=5, dws=50, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-5	14	13	14	1	7.70	7.70	7.70	0.00	7.70	.	.
1-H4-6	14	13	14	1	7.30	7.30	7.30	0.00	7.30	.	.
1-H4-4	15	14	14	1	7.10	7.10	7.10	0.00	7.10	.	.
1-H4-12A	11	10	11	1	5.00	5.00	5.00	0.00	5.00	.	.
1-H4-15B	11	10	11	1	5.00	5.00	5.00	0.00	5.00	.	.
1-H3-1	14	14	14	.	.	.	.	.	.	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H3-2C	11	11	11	.	.	.	.	.	.	.	.
1-H4-3	16	15	15	.	.	.	.	.	.	.	.
1-H4-7	12	12	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	10	10	10	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12B	10	10	10	.	.	.	.	.	.	.	.
1-H4-12C	12	12	12	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	8	8	8	.	.	.	.	.	.	.	.
1-H4-17	3	3	3	.	.	.	.	.	.	.	.
1-H4-18	6	6	6	.	.	.	.	.	.	.	.

- Constituent=Magnesium

(code=A50, name=MAGNES, units=PPB, dl=0, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	18	0	17	17	28500.00	4230.00	1950.00	26550.00	8888.82	7101.92	1.03
1-H3-1	18	0	18	18	22400.00	19500.00	18200.00	6200.00	19688.75	1557.88	0.08
1-H4-9	11	0	11	11	21300.00	17000.00	12700.00	8600.00	18845.45	3040.51	0.18
1-H4-17	5	0	5	5	17900.00	14100.00	13100.00	4800.00	15080.00	1998.00	0.13
1-H4-6	18	0	18	18	15500.00	14250.00	13500.00	2000.00	14806.25	853.68	0.05
1-H4-7	11	0	11	11	14200.00	10700.00	9910.00	4290.00	11419.09	1392.34	0.12
1-H3-2A	11	0	11	11	13200.00	9640.00	8300.00	4900.00	9732.73	1381.66	0.14
1-H4-12C	12	0	12	12	12700.00	11400.00	10500.00	2200.00	11441.67	589.62	0.05
1-H4-12A	11	0	11	11	12500.00	10700.00	7320.00	5180.00	10363.64	1812.40	0.16
1-H4-12B	11	0	11	11	12200.00	11100.00	8310.00	3890.00	10698.18	1176.37	0.11
1-H4-5	18	0	18	18	12000.00	10000.00	8130.00	2870.00	10196.63	777.85	0.08
1-H3-2B	11	0	11	11	11700.00	9830.00	9190.00	2510.00	10020.00	821.35	0.08
1-H3-2C	11	0	11	11	11600.00	9010.00	7850.00	3750.00	9440.00	1208.38	0.13
1-H4-8	11	0	11	11	11600.00	10800.00	9960.00	1640.00	10832.73	849.14	0.08
1-H4-15B	11	0	11	11	11400.00	11000.00	9790.00	1610.00	10890.00	441.70	0.04
1-H4-15A	11	0	11	11	11300.00	10100.00	8650.00	2450.00	10237.27	718.83	0.07
1-H4-10	11	0	11	11	10600.00	9650.00	6220.00	4380.00	9341.82	1428.18	0.15
1-H4-18	8	0	8	8	10400.00	8320.00	7670.00	2730.00	8551.67	974.15	0.11
1-H4-4	18	0	17	17	9830.00	8780.00	3710.00	6120.00	6847.35	1918.64	0.28
1-H4-14	11	0	11	11	8570.00	7970.00	7210.00	1360.00	8041.82	400.06	0.05
1-H4-11	12	0	12	12	7930.00	6935.00	6500.00	1430.00	7020.00	418.46	0.06
1-H4-13	11	0	11	11	7910.00	6850.00	5980.00	1950.00	6790.00	553.62	0.08
1-H4-16	7	0	7	7	5510.00	5178.00	4860.00	650.00	5148.57	284.34	0.06

B.15

- Constituent=Magnesium, filtered

(code=M32, name=FMAGNES, units=PPB , dl=0 , dws= , reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-9	11	0	10	10	22800.00	18000.00	12800.00	10000.00	17810.00	3583.12	0.20
1-H3-1	14	0	14	14	21900.00	19650.00	16100.00	8900.00	19185.71	1982.67	0.10
1-H4-6	14	0	14	14	15700.00	14800.00	13200.00	2500.00	14578.67	694.13	0.06
1-H4-17	3	0	3	3	15400.00	15200.00	13900.00	1500.00	14833.33	814.45	0.05
1-H4-7	12	0	11	11	13900.00	11300.00	9990.00	3920.00	11693.84	1328.93	0.11
1-H4-12C	12	0	12	12	13000.00	11400.00	10700.00	2300.00	11441.67	809.71	0.05
1-H3-2A	11	0	11	11	12900.00	9480.00	8300.00	4500.00	9693.64	1361.20	0.14
1-H4-8	11	0	11	11	12400.00	11000.00	9800.00	2600.00	10990.91	772.60	0.07
1-H4-12A	11	0	11	11	12300.00	10700.00	7240.00	5060.00	10361.82	1802.18	0.15
1-H4-15B	11	0	11	11	12200.00	10900.00	10500.00	1700.00	11045.45	512.57	0.05
1-H4-5	14	0	14	14	12000.00	10250.00	9420.00	2580.00	10491.43	799.07	0.08
1-H4-12B	10	0	10	10	11800.00	10700.00	1090.00	10710.00	9543.00	3164.93	0.33
1-H4-15A	11	0	11	11	11700.00	10500.00	8840.00	2860.00	10485.45	739.14	0.07
1-H3-2B	11	0	11	11	11200.00	9940.00	8900.00	2300.00	9958.18	817.98	0.08
1-H4-10	11	0	11	11	10900.00	9900.00	8470.00	4430.00	9396.36	1448.56	0.15
1-H3-2C	11	0	11	11	10400.00	9410.00	7820.00	2580.00	9180.00	767.11	0.08
1-H4-19	8	0	8	8	10100.00	8385.00	8020.00	2080.00	8591.67	782.11	0.09
1-H4-4	17	0	14	14	9430.00	8615.00	3830.00	5600.00	8873.21	1938.23	0.29
1-H4-3	18	0	16	16	9030.00	3310.00	1410.00	7620.00	4240.67	2389.51	0.56
1-H4-14	11	0	11	11	8720.00	8010.00	7330.00	1390.00	8081.82	399.37	0.05
1-H4-11	12	0	12	12	7980.00	7005.00	6260.00	1720.00	7123.33	524.81	0.07
1-H4-13	11	0	11	11	7800.00	6910.00	5580.00	2240.00	6822.73	825.89	0.09
1-H4-18	8	0	8	8	5800.00	5320.00	4780.00	1040.00	5301.67	411.51	0.08

- Constituent=Manganese

(code=A17, name=MANGESE, units=PPB , dl=5 , dws=50 , reg=EPAS)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-17	6	0	5	5	328.00	35.00	11.00	315.00	122.40	138.43	1.13
1-H3-2C	11	0	11	11	198.00	35.00	9.00	178.00	64.27	59.24	0.92
1-H3-2B	11	1	11	10	142.00	88.00	32.00	110.00	88.40	40.47	0.46
1-H4-8	28	0	28	28	115.00	71.50	32.00	83.00	72.75	23.04	0.32
1-H4-12C	12	1	12	11	112.00	33.00	6.00	107.00	40.18	31.32	0.78
1-H4-16	7	5	7	2	92.00	52.00	12.00	80.00	62.00	58.67	1.09
1-H4-8	11	6	11	8	78.00	42.50	8.00	72.00	38.17	27.43	0.72
1-H4-18	8	4	8	2	63.00	39.50	18.00	47.00	39.50	33.23	0.84
1-H4-11	12	9	12	3	64.00	8.00	5.00	49.00	21.87	28.01	1.29
1-H4-12B	11	8	11	3	44.00	30.00	7.00	37.00	27.00	18.88	0.69
1-H4-12	11	7	11	4	37.00	18.50	8.00	31.00	19.00	13.29	0.70
1-H4-3	30	4	29	25	30.00	9.00	5.00	25.00	10.60	5.32	0.50
1-H4-5	38	35	28	3	30.00	18.00	15.00	15.00	20.33	8.39	0.41
1-H3-1	35	29	29	4	29.00	12.88	9.00	20.00	15.94	9.03	0.67
1-H4-15B	11	7	11	4	28.00	11.50	5.00	23.00	14.00	10.23	0.73
1-H4-4	30	26	29	4	15.00	11.00	6.00	9.00	10.75	4.92	0.46
1-H4-15A	11	9	11	2	14.00	10.50	7.00	7.00	10.50	4.95	0.47
1-H4-9	11	7	11	4	12.00	8.00	5.00	7.00	8.25	2.99	0.36
1-H4-12A	11	10	11	1	12.00	12.00	12.00	0.00	12.00	.	.
1-H4-7	11	6	11	5	10.00	8.00	5.00	6.00	8.80	1.92	0.28
1-H4-14	11	10	11	1	5.00	5.00	5.00	0.00	5.00	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.

B.16

- Constituent=Manganese, filtered

(code=H29, name=FMANGAN, units=PPB , dl=5 , dws=60 , reg=EPAS)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H3-2B	11	2	11	9	133.00	85.00	28.00	106.00	91.11	36.87	0.44
1-H3-2C	11	0	11	11	128.00	88.00	7.00	121.00	52.82	41.95	0.79
1-H4-6	14	0	14	14	85.00	63.00	48.00	39.00	63.00	11.02	0.17
1-H4-12C	12	1	12	11	78.00	35.00	8.00	70.00	35.82	23.72	0.66
1-H4-18	8	4	8	2	81.00	33.50	8.00	55.00	33.50	38.89	1.18
1-H4-15B	11	7	11	4	58.00	17.50	5.00	53.00	24.50	24.12	0.99
1-H4-12B	10	8	10	2	30.00	18.50	7.00	23.00	18.50	18.28	0.88
1-H4-11	12	11	12	1	19.00	19.00	19.00	0.00	19.00	.	.
1-H4-17	3	1	3	2	18.00	13.00	7.00	12.00	13.00	8.48	0.65
1-H4-13	11	10	11	1	10.00	10.00	10.00	0.00	10.00	.	.
1-H4-18	8	6	8	1	10.00	10.00	10.00	0.00	10.00	.	.
1-H4-7	12	11	11	1	8.00	8.00	8.00	0.00	8.00	.	.
1-H4-8	11	9	11	2	7.00	6.50	6.00	1.00	6.50	0.71	0.11
1-H4-15A	11	10	11	1	7.00	7.00	7.00	0.00	7.00	.	.
1-H4-3	18	16	16	1	8.00	6.00	8.00	0.00	6.00	.	.
1-H4-14	11	10	11	1	5.00	5.00	5.00	0.00	5.00	.	.
1-H3-1	14	14	14	.	.	.	.	.	.	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H4-4	17	17	14	.	.	.	.	.	.	.	.
1-H4-5	14	14	14	.	.	.	.	.	.	.	.
1-H4-9	11	11	10	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.

- Constituent=Mercury

(code=A21, name=MERCURY, units=PPB , dl=0.1 , dws=2 , reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-4	29	29	29	1	7.40	7.40	7.40	0.00	7.40	.	.
1-H4-3	29	29	29	1	4.90	4.90	4.90	0.00	4.90	.	.
1-H3-1	35	33	29	1	4.75	4.75	4.75	0.00	4.75	.	.
1-H3-2B	11	10	11	1	0.18	0.18	0.18	0.00	0.18	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2C	11	11	11	.	.	.	.	.	.	.	.
1-H4-5	38	38	28	.	.	.	.	.	.	.	.
1-H4-8	28	28	28	.	.	.	.	.	.	.	.
1-H4-7	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	10	11	.	.	.	.	.	.	.	.
1-H4-12C	12	12	12	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	6	6	6	.	.	.	.	.	.	.	.
1-H4-17	6	6	6	.	.	.	.	.	.	.	.
1-H4-18	6	6	6	.	.	.	.	.	.	.	.

B.17

- Constituent=Methylene chloride (code=A93, name=WETHYCH, units=PPB, di=10, dws=, reg=)											
WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-4	23	19	19	3	8800.00	570.00	340.00	8280.00	2609.33	3549.88	1.42
1-H4-12B	11	9	11	2	2650.00	1506.00	380.00	2290.00	1506.00	1819.27	1.08
1-H3-2C	12	9	11	2	2380.00	1410.00	440.00	1940.00	1410.00	1371.79	0.97
1-H3-1	32	28	28	5	1500.00	36.00	28.00	1472.00	336.60	651.27	1.94
1-H4-3	29	24	28	4	1400.00	260.00	34.00	1366.00	483.80	829.89	1.30
1-H4-6	20	16	20	4	920.00	504.50	47.00	873.00	494.00	386.03	0.74
1-H4-8	20	14	20	8	470.00	76.00	22.00	448.00	136.00	170.10	1.28
1-H4-16B	11	10	11	1	480.00	480.00	480.00	0.00	480.00	.	.
1-H4-12C	12	11	12	1	410.00	410.00	410.00	0.00	410.00	.	.
1-H4-17	5	4	6	1	49.00	49.00	49.00	0.00	49.00	.	.
1-H3-2B	11	10	11	1	42.00	42.00	42.00	0.00	42.00	.	.
1-H4-14	11	10	11	1	37.00	37.00	37.00	0.00	37.00	.	.
1-H3-2A	11	10	11	1	12.00	12.00	12.00	0.00	12.00	.	.
1-H4-7	12	12	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	12	12	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	8	8	8	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.

- Constituent=Nickel (code=A12, name=NICKEL, units=PPB, di=10, dws=, reg=)											
WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	30	0	29	29	150.00	38.00	11.50	138.50	46.74	32.46	0.71
1-H4-17	5	4	5	1	63.00	63.00	63.00	0.00	63.00	.	.
1-H4-11	12	9	12	3	61.00	14.00	11.00	60.00	28.87	28.04	0.98
1-H4-12C	12	0	12	12	38.00	22.00	10.00	28.00	24.58	7.48	0.30
1-H4-7	11	9	11	3	29.00	19.00	11.00	18.00	19.87	9.02	0.46
1-H4-4	30	13	29	18	28.00	17.50	10.00	18.00	18.72	4.90	0.29
1-H4-8	11	9	11	2	20.00	18.00	16.00	4.00	18.00	2.83	0.16
1-H3-2C	11	10	11	1	18.00	18.00	18.00	0.00	18.00	.	.
1-H3-2A	11	9	11	2	14.00	13.50	13.00	1.00	13.50	0.71	0.05
1-H4-9	11	10	11	1	12.00	12.00	12.00	0.00	12.00	.	.
1-H4-10	11	10	11	1	11.00	11.00	11.00	0.00	11.00	.	.
1-H4-14	11	10	11	1	11.00	11.00	11.00	0.00	11.00	.	.
1-H4-18	8	5	8	1	10.00	10.00	10.00	0.00	10.00	.	.
1-H3-1	35	35	28	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H4-5	39	38	29	.	.	.	.	.	.	.	.
1-H4-6	29	29	29	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	11	11	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	7	7	7	.	.	.	.	.	.	.	.

B.10

- Constituent=Nickel, filtered

(code=H26, name=FNICKEL, units=PPB, dl=10, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-12C	12	1	12	11	74.00	27.00	11.00	63.00	29.18	18.38	0.58
1-H4-3	18	1	15	14	50.00	24.50	11.00	39.00	25.82	12.68	0.49
1-H4-4	17	8	14	10	26.00	15.50	10.00	16.00	15.80	4.76	0.30
1-H4-18	6	5	5	1	21.00	21.00	21.00	0.00	21.00	.	.
1-H4-15B	11	10	11	1	18.00	18.00	18.00	0.00	18.00	.	.
1-H4-17	3	2	3	1	15.00	15.00	15.00	0.00	15.00	.	.
1-H4-7	12	11	11	1	13.00	13.00	13.00	0.00	13.00	.	.
1-H4-9	11	10	10	1	10.00	10.00	10.00	0.00	10.00	.	.
1-H3-1	14	14	14	.	.	.	.	.	.	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H3-2C	11	11	11	.	.	.	.	.	.	.	.
1-H4-5	14	14	14	.	.	.	.	.	.	.	.
1-H4-8	14	14	14	.	.	.	.	.	.	.	.
1-H4-9	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	10	10	10	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	6	6	6	.	.	.	.	.	.	.	.

- Constituent=Nitrate

(code=C72, name=NITRATE, units=PPB, dl=600, dws=45000, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	31	0	29	29	915000.00	818000.00	248000.00	2904000.00	1109500.00	887384.82	0.80
1-H4-4	33	0	29	29	1300000.00	328000.00	9720.00	1290280.00	332731.72	253136.83	0.76
1-H4-8	12	0	11	11	253000.00	145000.00	51800.00	201200.00	152183.84	68275.72	0.45
1-H4-12A	11	0	11	11	171000.00	87500.00	22900.00	148100.00	83045.45	40477.48	0.49
1-H3-1	34	0	28	28	96000.00	85300.00	47100.00	50900.00	63807.14	10393.23	0.16
1-H4-12B	11	0	11	11	85900.00	58400.00	29300.00	56600.00	57154.55	17314.81	0.30
1-H4-18	6	0	6	6	63800.00	24300.00	20100.00	43700.00	30450.00	18478.58	0.64
1-H4-17	5	0	5	5	48500.00	43800.00	42100.00	8400.00	44840.00	3023.74	0.07
1-H4-15A	11	0	11	11	45000.00	28100.00	25400.00	19800.00	29454.55	5381.52	0.18
1-H4-7	12	0	11	10	44700.00	29600.00	28600.00	18100.00	31410.00	5930.80	0.19
1-H4-6	28	0	28	28	40700.00	32250.00	15000.00	25700.00	31475.00	8989.39	0.22
1-H4-13	11	0	11	11	40300.00	21500.00	12100.00	29200.00	23090.91	7301.57	0.32
1-H4-5	37	0	28	28	39900.00	28950.00	15000.00	24900.00	27448.21	5902.97	0.22
1-H4-8	11	0	11	11	36800.00	29900.00	27800.00	9000.00	31890.91	3184.00	0.10
1-H4-11	12	0	12	12	32600.00	26800.00	21800.00	10800.00	27075.00	2853.43	0.11
1-H3-2A	11	0	11	11	29900.00	19300.00	15800.00	14300.00	20345.45	4081.37	0.20
1-H4-15B	11	0	11	11	28500.00	24800.00	23200.00	5300.00	25054.55	1518.81	0.08
1-H4-10	11	0	11	11	26200.00	21900.00	10400.00	15800.00	21072.73	4057.85	0.19
1-H3-2B	11	0	11	11	24400.00	19700.00	14700.00	9700.00	19618.18	3182.08	0.16
1-H4-14	11	0	11	11	20500.00	19200.00	17100.00	3400.00	19018.18	986.25	0.05
1-H4-16	7	0	7	7	18900.00	13000.00	6320.00	13580.00	12740.00	6509.58	0.43
1-H3-2C	11	0	11	11	9180.00	4010.00	3280.00	5920.00	5554.55	2489.28	0.45
1-H4-12C	12	0	12	12	8140.00	5195.00	2840.00	3500.00	4875.00	1027.81	0.21

B.19

- Constituent=Perchloroethylene

(code=A70, name=PERCENE, units=PPB , dl=10 , dws= , reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-4	30	28	26	1	52.00	52.00	52.00	0.00	52.00	.	.
1-H4-3	31	27	29	4	23.00	11.20	10.00	13.00	13.96	6.13	0.44
1-H4-6	25	24	25	1	15.00	15.00	15.00	0.00	15.00	.	.
1-H3-1	35	34	28	.	.	.	.	.	.	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H3-2C	12	12	11	.	.	.	.	.	.	.	.
1-H4-5	26	26	25	.	.	.	.	.	.	.	.
1-H4-7	12	12	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	12	12	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	11	11	.	.	.	.	.	.	.	.
1-H4-12C	12	12	12	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	6	6	6	.	.	.	.	.	.	.	.
1-H4-17	5	5	5	.	.	.	.	.	.	.	.
1-H4-18	6	6	6	.	.	.	.	.	.	.	.

8.20 - Constituent=pH, field

(code=199, name=PHFIELD, units= , dl=0.1 , dws= , reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-12A	11	0	11	11	9.40	7.40	7.00	2.40	7.67	0.65	0.09
1-H4-3	29	0	29	27	9.10	7.70	6.30	2.80	7.78	0.58	0.07
1-H4-16	6	0	6	6	9.10	7.45	5.90	3.20	7.45	1.03	0.14
1-H3-1	28	0	28	27	8.90	7.60	6.90	2.00	7.66	0.47	0.06
1-H4-7	11	0	11	11	8.90	7.70	6.20	2.80	7.63	0.68	0.09
1-H4-8	11	0	11	11	8.90	7.30	6.70	3.10	7.33	0.74	0.10
1-H4-11	12	0	12	12	8.80	7.50	7.30	1.50	7.63	0.42	0.06
1-H3-2C	11	0	11	11	8.60	7.50	5.90	2.70	7.48	0.68	0.09
1-H4-4	29	0	29	27	8.80	7.60	6.60	2.00	7.55	0.37	0.05
1-H4-5	29	0	29	27	8.50	7.80	6.80	1.70	7.58	0.35	0.05
1-H4-8	26	0	26	26	8.40	7.65	6.70	1.70	7.59	0.43	0.06
1-H4-12B	11	0	11	11	8.40	7.60	6.90	1.50	7.64	0.42	0.05
1-H4-18	6	0	6	6	8.40	7.15	6.70	2.70	7.13	0.67	0.12
1-H4-12C	12	0	12	12	8.30	7.35	5.40	2.90	7.28	0.78	0.10
1-H4-9	11	0	11	11	8.28	7.60	6.70	1.58	7.55	0.43	0.06
1-H3-2A	11	0	11	11	8.20	7.50	7.10	1.10	7.54	0.33	0.04
1-H4-10	11	0	11	11	8.10	7.10	6.50	1.60	7.11	0.40	0.06
1-H3-2B	11	0	11	11	7.90	7.60	6.20	1.70	7.58	0.49	0.06
1-H4-15B	11	0	11	11	7.90	7.30	6.20	1.70	7.25	0.48	0.06
1-H4-14	11	0	11	11	7.80	7.50	6.50	1.30	7.46	0.34	0.05
1-H4-17	5	0	5	4	7.70	7.05	6.90	0.80	7.17	0.38	0.05
1-H4-15A	11	0	11	11	7.68	7.10	6.50	1.18	7.11	0.39	0.05
1-H4-13	11	0	11	11	7.60	7.00	6.60	1.00	7.08	0.28	0.04

- Constituent=pH, laboratory

(code=207, name=PH-LAB, units=, dl=0.01, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	2	0	2	2	8.30	8.13	7.97	0.33	8.13	0.23	0.03
1-H3-2B	2	0	2	2	8.18	7.98	7.77	0.41	7.98	0.29	0.04
1-H4-14	2	0	2	2	8.02	7.89	7.75	0.27	7.89	0.19	0.02
1-H3-2A	2	0	2	2	8.00	7.91	7.83	0.17	7.91	0.12	0.02
1-H4-4	2	0	2	2	7.91	7.88	7.84	0.07	7.88	0.06	0.01
1-H4-8	1	0	1	1	7.89	7.89	7.89	0.00	7.89	.	.
1-H4-12C	2	0	2	2	7.79	7.71	7.64	0.15	7.71	0.11	0.01
1-H4-12A	2	0	2	2	7.77	7.68	7.60	0.17	7.68	0.12	0.02
1-H4-11	2	0	2	2	7.76	7.76	7.76	0.00	7.76	0.00	0.00
1-H4-12B	2	0	2	2	7.74	7.68	7.63	0.11	7.68	0.08	0.01
1-H4-15B	2	0	2	2	7.74	7.71	7.69	0.06	7.71	0.04	0.00
1-H4-18	2	0	2	2	7.73	7.67	7.62	0.11	7.67	0.08	0.01
1-H4-7	1	0	1	1	7.70	7.70	7.70	0.00	7.70	.	.
1-H3-2C	1	0	1	1	7.69	7.69	7.69	0.00	7.69	.	.
1-H4-15A	2	0	2	2	7.69	7.67	7.45	0.24	7.67	0.17	0.02
1-H4-5	1	0	1	1	7.68	7.68	7.68	0.00	7.68	.	.
1-H4-9	2	0	2	2	7.68	7.47	7.37	0.21	7.47	0.15	0.02
1-H4-18	2	0	2	2	7.57	7.57	7.57	0.00	7.57	0.00	0.00
1-H3-1	1	0	1	1	7.50	7.50	7.50	0.00	7.50	.	.
1-H4-17	2	0	2	2	7.50	7.49	7.48	0.02	7.49	0.01	0.00
1-H4-13	2	0	2	2	7.47	7.43	7.39	0.08	7.43	0.08	0.01
1-H4-8	1	0	1	1	7.46	7.46	7.46	0.00	7.46	.	.
1-H4-10	1	0	1	1	7.10	7.10	7.10	0.00	7.10	.	.

- Constituent=Phosphate

(code=C78, name=PHOSPHA, units=PPB, dl=1000, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	31	30	29	1	11700.00	11700.00	11700.00	0.00	11700.00	.	.
1-H4-9	12	10	11	1	8570.00	8570.00	8570.00	0.00	8570.00	.	.
1-H4-4	33	31	29	1	8380.00	8380.00	8380.00	0.00	8380.00	.	.
1-H4-12C	12	11	12	1	1090.00	1090.00	1090.00	0.00	1090.00	.	.
1-H3-1	34	33	28	0	.	.	.	.	.	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H3-2C	11	11	11	.	.	.	.	.	.	.	.
1-H4-5	37	37	28	.	.	.	.	.	.	.	.
1-H4-8	28	28	28	.	.	.	.	.	.	.	.
1-H4-7	12	12	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	11	11	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	6	6	6	.	.	.	.	.	.	.	.
1-H4-17	5	5	5	.	.	.	.	.	.	.	.
1-H4-18	6	6	6	.	.	.	.	.	.	.	.

B.21

- Constituent=Potassium

(code=A18, name=POTASUM, units=PPB, dl=100, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	30	0	29	29	18900.00	8780.00	3480.00	13410.00	7600.62	3680.08	0.49
1-H4-17	8	0	8	8	8980.00	7180.00	6880.00	2280.00	7422.00	898.61	0.12
1-H3-1	36	0	28	28	8005.00	6405.00	6370.00	2835.00	6378.25	562.97	0.09
1-H4-4	30	0	29	29	7430.00	6360.00	3180.00	4270.00	6291.21	1213.68	0.23
1-H4-6	28	0	28	28	7290.00	6020.00	4880.00	2410.00	6958.93	542.70	0.08
1-H4-12C	12	0	12	12	7120.00	6290.00	4480.00	2840.00	6364.17	808.95	0.15
1-H4-9	11	0	11	11	6590.00	6920.00	6090.00	1500.00	6825.46	498.77	0.09
1-H3-2C	11	0	11	11	6500.00	4820.00	4370.00	2130.00	6181.82	782.85	0.16
1-H4-7	11	0	11	11	8120.00	6000.00	4850.00	1270.00	6246.45	448.14	0.08
1-H4-12A	11	0	11	11	6880.00	6190.00	4080.00	1880.00	6034.56	613.78	0.12
1-H4-15B	11	0	11	11	5750.00	5360.00	4940.00	810.00	6318.18	243.84	0.05
1-H4-12B	11	0	11	11	6820.00	6180.00	4370.00	1250.00	6080.00	359.61	0.07
1-H4-15A	11	0	11	11	6520.00	6240.00	4720.00	800.00	6221.82	229.34	0.04
1-H4-8	11	0	11	11	5240.00	4920.00	4440.00	800.00	4889.09	243.86	0.05
1-H3-2A	11	0	11	11	5178.00	4810.00	3990.00	1180.00	4521.82	302.45	0.07
1-H4-5	38	0	28	28	6110.00	4485.00	3470.00	1840.00	4482.32	350.48	0.08
1-H3-2B	11	0	11	11	5080.00	4710.00	4570.00	520.00	4782.73	184.88	0.04
1-H4-10	11	0	11	11	4800.00	4210.00	2880.00	1740.00	4069.09	611.51	0.15
1-H4-18	8	0	8	8	4550.00	4035.00	3820.00	730.00	4071.87	288.34	0.07
1-H4-14	11	0	11	11	4420.00	4020.00	3880.00	540.00	4082.73	178.07	0.04
1-H4-16	7	0	7	7	3048.00	2870.00	2550.00	490.00	2731.43	178.48	0.07
1-H4-11	12	0	12	12	2780.00	2820.00	2210.00	670.00	2803.33	157.15	0.06
1-H4-13	11	0	11	11	2480.00	2250.00	1980.00	500.00	2185.45	169.55	0.08

- Constituent=Potassium, filtered

(code=H30, name=FPOTASS, units=PPB, dl=100, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	18	0	15	15	8540.00	4840.00	2200.00	6340.00	5217.00	1744.11	0.33
1-H4-17	3	0	3	3	8010.00	7550.00	7520.00	490.00	7893.33	274.85	0.04
1-H4-9	11	0	10	10	7290.00	6130.00	5030.00	2280.00	6095.00	745.79	0.12
1-H4-4	17	0	14	14	7220.00	5400.00	3080.00	4160.00	5482.14	1328.78	0.24
1-H4-12C	12	0	12	12	6970.00	6325.00	4580.00	2410.00	6420.83	742.85	0.14
1-H3-1	14	0	14	14	6950.00	6525.00	5520.00	1430.00	6407.14	387.90	0.06
1-H4-8	14	0	14	14	6810.00	6360.00	5860.00	750.00	6287.14	271.98	0.04
1-H3-2C	11	0	11	11	6140.00	6180.00	4380.00	1780.00	6134.55	572.72	0.11
1-H4-7	12	0	11	11	6085.00	6220.00	4740.00	1345.00	6384.09	431.05	0.08
1-H4-15B	11	0	11	11	6010.00	5310.00	4820.00	1190.00	5340.00	297.12	0.06
1-H4-12A	11	0	11	11	5750.00	6180.00	3800.00	1850.00	6042.73	854.59	0.13
1-H4-8	11	0	11	11	5890.00	6030.00	4690.00	1000.00	5049.91	288.70	0.06
1-H4-5	14	0	14	14	6820.00	4590.00	4370.00	1260.00	4727.88	380.09	0.08
1-H4-15A	11	0	11	11	5820.00	5380.00	4780.00	840.00	5289.09	380.54	0.04
1-H4-12B	10	0	10	10	5420.00	6055.00	4390.00	1030.00	4948.00	335.89	0.07
1-H3-2B	11	0	11	11	6320.00	4820.00	4530.00	780.00	4849.91	272.83	0.06
1-H3-2A	11	0	11	11	4980.00	4490.00	3830.00	1150.00	4479.09	329.74	0.07
1-H4-10	11	0	11	11	4580.00	4310.00	2830.00	1730.00	4101.82	619.42	0.16
1-H4-14	11	0	11	11	4530.00	4090.00	3780.00	750.00	4096.45	198.18	0.05
1-H4-18	8	0	8	8	4500.00	4160.00	3870.00	830.00	4180.00	285.83	0.08
1-H4-16	6	0	6	6	3080.00	2910.00	2800.00	480.00	2881.87	181.70	0.06
1-H4-11	12	0	12	12	2870.00	2815.00	2580.00	310.00	2683.33	108.54	0.04
1-H4-13	11	0	11	11	2420.00	2280.00	2030.00	390.00	2246.36	130.58	0.06

8.22

- Constituent=Total radium

(code=181, name=RADIUM, units=PCI/L, dl=1

, dws=6

, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-12C	12	6	12	7	1.30	0.48	0.17	1.13	0.67	0.48	0.80
1-H4-17	6	1	6	4	1.30	0.66	0.44	0.86	0.72	0.39	0.56
1-H4-15B	11	0	11	11	0.93	0.26	0.16	0.76	0.37	0.24	0.63
1-H3-2C	11	4	11	7	0.90	0.34	0.20	0.69	0.43	0.28	0.64
1-H4-12B	11	4	11	7	0.72	0.41	0.14	0.69	0.40	0.18	0.48
1-H4-15A	11	6	11	6	0.66	0.33	0.18	0.50	0.39	0.16	0.47
1-H4-6	37	33	28	4	0.61	0.23	0.14	0.47	0.31	0.21	0.69
1-H3-1	34	30	28	4	0.66	0.23	0.21	0.36	0.31	0.17	0.66
1-H3-2B	11	6	11	6	0.55	0.29	0.18	0.37	0.33	0.14	0.44
1-H4-7	11	3	11	8	0.51	0.31	0.16	0.36	0.33	0.12	0.38
1-H4-12A	11	6	11	8	0.43	0.32	0.19	0.25	0.32	0.09	0.29
1-H4-18	8	6	8	1	0.42	0.42	0.42	0.00	0.42	.	.
1-H4-3	29	15	29	14	0.40	0.31	0.18	0.22	0.30	0.07	0.22
1-H4-10	11	8	11	3	0.37	0.17	0.16	0.21	0.24	0.12	0.50
1-H4-8	11	6	11	8	0.34	0.26	0.22	0.12	0.27	0.04	0.16
1-H4-11	12	10	12	2	0.33	0.26	0.18	0.16	0.26	0.11	0.43
1-H4-13	11	6	11	8	0.33	0.23	0.18	0.17	0.24	0.07	0.31
1-H4-18	8	4	8	2	0.31	0.28	0.25	0.07	0.28	0.06	0.17
1-H3-2A	11	7	11	4	0.31	0.24	0.10	0.21	0.22	0.10	0.44
1-H4-9	11	8	11	3	0.31	0.26	0.16	0.16	0.24	0.08	0.33
1-H4-4	29	19	29	10	0.28	0.18	0.08	0.19	0.18	0.08	0.37
1-H4-8	28	26	28	3	0.24	0.18	0.12	0.12	0.18	0.08	0.34
1-H4-14	11	8	11	3	0.20	0.20	0.15	0.06	0.16	0.03	0.17

- Constituent=Selenium

(code=A22, name=SELENIUM, units=PPB, dl=5

, dws=10

, reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-6	38	36	28	2	12.50	9.00	5.50	7.00	9.00	4.96	0.56
1-H3-1	36	36	28	.	.	.	.	.	.	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H3-2C	11	11	11	.	.	.	.	.	.	.	.
1-H4-3	30	30	29	.	.	.	.	.	.	.	.
1-H4-4	30	30	29	.	.	.	.	.	.	.	.
1-H4-6	28	28	28	.	.	.	.	.	.	.	.
1-H4-7	11	11	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	11	11	.	.	.	.	.	.	.	.
1-H4-12C	12	12	12	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.
1-H4-17	6	6	6	.	.	.	.	.	.	.	.
1-H4-19	8	8	8	.	.	.	.	.	.	.	.

- Constituent=Selenium, filtered

(code=H39, name=FSELENI, units=PPB , dl=5 , dws=10 , reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-9	10	9	10	1	5.00	5.00	5.00	0.00	5.00	.	.
1-H3-1	14	14	14	.	.	.	.	.	.	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H3-2C	11	11	11	.	.	.	.	.	.	.	.
1-H4-3	15	15	15	.	.	.	.	.	.	.	.
1-H4-4	15	15	14	.	.	.	.	.	.	.	.
1-H4-5	14	14	14	.	.	.	.	.	.	.	.
1-H4-6	14	14	14	.	.	.	.	.	.	.	.
1-H4-7	12	12	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	10	10	10	.	.	.	.	.	.	.	.
1-H4-12C	12	12	12	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	8	8	8	.	.	.	.	.	.	.	.
1-H4-17	3	3	3	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.

- Constituent=Silver

(code=A10, name=SILVER , units=PPB , dl=10 , dws=50 , reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	30	29	29	1	11.00	11.00	11.00	0.00	11.00	.	.
1-H3-1	35	35	29	.	.	.	.	.	.	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H3-2C	11	11	11	.	.	.	.	.	.	.	.
1-H4-4	30	30	29	.	.	.	.	.	.	.	.
1-H4-5	39	39	29	.	.	.	.	.	.	.	.
1-H4-6	29	29	29	.	.	.	.	.	.	.	.
1-H4-7	11	11	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-12B	11	11	11	.	.	.	.	.	.	.	.
1-H4-12C	12	12	12	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	7	7	7	.	.	.	.	.	.	.	.
1-H4-17	8	5	5	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.

0.24

- Constituent=Sodium

(code=All, name=SODIUM, units=PPB, dl=100, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	30	0	29	29	892000.00	354000.00	172000.00	720000.00	384862.07	181965.01	0.47
1-H4-4	30	0	29	29	213000.00	143000.00	12400.00	200600.00	124568.97	59289.83	0.48
1-H3-2C	11	0	11	11	48500.00	12700.00	11300.00	37200.00	21481.82	12784.59	0.60
1-H4-12C	12	0	12	12	36100.00	12100.00	3870.00	32230.00	14389.17	11077.08	0.77
1-H4-9	11	0	11	11	32000.00	28800.00	19600.00	12400.00	26718.18	4420.37	0.17
1-H4-12A	11	0	11	11	28100.00	18700.00	10700.00	17400.00	16109.09	5188.60	0.29
1-H4-8	28	0	28	28	27700.00	22300.00	16700.00	11000.00	21885.71	2839.76	0.13
1-H3-1	35	0	28	28	23700.00	20700.00	15700.00	8000.00	20525.00	1830.73	0.09
1-H4-12B	11	0	11	11	18100.00	12300.00	11000.00	7100.00	13254.55	2214.68	0.17
1-H4-17	6	0	5	5	17200.00	15200.00	14200.00	3000.00	15840.00	1299.23	0.08
1-H4-10	11	0	11	11	15800.00	13400.00	7690.00	6110.00	13050.00	2883.86	0.22
1-H4-7	11	0	11	11	14000.00	11200.00	10200.00	3800.00	11590.91	1409.58	0.12
1-H4-8	11	0	11	11	13800.00	12900.00	10800.00	3000.00	12472.73	944.55	0.08
1-H3-2A	11	0	11	11	13500.00	11900.00	10600.00	3000.00	12038.36	1023.99	0.09
1-H3-2B	11	0	11	11	12500.00	9000.00	8880.00	3840.00	9814.55	1186.48	0.12
1-H4-18	6	0	6	6	11900.00	9990.00	8230.00	3670.00	9876.87	1358.85	0.14
1-H4-18A	11	0	11	11	11400.00	10800.00	9500.00	1900.00	10745.45	582.79	0.05
1-H4-5	38	0	28	28	11300.00	9910.00	8385.00	2915.00	9815.00	894.25	0.09
1-H4-15B	11	0	11	11	11300.00	10200.00	9090.00	2210.00	10195.45	692.57	0.07
1-H4-11	12	0	12	12	10100.00	7295.00	6720.00	3380.00	7897.50	1131.34	0.14
1-H4-14	11	0	11	11	8280.00	7470.00	7060.00	1200.00	7663.84	333.58	0.04
1-H4-13	11	0	11	11	7350.00	6490.00	5930.00	1420.00	6827.27	495.74	0.07
1-H4-16	7	0	7	7	6280.00	4480.00	4090.00	1190.00	4528.57	408.02	0.09

- Constituent=Sodium, filtered

(code=H24, name=FSODIUM, units=PPB, dl=100, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	18	0	15	15	498000.00	272000.00	178000.00	320000.00	295800.00	92838.42	0.31
1-H4-4	17	0	14	14	199000.00	148750.00	12100.00	186900.00	135742.86	54066.98	0.40
1-H3-2C	11	0	11	11	45900.00	13400.00	11600.00	34300.00	21345.45	11979.93	0.56
1-H4-9	11	0	10	10	38500.00	28350.00	21100.00	17400.00	29040.00	5758.00	0.20
1-H4-12C	12	0	12	12	37100.00	11700.00	4090.00	33010.00	14435.00	11214.02	0.78
1-H4-12A	11	0	11	11	27400.00	18800.00	10300.00	17100.00	18218.18	5147.39	0.28
1-H4-8	14	0	14	14	25500.00	24200.00	21800.00	3700.00	23935.71	1288.32	0.05
1-H3-1	14	0	14	14	23700.00	21000.00	18000.00	5700.00	21192.86	1691.82	0.08
1-H4-17	3	0	3	3	18100.00	17300.00	16200.00	1900.00	17200.00	953.94	0.05
1-H4-10	11	0	11	11	16100.00	14300.00	7640.00	8460.00	13270.00	2883.89	0.22
1-H4-12B	10	0	10	10	15300.00	12850.00	10700.00	4600.00	12700.00	1489.22	0.12
1-H4-8	11	0	11	11	14600.00	13000.00	12000.00	2600.00	13000.00	701.43	0.05
1-H3-2A	11	0	11	11	14200.00	12100.00	10100.00	4100.00	11990.91	1051.15	0.09
1-H4-7	12	0	11	11	13600.00	11900.00	10500.00	3300.00	12072.73	1150.73	0.10
1-H4-5	14	0	14	14	12900.00	10700.00	9280.00	3840.00	10737.14	1078.04	0.10
1-H3-2B	11	0	11	11	12400.00	10000.00	8370.00	4030.00	9839.09	1216.98	0.12
1-H4-18A	11	0	11	11	11700.00	10900.00	10500.00	1200.00	10945.45	332.76	0.03
1-H4-15B	11	0	11	11	11600.00	10100.00	9480.00	2120.00	10310.91	595.88	0.06
1-H4-18	6	0	6	6	11300.00	10350.00	9350.00	1950.00	10321.87	849.24	0.08
1-H4-11	12	0	12	12	9980.00	7855.00	6810.00	3150.00	8045.83	1028.34	0.13
1-H4-14	11	0	11	11	8590.00	7800.00	7010.00	1880.00	7661.82	576.83	0.08
1-H4-13	11	0	11	11	7420.00	7180.00	5590.00	1830.00	6894.55	574.48	0.08
1-H4-16	8	0	6	6	6350.00	4980.00	4350.00	1000.00	4950.00	395.32	0.08

B.25

- Constituent=Strontium-90 (code=121, name=SR 90 , units=PCI/L, dl=5 , dwa=8 , reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	8	0	8	6	10.80	0.83	0.85	9.85	2.38	3.88	1.83
1-H3-1	6	4	8	2	0.47	0.42	0.38	0.09	0.42	0.07	0.15

- Constituent=Strontium (code=A03, name=STRONUM, units=PPB , dl=300 , dwa= , reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	30	17	29	13	1820.00	550.00	67.00	1753.00	632.00	446.06	0.71
1-H3-1	35	5	28	27	534.00	488.00	382.00	152.00	460.83	40.98	0.09
1-H4-9	11	1	11	10	514.00	428.00	318.00	196.00	423.80	84.38	0.16
1-H4-17	5	0	5	5	408.00	336.00	328.00	78.00	363.80	32.74	0.09
1-H4-12A	11	2	11	9	387.00	326.00	310.00	77.00	334.22	23.71	0.07
1-H4-6	24	7	24	17	377.00	339.00	301.00	76.00	340.24	20.95	0.06
1-H4-4	28	18	26	7	368.00	323.00	165.00	213.00	298.38	89.89	0.31
1-H4-7	11	7	11	4	361.00	319.00	282.00	79.00	320.26	32.79	0.10
1-H4-12B	11	3	11	8	360.00	329.00	320.00	40.00	331.88	11.95	0.04
1-H4-5	25	22	24	3	330.00	308.00	301.00	29.00	313.00	15.13	0.06
1-H4-8	11	7	11	4	323.00	314.00	301.00	22.00	313.00	10.71	0.03
1-H3-2A	11	8	11	3	308.00	222.00	221.00	87.00	260.33	49.94	0.20
1-H4-15A	11	9	11	2	278.00	262.50	249.00	27.00	262.50	19.09	0.07
1-H4-15B	11	9	11	2	269.00	251.00	233.00	36.00	251.00	26.48	0.10
1-H4-11	12	10	12	2	247.00	232.00	217.00	30.00	232.00	21.21	0.09
1-H3-2B	11	9	11	2	246.00	240.00	234.00	12.00	240.00	8.49	0.04
1-H4-18	8	4	8	2	237.00	226.50	216.00	21.00	226.50	14.85	0.07
1-H4-12C	12	11	12	1	223.00	223.00	223.00	0.00	223.00	.	.
1-H4-14	11	9	11	2	219.00	218.00	213.00	6.00	218.00	4.24	0.02
1-H4-16	8	4	8	2	198.00	188.50	179.00	19.00	188.50	13.44	0.07
1-H4-13	11	9	11	2	193.00	181.50	170.00	23.00	181.50	18.26	0.09
1-H3-2C	11	10	11	1	184.00	184.00	184.00	0.00	184.00	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.

- Constituent=Strontium, filtered (code=H35, name=FSTRONT, units=PPB , dl=300 , dwa= , reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-9	11	1	10	9	534.00	449.00	359.00	175.00	448.87	87.80	0.16
1-H3-1	13	0	13	13	508.00	488.00	389.00	139.00	458.77	38.06	0.08
1-H4-12A	11	2	11	9	381.00	328.00	303.00	78.00	334.22	24.83	0.07
1-H4-4	18	8	13	8	380.00	323.50	168.00	224.00	281.92	92.28	0.33
1-H4-17	3	0	3	3	375.00	363.00	337.00	38.00	358.33	19.43	0.05
1-H4-6	12	0	12	12	373.00	348.50	318.00	57.00	343.42	16.18	0.05
1-H4-12B	10	2	10	8	340.00	323.00	309.00	31.00	323.38	11.41	0.04
1-H4-7	12	7	11	4	333.00	316.50	312.00	21.00	319.50	9.88	0.03
1-H4-8	11	6	11	5	328.00	315.00	308.00	18.00	317.80	7.37	0.02
1-H4-5	12	8	12	4	325.00	314.50	301.00	24.00	313.75	10.81	0.03
1-H4-3	15	12	14	3	324.00	312.00	74.00	250.00	238.87	141.00	0.60
1-H4-15A	11	9	11	2	289.00	270.50	252.00	37.00	270.50	28.16	0.10
1-H4-15B	11	9	11	2	284.00	273.00	262.00	22.00	273.00	16.58	0.06
1-H4-11	12	10	12	2	283.00	284.00	245.00	38.00	284.00	28.87	0.10
1-H3-2B	11	9	11	2	245.00	240.50	238.00	9.00	240.50	8.38	0.03
1-H4-18	8	4	8	2	229.00	225.00	221.00	8.00	225.00	5.88	0.03
1-H3-2A	11	9	11	2	222.00	214.00	206.00	16.00	214.00	11.31	0.05
1-H4-12C	12	11	12	1	218.00	218.00	218.00	0.00	218.00	.	.
1-H4-14	11	9	11	2	215.00	212.50	210.00	5.00	212.50	3.54	0.02
1-H4-13	11	9	11	2	205.00	198.00	187.00	18.00	196.00	12.73	0.06
1-H4-16	8	4	8	2	198.00	191.00	184.00	14.00	191.00	9.90	0.05
1-H3-2C	11	10	11	1	188.00	188.00	188.00	0.00	188.00	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.

8.26

- Constituent=Sulfate

(code=C73, name=SULFATE, units=PPB, dl=500, dws=250000, reg=EPAS)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	31	0	29	29	328000.00	110000.00	82200.00	285800.00	125877.59	81351.81	0.49
1-H4-8	28	0	28	28	118000.00	87400.00	40000.00	78000.00	77828.57	21898.87	0.28
1-H4-7	12	0	11	10	102000.00	87100.00	53400.00	48600.00	71005.00	18194.69	0.23
1-H4-4	33	0	29	29	94200.00	86200.00	21300.00	72900.00	82179.31	19859.04	0.32
1-H4-17	6	0	6	6	93700.00	90500.00	81400.00	12300.00	88180.00	8238.75	0.07
1-H3-1	34	0	28	28	91400.00	72800.00	52800.00	36800.00	72046.21	10196.91	0.14
1-H4-9	12	0	11	11	87200.00	77500.00	82000.00	26200.00	75877.27	8437.37	0.11
1-H4-8	11	0	11	11	75900.00	82900.00	56300.00	19800.00	85083.64	8797.25	0.10
1-H3-2A	11	0	11	11	73900.00	39600.00	30600.00	43100.00	42709.09	11698.84	0.27
1-H4-6	37	0	28	28	86900.00	45000.00	29600.00	37400.00	48108.93	9982.97	0.21
1-H4-12A	11	0	11	11	80900.00	50000.00	29400.00	31500.00	49727.27	10543.44	0.21
1-H4-12B	11	0	11	11	60200.00	54100.00	36400.00	23800.00	52054.55	6912.38	0.13
1-H4-15A	11	0	11	11	56800.00	48300.00	32300.00	23500.00	46383.64	6000.38	0.13
1-H3-2B	11	0	11	11	55800.00	43400.00	33500.00	22100.00	42990.91	7219.07	0.17
1-H3-2C	11	0	11	11	52100.00	24000.00	19800.00	33300.00	30472.73	12019.08	0.39
1-H4-10	11	0	11	11	50700.00	43200.00	21700.00	29000.00	39881.82	9588.43	0.24
1-H4-15B	11	0	11	11	49100.00	45100.00	34300.00	14800.00	44227.27	3978.21	0.09
1-H4-18	8	0	8	8	45400.00	39000.00	37300.00	8100.00	39786.67	2842.30	0.07
1-H4-14	11	0	11	11	43300.00	41000.00	32800.00	10500.00	40054.55	3172.50	0.08
1-H4-11	12	0	12	12	41200.00	39000.00	32900.00	8300.00	38618.87	2504.84	0.06
1-H4-13	11	0	11	11	38200.00	33300.00	27700.00	8500.00	32200.00	2757.90	0.09
1-H4-16	8	0	8	8	29800.00	27100.00	24800.00	5000.00	27250.00	1868.42	0.07
1-H4-12C	12	0	12	12	28900.00	28550.00	24200.00	4700.00	28500.00	1545.87	0.08

- Constituent=Total carbon

(code=H18, name=TC, units=PPB, dl=1000, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H3-1	1	0	1	1	43700.00	43700.00	43700.00	0.00	43700.00	.	.
1-H4-17	2	0	2	2	37200.00	36400.00	36800.00	1800.00	36400.00	1131.37	0.03
1-H4-8	2	0	2	2	38800.00	38800.00	38400.00	400.00	38800.00	282.84	0.01
1-H4-3	2	0	2	2	38100.00	35050.00	34000.00	2100.00	35050.00	1484.92	0.04
1-H4-12A	2	0	2	2	34000.00	33550.00	33300.00	700.00	33650.00	494.97	0.01
1-H4-6	1	0	1	1	33900.00	33900.00	33900.00	0.00	33900.00	.	.
1-H4-12C	2	0	2	2	33900.00	29300.00	24700.00	9200.00	29300.00	6505.38	0.22
1-H4-12B	2	0	2	2	33800.00	33850.00	32300.00	1500.00	33850.00	1080.88	0.03
1-H4-8	1	0	1	1	32900.00	32900.00	32900.00	0.00	32900.00	.	.
1-H4-8	1	0	1	1	32300.00	32300.00	32300.00	0.00	32300.00	.	.
1-H4-15A	2	0	2	2	32000.00	31800.00	31200.00	600.00	31800.00	565.89	0.02
1-H4-15B	2	0	2	2	31300.00	31100.00	30900.00	400.00	31100.00	282.84	0.01
1-H4-7	1	0	1	1	30800.00	30800.00	30600.00	0.00	30800.00	.	.
1-H4-4	2	0	2	2	30500.00	29900.00	29300.00	1200.00	29900.00	848.53	0.03
1-H4-10	1	0	1	1	30200.00	30200.00	30200.00	0.00	30200.00	.	.
1-H4-11	2	0	2	2	27200.00	26950.00	26700.00	500.00	26950.00	353.55	0.01
1-H4-16	2	0	2	2	26900.00	26700.00	26500.00	400.00	26700.00	282.84	0.01
1-H3-28	2	0	2	2	28100.00	26000.00	23900.00	2200.00	26000.00	1555.83	0.08
1-H3-2A	2	0	2	2	25900.00	25350.00	24800.00	1100.00	25350.00	777.82	0.03
1-H3-2C	1	0	1	1	24000.00	24000.00	24000.00	0.00	24000.00	.	.
1-H4-13	2	0	2	2	23900.00	23100.00	22300.00	1800.00	23100.00	1131.37	0.05
1-H4-14	2	0	2	2	23700.00	23250.00	22900.00	900.00	23250.00	538.40	0.03
1-H4-18	2	0	2	2	23700.00	22450.00	21200.00	2500.00	22450.00	1787.77	0.08

5.27

- Constituent=Technetium-99

(code=197, name=TC-99 , units=PCI/L, dl=15 , dws=900 , reg=EPA)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	2	0	1	1	3835.00	3835.00	3835.00	0.00	3835.00	.	.

- Constituent=Total dissolved solids

(code=H17, name=TDS , units=PPB , dl=5000 , dws=500000 , reg=EPAS)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	2	0	2	2	711000.00	687500.00	664000.00	47000.00	687500.00	33234.02	0.05
1-H4-9	2	0	2	2	684000.00	482500.00	401000.00	163000.00	482500.00	116258.41	0.24
1-H4-4	2	0	2	2	530000.00	489000.00	448000.00	82000.00	489000.00	67982.76	0.12
1-H3-1	1	0	1	1	432000.00	432000.00	432000.00	0.00	432000.00	.	.
1-H4-17	2	0	2	2	384000.00	371000.00	358000.00	26000.00	371000.00	18384.78	0.05
1-H4-8	1	0	1	1	377000.00	377000.00	377000.00	0.00	377000.00	.	.
1-H4-12A	2	0	2	2	388000.00	349000.00	330000.00	38000.00	349000.00	28870.08	0.08
1-H4-12B	2	0	2	2	332000.00	325000.00	318000.00	14000.00	325000.00	9899.49	0.03
1-H4-8	1	0	1	1	307000.00	307000.00	307000.00	0.00	307000.00	.	.
1-H4-15B	2	0	2	2	301000.00	278000.00	255000.00	46000.00	278000.00	32528.91	0.12
1-H4-6	1	0	1	1	299000.00	299000.00	299000.00	0.00	299000.00	.	.
1-H4-7	1	0	1	1	294000.00	294000.00	294000.00	0.00	294000.00	.	.
1-H4-15A	2	0	2	2	284000.00	275500.00	267000.00	17000.00	275500.00	12020.82	0.04
1-H4-10	1	0	1	1	228000.00	229000.00	229000.00	0.00	229000.00	.	.
1-H4-14	2	0	2	2	228000.00	219500.00	211000.00	17000.00	219500.00	12020.82	0.05
1-H4-11	2	0	2	2	227000.00	221000.00	216000.00	12000.00	221000.00	8485.28	0.04
1-H3-2B	2	0	2	2	224000.00	211500.00	199000.00	25000.00	211500.00	17877.67	0.08
1-H4-18	2	0	2	2	221000.00	218000.00	215000.00	6000.00	218000.00	4242.64	0.02
1-H3-2A	2	0	2	2	217000.00	211500.00	206000.00	11000.00	211500.00	7778.17	0.04
1-H4-13	2	0	2	2	187000.00	178000.00	165000.00	22000.00	178000.00	16556.35	0.09
1-H4-12C	2	0	2	2	182000.00	177500.00	173000.00	9000.00	177500.00	6363.96	0.04
1-H4-16	2	0	2	2	173000.00	165500.00	158000.00	15000.00	165500.00	10806.60	0.06
1-H3-2C	1	0	1	1	168000.00	168000.00	168000.00	0.00	168000.00	.	.

- Constituent=Thallium

(code=A23, name=THALIUM, units=PPB , dl=10 , dws= , reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	12	11	12	1	21.00	21.00	21.00	0.00	21.00	.	.
1-H3-1	18	16	12	1	14.00	14.00	14.00	0.00	14.00	.	.

- Constituent=Total organic carbon (code=C69, name=TOC , units=PPB , dl=1000 , dws= , reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-4	28	15	28	13	9210.00	2830.00	1010.00	8200.00	3122.31	2322.68	0.74
1-H4-3	29	8	29	21	8890.00	1870.00	1000.00	7890.00	3090.95	2387.27	0.77
1-H3-1	34	7	29	22	8440.00	1220.00	1030.00	7410.00	1850.23	1834.04	0.88
1-H4-5	33	20	27	10	8720.00	1185.00	1020.00	5700.00	1787.50	1750.21	0.99
1-H4-6	27	10	27	17	2460.00	1130.00	1010.00	1450.00	1332.94	408.51	0.30
1-H4-12C	11	9	11	2	2020.00	1635.00	1250.00	770.00	1635.00	544.47	0.33
1-H3-2C	11	9	11	2	1880.00	1620.00	1360.00	520.00	1620.00	367.70	0.23
1-H4-17	5	2	5	3	1300.00	1050.00	1020.00	280.00	1123.33	153.73	0.14
1-H4-7	11	9	11	2	1220.00	1155.00	1090.00	130.00	1155.00	91.92	0.08
1-H4-8	11	9	11	2	1120.00	1085.00	1050.00	70.00	1085.00	49.50	0.05
1-H4-9	11	8	11	5	1070.00	1040.00	1020.00	50.00	1044.00	20.74	0.02
1-H4-12A	11	9	11	2	1040.00	1020.00	1000.00	40.00	1020.00	28.28	0.03
1-H3-2B	11	10	11	1	1020.00	1020.00	1020.00	0.00	1020.00	.	.
1-H4-12B	11	10	11	1	1010.00	1010.00	1010.00	0.00	1010.00	.	.
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-15B	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	8	8	8	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.

- Constituent=Total organic halogen (code=C68, name=TOX , units=PPB , dl=100 , dws= , reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H3-2C	11	9	11	2	4510.00	2434.00	358.00	4152.00	2434.00	2935.91	1.21
1-H4-4	28	25	28	3	4220.00	822.00	133.00	4087.00	1658.33	2231.90	1.35
1-H4-12B	11	10	11	1	3200.00	3200.00	3200.00	0.00	3200.00	.	.
1-H3-1	34	33	29	1	2860.00	2860.00	2860.00	0.00	2860.00	.	.
1-H4-3	29	28	29	3	2060.00	402.00	137.00	1923.00	666.33	1042.20	1.20
1-H4-6	33	30	27	3	836.00	609.00	347.00	489.00	598.67	244.20	0.41
1-H4-15B	11	10	11	1	414.00	414.00	414.00	0.00	414.00	.	.
1-H4-8	27	25	27	2	364.00	258.50	149.00	215.00	258.50	152.03	0.59
1-H4-12C	12	10	12	2	312.00	299.50	267.00	25.00	299.50	17.68	0.08
1-H3-2A	11	11	11	.	.	.	.	.	.	.	.
1-H3-2B	11	11	11	.	.	.	.	.	.	.	.
1-H4-7	11	11	11	.	.	.	.	.	.	.	.
1-H4-8	11	11	11	.	.	.	.	.	.	.	.
1-H4-9	11	11	11	.	.	.	.	.	.	.	.
1-H4-10	11	11	11	.	.	.	.	.	.	.	.
1-H4-11	12	12	12	.	.	.	.	.	.	.	.
1-H4-12A	11	11	11	.	.	.	.	.	.	.	.
1-H4-13	11	11	11	.	.	.	.	.	.	.	.
1-H4-14	11	11	11	.	.	.	.	.	.	.	.
1-H4-15A	11	11	11	.	.	.	.	.	.	.	.
1-H4-16	8	8	8	.	.	.	.	.	.	.	.
1-H4-17	5	5	5	.	.	.	.	.	.	.	.
1-H4-18	8	8	8	.	.	.	.	.	.	.	.

5.29

- Constituent=Natural uranium

(code=124, name=U-CHEM, units=UG/L, dl=0.725, dws=14.5, reg=RND)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	6	0	8	6	2090.00	257.00	191.00	1959.00	636.60	762.88	1.42
1-H3-1	6	0	8	6	9.79	6.42	6.02	3.77	6.06	1.60	0.19

- Constituent=Unknown

(code=I99, name=UNKNOWN, units=PPB, dl=0, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H3-1	1	0	1	1	9.00	9.00	9.00	0.00	9.00	.	.

- Constituent=Vanadium

(code=A14, name=VANADIUM, units=PPB, dl=6, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-5	30	24	29	11	32.00	8.00	5.00	27.00	10.27	8.28	0.80
1-H4-17	5	2	5	3	32.00	8.00	7.00	25.00	16.87	14.15	0.90
1-H3-1	35	5	28	24	29.00	10.00	6.00	23.00	11.08	4.74	0.43
1-H4-12C	12	0	12	12	29.00	20.50	10.00	19.00	19.67	6.40	0.27
1-H4-3	30	12	29	17	24.00	11.00	5.00	19.00	10.88	4.41	0.41
1-H3-2C	11	0	11	11	20.00	16.00	13.00	7.00	16.91	2.12	0.13
1-H4-6	29	7	29	21	18.00	7.00	5.00	13.00	7.33	2.94	0.40
1-H4-4	30	15	29	15	16.00	6.00	5.00	11.00	7.47	2.95	0.39
1-H4-8	11	0	11	11	15.00	8.00	5.00	10.00	8.27	3.29	0.40
1-H3-2A	11	2	11	9	13.00	10.00	7.00	6.00	9.58	1.87	0.17
1-H4-15A	11	0	11	11	11.00	8.00	5.00	8.00	8.09	1.87	0.23
1-H4-15B	11	0	11	11	11.00	8.00	5.00	8.00	7.73	1.79	0.23
1-H3-2B	11	6	11	5	10.00	7.00	6.00	4.00	7.80	1.82	0.24
1-H4-7	11	0	11	11	10.00	8.00	6.00	4.00	7.91	1.30	0.16
1-H4-10	11	1	11	10	10.00	8.00	5.00	5.00	8.10	1.80	0.20
1-H4-12A	11	3	11	8	10.00	8.00	5.00	5.00	8.50	1.69	0.28
1-H4-14	11	2	11	9	10.00	8.00	5.00	5.00	8.89	1.76	0.28
1-H4-18	8	3	6	3	10.00	8.00	8.00	2.00	9.00	1.00	0.11
1-H4-9	11	3	11	8	9.00	7.00	5.00	4.00	7.25	1.39	0.19
1-H4-12B	11	5	11	6	9.00	7.00	5.00	4.00	8.83	1.72	0.25
1-H4-11	12	5	12	7	8.00	8.00	5.00	3.00	8.29	1.11	0.16
1-H4-16	7	2	7	5	8.00	6.00	5.00	3.00	6.40	1.14	0.18
1-H4-13	11	4	11	7	7.00	5.00	5.00	2.00	5.57	0.96	0.18

B.30

- Constituent=Vanadium, filtered

(code=M27, name=FVANADI, units=PPB, dl=6, dws=, reg=)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-12C	12	0	12	12	27.00	19.00	11.00	16.00	19.33	6.10	0.26
1-H3-2C	11	0	11	11	20.00	16.00	10.00	10.00	16.91	3.30	0.21
1-H4-3	18	2	15	13	14.00	9.00	5.00	9.00	9.73	3.02	0.36
1-H4-16B	11	1	11	10	14.00	9.00	8.00	8.00	9.20	2.10	0.23
1-H3-1	14	0	14	14	13.00	8.00	8.00	7.00	8.79	1.72	0.20
1-H4-8	11	2	11	9	11.00	7.00	6.00	6.00	7.44	1.94	0.26
1-H4-15A	11	1	11	10	11.00	9.00	8.00	6.00	8.80	1.82	0.18
1-H3-2A	11	0	11	11	10.00	9.00	7.00	3.00	8.91	1.22	0.14
1-H3-2B	11	4	11	7	10.00	8.00	5.00	5.00	7.00	2.24	0.32
1-H4-6	14	3	14	11	10.00	7.00	5.00	5.00	7.36	1.69	0.23
1-H4-7	12	0	11	11	10.00	7.00	5.50	4.50	7.41	1.74	0.24
1-H4-14	11	3	11	8	10.00	7.00	5.00	5.00	8.88	1.46	0.21
1-H4-4	17	7	14	8	9.00	5.75	5.00	4.00	6.19	1.51	0.24
1-H4-10	11	2	11	9	9.00	8.00	7.00	2.00	8.00	0.87	0.11
1-H4-12B	10	4	10	6	9.00	6.50	5.00	4.00	6.67	1.37	0.20
1-H4-5	14	5	14	9	9.00	8.00	5.00	3.00	8.00	1.00	0.17
1-H4-11	12	9	12	3	8.00	6.00	5.00	3.00	6.33	1.53	0.24
1-H4-12A	11	5	11	8	8.00	5.50	5.00	3.00	6.00	1.28	0.21
1-H4-17	3	2	3	1	8.00	8.00	8.00	0.00	8.00		
1-H4-9	11	8	10	5	7.00	6.00	5.00	2.00	6.00	1.00	0.17
1-H4-18	8	2	8	4	7.00	8.00	8.00	1.00	6.25	0.50	0.08
1-H4-13	11	7	11	4	6.00	6.00	5.00	1.00	6.75	0.50	0.09
1-H4-16	8	4	8	2	6.00	5.50	5.00	1.00	5.50	0.71	0.13

- Constituent=Zinc

(code=A04, name=ZINC, units=PPB, dl=6, dws=6000, reg=EPAS)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-6	25	0	24	24	2400.00	58.50	38.00	2382.00	152.88	478.74	3.13
1-H4-11	12	5	12	7	404.00	19.00	5.00	399.00	89.00	147.91	2.14
1-H4-4	28	0	25	25	354.00	89.00	21.00	333.00	87.62	81.42	0.93
1-H4-8	24	0	24	24	309.00	141.50	104.00	205.00	168.17	47.05	0.30
1-H4-19	8	0	8	8	115.00	9.50	5.00	110.00	28.33	43.01	1.52
1-H4-7	11	3	11	8	80.00	14.50	9.00	71.00	26.13	25.11	0.96
1-H4-16B	11	3	11	8	79.00	28.50	9.00	71.00	35.75	22.21	0.62
1-H3-2C	11	0	11	11	71.00	14.00	5.00	66.00	21.00	18.53	0.88
1-H4-15A	11	3	11	8	53.00	9.00	6.00	47.00	13.25	16.10	1.21
1-H4-17	5	0	5	5	45.00	14.00	11.00	34.00	19.80	14.27	0.72
1-H4-12C	12	0	12	12	44.00	13.00	5.00	39.00	17.42	11.72	0.67
1-H4-12B	11	3	11	8	41.00	10.00	5.00	36.00	14.75	12.10	0.82
1-H3-2B	11	8	11	5	38.00	7.00	6.00	32.00	13.00	14.00	1.08
1-H4-13	11	1	11	10	36.00	11.00	5.00	31.00	14.80	10.29	0.70
1-H3-1	35	22	29	9	30.00	7.00	5.00	25.00	9.11	8.02	0.88
1-H4-9	11	4	11	7	24.00	6.00	5.00	19.00	9.14	6.99	0.76
1-H4-14	11	3	11	8	23.00	11.50	5.00	18.00	11.60	6.23	0.54
1-H4-8	11	2	11	9	22.00	13.00	5.00	17.00	12.89	5.28	0.41
1-H4-3	30	21	29	8	20.00	7.00	5.00	15.00	9.25	5.01	0.54
1-H3-2A	11	4	11	7	18.00	7.00	5.00	13.00	9.57	4.47	0.52
1-H4-18	7	4	7	3	15.00	9.00	5.00	10.00	9.67	5.03	0.52
1-H4-10	11	4	11	7	12.00	9.00	5.00	7.00	8.57	3.21	0.37
1-H4-12A	11	7	11	4	12.00	7.50	6.00	6.00	9.25	2.87	0.36

B.31

- Constituent=Zinc, filtered

(code=H19, name=FZINC, unit=PPB, dl=5, dwe=5000, reg=EPAS)

WELLNAME	SAMPLES	BELOWDL	DAYS	N	MAX	MEDIAN	MIN	RANGE	MEAN	STD	CV
1-H4-3	16	11	16	6	1400.00	12.00	5.00	1395.00	287.40	621.97	2.18
1-H4-6	14	0	14	14	247.00	137.50	107.00	140.00	143.38	38.40	0.26
1-H4-10	11	7	11	4	199.00	8.50	5.00	194.00	54.25	98.50	1.78
1-H4-12C	12	1	12	11	184.00	14.00	5.00	178.00	29.55	61.96	1.76
1-H4-4	17	0	14	14	125.00	65.25	10.00	115.00	65.89	28.89	0.44
1-H4-5	14	0	14	14	109.00	48.50	33.00	76.00	62.88	20.04	0.38
1-H4-7	12	3	11	6	76.00	9.00	5.00	71.00	20.83	24.53	1.19
1-H4-15B	11	3	11	6	73.00	28.50	10.00	63.00	32.50	19.31	0.59
1-H4-18	6	0	6	6	57.00	7.00	5.00	52.00	15.00	20.63	1.38
1-H3-2C	11	2	11	9	52.00	8.00	5.00	47.00	14.11	14.93	1.06
1-H4-16	8	3	8	3	45.00	5.00	5.00	40.00	18.33	23.09	1.26
1-H3-1	14	8	14	6	31.00	5.00	5.00	26.00	10.17	10.23	1.01
1-H4-12B	10	3	10	7	28.00	10.00	5.00	23.00	13.29	7.87	0.60
1-H4-13	11	4	11	7	19.00	9.00	7.00	12.00	11.43	4.79	0.42
1-H4-8	11	6	11	5	11.00	8.00	5.00	8.00	8.00	2.24	0.28
1-H4-9	11	6	10	4	10.00	7.00	5.00	5.00	7.25	2.22	0.31
1-H4-14	11	9	11	2	10.00	8.50	7.00	3.00	8.50	2.12	0.25
1-H4-11	12	10	12	2	9.00	7.00	5.00	4.00	7.00	2.83	0.40
1-H4-17	3	1	3	2	7.00	5.00	5.00	2.00	5.00	1.41	0.24
1-H4-12A	11	9	11	2	5.00	5.50	5.00	1.00	5.50	0.71	0.13
1-H4-15A	11	10	11	1	5.00	5.00	5.00	0.00	5.00	.	.
1-H3-2B	11	8	11	3	5.00	5.00	5.00	0.00	5.00	0.00	0.00
1-H3-2A	11	11	11

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