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6 Author

T. J. Gilmore — M. J. Hartman

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7 Abstract

The 1324-N Surface Impoundment and 1324-NA Percolation Pond are hazardous waste disposal facilities under Resource Conservation and Recovery Act interim status. Statistical analyses on ground-water quality data from March 1989 indicate that specific conductance in down-gradient wells is elevated above background. This document proposes an expanded ground-water sampling and water-level data collection program. The intent of the program is to determine the source, extent, and concentration of contaminants. Existing wells in the vicinity of the 1324-N/NA facilities will be added to the ground-water monitoring network. Sampling frequency will be increased for constituents that can contribute to high specific conductance.

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GROUND-WATER QUALITY ASSESSMENT PROGRAM FOR THE 1324-N/NA FACILITIES

T. J. Gilmore

of Pacific Northwest Laboratory
Richland, Washington 99352

Prepared for Westinghouse Hanford Company

May, 1989

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INTRODUCTION

The 1324-N Surface Impoundment is a hazardous waste treatment facility and 1324-NA Percolation Pond is a hazardous waste disposal facility under Resource Conservation and Recovery Act (RCRA) interim status. These facilities are subject to requirements found in WAC 173-303 and 40 CFR 265. The 1324-N Surface Impoundment ceased operation in November 1988. Ground-water wells monitoring the 1324-N/NA facilities have been sampled for 1 year, and background values were established after the September 1988 quarterly sampling. The statistical analyses required by 40 CFR 265.93(b) have been completed for the March 1989 data collected at the 1324-N/NA facilities. Results from these analyses indicate that specific conductance values in wells 199-N-58, 199-N-59, 199-N-60, and 199-N-61, downgradient wells from the facility, are statistically different from the established background conductivity values. Because of the consistently high specific conductance values throughout the first year of sampling, it was not necessary to resample the wells for verification.

GROUND-WATER QUALITY ASSESSMENT PROGRAM

To assess the effect of the 1324-N/NA facilities on ground-water quality, an expanded ground-water sampling and water-level data collection program is presented here. The intent of this program is to determine whether hazardous waste constituents are present in the ground water, the concentration, source and extent of ground-water contamination, and the direction and rate of contaminant movement. Sampling methods are discussed in the text, and analytical methods used in this program may be found in Appendix A. Procedures used to evaluate the ground-water data follow guidelines in the technical Enforcement Guidance Document (EPA 1986). Progress on the quality assessment program will be reported in quarterly and annual RCRA reports.

Investigatory Approach

The ground-water assessment program will progress in phases. In phase one, the existing data will be evaluated, the existing wells in the vicinity

of the 1324-N/NA facilities will be sampled for constituents that contribute to high specific conductance values, and the ground-water levels will be monitored to determine the ground-water gradient in the vicinity of the facilities. The first phase is intended to identify the contaminants, their concentrations, source, extent, and rate and direction of migration. If data obtained are adequate determine these parameters, corrective actions will be developed and implemented in the additional phases. However, if these parameters are not adequately determined in the first phase, strategies will be developed to obtain the required data in additional phases. New wells may be recommended if the extent and pathways of the contamination cannot be adequately determined, and a field tracer test may be conducted if the rate of contaminant movement cannot be adequately defined. The first phase will be implemented immediately and continue until September 1989.

Recently, the monitoring program for the nearby 1301-N Liquid Waste Disposal Facility (LWDF) converted to a ground-water quality assessment program as a result of elevated specific conductance in one well. The program for the 1324-N/NA facilities and the ground-water quality assessment program for the 1301-N LWDF will determine if there is a relationship in the elevated specific conductance between the monitoring networks.

Hydrogeology

The unconfined aquifer in the 100-N Area is contained in the sands and gravels of the middle Ringold Formation. The water-table surface occurs just below the contact with the Hanford formation. The sands and gravels of the Ringold Formation are generally unconsolidated but can be locally cemented (Tallman et al. 1979). The thickness of the unconfined aquifer in the 100-N Area may be as great as 80 or 90 ft, and the general flow direction is northwest toward the Columbia River.

The elevation of the water table in the 100-N Area is affected by the release of effluent to disposal facilities, river stage in the nearby Columbia River, and ground water entering the 100-N Area from other parts of

the Hanford Site. A major influence on the ground water in the 100-N Area has been the ground-water mounds under the 1324-N/NA and 1325-N facilities (see Appendix B). The elevation of the ground-water mound under the 1324-N/NA facilities has ranged from 406 ft in June 1988 to 398 ft in November 1988. The ground-water mound under the nearby 1325-N LWDF fluctuated between an elevation of 402 ft in March 1989 to 394 ft in September 1988 as a function of discharges to the facility. These discharges are dependent on the operational status of the N Reactor. In January 1988, the N Reactor began preparations for achieving a cold standby status, resulting in a significant decrease in the volume of liquid effluent discharged to the 1325-N LWDF in 1988. Consequently, the ground-water mound under the 1325-N LWDF declined in 1988. Because this mound dissipated, the ground-water mound under the 1324-N/NA facilities had a greater influence on the ground-water flow patterns, altering flow directions slightly to the north in an area between the 1325-N LWDF and the river (Appendix B).

Beginning in January 1989, an operational change at the N Reactor resulted in increased discharge rates to the 1325-N LWDF from approximately 300 gpm during the last quarter of 1988 to approximately 1200 gpm, with short-term discharges of up to 1800 gpm from January to March 1989. Consequently, the elevation of the ground-water mound under the 1325-N LWDF increased approximately 2 ft from January to March 1989. The water-table maps in Appendix B and in Jensen (1987) illustrate the variable extent and shape of the mounding beneath the 100-N Area as a function of time.

PRESENT MONITORING NETWORK

There are at present five wells in the 1324-N/NA monitoring network. Well 699-81-58 is the designated upgradient well, and wells 199-N-58, 199-N-59, 199-N-60, and 199-N-61 are downgradient wells (Figure 1). Originally, well 199-N-61 was designated as the upgradient well, with wells 199-N-58, 199-N-59, and 199-N-60 sampled as downgradient wells. However, all four wells are affected by the ground-water mound under the facility,

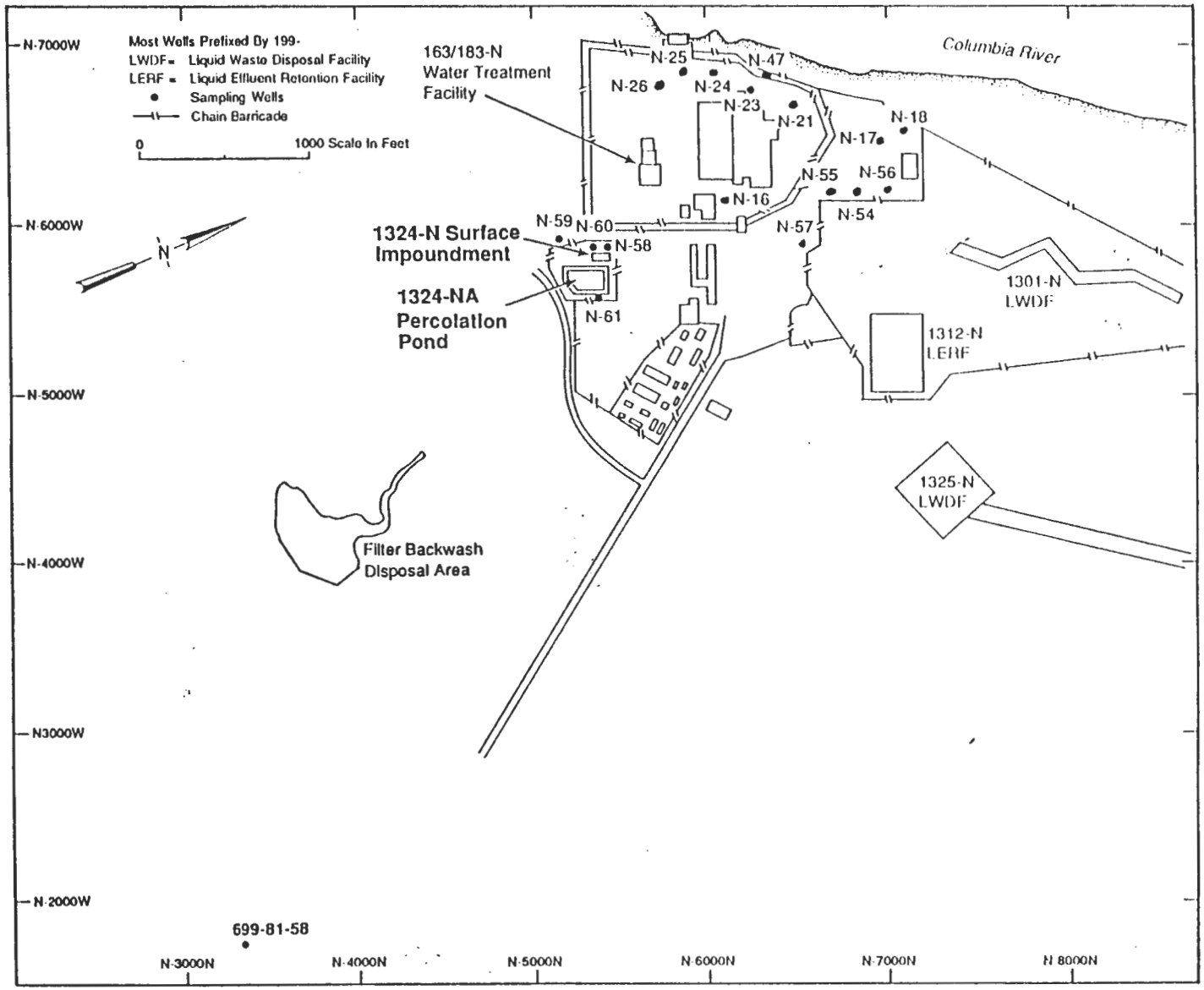

FIGURE 1. Monitoring Wells Near the 1324-N/NA Facilities

requiring the addition of well 699-81-58 as the upgradient well (Fruland, Bates, and Lundgren 1989b). A construction summary of wells in this monitoring network is presented in Table 1. As-built diagrams of these wells are included in Appendix C.

Existing Data and Evaluation

Specific conductivity data collected since December 1987 are summarized in Figure 2. The first year of data sets for the facilities consists of:

- December 1987 - 1 pH, 1 conductivity, 1 total organic carbon (TOC), 1 total organic halogen, lower detection limit (TOXDL)
- March 1988 - 1 pH, 1 conductivity, 1 TOC, 1 TOXDL
- June 1988 - 4 pH, 4 conductivity, 4 TOC, 4 TOXDL
- September 1988 - 4 pH, 4 conductivity, 4 TOC, 4 TOXDL.

Sample quadruplicates are required by regulation for contamination indicator parameters, and typically the first four quarters of data are used to determine background conditions. During the first two quarters of monitoring for the 1324-N/NA facilities, however, only single samples were collected and analyzed for contamination indicator parameters. Despite the lack of four quarters of quadruplicate samples, it is apparent that the average specific conductance measured in the past year in the downgradient wells is nearly an

TABLE 1. Construction Summary for Wells in the Present Monitoring Network

Well Number	Depth, ft	Depth to Water, ft	Date	Completion Interval	Date Completed
199-N-58	70	62.00	3/89	screen 55.4-70.4 ft	11/87
199-N-59	71.5	59.14	3/89	screen 56.5-71.5 ft	11/87
199-N-60	70.2	61.15	3/89	screen 55.0-70.2 ft	11/87
199-N-61	66.6	57.38	3/89	screen 51.5-66.6 ft	11/87
699-81-58	90	43.00	3/89	perforated 35-90 ft	10/62

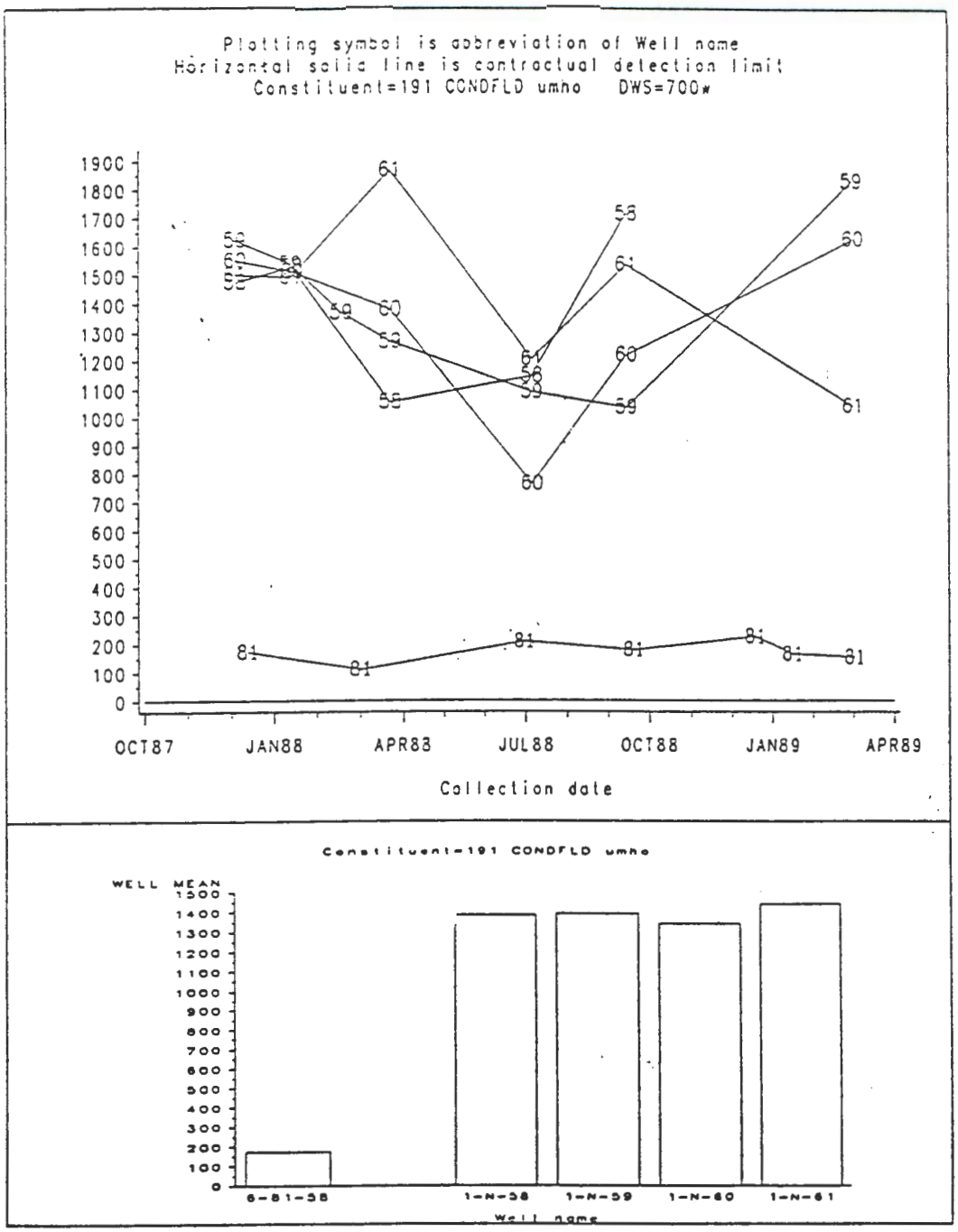

FIGURE 2. Specific Conductivity Values for Wells in the 1324-N/NA Facility Monitoring Network

order of magnitude above levels in the upgradient well. To meet the intent of the regulation, the statistical analyses were calculated with the available data. Quadruplicate samples for each indicator parameter will continue to be collected.

The background statistics for the 1324-N/NA facilities are presented in Table 2. The table lists the average background and standard deviation calculated from the first year of data from the upgradient well. The critical mean is the value above which (or below which in the case of pH) a compared value is determined to be statistically different from background. These values were determined following the recommended techniques in Appendix B of the Technical Enforcement Guidance Document (EPA 1986). Some of these critical mean values are outside the anticipated range.

In addition to sampling for the indicator parameters, site-specific constituents (discussed later) were sampled for at the 1324-N/NA facilities (PNL 1988a, 1988b; Fruland, Bates, and Lundgren 1989a, 1989b). Initial indications are that the major contributors to the high specific conductance are sodium, sulfate, calcium, chloride, and magnesium. None of these constituents are listed as hazardous wastes under 40 CFR 261.24; or 40 CFR 261 Subpart D.

GROUND-WATER QUALITY ASSESSMENT MONITORING NETWORK

Existing wells 199-N-16, 199-N-17, 199-N-18, 199-N-21, 199-N-23, 199-N-24, 199-N-25, 199-N-26, 199-N-47, 199-N-54, 199-N-55, 199-N-56, and

TABLE 2. Background (Upgradient) Ground-Water Constituent Values

Constituent	Average Background	Standard Deviation	Critical Mean
Specific Conductance, μmhos/cm	168.2	40.6	754.7
pH	7.89	0.38	0.95, 14.83
TOC, ppb	265.1	75.1	1,350
TOX, ppb	1.11	3.22	47.6

199-N-57 (Figure 1) will be evaluated to determine if they will yield data that are representative of the ground water. The wells determined suitable will be added to the current monitoring network. The expanded network is referred to as the ground-water quality assessment monitoring network (Table 3). These additional wells will provide more information on ground-water quality and the water table downgradient from the 1324-N/NA facilities to delineate the extent of the contamination. The rate of contaminant movement will be determined by the concentration over time of constituents in the monitoring wells, and a value for advective flow will be estimated using the variables ground-water gradient, porosity, and hydraulic conductivity.

TABLE 3. Construction Summary for Wells in the Ground-Water Quality Assessment Monitoring Network

Well Number	Depth, ft	Depth to Water, ft	Date	Completion Interval	Date Completed	Pump
199-N-16	80	57.5	4/84	Perforated 12-78 ft Screen 46-71 ft	2/81	None
199-N-17	84.5	70.56	2/89	Perforated 12-83 ft	1/81	None
199-N-18	80	69.79	2/89	Perforated 12-78 ft Screen 54-74 ft	2/81	None
199-N-21	80	60	1/81	Perforated 12-78 ft	1/81	None
199-N-23	80	59	1/81	Perforated 12-78 ft	1/81	None
199-N-24	55	34	1/81	Perforated 12-54 ft	1/81	None
199-N-25	49	35	1/81	Perforated 12-47 ft	1/81	None
199-N-26	79	63	1/81	Perforated 12-77	1/81	None
199-N-47	73	54	11/84	Screen 53-73 ft	11/84	Submersible
199-N-54	73	63.33	2/89	Screen 58-73 ft	6/87	HydroStar[a]
199-N-55	73	63.68	2/89	Screen 58-73 ft	6/87	HydroStar
199-N-56	74	65.19	2/89	Screen 59-74 ft	6/87	HydroStar
199-N-57	73	62.43	2/89	Screen 58-73 ft	6/87	HydroStar

(a) HydroStar is a trade name of Instrumentation Northwest, Redmond, Washington.

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As-built diagrams for the additional monitoring wells can be found in Appendix C. To sample these wells, sampling pumps must be installed in the wells that do not already have dedicated sampling pumps. Work will be initiated immediately on those wells requiring remedial work (e.g., redeveloping, cleaning) so that they may provide a representative sample as determined by the technical sampling support personnel.

Ground-Water Quality Assessment Sampling Schedule

In the first phase of the ground-water quality assessment program, quarterly sampling will continue for the original monitoring network as previously scheduled for the constituents listed in Table 4 (site-specific constituents). The additional wells in the ground-water quality assessment monitoring network will be sampled for the inorganic constituents listed in Table 5 on the same quarterly schedule. In addition, all wells included in the ground-water quality assessment monitoring network will be sampled for

TABLE 4. Inorganic, Organic, and Radiological Constituents and Other Parameters

Turbidity	Coliform Bacteria	Tritium
Total Organic Carbon	Metals Analyzed by Inductively Coupled Plasma Method	Total Organic Halogen
Mercury		Arsenic
Lead	Selenium	Nitrate
Herbicide	Phenol	Pesticides
Radium	Alpha	Beta
Strontium-90	Uranium	Gamma

TABLE 5. Inorganic Constituents and Parameters

Turbidity	Specific conductance
Metals Analyzed by the Inductively Coupled Plasma Method	pH
	Quality Control/Volatile Organic Constituents
Arsenic	Anions
Selenium	Alkalinity
Lead	Mercury

the Table 5 constituents in May and July 1989, according to the schedule in Table 6. The expanded network will be evaluated after the September 1989 sampling. Note that wells in the original monitoring network were sampled for the dangerous waste constituent list (i.e., those constituents listed in WAC 173-303-9905, Appendix A for which analytical methods exist) in March 1989.

WATER-TABLE MONITORING

Water levels are currently monitored monthly in approximately 44 wells in the 100-N Area. These measurements are taken in conjunction with two other RCRA projects in the 100-N Area. To enhance knowledge of the resolution of the ground-water gradient north of the 1324-N/NA facilities,

TABLE 6. Ground-Water Quality Assessment Sampling Schedule for 1989

Well	Mar	April	May	June	July	Aug	Sept
199-N-16*			T5	T5	T5		T5
199-N-17*			T5	T5	T5		T5
199-N-18*			T5	T5	T5		T5
199-N-21*			T5	T5	T5		T5
199-N-23*			T5	T5	T5		T5
199-N-24*			T5	T5	T5		T5
199-N-25*			T5	T5	T5		T5
199-N-26*			T5	T5	T5		T5
199-N-47*			T5	T5	T5		T5
199-N-54*			T5	T5	T5		T5
199-N-55*			T5	T5	T5		T5
199-N-56*			T5	T5	T5		T5
199-N-57*			T5	T4	T5		T4
199-N-58	DW		T5	T4	T5		T4
199-N-59	DW		T5	T4	T5		T4
199-N-60	DW		T5	T4	T5		T4
199-N-61	DW		T5	T4	T5		T4
699-81-58	DW		T5	T4	T5		T4

DW is the dangerous waste constituent list (i.e., those constituents listed in WAC 173-303-9905, Appendix A for which analytical methods exist).
T4 is the Table 4 constituent list.
T5 is the Table 5 constituent list.
* designates existing wells to be added to the current monitoring network.

monthly water-level measurements will be expanded to include wells 199-N-16, 199-N-21, 199-N-55, and 199-N-56. The water-table data will be used in conjunction with river stage data collected in the 100-N Area.

SAMPLING AND ANALYTICAL METHODS

This document introduces the procedures and methods used for sample collection (including well evacuation and sample withdrawal methods), field measurements, chemical analysis, chain of custody, and quality control. Preservation techniques, analytical methods used, and current detection levels of the constituents sampled for in the 1324-N/NA facilities ground-water monitoring network can be found in Appendix A. All sampling activities have been performed by Pacific Northwest Laboratory (PNL). United States Testing Company, Incorporated (UST), conducted sample analyses.

The procedures for ground-water sample collection, water-level measurements, and field measurements are contained in Procedures for Ground-Water Investigations (PNL 1989). Specific applicable procedures are

- GC-1 - Ground-Water Sample Collection Procedure
- GC-2 - In-Line Sample Filtration Procedure
- GC-3 - Disposal of Purge Water from Monitoring Wells
- FA-1 - Temperature Measurement Procedure
- FA-2 - Calibration of Conductivity Meter and Measurement of Field Conductivity
- FA-3 - Calibration of pH Meter and Measurement of Field pH
- WL-1 - Water-Level Measurement Procedure
- WL-2 - Procedure for Standardizing Steel Tapes.

Chain-of-custody procedures are also contained in PNL (1989). The specific applicable procedure is number AD-2, Ground-Water Sample Chain-of-Custody Procedure. The history of the custody of each sample is documented according to this procedure.

Quality Assurance

Quality assurance (QA) will be conducted in accordance with the PNL quality assurance manual. A site-specific QA plan describing the manner in which specific QA requirements are to be met has been prepared in accordance with that manual.

Quality Control

Quality control (QC) activities are conducted in accordance with the PNL quality control manual. The purpose of this effort is to determine and document the quality of the analytical results being produced by the laboratory and to bring potential problems with analyses to the attention of UST for corrective actions as needed. The QC effort has two main components: 1) routine internal checks performed by UST, and 2) external checks conducted by PNL to independently evaluate UST performance. The scope of these efforts is described in the following sections.

United States Testing Company, Incorporated, Internal Quality Control

Internal quality control at UST includes general practices applicable to a wide range of analyses, as well as specific procedures stipulated for particular analyses. The quality control and quality assurance programs at UST are documented in internal manuals. UST produces a quarterly Quality Control Report of Hazardous Substance Analyses to PNL for review by subcontracts, sample analyses management, quality control, and statistical task leaders of the ground-water monitoring program.

External Quality Control

Pacific Northwest Laboratory uses both interlaboratory comparisons and spiked, replicate, and blank samples in evaluating the accuracy of results

from UST. Comparisons are currently being conducted for anions, volatile organic constituents, metals, and gross alpha and beta. Each month, replicate samples from selected wells are delivered to four different PNL laboratories. The results from these PNL laboratories are then compared with the results from UST. Samples sent to PNL laboratories are from the same sampling set as those analyzed in duplicate by UST.

Replicate analyses of field samples are conducted to establish how much variability might be expected in the laboratory measurements performed on nearly identical samples. Trip (transport) blanks and transfer blanks are submitted to UST to determine whether environmental conditions encountered during collection and transportation of samples have affected the results obtained by analysis. Blind samples are submitted to UST to estimate the bias of analytical laboratory procedures and to determine when this bias exceeds control limits.

Data Evaluation Procedures

Data evaluation procedures follow the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (EPA 1986).

REFERENCES

40 CFR 261. U.S. Environmental Protection Agency, "Identification and Listing of Hazardous Waste." U.S. Code of Federal Regulations.

40 CFR 265. U.S. Environmental Protection Agency, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities." U.S. Code of Federal Regulations.

EPA. 1986. Resource Conservation and Recovery Act (RCRA) Ground-Water Monitoring Technical Enforcement Guidance Document. OSWER 9950.1, U.S. Environmental Protection Agency, Washington, D.C.

Fruland, R. M., D. J. Bates, and R. E. Lundgren, eds. 1989a. Resource Conservation and Recovery Act Ground-Water Monitoring Projects for Hanford Facilities: Progress Report for the Period July 1 to September 30, 1988. PNL-6789, Pacific Northwest Laboratory, Richland, Washington.

APPENDIX A

ANALYTICAL METHODS

This appendix contains the sample preservation techniques, analytical methods used, and the current detection levels for constituents analyzed for in the 1324-N/NA Surface Impoundment and Percolation Ponds ground-water monitoring.

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TABLE A.1. Preservation Techniques, Analytical Methods Used, and the Current Detection Levels for Listed Constituents as of January 1, 1989

Constituent	Collection and Preservation[a,b]	Analysis Methods[c]	Detection Limit, ppb[d]
ICP METALS - Unfiltered/Filtered			
Beryllium	P, HNO_3 to pH<2	SW-846, #6010	3
Strontium			10
Zinc			5
Calcium			50
Barium			6
Cadmium			5
Chromium			10
Silver			10
Sodium			200
Nickel			10
Copper			10
Vanadium			5
Antimony			100
Aluminum			150
Manganese			5
Potassium			100
Iron			30
Magnesium			50
Boron			10
Cobalt			20
Lithium			10
Molybdenum			40
Silicon			50
Tin			30
Titanium			60
Zirconium			50
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	5
ANIONS BY IC			
Nitrate	P, None	EPA Method 300.0[e]	500
Sulfate			500
Fluoride			500
Chloride			500
Phosphate			1000
Bromide			1000
Nitrite			1000

TABLE A.1. (contd)

Constituent	Collection and Preservation[a,b]	Analysis Methods[c]	Detection Limit, ppb[d]
PESTICIDES			
Endrin	G, None	SW-846, #8080	0.1
Methoxychlor			3
Toxaphene			1
Lindane (four isomers)			0.1
HERBICIDES			
2,4-D	G, None	SW-846, #8150	2
2,4-5-TP silvex			2
2,4,5-T			2
VOLATILE ORGANICS (VOA)			
Carbon tetrachloride	G, No headspace	SW-846, #8240	5
Benzene			5
Methylethyl ketone			10
Toluene			5
1,1,1-trichloroethane			5
1,1,2-trichloroethane			5
Trichloroethylene			5
Tetrachloroethylene			5
Xylene (O, P)			5
Chloroform			5
1,1-dichloroethane			5
1,2-dichloroethane			5
Trans-1,2 dichloroethylene			5
Methylene chloride			5
Vinyl chloride			10
Xylene (M)			5
p-dichlorobenzene			5
Methyl isobutyl ketone			10
Acetone			10
Tetrahydrofuran			10
RADIOLOGICAL			
Radium	P, HNO_3 to pH<2	SW-846,[f] #9315	1 pCi/L
Gross alpha	P, HNO_3 to pH<2	SW-846, #9310	4 pCi/L
Gross beta	P, HNO_3 to pH<2	SW-846, #9310	8 pCi/L
Tritium	P, None	ASTM, D2476-81	500 pCi/L
Uranium	P, HNO_3 to pH<2	(g)	
Uranium	P, HNO_3 to pH<2	(h)	
Gamma Scan	P, HNO_3 to pH<2	(i)	

TABLE A.1. (contd)

Constituent	Collection and Preservation[a,b]	Analysis Methods[c]	Detection Limit, ppb[d]
OTHER			
Coliform bacteria	P, None	SW-846, #9131	2.2 MPN
Temperature	Field measurement	PNL-MA-567,[j] FA-1	
Specific conductance	Field measurement	PNL-MA-567, FA-2	
pH	Field measurement	PNL-MA-567, FA-3	
Total organic halogen, low detection level	G, H_2SO_4 to pH<2 No headspace	SW-846, #9020	10
Total organic carbon	G, H_3PO_4 to pH<2	SW-846, #9060	2000
Total carbon	G, None	SW-846, #9060	2000
Ammonium ion	G, H_2SO_4 to pH<2	ASTM D1426-D[k]	50
Phenol	G, None	SW-846, #8040	10
Cyanide	P, NaOH to pH<2	SW-846, #9010	10
Hydrazine	G, HCl	ASTM D1385	30
Total dissolved solids	P, None	Std. Methods 209B[l]	--

(a) P, plastic; G, glass.
(b) All samples will be cooled to 4°C upon collection.
(c) Constituents grouped together are analyzed by the same method.
(d) Detection limit units except where indicated.
(e) In-house analytical method from UST, adapted from Method 300.0, EPA (1984).
(f) The method also references ASTM (1988) and Krieger and Whittaker (1980).
(g) Adopted from Techniques of Water Resources Investigations of the U.S. Geological Survey, U.S. Govt. Printing Office.
(h) Adopted NCRP (1985).
(i) From Krieger and Whittaker (1980) and Volchok and de Planque (1983).
(j) PNL (1989).
(k) By ion selective electrode.
(l) APHA (1985).

TABLE A.2. Preservation Techniques, Analytical Methods Used, and the Current Detection Levels for Additional Constituents on the 9905 and Appendix IX Lists[a]

Constituent	Collection and Preservation[b,c]	Analysis Methods[d]	Detection Limit, ppb[e]
ICP METALS, ENHANCED ADDITIONS			
Thallium	P, HNO_3 to pH<2	SW-846, #7840	5
THIOUREA GROUP, ENHANCED ADDITIONS			
Thiourea	G, None	SW-846, #8330 (modified)	200
1-Acetyl-2-thiourea			200
1-(O-Chlorophenyl) thiourea			200
Diethylstilbestrol			200
Ethylenethiourea			200
1-Naphthyl-2-thiourea			200
N-Phenylthiourea			500
PESTICIDES, ENHANCED ADDITIONS			
Aldrin	G, None	SW-846, #8080	0.1
Chlordane			1
4,4'-DDD			0.1
4,4'-DDE			0.1
4,4'-DDT			0.1
Endosulfan I			0.1
Endosulfan II			0.1
Endosulfan sulfate			0.5
Haptachlor			0.1
Heptachlor epoxide			0.1
Kepone			1
Dieldrin			0.1
Chlorobenzilate			300
PHOSPHOROUS PESTICIDES			
Carbophenothion	G, None	SW-846, #8140	2
Tetraethylpyrophosphate			2
Disulfoton			2
Dimethoate			2
Methyl parathion			2
Parathion			2
Phorate			2

TABLE A.2. (contd)

Constituent	Collection and Preservation[b,c]	Analysis Methods[d]	Detection Limit, ppb[e]
DIRECT AQUEOUS INJECTION			
Acrylamide	G, None	SW-846, #8240 DAI[f]	10,000
Allyl alcohol			2,500
Chloroacetaldehyde			16,000
3-chloroproprionitrile			4,000
Ethyl carbamate			5,000
Ethyl cyanide			2,000
Ethylene glycol			10,000
Isobutyl alcohol			1,000
Paralydehyde			2,000
N-proprylamine			10,000
2-probyb-1-ol			8,000
DIOXINS			
PCDDs	G, None	SW-846, #8280	0.01
PCDFs			0.01
2,3,7,8 TCDD			0.01
VOAs, ENHANCED ADDITIONS			
1,4-dioxane	G, No headspace	SW-846, #8240	500
Pryidine			500
Acrolein			10
Acrylonitrile			10
Bis(chloromethyl) ether			5
Bromoacetone			5
Methyl bromide			10
Carbon disulfide			10
Chlorobenzene			5
2-chloroethylvinyl-ether			5
Methyl chloride			10
Chloromethylmethyl-ether			5
Crotonaldehyde			10
1,2-dibromo-3-chloropropane			10
1,2-dibromoethane			10
Dibromomethane			10
1,4-dichloro-2-butene			10
Dichlorodiflouro-methane			10
1,2-dichloropropane			5
N-N-diethylhydrazine			10

TABLE A.2. (contd)

Constituent	Collection and Preservation[b,c]	Analysis Methods[d]	Detection Limit, ppb[e]
1,1-dimethylhydrazine			10
1,2-dimethylhydrazine			10
Iodomethane			10
Methacrylonitrile			10
Methanethiol			10
Pentachloroethane			10
1,1,2,2-tetrachloroethane			5
Bromoform			5
Trichloromethanethiol			10
Trichloromonofluoromethane			10
1,2,3-trichloropropane			10
Acetonitrile			10
Formaldehyde	G, No headspace	SW-846, #8240	500
Ethylene oxide			10
Ethyl methacrylate			10
Ethyl benzene			5
Styrene			5
Bromodichloromethane			5
Dibromochloromethane			5
2-hexanone			50
1,3-dichloropropene			5
Allyl chloride			100
Chlorethane			10
Propionitrile			5
Vinyl acetate			5
Additional targeted compounds[g]			
Additional VOAs[h]			
SEMIVOLATILE ORGANIC ANALYSIS (ABN)			
Chlorobenzene			10
Cresol			10
1,2-dichlorobenzene			10
1,3-dichlorobenzene			10
p-dichlorobenzene			10
Hexachlorobenzene			10
Pentachlorobenzene			10
Pentachlorophenol	G, None	SW-846, #8270	50
1,2,4,5-tetrachlorobenzene			10
1,2,4-trichlorobenzene			10
Hexachlorophene			10
Naphthalene			10
1,2,3-trichlorobenzene			10

TABLE A.2. (contd)

Constituent	Collection and Preservation[b,c]	Analysis Methods[d]	Detection Limit, ppb[e]
Phenol	G, None	SW-846, #8270	10
1,3,5-trichlorobenzene			10
1,2,3,4-tetrachlorobenzene			10
1,2,3,5-tetrachlorobenzene			10
Kerosene			10
Strychnine			50
Maleic hydrazide			500
Nicotinic acid			100
Tributylphosphate			10
Additional semivolatiles[i]			
OTHER			
Polychlorinated biphenyls	G, None	SW-846, #8080	1
Perchlorate	P, None	70-IC[i,j]	500
Sulfide	P, NaOH/Zinc acetate	SW-846, #9030	1,000
Citrus red #2	G, None	AOAC #34.015B	1,000

(a) WAC 173-303-9905, Dangerous Waste Constituents List; and 40 CFR 264, Appendix IX, Ground-Water Monitoring List.
(b) P, plastic; G, glass.
(c) All samples will be cooled to 4°C upon collection.
(d) Constituents grouped together are analyzed by the same method.
(e) Detection limit units except where indicated.
(f) DAI, direct aqueous injection.
(g) Additional list of targeted compounds. Constituents on the Dangerous Waste Constituent List (WAC 173-303-9905).
(h) Tentatively identified compounds are listed when detected, but there are no established detection limits for these.
(i) There are more than 100 additional semivolatile compounds on the "long list" that are not listed here. Most of these analyses have a detection level of 10 ppb.
(j) In-house analytical method from UST, adapted from Method 300.0, EPA (1984).

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APPENDIX B

WATER-TABLE MAPS

9 2 1 2 4 5 9 1 7 5 3

APPENDIX B

WATER-TABLE MAPS

This appendix contains monthly water-table elevation maps for the 100-N Area in 1988 and early 1989.

9 2 1 2 4 5 9 1 7 5 4

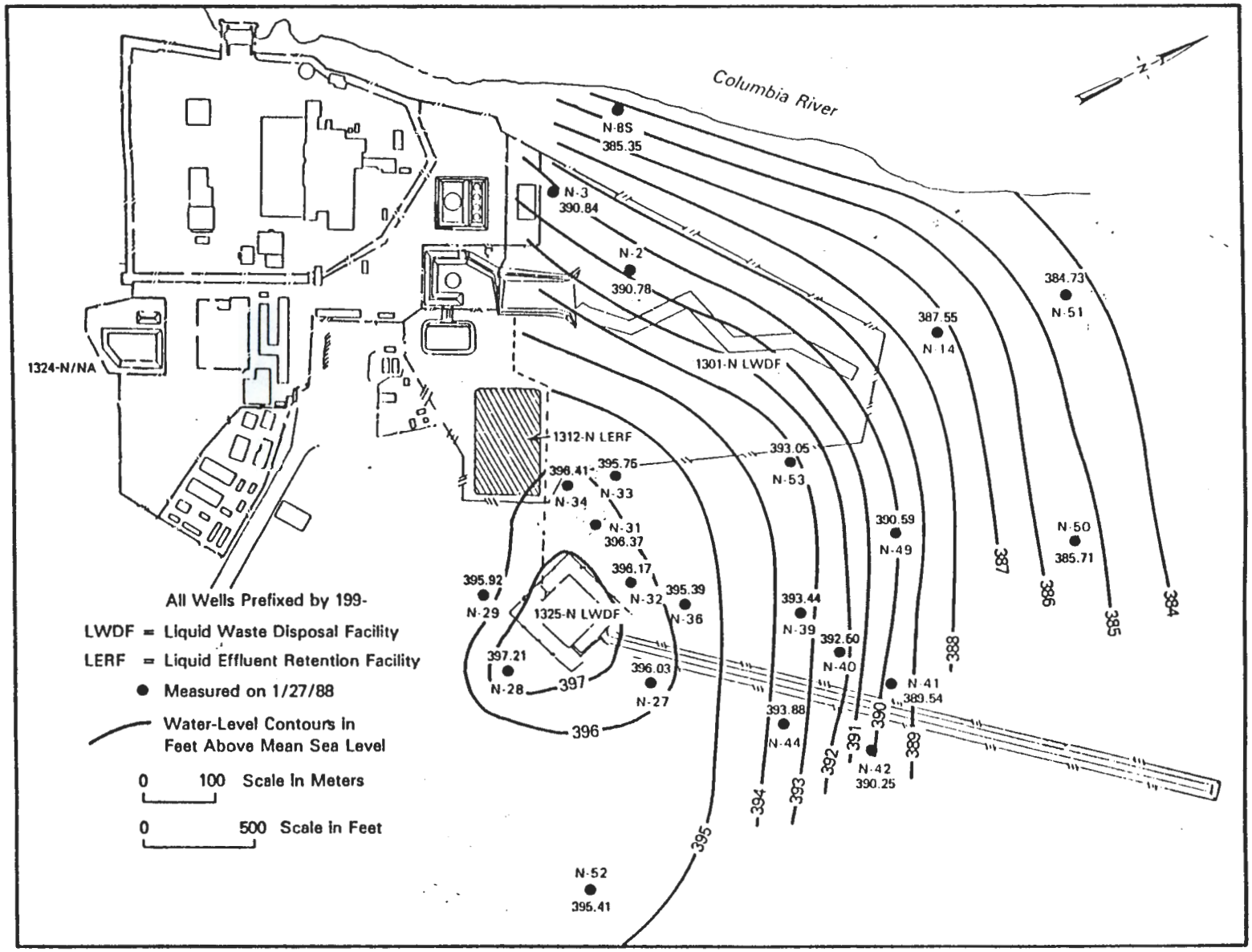


FIGURE B.1. Water-Table Map of the 100-N Area, January 1988

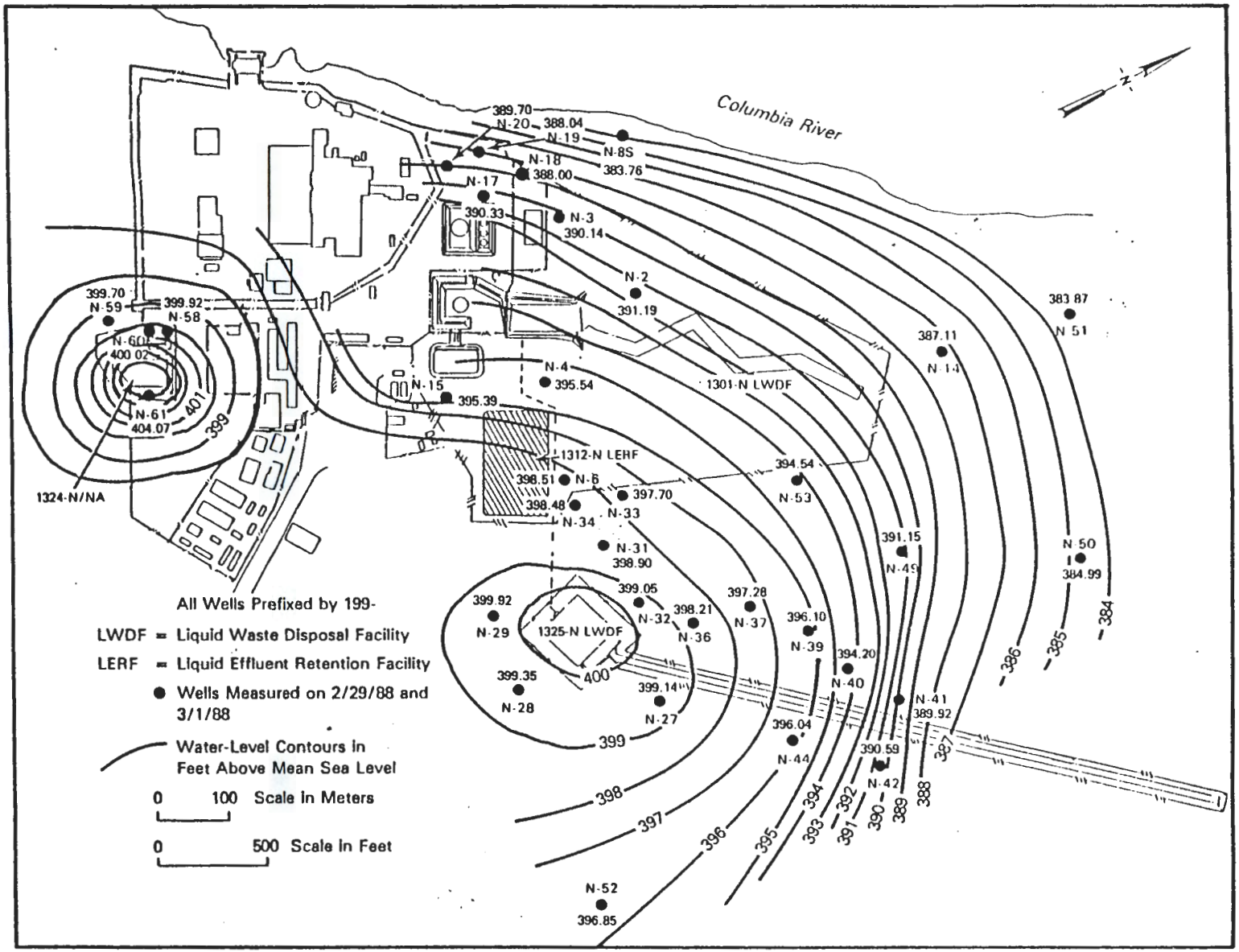


FIGURE B.2. Water-Table Map of the 100-Area, February 1988

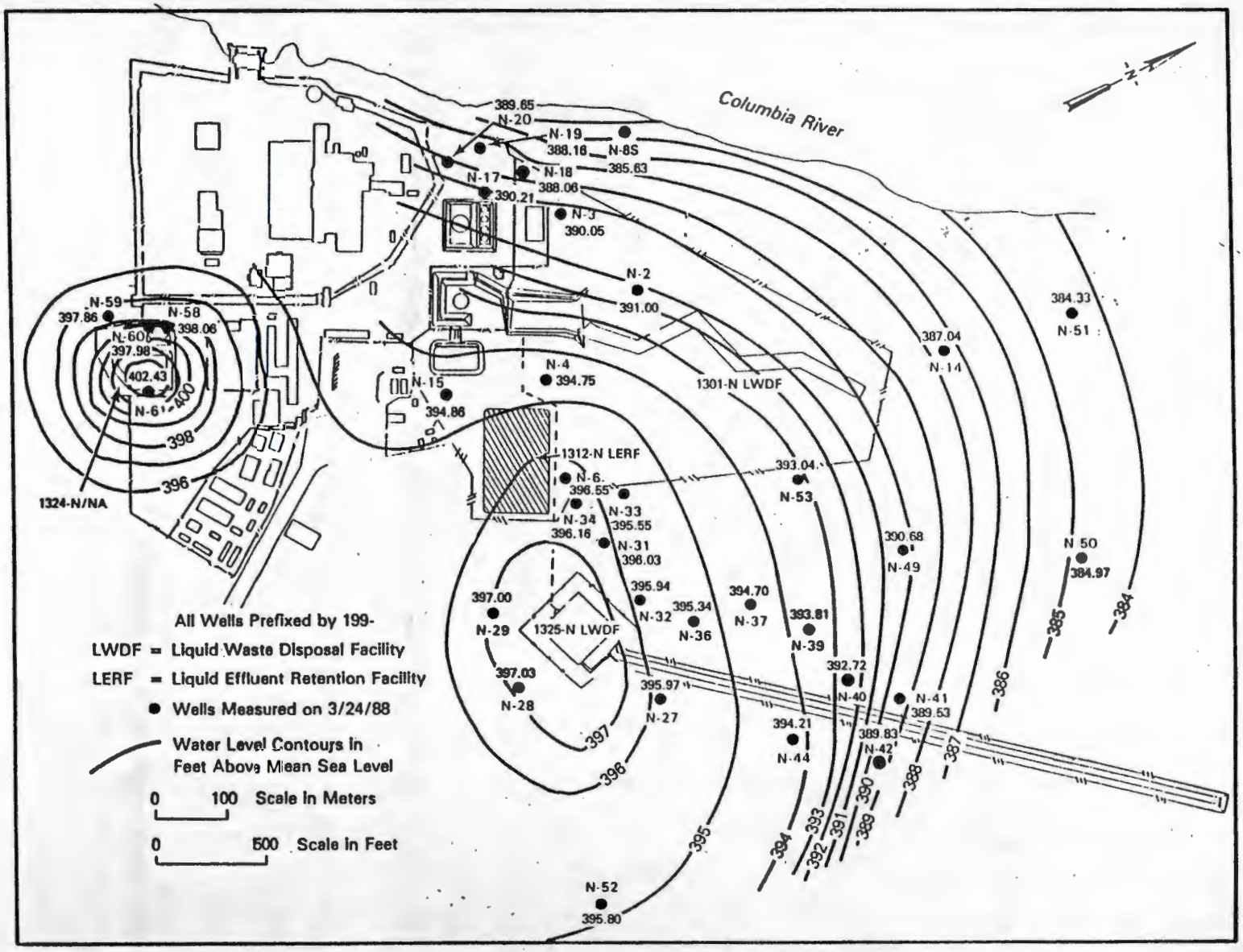
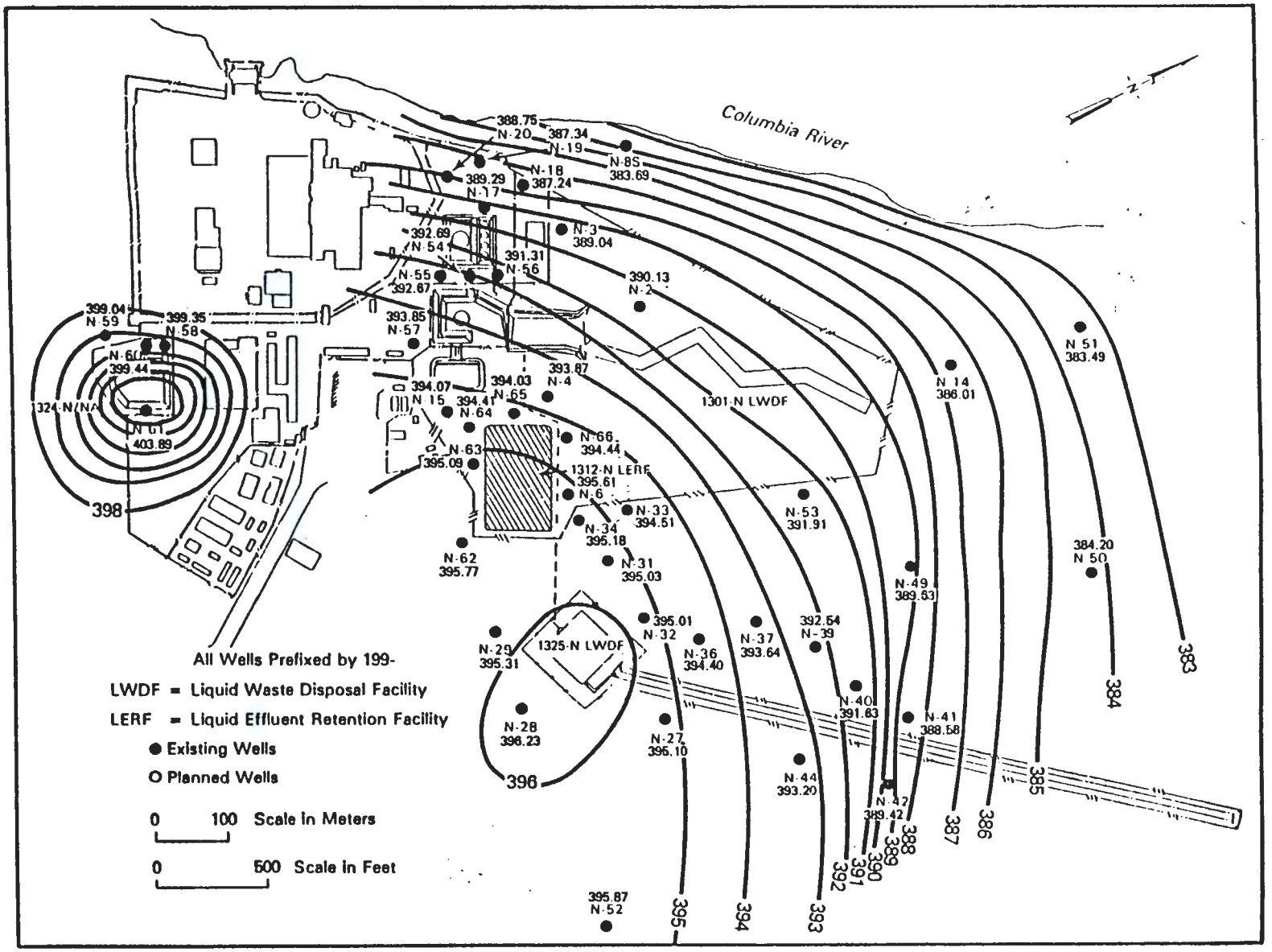
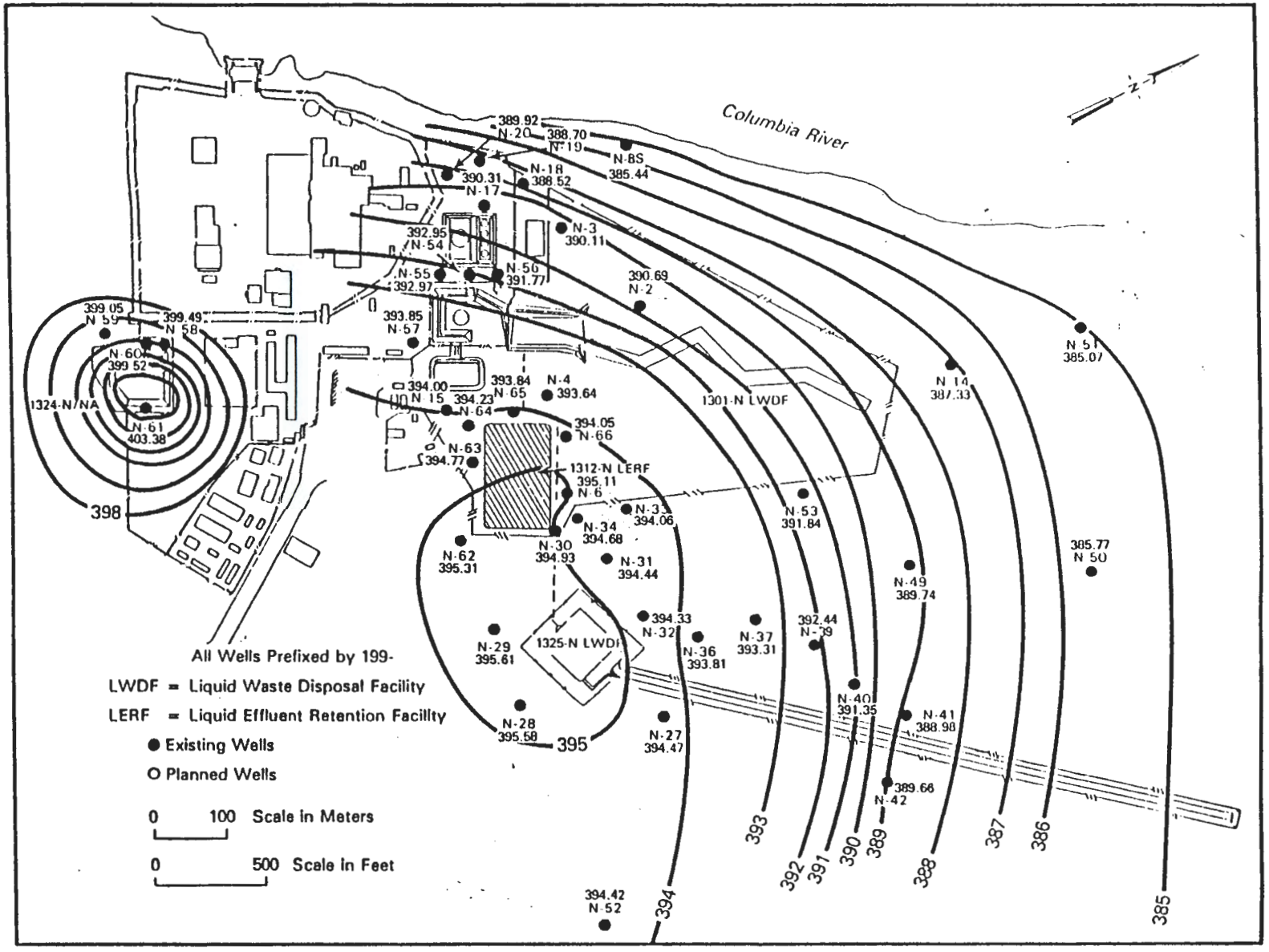


FIGURE B.3. Water-Table Map for the 100-N Area, March 1988



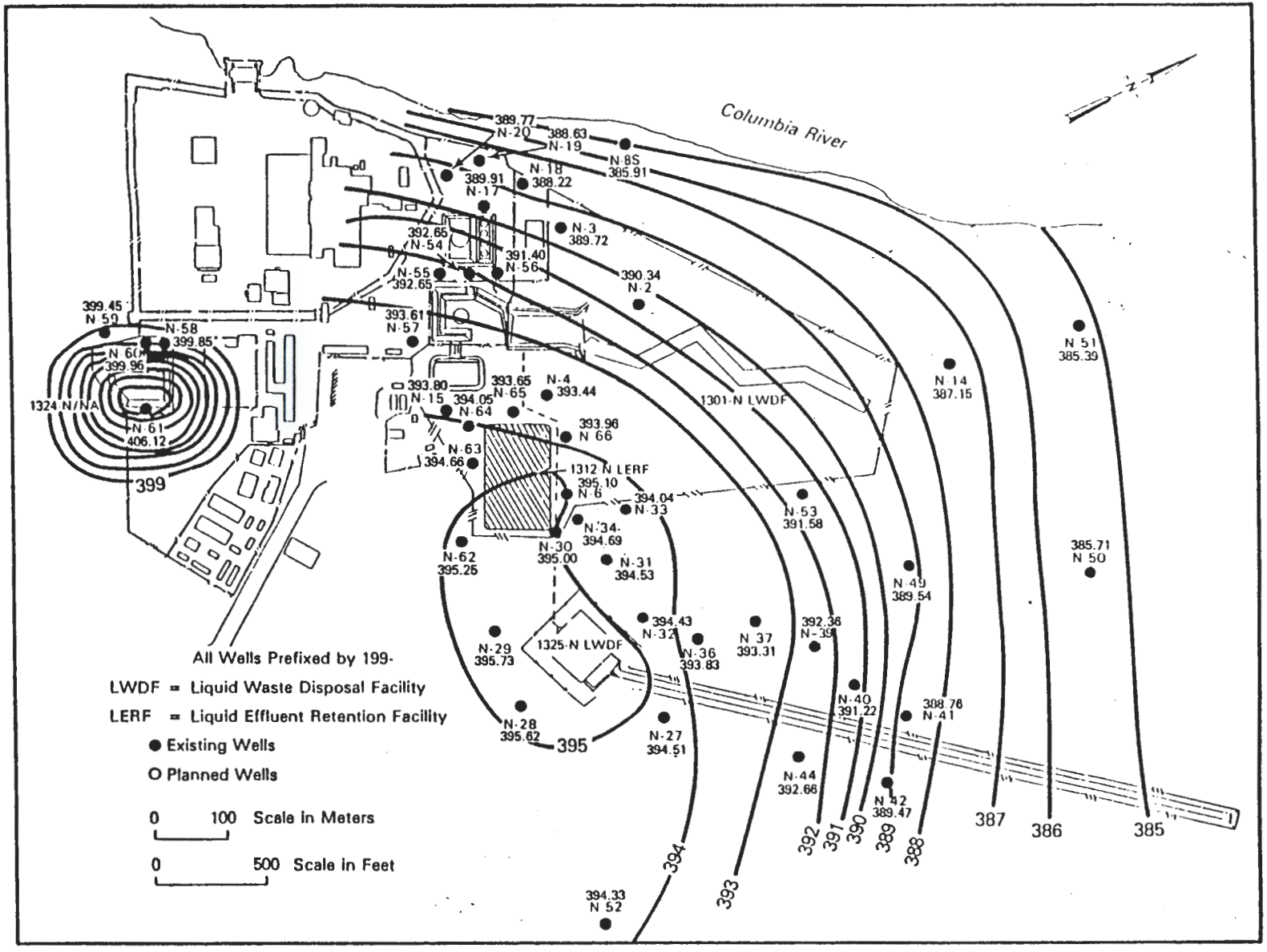
April 1988

FIGURE B.4. Water-Table Map for the 100-N Area, April 1988



May 1988

FIGURE B.5. Water-Table Map for the 100-N Area, May 1988



June 1988

FIGURE B.6. Water-Table Map for the 100-N Area, June 1988

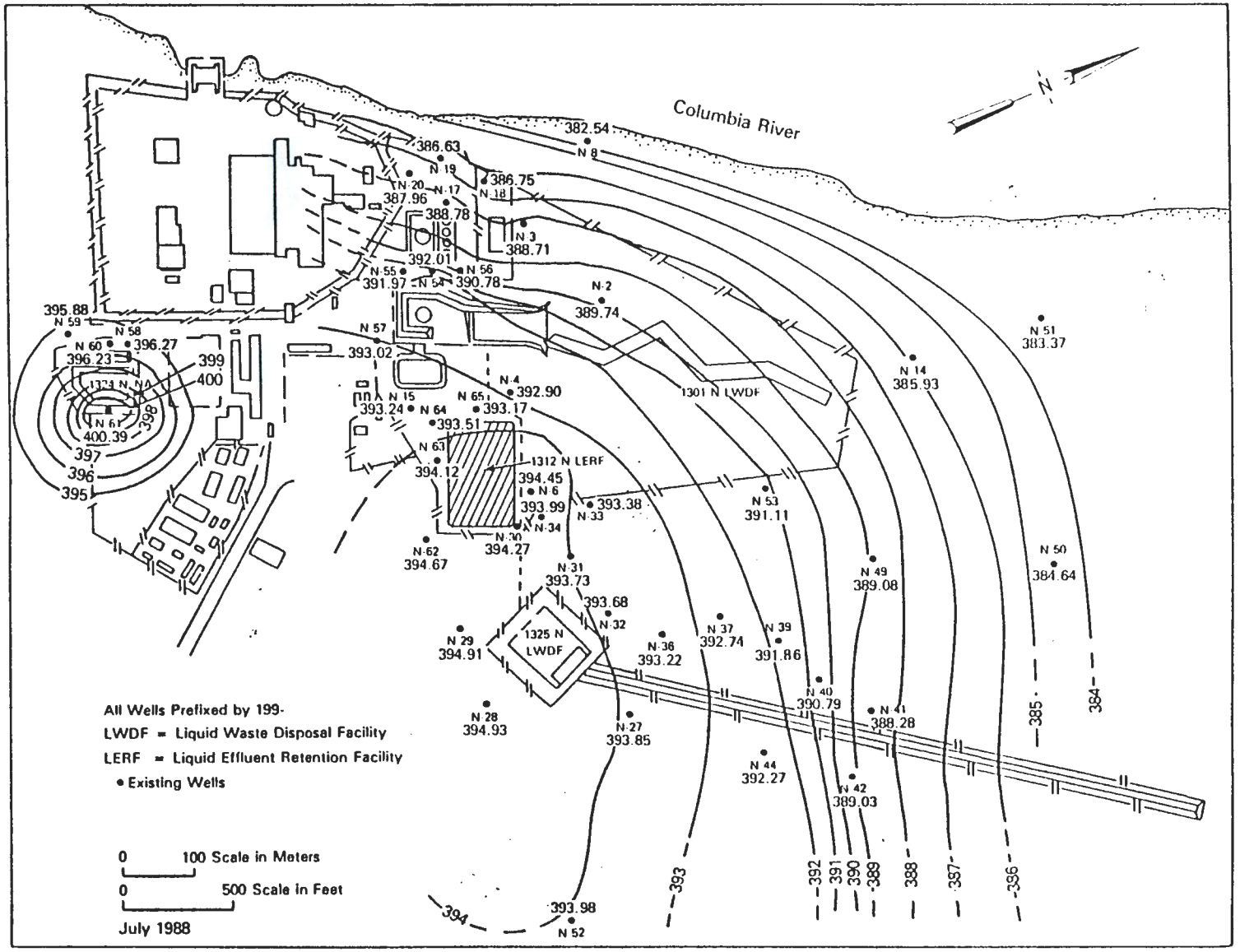


FIGURE B.7. Water-Table Map for the 100-N Area, July 1988

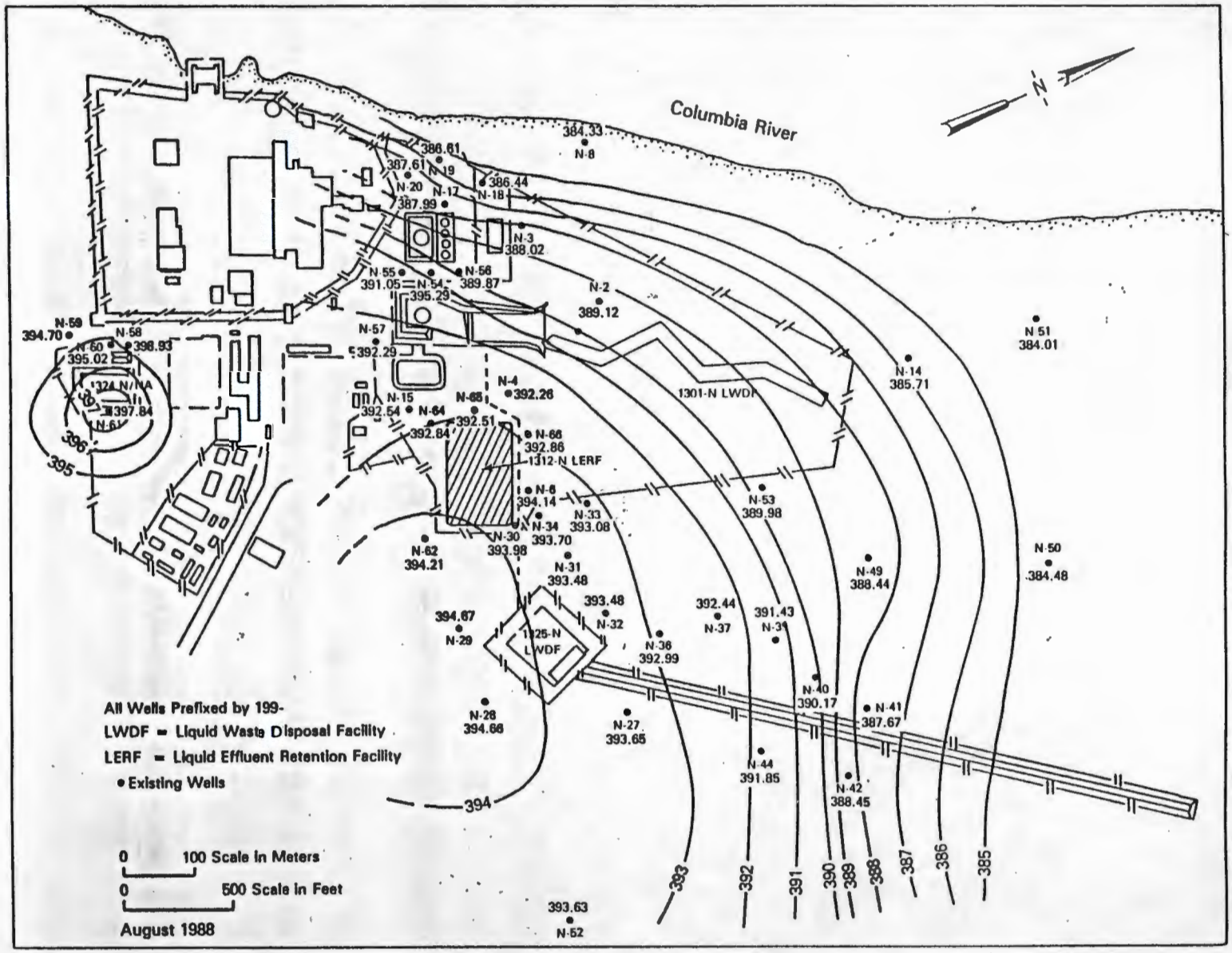


FIGURE B.8. Water-Table Map for the 100-N Area, August 1988

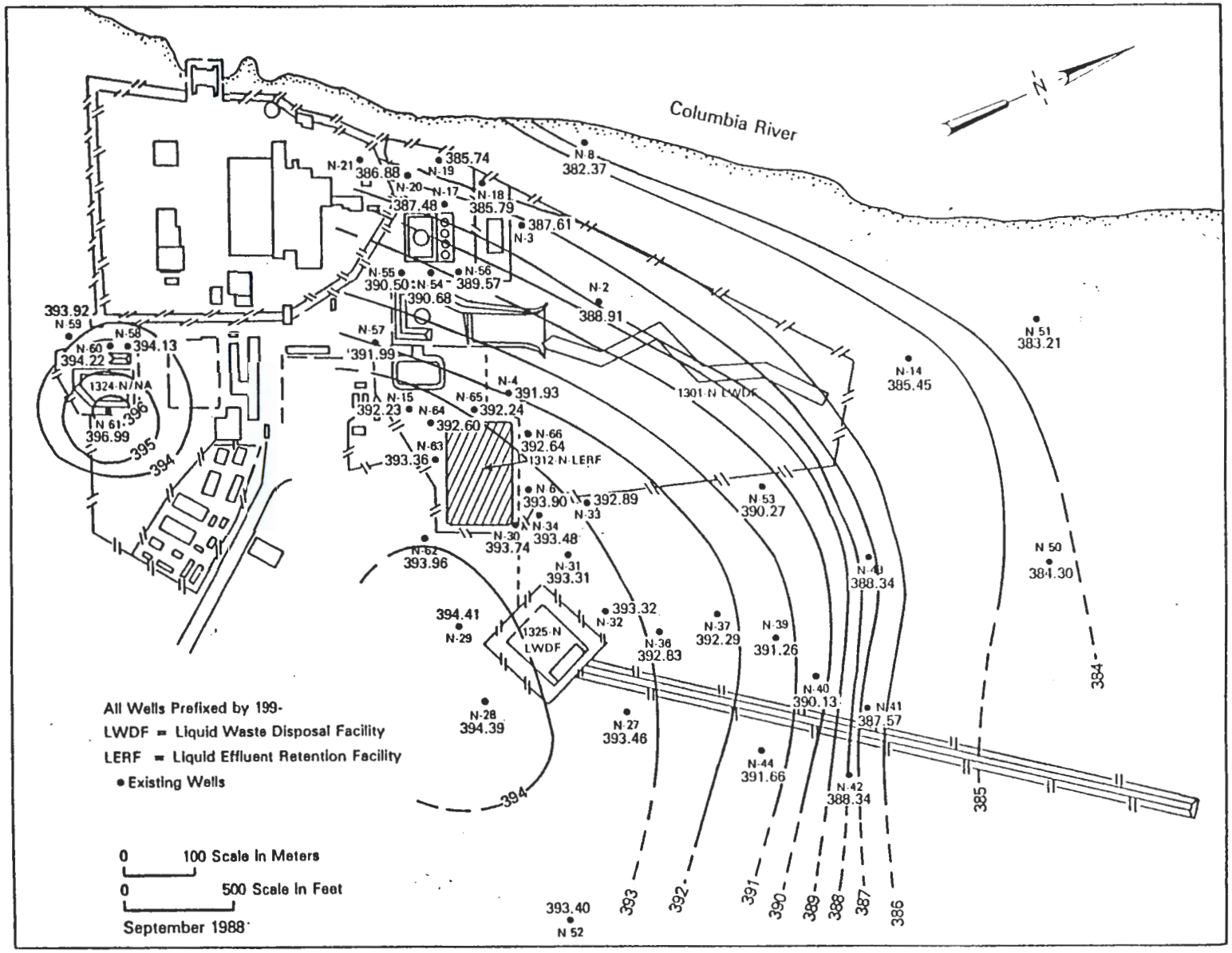


FIGURE B.9. Water-Table Map for the 100-N Area, September 1988

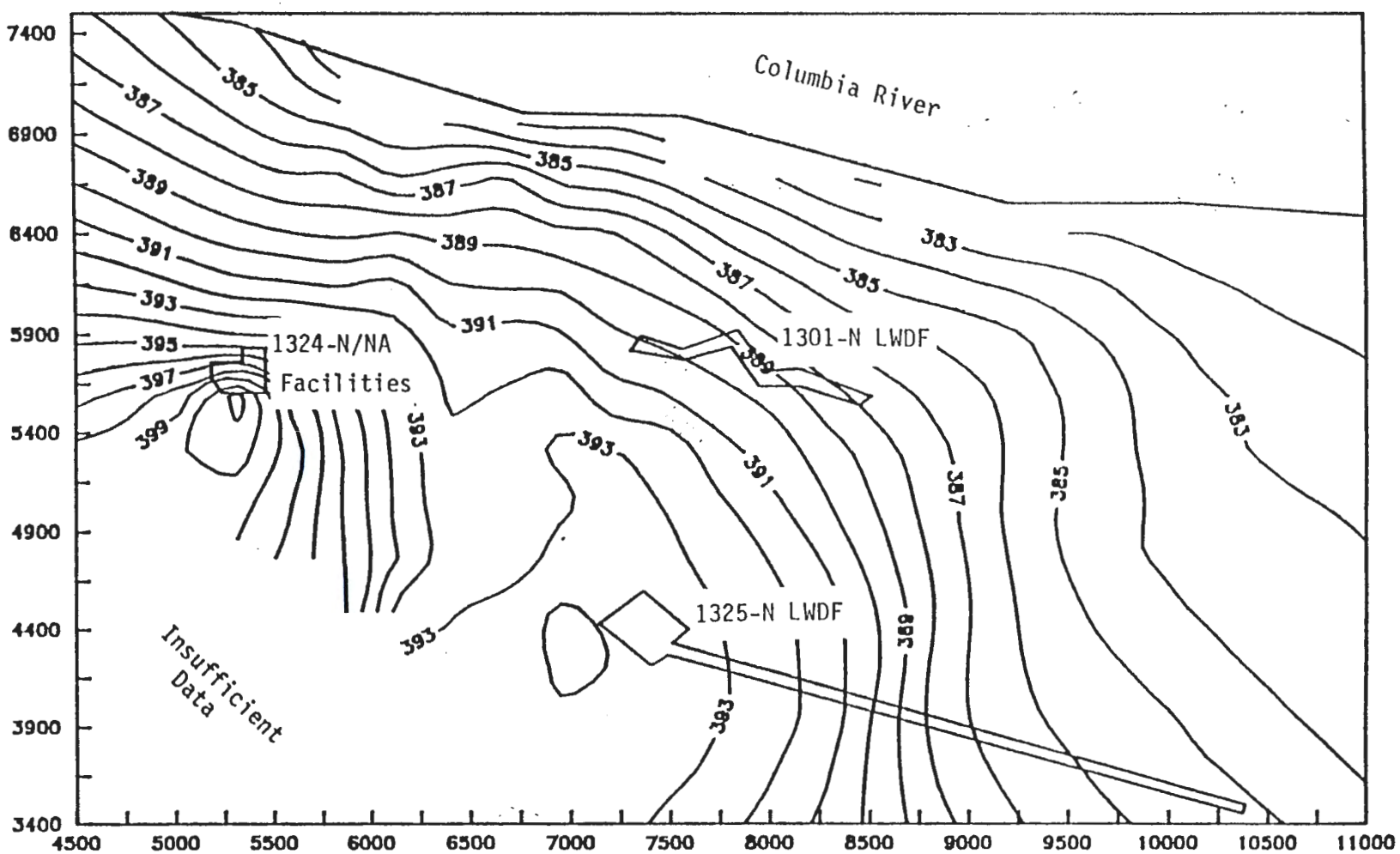


FIGURE B.10. Water-Table Map for the 100-N Area, October 1988

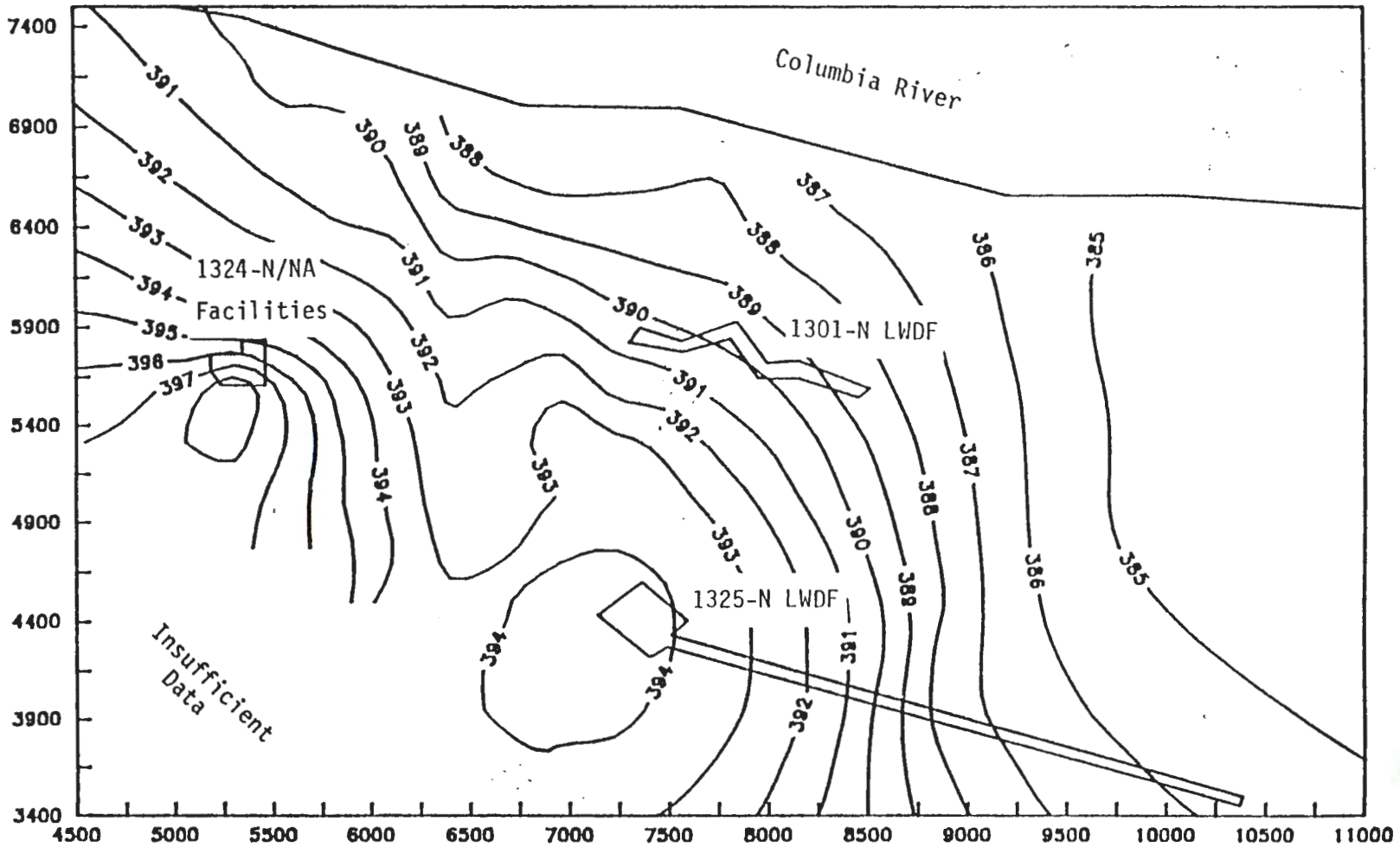


FIGURE B.11. Water-Table Map for the 100-N Area, November 1988

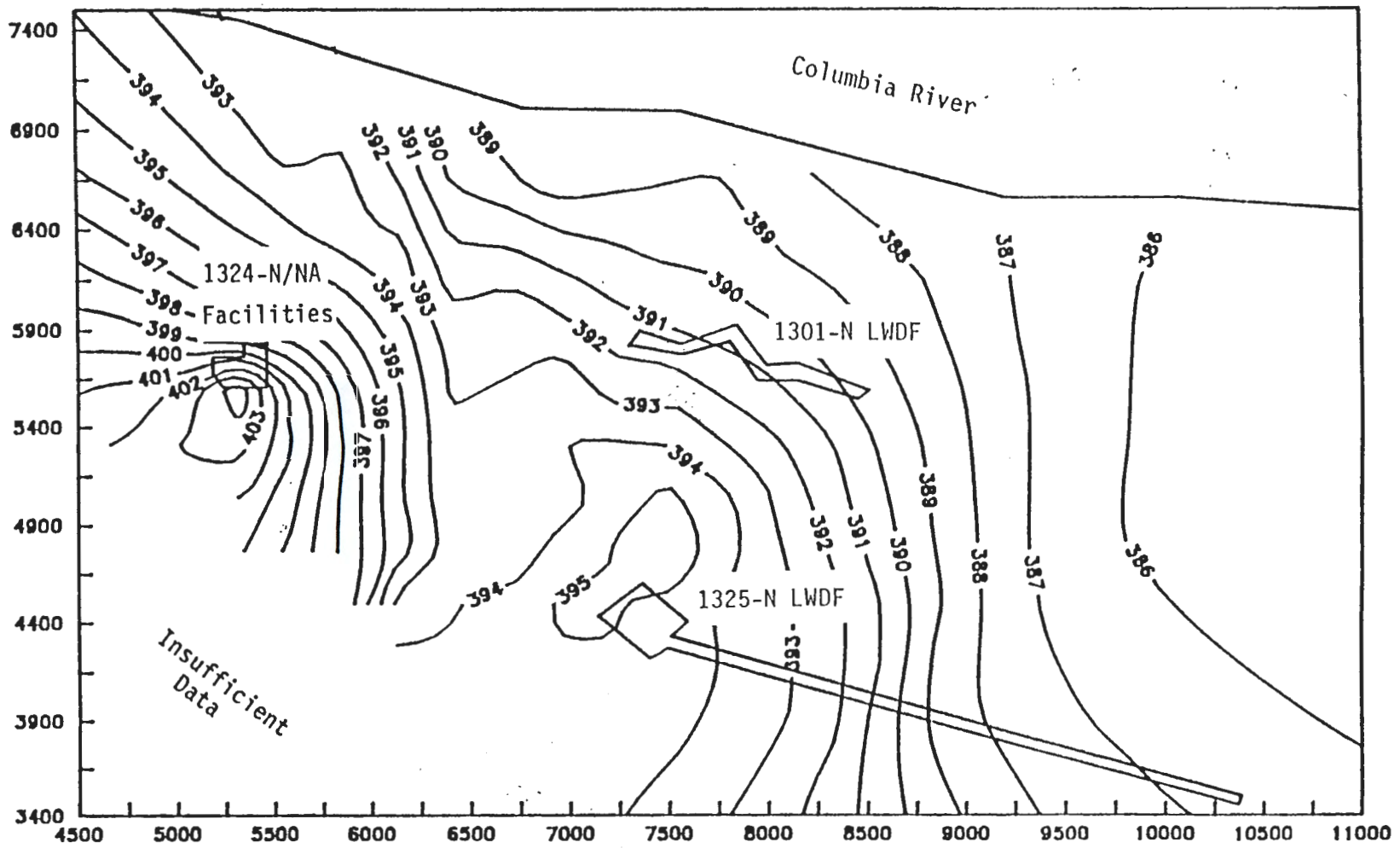


FIGURE B.12. Water-Table Map for the 100-N Area, December 1988

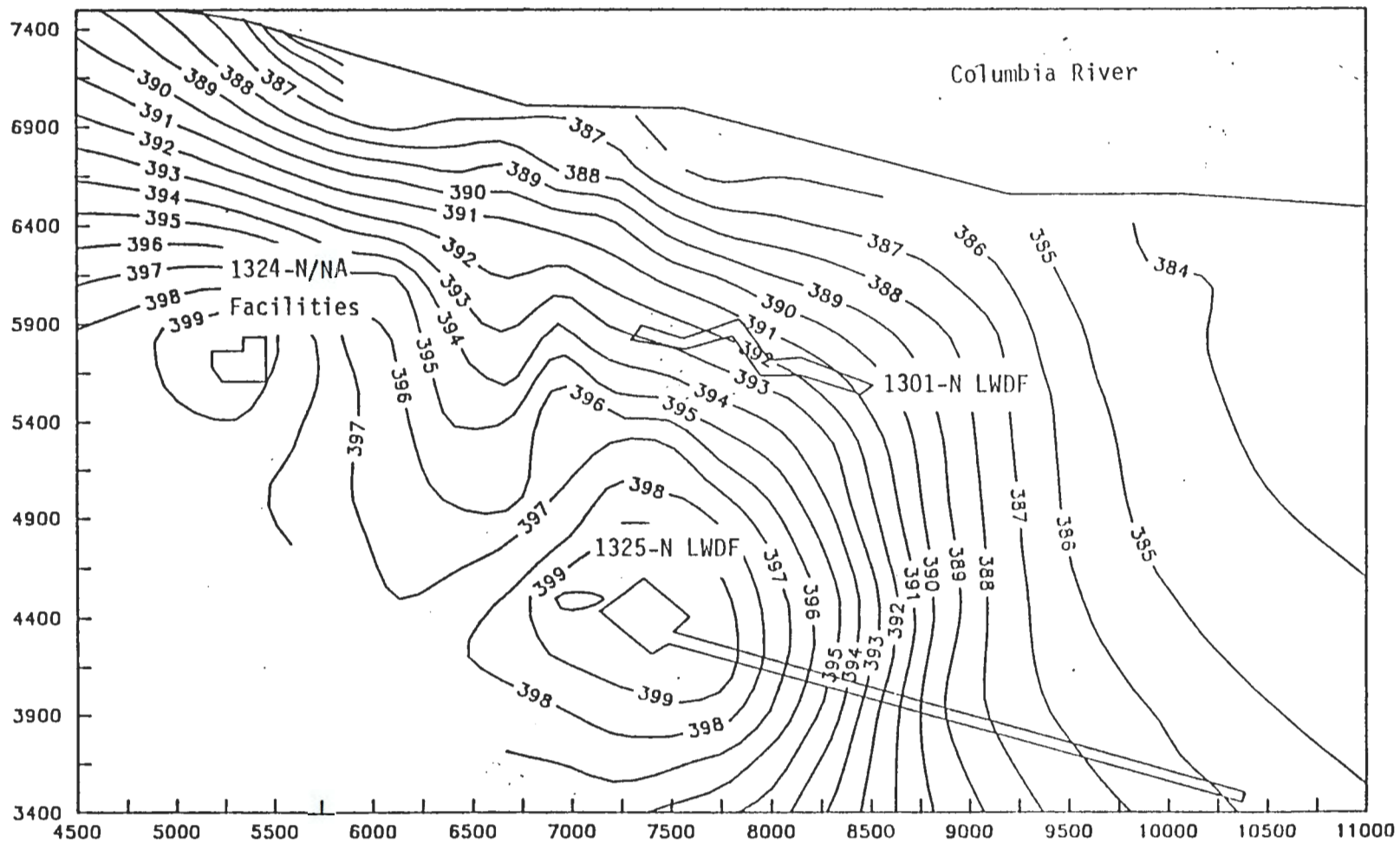


FIGURE B.13. Water-Table Map for the 100-N Area, January 1989

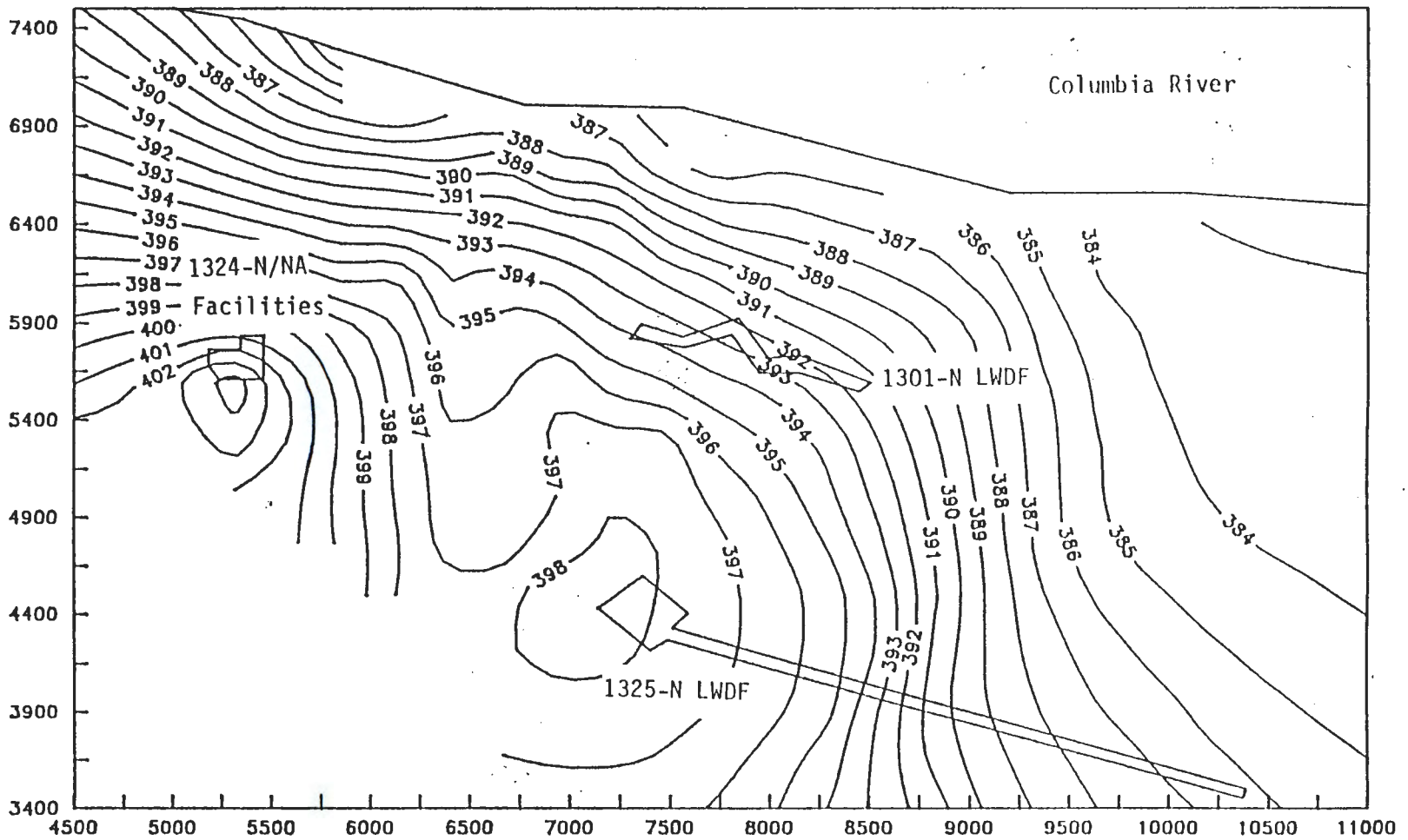


FIGURE B.14. Water-Table Map for the 100-N Area, February 1989

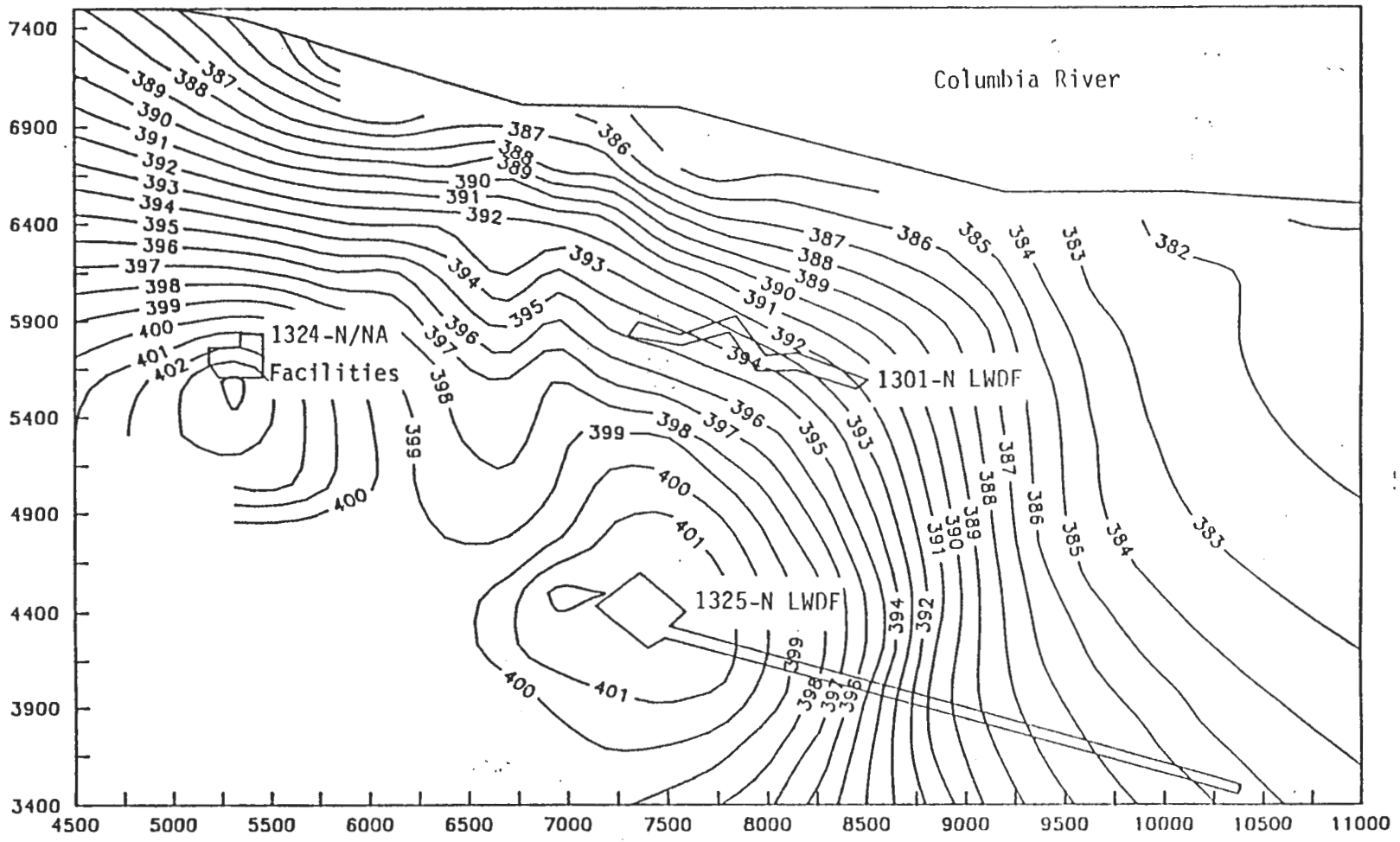


FIGURE B.15. Water-Table Map for the 100-N Area, March 1989

APPENDIX C

AS-BUILT DIAGRAMS FOR WELLS IN THE 1324-N/NA MONITORING NETWORKS

9 2 1 2 4 5 9 1 7 7 0

APPENDIX C

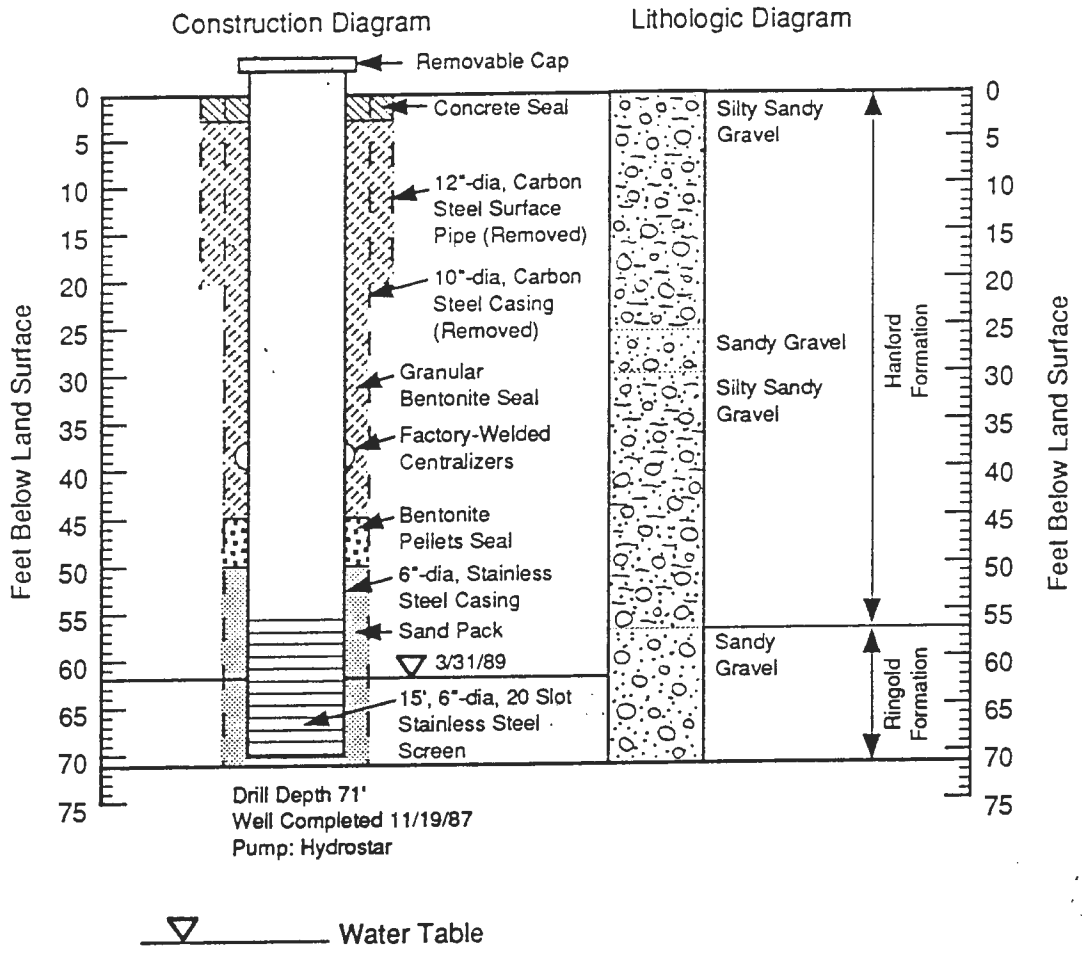
AS-BUILT DIAGRAMS FOR WELLS IN THE 1324-N/NA MONITORING NETWORKS

C.1 ORIGINAL MONITORING WELLS

This section contains the as-built diagrams for the original wells in the 1324-N/NA monitoring network.

9 2 1 2 4 5 9 1 7 7 1

Well Number 199-N-58



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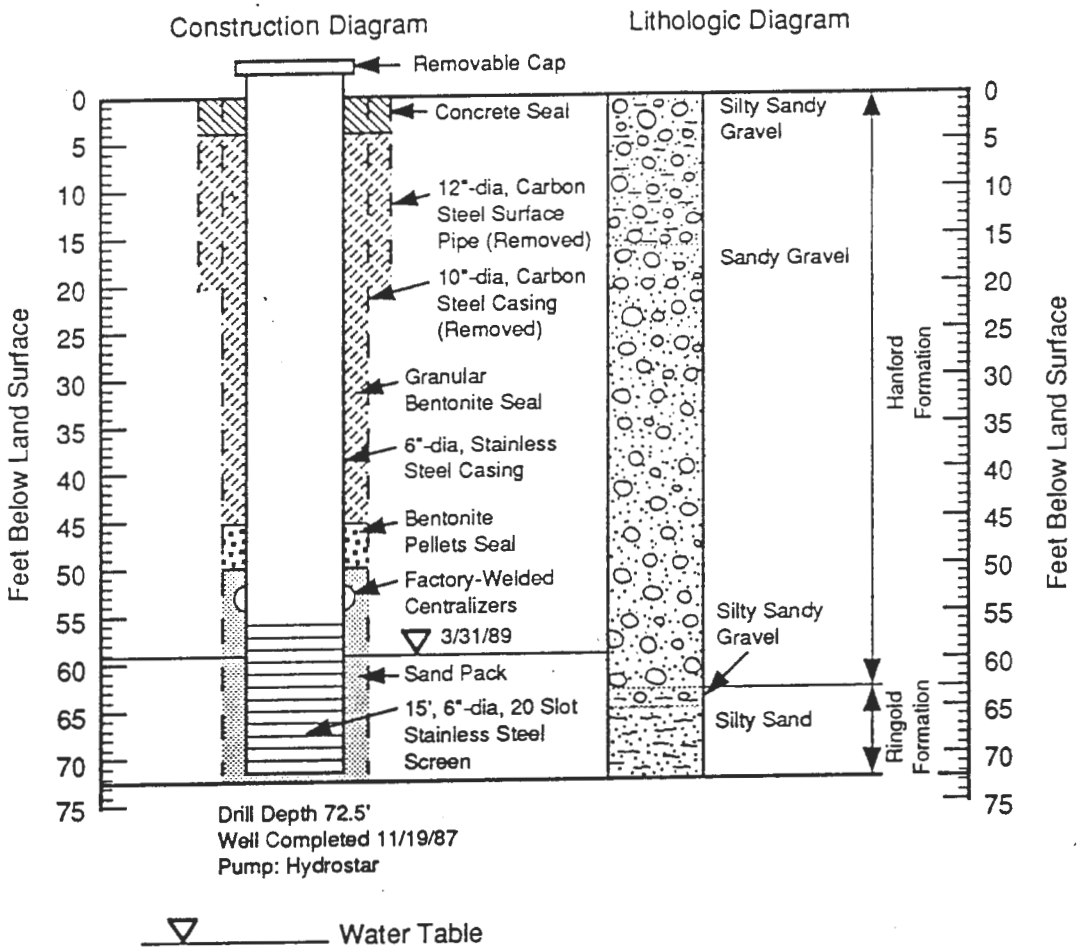

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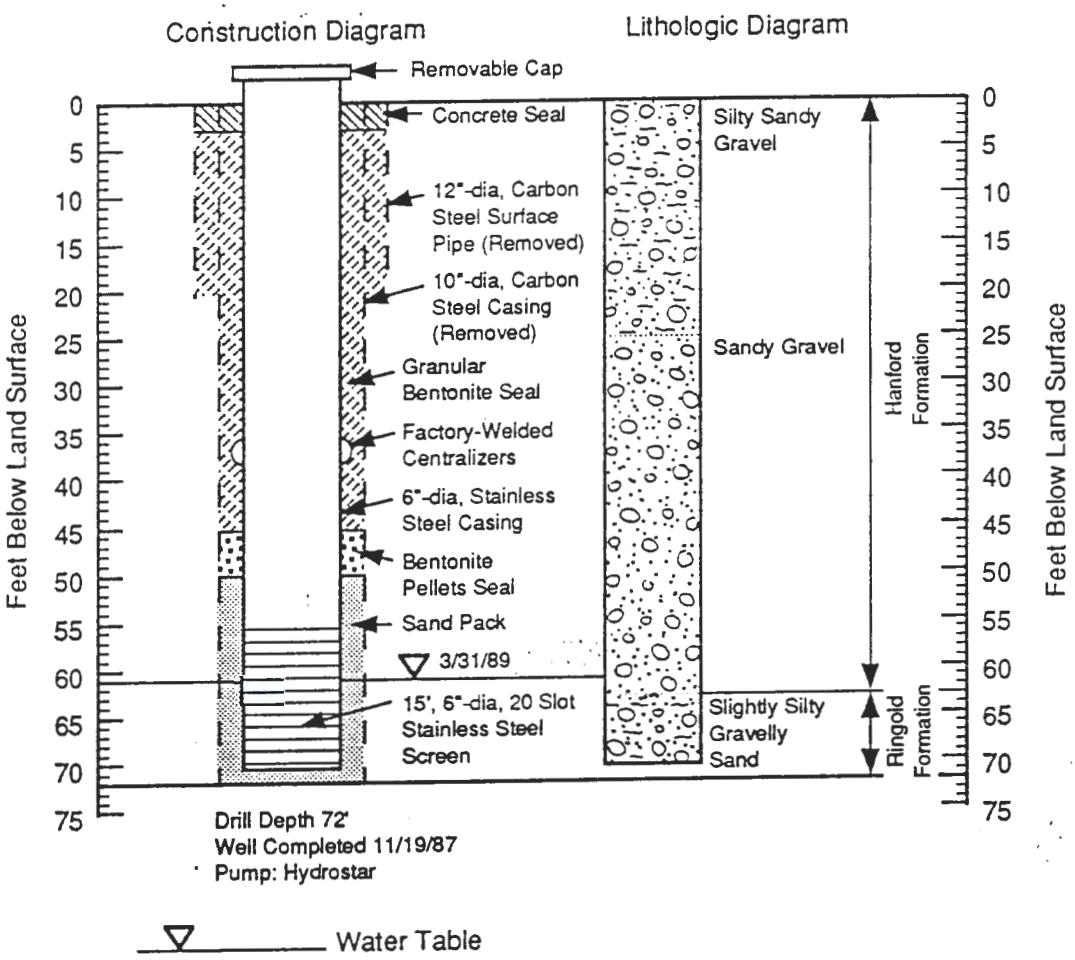
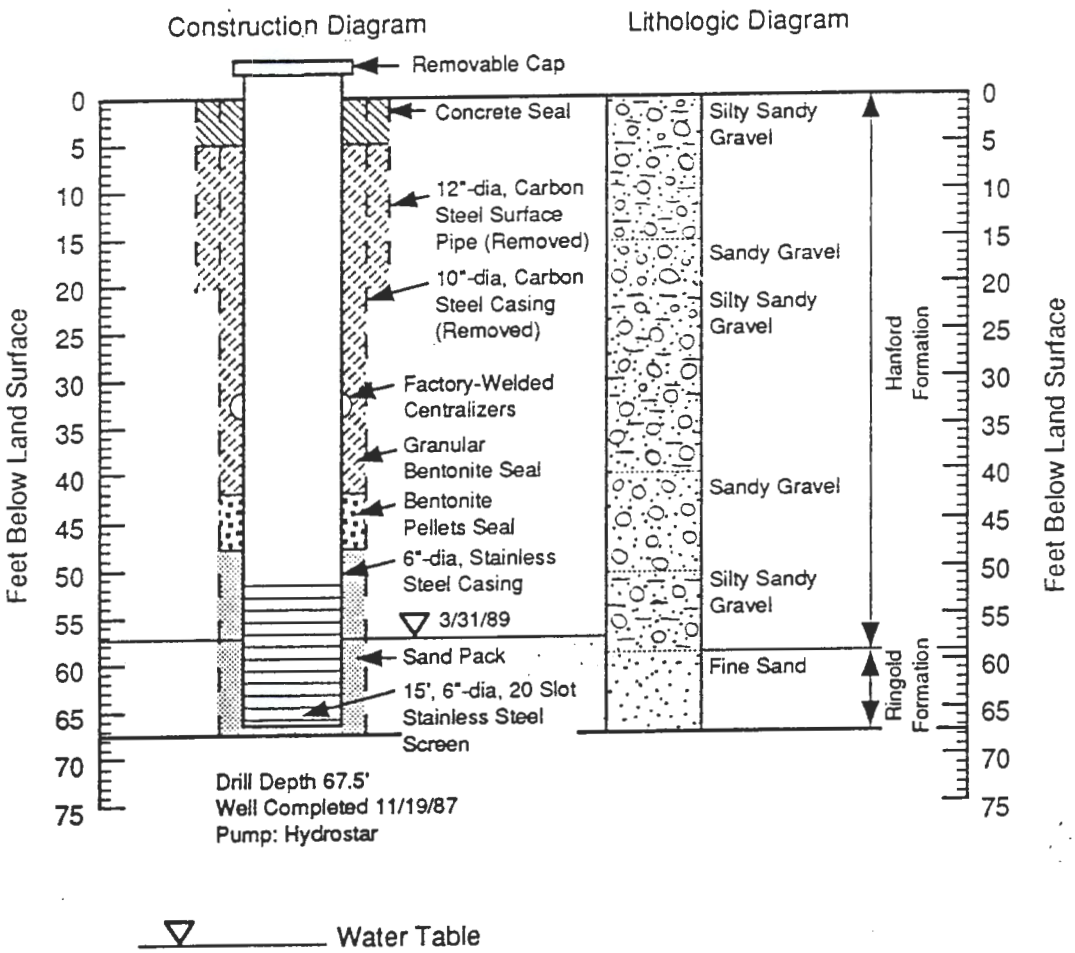


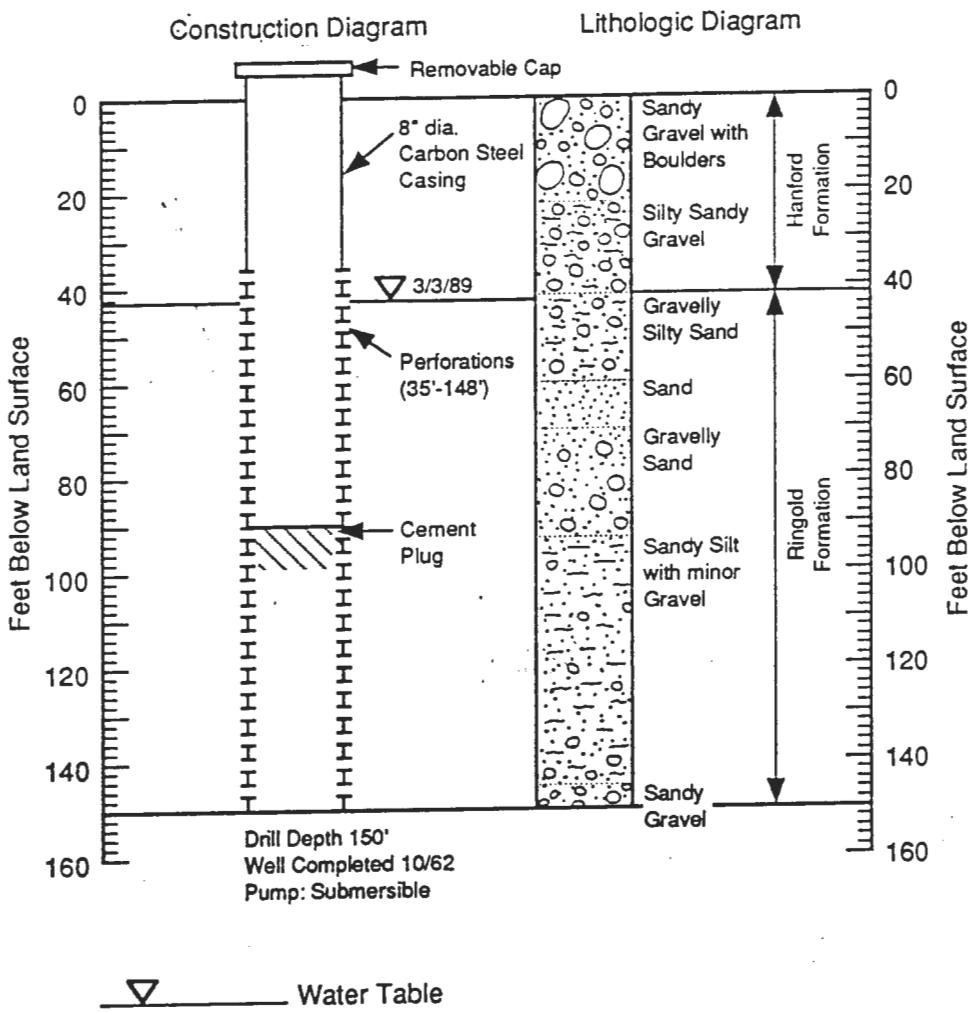
S8904084.3M

Well Number 199-N-61



S8904084.2M

Well Number 699-81-58



S8904084.5M

C.2 GROUND-WATER QUALITY ASSESSMENT MONITORING NETWORK

This section contains information on the expanded network.

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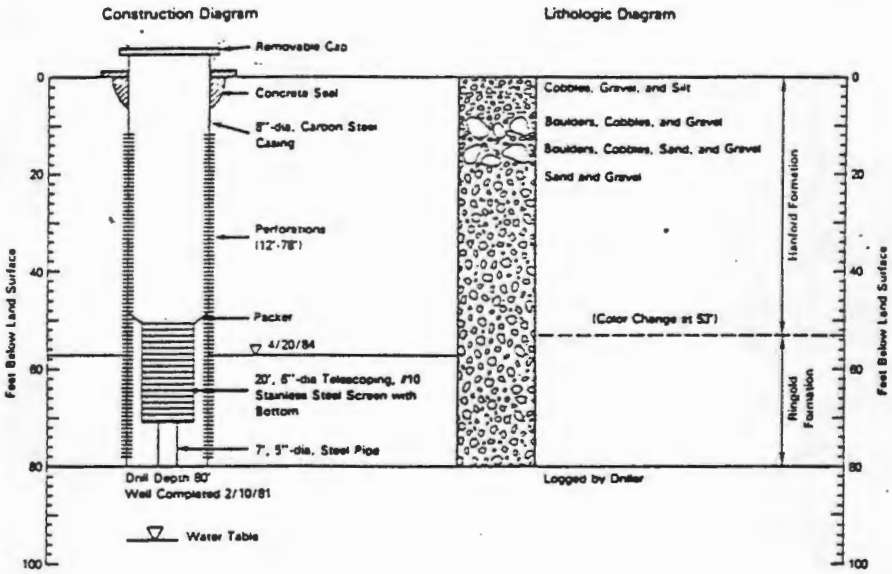
Well Number 199-N-16



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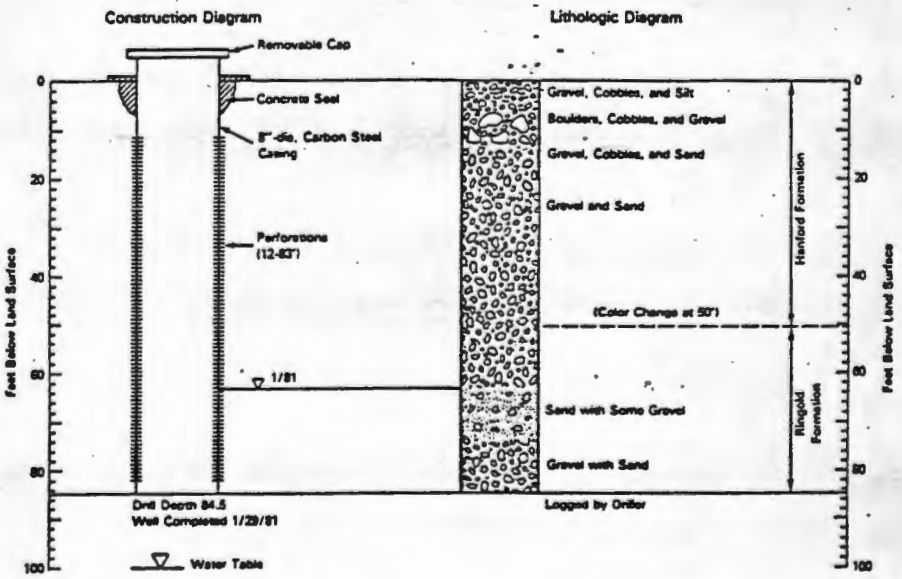
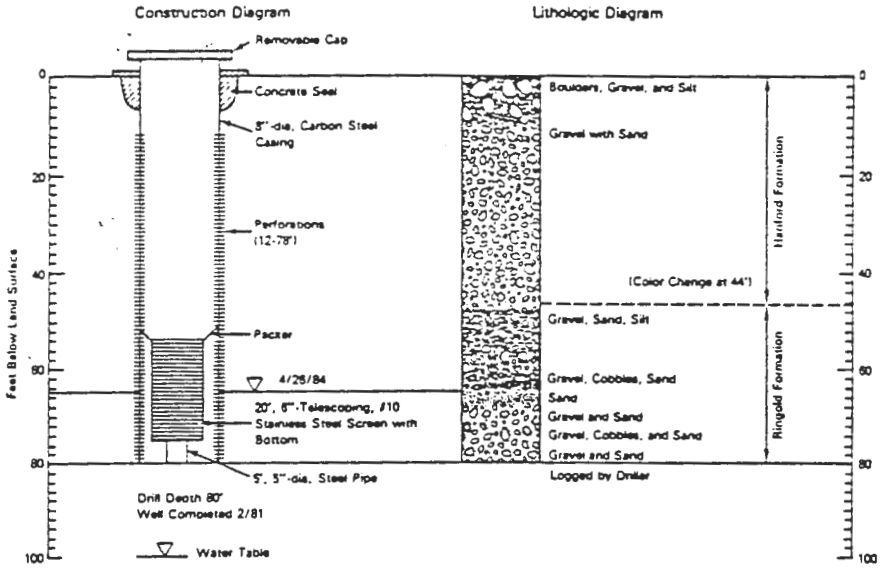


9 2 1 2 4 5 9 1 7 7 8

Well Number 199-N-18



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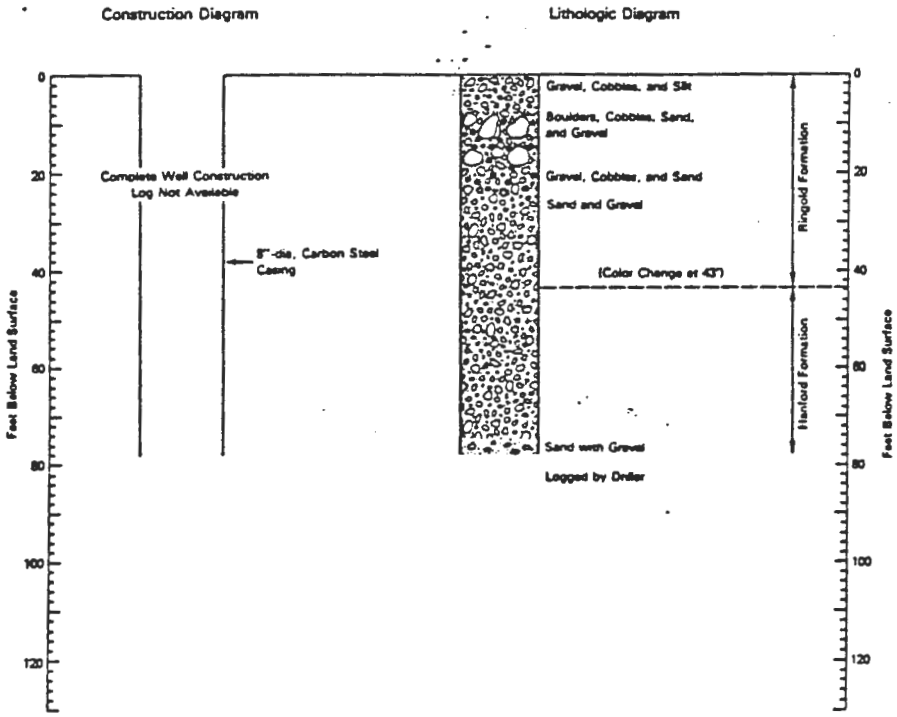

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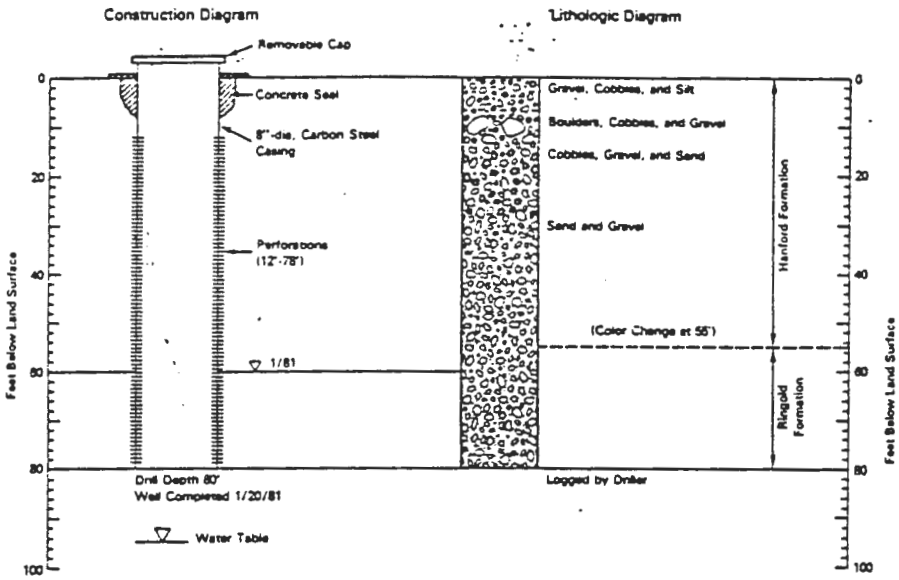

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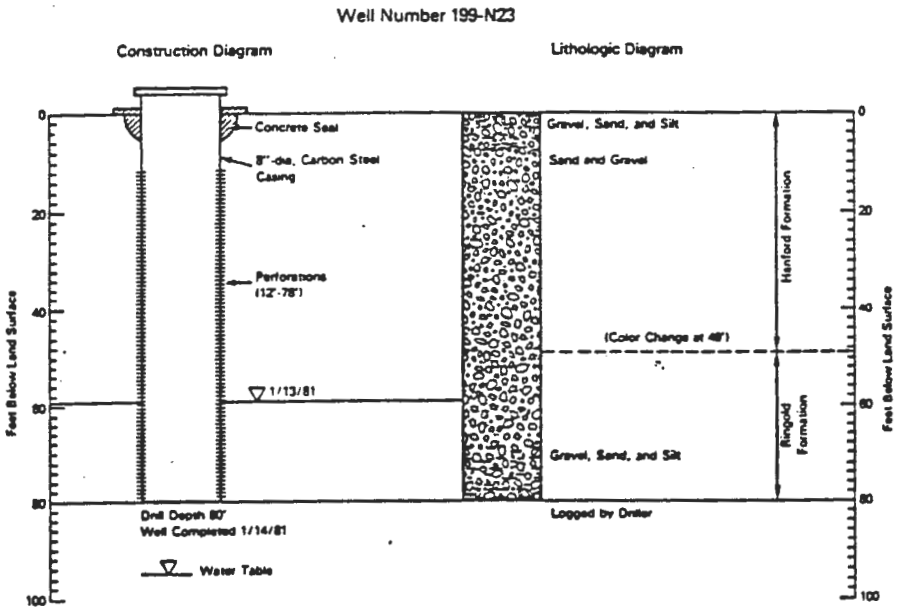

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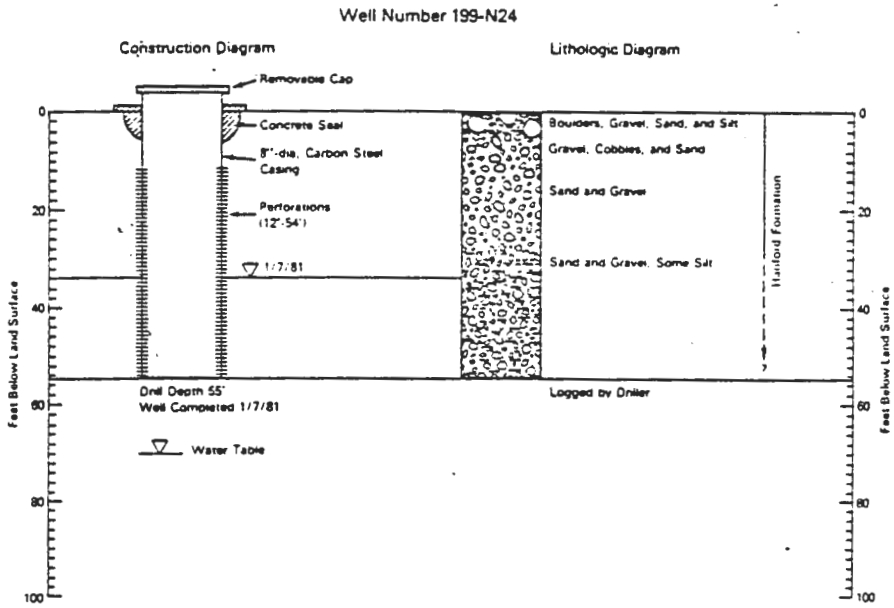

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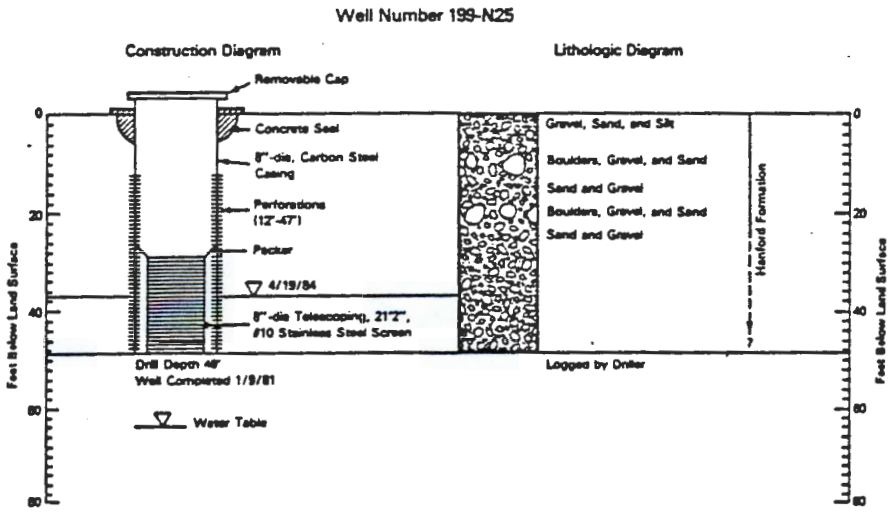

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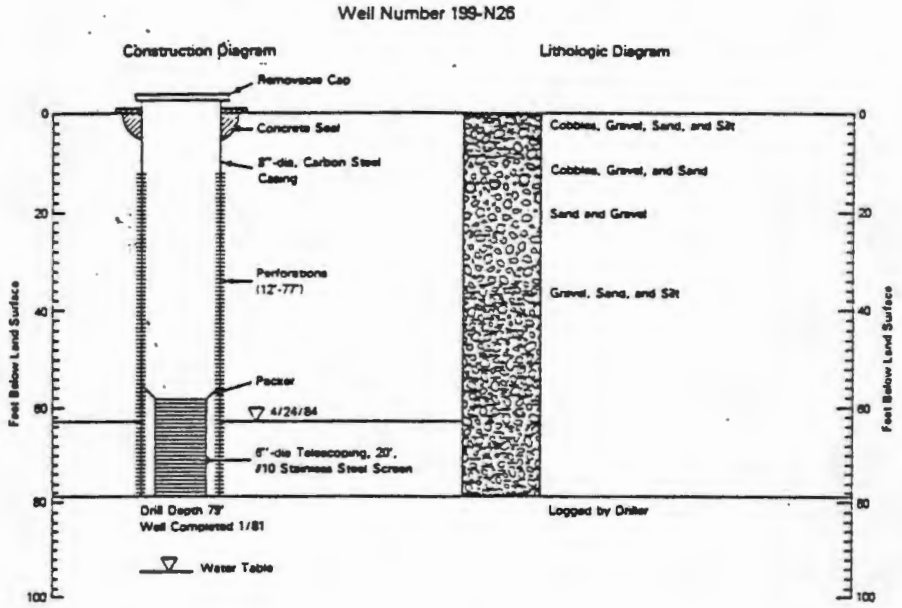

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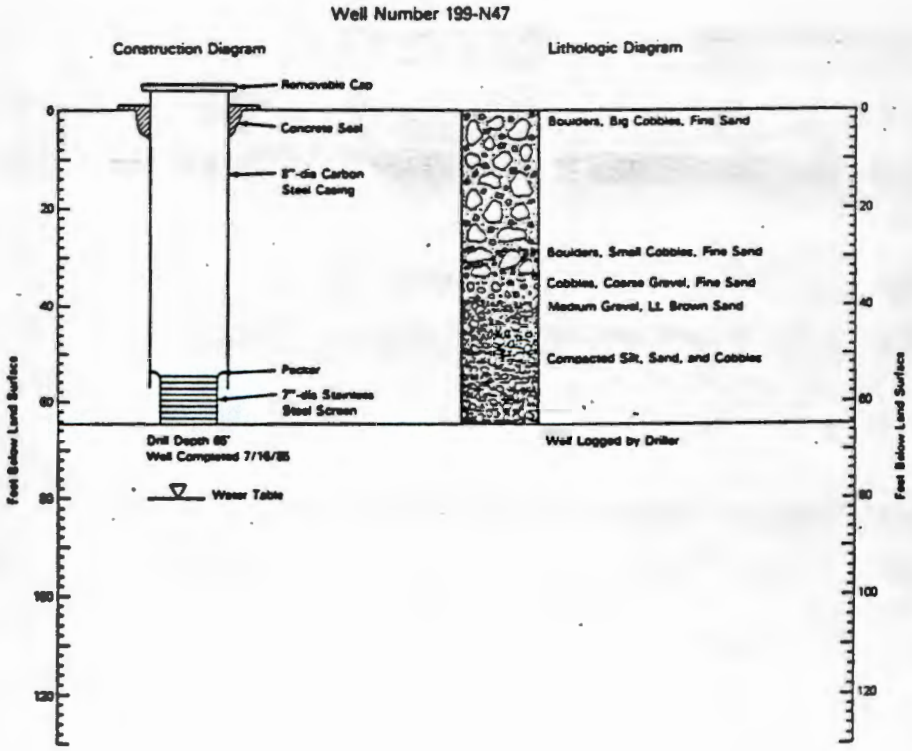
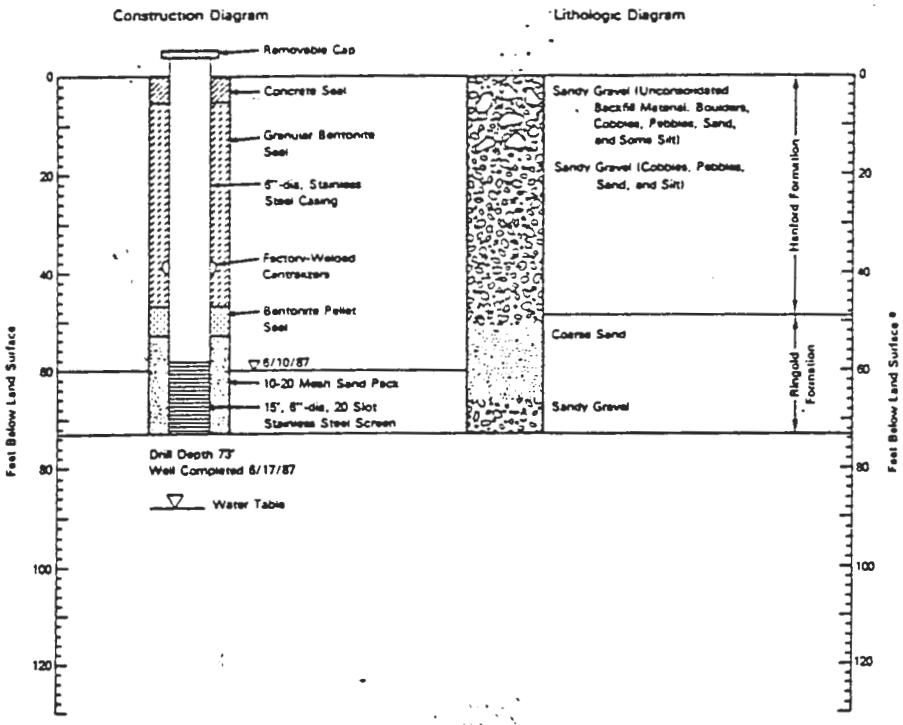


9 2 1 2 4 5 9 1 7 8 2

Well Number 199-N-54



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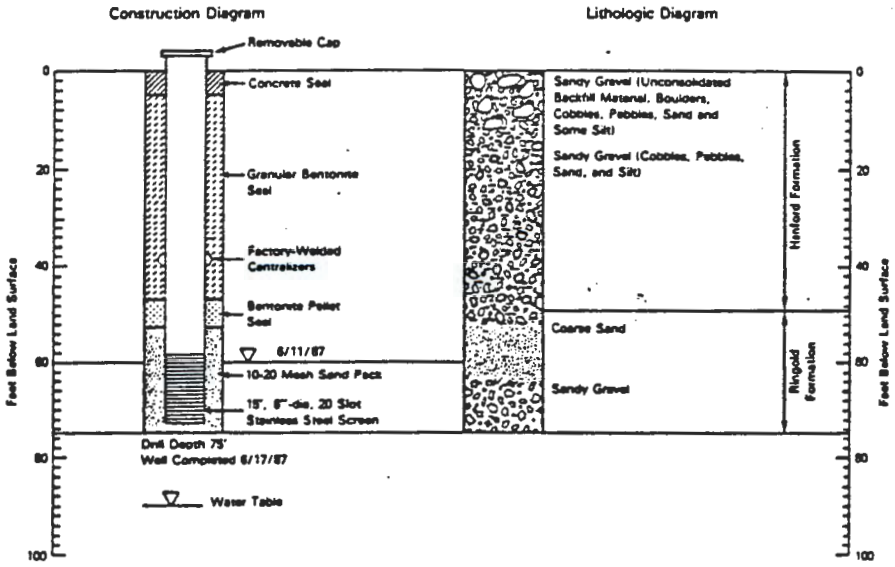

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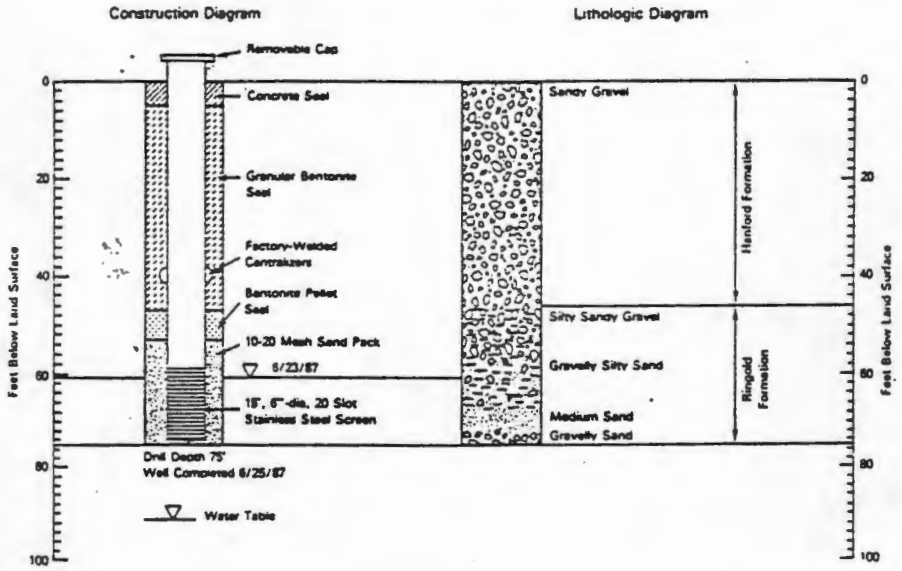

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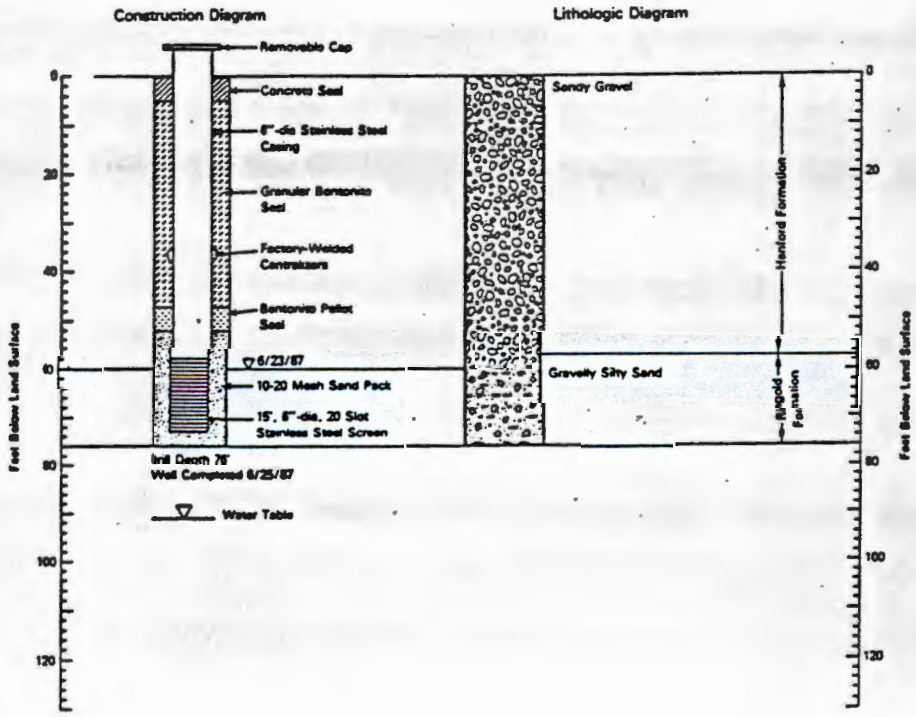

9 2 1 2 4 5 9 1 7 8 4