Water-Table Elevations on the Hanford Site, December 1989

**D. R. Newcomer
J. P. McDonald**

June 1990

**Prepared for the U.S. Department of Energy
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SUMMARY

The Pacific Northwest Laboratory prepared water-table maps of the U.S. Department of Energy's Hanford Site for December 1989 from water-level elevations measured in 225 wells across the Hanford Site. Changes in the elevation of the water table at Hanford occurred beneath the decommissioned U Pond in 200-West Area, B Pond, and 100-N Area. The elevation of the ground-water mound beneath the decommissioned U Pond generally continued to decline, decreasing as much as 0.28 m (0.9 ft) between June and December 1989. This decline has been observed in wells in much of the adjacent 200-West Area and is primarily the result of continued dissipation of the ground-water mound beneath U Pond since it was deactivated in 1984. The elevation of the ground-water mound beneath B Pond, which continues to receive wastewater, also declined as much as 0.28 m (0.9 ft) between June and December 1989. This decline in the water table is primarily the result of decreasing volumes of wastewater discharged to B Pond.

The greatest change in the elevation of the water table occurred beneath the 1325-N liquid waste disposal facility in the 100-N Area. The elevation of the water table beneath this facility decreased as much as 5.96 m (19.6 ft) between June and December 1989.

Other Hanford discharge facilities known to impact the ground-water flow system include the process trenches in the 300 Area and various cribs and trenches in the 200 Areas.

CONTENTS

SUMMARY	iii
INTRODUCTION	1
GEOLOGY	2
HYDROLOGY	2
DATA COLLECTION	5
DATA UNCERTAINTY	6
RESULTS	7
HANFORD SITE WATER-TABLE FEATURES	7
CHANGES IN THE HANFORD SITE WATER TABLE SINCE JUNE 1989	8
B Pond	9
U Pond	9
100-N Area	12
300 Area	14
CONCLUSIONS	17
REFERENCES	19
APPENDIX A - WATER-TABLE MEASUREMENTS FOR THE HANFORD SITE	A.1
APPENDIX B - WATER-LEVEL MEASUREMENTS AT SPECIFIC HANFORD SITE AREAS	B.1

FIGURES

1	Water-Table Map of the Area Beneath B Pond for December 1989 . .	10
2	Water-Table Map of the Area Beneath the Decommissioned U Pond in the 200-West Area for December 1989	11
3	Water-Table Map of the Area Beneath the 1325-N Liquid Waste Disposal Facility in the 100-N Area for December 1989	13
4	Water-Table Map of the Area Beneath the 300 Area for December 1989	15
Plate 1.		Pocket Inside Back Cover

INTRODUCTION

The Site Characterization and Assessment Section, Environmental Sciences Department, of the Pacific Northwest Laboratory (PNL) prepares water-table maps of the Hanford Site in southeastern Washington. Production of these maps supports the Ground-Water Environmental Surveillance Program, which is sponsored by the U.S. Department of Energy (DOE).

Water levels in selected wells open to the unconfined aquifer on the Hanford Site are measured in June and December of each year. The purpose of these measurements is to determine the changes in the configuration of the water table to assess the physical impact of waste disposal on ground-water flow.

Water-level measurements can be used to construct a water-table map that represents the elevation of the water-table surface. These maps can be used to infer general directions of ground-water flow, particularly in the upper part of the aquifer. Ground water moves from regions of higher water-table elevations to regions of lower water-table elevations perpendicular to contours of equal water-table elevation, assuming conditions of isotropic hydraulic conductivities. Water-table maps can be used to

- identify recharge and discharge areas
- evaluate the physical influence of wastewater discharges on ground-water flow directions
- determine the potential for water movement between adjacent ground-water and surface water bodies
- determine the horizontal hydraulic gradient and estimate the average linear velocity of ground-water flow
- improve the design of the water-level monitoring well network.

Also, water-level data used to construct water-table maps are required to calibrate ground-water models.

In addition to water levels measured across the Hanford Site, water levels were also measured from four specific areas within Hanford. Included are areas around the decommissioned 216-U-10 Pond (U Pond), the 216-B-3 Pond

(B-Pond), the 100-N Area, and the 300 Area. The locations of these areas are shown in Plate 1 (located in the pocket inside the back cover). Water-table maps of these areas are intended to enhance the definition of the water-table configuration beneath wastewater discharge facilities that may impact groundwater flow.

Water-level measurements and a water-table elevation map of the Hanford Site for June 1989 are presented in Newcomer et al. (1990). Water-level measurements and a water-table map of the Separations Areas for June 1989 are presented in Kasza et al. (1989). The Separations Areas encompass the 200-East and 200-West Areas and the surrounding vicinity on the Hanford Site. Historical water-level data and an evaluation of past changes to the water-table surface are presented in Zimmerman et al. (1986).

Water-levels are measured in wells that monitor the unconfined aquifer. The wells used to measure water-levels were chosen based on geologic and hydrologic information available. A summary of the geology and hydrology of the Hanford Site follows.

GEOLOGY

The Hanford Site lies within the Pasco Basin, one of many topographic and structural basins within the Columbia Plateau. Principal geologic units beneath the Hanford Site include, in ascending order, the Columbia River Basalt Group, the Ringold Formation, and a series of deposits informally referred to as the Hanford formation. These units are covered locally by a few meters or less of recent alluvial or windblown deposits. Older geologic units have been deformed into a series of roughly east-west trending folds.

HYDROLOGY

Both confined and unconfined aquifers are present beneath the Hanford Site. The confined aquifers lie primarily within the Columbia River basalts. The unconfined aquifer lies in river and lake deposits of the Ringold Formation and glaciofluvial sediments of the Hanford formation, as well as some more recent alluvial sediments in areas adjacent to the Columbia River (Gephart et al. 1979).

The unconfined aquifer is bounded below by either the basalt surface or, in places, the relatively impervious clays and silts of the lower unit of the Ringold Formation. Laterally, the unconfined aquifer is bounded by the basalt ridges that surround the basin and by the Yakima and Columbia rivers. The basalt ridges have a low permeability and act as a barrier to lateral flow of ground water (Gephart et al. 1979) where they rise above the water table. The saturated thickness of the unconfined aquifer is greater than 61 m (200 ft) in some areas of the Hanford Site and pinches out along the flanks of the basalt ridges. Depth from the ground surface to the water table ranges from less than 0.3 m (1 ft) near the Columbia River to more than 106 m (348 ft) near the 200 Areas.

DATA COLLECTION

During December 1989 water levels were measured across the Hanford Site in 225 wells open to the unconfined aquifer. Additional measurements were taken in 98 wells near U Pond, B Pond, the 100-N Area, and the 300 Area. Most monitoring wells at the Hanford Site used for water-level measurement are 15 or 20 cm (6 or 8 in.) in diameter and are constructed of steel casing. Several small-diameter [5-cm (2-in.)] piezometers and some larger diameter wells are also used. New wells constructed for Resource Conservation and Recovery Act ground-water monitoring are 10 cm (4 in.) in diameter. Monitoring wells used to measure water levels for the unconfined aquifer are completed with well screens or perforated casing generally open to the upper 3 to 6 m (10 to 20 ft) of the aquifer. This type of completion allows measurements representative of the water-table elevation. Well locations for water-level monitoring are shown in Plate 1.

Wells were added to the water-level monitoring network for December 1989 in areas where little information exists for estimating the water-table contours. The most notable area where wells were added include the area north of B Pond bordering the southern edge of Gable Mountain (see Plate 1). A few wells were removed from the network to eliminate redundancy in taking measurements in closely spaced wells where the gradient of the water table is very small (e.g., northern perimeter of the 200-East Area).

Five new wells, installed in 1989, were added to the water-level monitoring network at B Pond. These wells are located along the perimeter of the ponds and near the 216-A-29 Ditch.

A written procedure developed in accordance with the techniques described in ASTM (1988), EPA (1986), Garber and Koopman (1968), and USGS (1977) was followed to measure water levels in piezometers and wells (PNL 1989). A chalked standardized steel tape was used to measure the depth to the water surface in units of feet from a surveyed measuring point. These measurements were repeated to confirm the initial value. If the second measurement differed by more than 0.02 ft from the first, the water level was remeasured until two

measurements within this tolerance were obtained. Measurements were compared to previous measurements of depth to water to provide a check for gross errors.

Elevation of the water-table was determined from the depth-to-water measurements. The values were calculated by subtracting the depth-to-water measurements from the surveyed measuring point elevations on the well casings. The reference for all measuring point elevations is mean sea level. The elevation of the water-table surface, S , can be expressed as:

$$S = E - D$$

where S = elevation of the water-table surface above mean sea level.

E = elevation of surveyed measuring point above mean sea level

D = depth to the water-level surface in the piezometer or well, measured below the surveyed measuring point.

All depth-to-water measurements are conducted within a 3-week period to minimize the effects of long-term, time-variant water-level changes.

Steel tapes were standardized against a calibrated steel tape at a selected well at Hanford. This standardization procedure is documented in PNL (1989).

DATA UNCERTAINTY

All water-level measurements are collected within a 3-week period. The greatest short-term water-level changes that occur within this period are in wells influenced by the rise and fall of the Columbia River stage. This may cause some variability in the location of the water-table contours adjacent to the river. Other minor uncertainties in the water-level measurements are caused by effects from diurnal changes (e.g., barometric effects), deviations from the vertical installation of wells, errors in the elevation of the surveyed measuring points, and errors in the standard tolerances of the field equipment.

RESULTS

Water levels measured during December 1989 for the Hanford Site water-table map are listed in Appendix A. Water levels measured during December 1989 for specific areas within the Hanford Site are listed in Appendix B. The Hanford Site water-table map, presented in Plate 1, was constructed by hand-contouring the values for the water-table elevation. The contours in Plate 1 are in units of meters. To allow the map to be more easily read, the prefixes have been omitted from all well numbers shown on the map. Well numbers in the 100 Areas have the prefix 199, well numbers in the 200-East and 200-West Areas have the prefix 299, well numbers in the 300 Area have the prefix 399, and well numbers in the 600 Area have the prefix 699.

HANFORD SITE WATER-TABLE FEATURES

The following are important features of the Hanford Site water-table map:

- Water-table elevations generally decrease from west to east across the Hanford Site south of Gable Mountain and Gable Butte.
- Water-table elevations decrease northward through the gap between Umtanum Ridge and Gable Butte and between Gable Butte and Gable Mountain.
- The hydraulic gradient of the water table decreases abruptly between the 200-West and 200-East Areas.
- The water level in the Yakima River is of higher elevation than that of the water table in the adjacent region of the Hanford Site.
- Ground-water mounds are present beneath B Pond and the location of decommissioned U Pond.

Elevated water levels in the western region of the Hanford Site may be attributable to ground-water recharge in Cold Creek and Dry Creek valleys and on the adjacent ridges (i.e., Yakima, Umtanum, and Rattlesnake Ridges). The source of recharge is most likely infiltration of rain and snow at the higher elevations and excess irrigation of agricultural land at the lower elevations.

Water-table elevation generally decreases toward the Columbia River at the eastern edge of the Hanford Site and north of the Gable Mountain-Gable

Butte anticline, implying discharge of unconfined ground water to the Columbia River along the Hanford reach (the free-flowing stretch of the Columbia River between Priest Rapids Dam and the city of Richland).

The abrupt change in the hydraulic gradient of the water table between the 200-West and 200-East Areas is attributed to an increase in the hydraulic conductivity of the sediments from west to east (Graham et al. 1981).

A water-table elevation lower than the Yakima River in the region between Horn Rapids Dam and the city of Richland implies that the unconfined aquifer is being recharged by the Yakima River. Water levels measured in this region also indicate that ground water recharged by the Yakima River flows to the east beneath the southern portion of the Hanford Site and discharges to the Columbia River.

Ground-water mounds beneath B Pond and the location of the decommissioned U Pond have been caused by process cooling water and other liquid wastes recharging the ground water at those locations. A summary of wastewater discharges to disposal facilities in the 200 Areas is presented by Cooney and Thomas (1989).

CHANGES IN THE HANFORD SITE WATER TABLE SINCE JUNE 1989

The greatest change to the ground water at Hanford occurred beneath B Pond, located east of the 200-East Area, beneath the decommissioned U Pond in the 200-West Area, and beneath the 1325-N liquid waste disposal facility in the 100-N Area. Wastewater recharging the ground water at those locations has caused large ground-water mounds. Wastewater discharges to the process trenches in the 300 Area have also impacted the ground water. A summary of waste discharges to disposal facilities in the 200 and 600 Areas for 1988 is presented by Cooney and Thomas (1989).

The elevation of the water table beneath the 200 Areas declined between June 1989 and December 1989. This decline is primarily attributed to 1) an overall decrease in wastewater discharged to the ground surface at B Pond and various cribs and trenches in the 200 Areas and 2) continued dissipation of the ground-water mound beneath U Pond since it was decommissioned in 1984.

Water-level changes also occurred in wells near the Columbia River. These water-level changes indicate that the water table fell as much as 0.3 m (1 ft) along the Columbia River between June and December 1989. These changes are primarily the result of changes in bank storage caused by the fall of the river stage. The Columbia River stage changes in response to releases at the Priest Rapids Dam upstream from the Hanford reach and to seasonal influences.

B Pond

A map of the water table beneath B Pond is presented in Figure 1. This map indicates that ground water flows radially from beneath B Pond. The elevation of the water table beneath B Pond has decreased as much as 0.28 m (0.9 ft) since June 1989 (as reflected in the water level in well 699-42-40B). This decline in the elevation of the water table reflects the general decrease in wastewater discharged to B Pond.

An exception to this water-level change is the water level in well 699-39-39, located south of B Pond. The water level in this well decreased 0.67 m (2.2 ft) between June 8, 1989, and December 7, 1989, using the Hanford Site measurements. However, between December 7, and December 21, 1989, the water level increased 0.43 m (1.4 ft), to an elevation higher than the nearest well 699-40-39. Because the water level in well 699-39-39 is higher than expected relative to water levels in other wells at B Pond, the configuration of the water table in the vicinity of this well cannot be determined (see Figure 1). The water level in this well has been changing significantly since 1987, rising as much as 2.2 m (7.2 ft) in 1988 and falling as much as 2.1 m (6.9 ft) in 1989. Water-table maps of the B Pond area for June 1989 are presented in Kasza et al. (1989) and Newcomer et al. (1990). A water-table map of B Pond for November 1989 is presented in Smith and Gorst (1990).

U Pond

A map of the water table beneath the decommissioned U Pond is presented in Figure 2. This map indicates that ground water flows radially, mostly to the north and east from an area near the 216-U-14 Ditch, located east-northeast of the decommissioned U Pond. This ditch continues to receive cooling water

FIGURE 1. Water-Table Map Beneath B Pond for December 1989

- NM No Measurement
- W22-8 Well Location and Number (Well Prefixed by 199- or 699- as Appropriate)
- Contour Line
- - - Chain Link Fence
- + + + + + Railroad Tracks
- == Roads
- Hanford Plant Coordinates

FIGURE 2. Water-Table Map of the Area Beneath the Decommissioned U Pond in the 200-West Area for December 1989

and steam condensate (Cooney and Thomas 1989). The Hanford Site water-table map in Plate 1 indicates that the ground-water mound in this area has influenced regional flow.

U Pond was decommissioned in 1984, and the elevation of the ground-water mound at that location continues to decline. The maximum elevation, which occurred in 1984, of the ground-water mound was approximately 148 m (485 ft) above mean sea level. The elevation of the ground-water mound beneath the decommissioned U Pond has decreased as much as 4.7 m (15 ft) (as reflected in the water level in well 299-W18-15) since June 1984. Since June 1989, the elevation of the ground-water mound has decreased as much as 0.28 m (0.9 ft) (as reflected in the water level in well 299-W19-1). This decline in the elevation of the ground-water mound beneath the deactivated U Pond has been observed in wells in much of the adjacent 200-West Area. This decline is primarily attributed to continued dissipation of the ground-water mound beneath U Pond since it was decommissioned in 1984. A water-table map of the U Pond area for June 1989 is presented in Newcomer et al. (1990). A water-table map of the Separations Area, which includes the deactivated U Pond area, is presented in Kasza et al. (1989).

100-N Area

The Hanford Site water-table map indicates that ground water passing beneath the 100-N Area flows from the south through the gap between Gable Butte and Gable Mountain and discharges to the Columbia River. The water-table map of the 100-N Area is shown in Figure 3. Water-table maps of the 100-N Area, presented in Smith et al. (1989a, 1989b) and Newcomer et al. (1990), between January and June 1989 indicated a ground-water mound beneath the 1325-N liquid waste disposal facility. Wastewater discharge to this facility was the primary influence on the water table beneath the 100-N Area. The water-table map of the 100-N Area for December 1989, however, indicates that the ground-water mound beneath the 1325-N facility has dissipated significantly since June 1989. The water table is also influenced by wastewater discharged to the 1324 N/NA facility and by changes in the stage of the Columbia River. The configuration of the water table is dependent on all the aforementioned influences.

FIGURE 3. Water-Table Map of the Area Beneath the 1325-N Liquid Waste Disposal Facility in the 100-N Area for December 1989 (modified from Smith et al. 1990)

The water table declined as much as 5.96 m (19.6 ft) (as reflected in the water level in well 199-N-27) beneath the 1325-N liquid waste disposal facility between June and December 1989. This decline is primarily the result of decreasing wastewater discharged to the 1325-N facility between June and December 1989 (Smith et al. 1989c; 1990). The water-table map in Figure 3 indicates that the primary ground-water flow directions beneath the 100-N Area is northwest toward the Columbia River. Water-table maps of the 100-N Area between June and December 1989 are presented in quarterly reports by Smith et al. (1989c; 1990) and by Smith and Gorst (1990).

300 Area

The water-table map of the 300 Area for December 1989 in Figure 4 indicates that ground water flows from the northwest, west, and southwest and discharges to the Columbia River. The primary influences on the ground-water elevation are changes in the stage of the Columbia River and recharge from the process trenches. These trenches have received large volumes of process water (Schalla et al. 1988). The configuration of the water table is primarily dependent on these influences.

The water table rose as much as 0.42 m (1.4 ft) in most of the 300 Area between June 23 and December 27, 1989, primarily as a result of an increasing stage elevation of the Columbia River. The water-table map in Figure 4 indicates that the primary ground-water flow direction beneath the 300 Area is southeasterly toward the Columbia River. However, a "reversed" hydraulic gradient occurs between the river stage and the water table, causing river water to flow into the aquifer. This is a result of the river stage rising to an elevation higher than the water table. Water-table maps of the 300 Area between June and December 1989 are presented in reports by Smith et al. (1989c; 1990) and by Smith and Gorst (1990).

Figure 1. Bathymetry of the area around the 300 ft depth contour (for December 1989) (contour interval 100 ft).

CONCLUSIONS

Changes to the configuration of the Hanford Site water table are summarized as follows:

- The elevation of the ground-water mound beneath the decommissioned U Pond declined as much as 0.28 m (0.9 ft) since June 1989, primarily as a result of continued dissipation of the ground-water mound beneath much of the 200-West Area.
- The elevation of the ground-water mound beneath B Pond declined as much as 0.28 m (0.9 ft) since June 1989 as a result of decreasing volumes of wastewater discharged to B Pond.
- The elevation of the water table beneath the 1325-N liquid waste disposal facility in the 100-N Area decreased approximately 5.96 m (19.6 ft) between June and December 1989, primarily the result of decreasing wastewater discharged to this facility between June and December 1989.
- Other Hanford discharge facilities known to impact the ground-water flow system include the process trenches in the 300 Area and various cribs and trenches in the 200 Areas.

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APPENDIX A

WATER-LEVEL MEASUREMENTS FOR THE HANFORD SITE

APPENDIX A

WATER-LEVEL MEASUREMENTS FOR THE HANFORD SITETABLE A.1. Hanford Site Water-Level Measurements in Unconfined Aquifer Wells, December 1989

<u>Well</u>	<u>Date</u>	<u>Casing Elevation, ft above MSL (a)</u>	<u>Depth to Water, ft</u>	<u>Water-Table Elevation, ft above MSL</u>	<u>Water-Table Elevation, m above MSL</u>
199-B04-01	12/04/89	461.80	63.72	398.08	121.33
199-D02-05	12/04/89	460.87	74.74	386.13	117.69
199-F05-01	12/05/89	406.56	37.08	369.48	112.62
199-H03-01	12/05/89	421.48	46.08	375.40	114.42
199-K00-11	12/04/89	467.66	74.39	393.27	119.87
299-E13-10	12/14/89	738.84	333.73	405.11	123.48
299-E17-10	12/13/89	714.74	310.09	404.65	123.34
299-E18-01	12/13/89	720.24	315.37	404.87	123.40
299-E23-02(0)	12/13/89	720.91	316.18	404.73	123.36
299-E25-11	12/13/89	681.28	276.36	404.92	123.42
299-E25-32P	12/13/89	669.19	263.59	405.60	123.63
299-E25-34	12/13/89	662.87	257.41	405.46	123.58
299-E25-35	12/13/89	674.39	269.41	404.98	123.44
299-E26-01	12/13/89	617.25	211.71	405.54	123.61
299-E27-09	12/13/89	629.21	224.38	404.83	123.39
299-E28-01	12/13/89	685.20	280.25	404.95	123.43
299-E28-27	12/13/89	680.37	275.93	404.44	123.27
299-E32-02	12/13/89	670.06	265.79	404.27	123.22
299-E33-14	12/13/89	622.12	217.26	404.86	123.40
299-E33-33	12/13/89	640.18	235.59	404.59	123.32
299-E34-02	12/13/89	630.80	226.10	404.70	123.35
299-E34-05	12/13/89	590.79	185.21	405.58	123.62
299-W07-01	12/18/89	690.71	229.40	461.31	140.61
299-W07-04	12/18/89	671.69	209.08	462.61	141.00
299-W07-06	12/18/89	678.64	218.78	459.86	140.17
299-W09-01	12/18/89	737.73	273.01	464.72	141.65
299-W10-05	12/13/89	672.31	205.33	466.98	142.34
299-W10-13	12/18/89	699.04	232.90	466.14	142.08
299-W11-10	12/13/89	728.89	271.21	457.68	139.50
299-W15-16	12/18/89	684.89	215.41	469.48	143.10
299-W18-15	12/13/89	660.76	190.37	470.39	143.37
299-W18-21	12/18/89	668.62	199.76	468.86	142.91
299-W18-24	12/18/89	684.35	214.31	470.04	143.27
299-W19-01	12/13/89	673.77	201.22	472.55	144.03
299-W19-04	12/13/89	715.26	254.23	461.03	140.52
299-W19-13	12/13/89	695.08	229.34	465.74	141.96
299-W21-01	12/13/89	699.26	243.01	456.25	139.07
299-W22-08	12/13/89	683.55	225.04	458.51	139.75

TABLE A.1. (contd)

Well	Date	Casing Elevation, ft above MSL (a)	Depth to Water, ft	Water-Table Elevation, ft above MSL	Water-Table Elevation, m above MSL
299-W23-11	12/13/89	664.14	197.01	467.13	142.38
399-08-01	12/11/89	394.88	51.99	342.89	104.51
699-02-03	12/12/89	477.14	86.64	390.50	119.02
699-02-33A	12/11/89	536.37	132.70	403.67	123.04
699-03-45	12/11/89	504.54	93.09	411.45	125.41
699-08-17	12/12/89	522.44	123.38	399.06	121.63
699-08-25	12/11/89	509.30	108.78	400.52	122.08
699-08-32	12/11/89	554.39	153.48	400.91	122.20
699-09-E02	12/12/89	418.09	46.13	371.96	113.37
699-10-54B	12/07/89	516.20	103.19	413.01	125.89
699-10-E12	12/08/89	430.86	73.62	357.24	108.89
699-11-45A	12/07/89	578.58	167.01	411.57	125.45
699-14-38	12/07/89	514.89	110.39	404.50	123.29
699-14-47	12/07/89	587.23	175.38	411.85	125.53
699-15-15A	12/11/89	547.14	147.93	399.21	121.68
699-15-26	12/11/89	523.83	121.70	402.13	122.57
699-17-05	12/12/89	433.19	44.69	388.50	118.41
699-17-70	12/22/89	563.18	88.83	474.35	144.58
699-19-43	12/07/89	551.58	146.43	405.15	123.49
699-19-58	12/07/89	573.05	153.83	419.22	127.78
699-19-88	12/11/89	644.45	131.44	513.01	156.37
699-20-20	12/12/89	505.58	103.35	402.23	122.60
699-20-39	12/07/89	539.98	135.52	404.46	123.28
699-20-E12	12/08/89	437.25	79.70	357.55	108.98
699-21-17	12/08/89	527.31	129.00	398.31	121.40
699-24-01T	12/08/89	475.54	98.87	376.67	114.81
699-24-33	12/07/89	524.21	120.25	403.96	123.13
699-25-55	12/14/89	676.55	262.85	413.70	126.10
699-25-70	12/07/89	629.78	180.73	449.05	136.87
699-26-15A	12/08/89	442.64	43.28	399.36	121.72
699-26-89	12/11/89	653.08	180.12	472.96	144.16
699-27-08	12/08/89	465.67	70.64	395.03	120.41
699-28-40	12/07/89	559.44	154.88	404.56	123.31
699-28-52A	12/14/89	684.67	278.53	406.14	123.79
699-29-78	12/06/89	647.05	182.93	464.12	141.46
699-31-31	12/07/89	529.32	125.34	403.98	123.13
699-32-22	12/07/89	517.55	115.63	401.92	122.51
699-32-43	12/07/89	516.62	111.87	404.75	123.37
699-32-62	12/07/89	707.09	277.94	429.15	130.80
699-32-70B	12/07/89	666.68	214.45	452.23	137.84
699-32-72	12/07/89	668.16	213.58	454.58	138.56
699-32-77	12/07/89	653.74	190.84	462.90	141.09
699-33-56	12/14/89	717.03	311.21	405.82	123.69
699-34-39A	12/07/89	537.07	132.43	404.64	123.33
699-34-41B	12/07/89	570.89	166.07	404.82	123.39

TABLE A.1. (contd)

Well	Date	Casing Elevation, ft above MSL ^(a)	Depth to Water, ft	Water-Table Elevation, ft above MSL	Water-Table Elevation, m above MSL
699-34-42	12/07/89	540.20	135.34	404.86	123.40
699-34-51	12/14/89	736.76	331.51	405.25	123.52
699-34-88	12/06/89	632.82	162.82	470.00	143.26
699-35-09	12/08/89	499.83	112.97	386.86	117.91
699-35-66	12/07/89	725.65	285.96	439.69	134.02
699-35-70	12/07/89	693.72	241.52	452.20	137.83
699-35-78A	12/07/89	660.65	193.07	467.58	142.52
699-36-61A	12/07/89	748.11	339.11	409.00	124.66
699-36-93	12/11/89	644.77	172.48	472.29	143.95
699-37-43	12/07/89	690.17	284.70	405.47	123.59
699-37-82A	12/06/89	636.75	168.86	467.89	142.61
699-38-65	12/07/89	753.33	322.83	430.50	131.22
699-38-70	12/07/89	710.67	256.65	454.02	138.39
699-39-39	12/07/89	536.65	122.87	413.78	126.12
699-39-79	12/14/89	673.52	205.18	468.34	142.75
699-40-01	12/08/89	438.71	75.39	363.32	110.74
699-40-33A	12/07/89	518.05	106.76	411.29	125.36
699-40-62	12/07/89	747.78	340.61	407.17	124.11
699-41-23	12/08/89	466.50	67.58	398.92	121.59
699-42-12A	12/08/89	514.27	137.85	376.42	114.73
699-42-40B	12/07/89	546.46	124.05	422.41	128.75
699-43-42	12/07/89	566.36	145.16	421.20	128.38
699-43-89	12/06/89	644.15	177.25	466.90	142.31
699-43-104	12/11/89	766.07	265.15	500.92	152.68
699-44-64	12/07/89	725.60	317.71	407.89	124.32
699-45-42	12/12/89	577.33	159.26	418.07	127.43
699-45-69A	12/07/89	725.46	276.51	448.95	136.84
699-46-21B	12/08/89	522.02	130.16	391.86	119.44
699-47-35A	12/12/89	476.36	62.27	414.09	126.21
699-47-46A	12/12/89	580.14	174.21	405.93	123.73
699-47-60	12/12/89	649.84	245.65	404.19	123.20
699-48-07	12/08/89	384.72	27.41	357.31	108.91
699-48-71	12/07/89	688.15	241.28	446.87	136.21
699-49-13E	12/08/89	412.72	51.51	361.21	110.10
699-49-28	12/08/89	535.40	140.90	394.50	120.24
699-49-57	12/12/89	552.81	148.45	404.36	123.25
699-49-79	12/06/89	689.20	231.78	457.42	139.42
699-50-30	12/08/89	528.84	134.36	394.48	120.24
699-50-42	12/12/89	466.84	55.25	411.59	125.45
699-50-53	12/12/89	556.30	151.99	404.31	123.23
699-50-85	12/06/89	739.35	283.21	456.14	139.03
699-51-63	12/06/89	571.84	165.54	406.30	123.84
699-51-75	12/06/89	641.51	191.31	450.20	137.22
699-52-19	12/08/89	411.08	49.65	361.43	110.16
699-53-35	12/08/89	530.99	132.79	398.20	121.37

TABLE A.1. (contd)

Well	Date	Casing Elevation, ft above MSL (a)	Depth to Water, ft	Water-Table Elevation, ft above MSL	Water-Table Elevation, m above MSL
699-53-48B	12/08/89	442.71	38.12	404.59	123.32
699-53-55C	12/08/89	576.08	172.48	403.60	123.02
699-54-19	12/05/89	383.60	22.09	361.51	110.19
699-54-34	12/08/89	550.24	140.87	409.37	124.78
699-54-37A	12/08/89	534.17	124.91	409.26	124.74
699-54-42	12/08/89	511.49	115.45	396.04	120.71
699-54-45A	12/08/89	494.29	96.43	397.86	121.27
699-54-48	12/08/89	457.02	53.50	403.52	122.99
699-55-21	12/05/89	395.96	35.68	360.28	109.81
699-55-40	12/08/89	543.13	133.04	410.09	125.00
699-55-44	12/08/89	519.67	124.35	395.32	120.49
699-55-50C	12/08/89	444.43	40.92	403.51	122.99
699-55-70	12/06/89	569.03	136.49	432.54	131.84
699-55-76	12/06/89	583.24	138.66	444.58	135.51
699-55-89	12/04/89	617.43	162.30	455.13	138.72
699-55-95	12/06/89	777.05	311.10	465.95	142.02
699-56-43	12/08/89	540.42	130.94	409.48	124.81
699-57-25A	12/05/89	414.57	50.71	363.86	110.90
699-57-29B	12/05/89	416.18	54.55	361.63	110.22
699-57-83A	12/06/89	577.96	145.10	432.86	131.94
699-58-24	12/05/89	418.80	57.29	361.51	110.19
699-59-32	12/05/89	424.29	62.38	361.91	110.31
699-59-58	12/06/89	497.77	95.10	402.67	122.73
699-59-80B	12/06/89	583.25	154.77	428.48	130.60
699-60-32	12/05/89	425.30	63.58	361.72	110.25
699-60-60	12/06/89	512.03	108.70	403.33	122.94
699-61-37	12/05/89	442.94	60.79	382.15	116.48
699-61-41	12/05/89	428.92	32.55	396.37	120.81
699-61-62	12/06/89	497.51	94.25	403.26	122.91
699-61-66	12/06/89	522.18	119.95	402.23	122.60
699-62-31	12/05/89	434.12	72.45	361.67	110.24
699-62-43A	12/05/89	432.30	35.57	396.73	120.92
699-63-25A	12/05/89	395.15	33.73	361.42	110.16
699-63-51	12/05/89	424.54	24.00	400.54	122.08
699-63-58	12/06/89	491.90	90.01	401.89	122.50
699-63-90	12/04/89	509.73	112.61	397.12	121.04
699-64-27	12/05/89	414.29	52.68	361.61	110.22
699-64-62	12/06/89	500.25	98.74	401.51	122.38
699-65-50	12/05/89	467.06	66.50	400.56	122.09
699-65-59A	12/06/89	506.96	105.52	401.44	122.36
699-65-72	12/06/89	540.28	141.16	399.12	121.65
699-65-83	12/04/89	485.63	87.64	397.99	121.31
699-65-95	12/04/89	452.26	54.44	397.82	121.26
699-66-23	12/05/89	389.01	28.40	360.61	109.91
699-66-38	12/05/89	436.20	33.24	402.96	122.82

TABLE A.1. (contd)

Well	Date	Casing Elevation, ft above MSL ^(a)	Depth to Water, ft	Water-Table Elevation, ft above MSL	Water-Table Elevation, m above MSL
699-66-39	12/05/89	453.70	47.15	406.55	123.92
699-66-58	12/06/89	503.33	102.03	401.30	122.32
699-66-64	12/06/89	505.92	105.19	400.73	122.14
699-66-91	12/04/89	467.75	69.19	398.56	121.48
699-66-103	12/04/89	463.01	66.20	396.81	120.95
699-67-51	12/05/89	524.59	123.93	400.66	122.12
699-67-86	12/04/89	472.39	74.68	397.71	121.22
699-67-98	12/04/89	455.47	57.75	397.72	121.23
699-68-105	12/04/89	451.85	57.05	394.80	120.34
699-69-38	12/05/89	422.93	21.29	401.64	122.42
699-69-45(0)	12/05/89	486.94	87.30	399.64	121.81
699-70-23	12/05/89	391.71	29.88	361.83	110.29
699-70-68	12/04/89	526.21	126.72	399.49	121.76
699-71-30	12/05/89	400.68	30.17	370.51	112.93
699-71-52	12/05/89	523.04	123.00	400.04	121.93
699-71-77	12/04/89	472.28	75.90	396.38	120.82
699-72-73	12/04/89	482.57	85.40	397.17	121.06
699-72-88	12/04/89	437.37	37.82	399.55	121.78
699-72-92	12/04/89	452.22	54.03	398.19	121.37
699-73-61	12/04/89	531.53	131.63	399.90	121.89
699-74-44	12/05/89	445.18	48.22	396.96	120.99
699-74-48	12/05/89	487.18	88.29	398.89	121.58
699-77-36	12/05/89	412.28	36.09	376.19	114.66
699-77-54	12/04/89	480.59	82.33	398.26	121.39
699-78-62	12/04/89	469.88	73.79	396.09	120.73
699-81-38	12/05/89	406.47	27.23	379.24	115.59
699-81-58	12/04/89	439.55	41.71	397.84	121.26
699-82-45A	12/04/89	413.73	24.57	389.16	118.62
699-83-47	12/04/89	435.27	46.05	389.22	118.63
699-86-42	12/05/89	409.92	25.22	384.70	117.26
699-87-55	12/04/89	458.63	69.99	388.64	118.46
699-89-35	12/05/89	397.46	27.18	370.28	112.86
699-90-45	12/05/89	422.15	37.51	384.64	117.24
699-91-37	12/05/89	422.93	50.28	372.65	113.58
699-92-49	12/04/89	432.00	48.68	383.32	116.84
699-96-49	12/04/89	419.29	37.81	381.48	116.28
699-97-43	12/05/89	421.81	43.32	378.49	115.36
699-S03-25	12/11/89	523.50	123.78	399.72	121.83
699-S03-E12	12/08/89	397.90	43.75	354.15	107.94
699-S06-E04D	12/12/89	430.47	58.14	372.33	113.49
699-S06-E14A	12/11/89	378.29	28.30	349.99	106.68
699-S07-34	12/11/89	527.12	119.34	407.78	124.29
699-S08-19	12/11/89	503.81	107.10	396.71	120.92
699-S12-03	12/11/89	435.52	55.05	380.47	115.97
699-S12-29	12/11/89	487.68	83.42	404.26	123.22

TABLE A.1. (contd)

<u>Well</u>	<u>Date</u>	<u>Casing Elevation, ft above MSL (a)</u>	<u>Depth to Water, ft</u>	<u>Water-Table Elevation, ft above MSL</u>	<u>Water-Table Elevation, m above MSL</u>
699-S14-20A	12/11/89	492.74	92.05	400.69	122.13
699-S18-E02A	12/11/89	434.85	75.60	359.25	109.50
699-S19-11	12/11/89	483.74	94.47	389.27	118.65
699-S19-E13	12/11/89	394.51	50.48	344.03	104.86
699-S29-E12	12/11/89	387.95	42.41	345.54	105.32
699-S30-E15A	12/11/89	400.14	57.84	342.30	104.33
699-S31-01	12/11/89	460.11	84.36	375.75	114.53

(a) MSL = mean sea level.

APPENDIX B

WATER-LEVEL MEASUREMENTS AT SPECIFIC HANFORD SITE AREAS

APPENDIX B

WATER-LEVEL MEASUREMENTS AT SPECIFIC HANFORD SITE AREAS

TABLE B.1. Decommissioned 216-U-10 Pond Water-Level Measurements in Unconfined Aquifer Wells, December 1989

<u>Well</u>	<u>Date</u>	<u>Casing Elevation, ft above MSL (a)</u>	<u>Depth to Water, ft</u>	<u>Water-Table Elevation, ft above MSL</u>	<u>Water-Table Elevation, m above MSL</u>
299-W10-05	12/13/89	672.31	205.33	466.98	142.34
299-W10-13	12/18/89	699.04	232.90	466.14	142.08
299-W11-10	12/13/89	728.89	271.21	457.68	139.50
299-W15-04	No Measurement				
299-W15-15	12/18/89	697.96	229.35	468.61	142.83
299-W15-16	12/18/89	684.89	215.41	469.48	143.10
299-W18-10	12/13/89	682.63	210.63	472.00	143.87
299-W18-15	12/13/89	660.76	190.37	470.39	143.37
299-W18-21	12/18/89	668.62	199.76	468.86	142.91
299-W18-23	12/18/89	696.81	227.95	468.86	142.91
299-W18-24	12/18/89	684.35	214.31	470.04	143.27
299-W19-01	12/13/89	673.77	201.22	472.55	144.03
299-W19-04	12/13/89	715.26	254.23	461.03	140.52
299-W19-13	12/13/89	695.08	229.34	465.74	141.96
299-W21-01	12/13/89	699.26	243.01	456.25	139.07
299-W22-08	12/13/89	683.55	225.04	458.51	139.75
299-W23-11	12/13/89	664.14	197.01	467.13	142.38
699-32-70B	12/07/89	666.68	214.45	452.23	137.84
699-32-72	12/07/89	668.16	213.58	454.58	138.56
699-32-77	12/07/89	653.74	190.84	462.90	141.09
699-35-78A	12/07/89	660.65	193.07	467.58	142.52
699-37-82A	12/06/89	636.75	168.86	467.89	142.61
699-38-70	12/07/89	710.67	256.65	454.02	138.39
699-39-79	12/14/89	673.52	205.18	468.34	142.75

(a) MSL = mean sea level.

TABLE B.2. 216-B-3 Pond Water-Level Measurements in Unconfined Aquifer Wells, December 21, 1989

<u>Well</u>	<u>Casing Elevation, ft above MSL (a)</u>	<u>Depth to Water, ft</u>	<u>Water-Table Elevation, ft above MSL</u>	<u>Water-Table Elevation, m above MSL</u>
299-E25-32P	669.19	263.65	405.54	123.61
699-39-39	536.65	121.44	415.21	126.56
699-40-33A	518.05	106.87	411.18	125.33
699-40-39	541.84	127.89	413.95	126.17
699-41-40	545.94	129.39	416.55	126.96
699-42-40B	546.46	124.42	422.04	128.64
699-43-41E	550.86	129.56	421.30	128.41
699-43-42J	581.68	162.35	419.33	127.81
699-43-43	579.37	164.24	415.13	126.53
699-43-45	597.68	191.50	406.18	123.80
699-44-42	579.22	158.22	421.00	128.32
699-44-43B	580.12	164.54	415.58	126.67
699-45-42	577.33	159.40	417.93	127.39
699-47-35A	476.36	62.33	414.03	126.20
699-47-46A	580.14	174.29	405.85	123.70

(a) MSL = mean sea level.

TABLE B.3. 100-N Area Water-Level Measurements in Unconfined Aquifer Wells, December 28, 1989

<u>Well</u>	<u>Casing Elevation, ft above MSL (a)</u>	<u>Depth to Water, ft</u>	<u>Water-Table Elevation, ft above MSL</u>	<u>Water-Table Elevation, m above MSL</u>
199-N-8S	404.32	18.67	385.65	117.55
199-N-14	453.15	66.27	386.88	117.92
199-N-16	456.78	64.47	392.31	119.58
199-N-17	461.21	71.91	389.30	118.66
199-N-18	458.53	70.50	388.03	118.27
199-N-19	453.94	65.89	388.05	118.28
199-N-20	455.85	66.92	388.93	118.55
199-N-21	456.97	68.21	388.76	118.49
199-N-23	456.30	68.58	387.72	118.18
199-N-24	432.49	46.03	386.46	117.79
199-N-25	425.76	39.73	386.03	117.66
199-N-27	449.09	55.42	393.67	119.99
199-N-28	464.24	69.67	394.57	120.26
199-N-29	465.25	70.76	394.49	120.24
199-N-32	462.08	68.62	393.46	119.93
199-N-33	459.87	66.64	393.23	119.86
199-N-34	459.63	65.88	393.75	120.02
199-N-36	458.97	65.86	393.11	119.82
199-N-37	456.12	63.42	392.70	119.70
199-N-39	454.31	62.41	391.90	119.45
199-N-40	456.35	65.46	390.89	119.14
199-N-41	457.59	69.10	388.49	118.41
199-N-42	455.14	65.88	389.26	118.65
199-N-44	460.76	68.49	392.27	119.56
199-N-49	450.72	61.44	389.28	118.65
199-N-50	463.36	77.77	385.59	117.53
199-N-51	462.18	76.90	385.28	117.43
199-N-52	463.70	69.62	394.08	120.12
199-N-53	461.76	70.53	391.23	119.25
199-N-54	457.51	65.45	392.06	119.50
199-N-55	457.85	65.78	392.07	119.50
199-N-56	458.09	67.27	390.82	119.12
199-N-57	457.76	64.78	392.98	119.78
199-N-58	462.88	67.22	395.66	120.60
199-N-59	459.53	63.68	395.85	120.66
199-N-60	461.94	66.05	395.89	120.67
199-N-61	462.02	63.77	398.25	121.39
199-N-62	463.59	69.16	394.43	120.22
199-N-63	466.70	72.78	393.92	120.07
Hanford Generating Plant (HGP) (River Stage Elevation)			385.5	117.5

(a) MSL = mean sea level.

TABLE B.4. 300 Area Water-Level Measurements in Unconfined Aquifer Wells, December 27, 1989

Well	Casing Elevation, ft above MSL (a)	Depth to Water, ft	Water-Table Elevation, ft above MSL	Water-Table Elevation, m above MSL
399-01-01	375.90	32.89	343.01	104.55
399-01-02	384.52	42.12	342.40	104.36
399-01-03	384.75	42.31	342.44	104.38
399-01-04	380.83	37.37	343.46	104.69
399-01-05	379.82	37.07	342.75	104.47
399-01-06	373.81	30.48	343.33	104.65
399-01-07	385.63	43.20	342.43	104.37
399-01-10	373.65	30.53	343.12	104.58
399-01-11	377.79	34.48	343.31	104.64
399-01-12	384.45	41.76	342.69	104.45
399-01-13	388.62	45.92	342.70	104.46
399-01-14	383.23	40.05	343.18	104.60
399-01-15	379.59	36.25	343.34	104.65
399-01-16A	381.51	39.05	342.46	104.38
399-01-17A	377.47	35.05	342.42	104.37
399-01-18A	390.83	47.18	343.65	104.74
399-01-19	374.64	32.05	342.59	104.42
399-02-01	375.26	32.86	342.40	104.36
399-02-02	375.53	33.08	342.45	104.38
399-02-03	375.44	33.02	342.42	104.37
399-03-01	384.43	42.15	342.28	104.33
399-03-02	392.36	50.22	342.14	104.28
399-03-06	392.85	50.59	342.26	104.32
399-03-07	394.22	51.97	342.25	104.32
399-03-09	387.31	45.12	342.19	104.30
399-03-10	385.40	43.27	342.13	104.28
399-03-12	386.38	44.20	342.18	104.30
399-04-01	395.00	53.06	341.94	104.22
399-04-07	376.99	34.95	342.04	104.25
399-04-09	381.40	39.29	342.11	104.28
399-04-10	377.59	35.49	342.10	104.27
399-04-11	404.53	62.39	342.14	104.28
399-05-01	395.60	53.28	342.32	104.34
399-06-01	386.93	44.29	342.64	104.44
399-08-01	394.88	52.18	342.70	104.46
399-08-02	396.06	52.66	343.40	104.67
399-08-03	393.11	50.08	343.03	104.56
699-S19-E13	394.51	50.42	344.09	104.88
699-S27-E14	399.76	57.88	341.88	104.21
699-S29-E12	387.95	42.39	345.56	105.33
699-S30-E15A	400.14	58.15	341.99	104.03
SWS-1	(River Stage Elevation)		343.27	104.62

(a) MSL = mean sea level.

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CENTER OF SHEET

SCALE
0 1 2 3 MILES
0 1 2 3 4 KILOMETERS

- WELLS USED IN PREPARATION OF MAP. WELL NUMBERS IN THE 100 AREAS HAVE THE PREFIX 199-. WELLS IN THE 200-EAST AND 200-WEST AREAS HAVE THE PREFIX 299-. REMAINING WELLS HAVE THE PREFIX 699-.
- ▬ POND, WATER-SURFACE ELEVATION IN METERS ABOVE MEAN SEA LEVEL
- ▨ GENERALIZED OUTCROP OF BASALT ABOVE THE WATER TABLE
- WATER-TABLE CONTOUR IN METERS ABOVE MEAN SEA LEVEL (CONTOUR INTERVAL = 2 METERS)

TO CONVERT METERS TO FEET,
DIVIDE BY 0.3048.

BASE MAPS ARE PORTIONS OF
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PLATE 1. HANFORD SITE WATER-TABLE MAP, DECEMBER 1989