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 Airdustrial Park, Bldg. 5, LE-13
 Olynpia, Wash. 98504-0095

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7. Abstract Peterson, R.E., 1994, "Groundwater Monitoring Results for the 100-K Area, Fuel Storage Basins: January 1 to March 31, 1994", WHC-SD-EN-TI-280, Rev. 0, Westinghouse Hanford Company, Richland, Washington. This report describes the results of groundwater monitoring being conducted to support operations at the 100-K Fuel Storage Basins. The results are for the first quarter of 1994 and were obtained under the RCRA/Operational Monitoring program. The concentrations of basin leakage indicators, spatial and temporal trends in these indicators, and groundwater flow through the area are all described.		
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1.0 INTRODUCTION

Fuel storage basins associated with the 105-KE and 105-KW reactor buildings are currently being used to store irradiated fuel rods from past operations. Each reactor building contains a basin that holds approximately 1.3 million gal of water. The water provides a radiation shield, as well as a thermal sink for heat generated by the stored fuel. Some of the fuel rods stored in the K-East basin have damaged cladding and are stored in open canisters, allowing contact between the metallic uranium fuel and basin water. The interaction results in radionuclides being released to the basin water.

Various exchange columns and filters associated with a closed-circuit circulation system are in place to reduce radionuclide concentrations in basin water. Tritium cannot be removed by these methods and is present in K-East basin water at a concentration of several million pCi/L. In contrast, K-West basin, where only fully encapsulated, undamaged fuel is stored, exhibits tritium concentrations at much lower levels--several hundred thousand pCi/L.

The water budget for the basins includes water losses resulting from evaporation and possibly leakage, and the addition of make-up water to maintain a specific level. Water loss calculations are based on water level decreases during time intervals when no make-up water is added. A calculated loss rate beyond what is expected due to evaporation and uncertainty in the calculations, is assumed to be leakage to the soil column. Given sufficiently high leakage rates, and/or a preferential pathway for downward migration through the soil column, basin water may contaminate groundwater flowing beneath the basins.

A program is in place to monitor the influence of current and future operations at the K-East and K-West fuel storage basins on groundwater characteristics. Program objectives include:

- Enhance the existing monitoring capability by installing additional groundwater wells and increase the sampling frequency, and expand the analysis list
- Detect the influence of potential basin leakage by monitoring chemical and radiological indicators in the groundwater that flows beneath each basin
- Infer groundwater flow rate, direction, and variability from water table elevation data and by flowmeter measurements in wells
- Assess the impact of past and current basin operations on groundwater quality
- Predict the spread of hypothetical basin leakage via the groundwater pathway, using numerical models.

The requirement for the current groundwater monitoring program at the fuel storage basins is included in DOE Order 5400.1 (DOE 1988). Groundwater monitoring requirements under the DOE Order are described in an environmental monitoring plan for the Hanford Site

(DOE-RL 1991, Section II.B, "Operational Environmental Monitoring". Westinghouse Hanford Company (WHC) requirements that apply to operational groundwater monitoring are described in an environmental compliance manual (WHC 1988, Section 8.3.6.1). Procedures for various aspects of the program are found in several manuals (WHC 1988, 1992, and 1993).

The following sections describe the current sampling and analysis schedule; recent water table elevation data; and recent chemical/radiological analysis results. The data presented are first quarter results for 1994.

2.0 SAMPLING AND ANALYSIS

Sampling and analysis of groundwater from the fuel storage basins monitoring network is coordinated by WHC as part of the Resource Conservation and Recovery Act (RCRA)/Operational Monitoring Program. Groundwater monitoring around the basins was substantially enhanced during 1993 in response to indications of increased water loss from the K-East basin. The following sections describe the well network, basin water constituents that are good indicators for assessing groundwater impact, and the sampling schedule and analysis list.

2.1 GROUNDWATER MONITORING WELL NETWORK

All existing groundwater monitoring wells located in the 100-K Area are shown in Figure 1. The installation plan for six new monitoring wells constructed during FY 1994 includes a summary of the characteristics of existing wells and brief description of the hydrogeologic units in the 100-K Area (Williams and Peterson, 1994). A more complete description of the stratigraphy of the 100-K Area, which is based on all existing well logs, is contained in Lindberg (1993).

During late 1993 and early 1994, four of six planned groundwater wells were completed to augment the monitoring capability around the basins. Wells five and six are scheduled for completion during July 1994.

2.2 BASIN LEAKAGE INDICATOR CONSTITUENTS

The radiological constituents in K-East basin water that are useful in assessing the impact of basin leakage on groundwater are listed in Table 1. Of these indicators, tritium is the most mobile in an aqueous environment. It is essentially unaffected by chemical and physical processes that might retard its migration with groundwater, other than dilution and radioactive decay. Americium, cesium, cobalt, plutonium, and strontium are all strongly adsorbed by sediments, thus preventing or retarding their movement into groundwater, unless a preferential pathway from the basin to groundwater exists. Antimony and ruthenium have highly variable chemical states, and their potential for reaching groundwater is less predictable.

Table 1. Radiological Constituents in K-East Basin.

Constituent	Isotope	Half-life (yr)
americium	²⁴¹ Am	458
antimony	¹²⁵ Sb	2.8
carbon	¹⁴ C ^a	5,730
cesium	¹³⁷ Cs	30.2
cobalt	⁶⁰ Co	5.3
plutonium	²³⁸ Pu	88
	²³⁹ Pu	24,100
	²⁴⁰ Pu	6,560
ruthenium	¹⁰⁶ Ru	1.0
strontium	⁹⁰ Sr	29.1
tritium	³ H	12.3

^aNot known to be present in basin water.

Carbon-14 is useful in assessing groundwater impacts because it can help differentiate basin-derived tritium from other sources for radiological contamination. Carbon-14 was disposed to the soil column, along with tritium, via french drains during the reactors' operating period (1955 to 1971). These french drains are located near the fuel storage basins along the east side of each reactor building. The effluent discharged to the drains contained tritium and carbon-14 in about equal amounts.

K-West basin water does not contain the same inventory of radionuclides that exist at K-East basin, because the fuel stored at K-West is fully encapsulated and undamaged. K-West basin water does contain significant concentrations of tritium, however, and that radionuclide is a good indicator for assessing groundwater impact. Individual chemical constituents are not good indicators for basin leakage. However, basin water is nearly free of dissolved salts and thus exhibits low electrical conductivity (approximately 10 μ mho/cm), in contrast to natural

groundwater, which does contain dissolved salts and shows higher electrical conductivity (300-500 $\mu\text{mho/cm}$).

2.3 MONITORING WELL SAMPLING AND ANALYSIS SCHEDULE

The planned sampling schedule for the fuel storage basins network wells is shown in Table 2, along with the list of analyses performed. Actual sample dates may vary as the result of scheduling logistics for well trips. Water table elevations are measured each time a well is sampled, and at regular monthly intervals in selected wells. Hourly measurements of water level, temperature, and electrical conductivity are obtained from well 199-K-30 near K-East basin.

Table 2. 100-K Area Operational Monitoring Program Sampling and Analysis Schedule for FY 1994.

Well	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
K-11	X			X			X			X		
K-13	A			A			A			A		
K-18	A			A			A			A		
K-19	X			X			X			X		
K-23	A						X			X		
K-27	X	A	A	X	A	A	X	A	A	X	A	A
K-28	X	A	A	X	A	A	X	A	A	X	A	A
K-29	X	A	A	X	A	A	X	A	A	X	A	A
K-30	X	A	A	X	A	A	X	A	A	X	A	A
K-32A		A	A	X	A	A	X	A	A	X	A	A
K-33				X			X			X		
K-34		A	A	X	A	A	X	A	A	X	A	A
K-106A								X		X		
K-107A								X		X		
K-108A								X		X		

"A" list:
Tritium screening

X" list:
Gross alpha and beta
Anions (IC)
Carbon-14
Conductivity (field)
Conductivity (lab)
Gamma scan
ICP metals (filtered)
pH (field)
Tritium
Turbidity (lab)

3.0 RADIOLOGICAL AND CHEMICAL ANALYSES RESULTS

Groundwater samples in the 100-K Area are collected and analyzed on monthly, quarterly, and semiannual schedules to meet the needs of several programs, including the fuel storage basins program. The results are available from the Hanford Environmental Information System (HEIS) and the Geosciences Data Analysis Toolkit (GeoDAT).

Sampling for the first quarter 1994 was completed during January for most of the fuel storage basins network wells. The three new wells near K-West basin (199-K-106A, -107A, and -108a) were sampled during drilling in February and March; the first regular sampling of these wells occurred in early May 1994. Monthly tritium sampling was completed in a subgroup of wells to provide enhanced monitoring for leak detection purposes. A summary of first quarter 1994 results is presented in Table 3. Analytical results for constituents with at least one value above the method detection limit are presented in Appendix A. Blank entries in these tables indicate either the constituent was not included in the analysis list or the results are not yet available. A complete guide to the format and conventions used in Table 3 and Appendix A is included with Appendix A, and is reproduced from the RCRA Quarterly Data Report for the first quarter 1994 (DOE-RL 1994, Section 1.4).

3.1 CONTAMINATION INDICATOR DISTRIBUTION MAPS

Maps showing the January and March 1994 distribution of tritium in groundwater are presented in Figures 2 and 3. The distribution patterns shown in these figures have not changed appreciably from the previous year, although the concentrations in wells adjacent to the K-East basin have changed--both increases and decreases. Background levels for tritium in groundwater that flows into the 100-K Area from the south are on the order of several thousand pCi/L. The U.S. Environmental Protection Agency (EPA) drinking water standard for tritium is 20,000 pCi/L.

3.2 TRENDS IN CONTAMINATION INDICATORS

Trend charts for tritium in groundwater near K-East basin are shown in Figures 4 through 7. These charts contain groups of wells to represent conditions adjacent to the basins, down-gradient of the basins, and upgradient or out of the flow path associated with the basins ("baseline" values). The 1993 pulse in tritium concentrations that occurred in well 199-K-30 adjacent to the K-East basin is readily apparent; concentrations in that well have shown a significant decrease ever since. A gradual rise in tritium concentrations in adjacent well 199-K-27 has continued since early 1993, however. Downgradient and baseline wells are maintaining essential steady state concentrations that are well below the drinking water standard.

Tritium trends near the K-West basin are shown in Figure 8. Concentrations are well below the drinking water standard and are either staying at constant levels or decreasing.

Table 3. Constituent List and Summary of Results for the 100-K Fuel Storage Basins
Data for Reporting Period January 1, 1994 through March 31, 1994. (sheet 1 of 2)

Contamination Indicator Parameters								
Constituent name			Lab	DWS		Number of samples		
Short (method)	Full	Units	MDL	Limit	Agency	Total	>MDL	>DWS
CONDUCT 94	conductivity, field	umhos	1			8	8	
CONDUCT 73	conductivity, lab	umhos				9	9	
PH	pH, field	pH	0.01	6.5 to 8.5	EPAS	8	8	0
Drinking Water Parameters								
FBARIUM	barium, filtered	ppb	1.3	1000	EPAI	8	8	0
FCADMIU	cadmium, filtered	ppb	3	10	EPAI	8	0	0
FCHROMI	chromium, filtered	ppb	11	50	EPAI	8	5	1
FLUORID	fluoride	ppb	51	1400	EPAI	9	9	0
ALPHA	gross alpha	pCi/L		15	EPA	14	13	2
NITRATE	nitrate	ppb	96	45000	EPA	9	9	3
Groundwater Quality Parameters								
CHLORID	chloride	ppb	71	250000	EPAS	9	9	0
FIRON	iron, filtered	ppb	18	300	EPAS	8	6	0
FMANGAN	manganese, filtered	ppb	1	50	EPAS	8	1	0
FSODIUM	sodium, filtered	ppb	150			8	8	
SULFATE	sulfate	ppb	89	250000	EPAS	9	9	0
Site Specific and Other Constituents								
FALUMIN	aluminum, filtered	ppb	19			8	0	
FANTIMO	antimony, filtered	ppb	26			8	0	
SB-125	Antimony-25	pCi/L				14	1	
FBERYLL	beryllium, filtered	ppb	1.5			8	0	
BROMIDE	bromide	ppb	110			9	1	
FCALCIU	calcium, filtered	ppb	47			8	8	
CS-137	cesium-137	pCi/L		200	EPA	14	1	0
FCOBALT	cobalt, filtered	ppb	6.5			8	0	
CO-60	cobalt-60	pCi/L		100	EPA	14	0	0
FCOPPER	copper, filtered	ppb	2.6	1000	EPAS	8	0	0
BETA	gross beta	pCi/L				14	14	
FMAGNES	magnesium, filtered	ppb	25			8	8	
FNICKEL	nickel, filtered	ppb	16			8	0	

Table 3. Constituent List and summary of Results for the 100-K Fuel Storage Basins
Data for Reporting Period January 1, 1994 through March 31, 1994. (sheet 2 of 2)

Site Specific and Other Constituents (cont)								
Constituent name			Lab	DWS		Number of samples		
Short (method)	Full	Units	MDL	Limit	Agency	Total	> MDL	> DWS
NITRATE	nitrate	ppb	110	1000	EPA	9	0	0
PHOSPHA	phosphate	ppb	470			9	0	
FPOTASS	potassium, filtered	ppb	890			8	8	
RU-106	ruthenium-106	pCi/L		30	EPA	14	0	*
FSILVER	silver, filtered	ppb	3.4	50	EPAI	8	0	0
FTIN	tin, filtered	ppb	24			8	0	
TRITIUM	tritium	pCi/L		20000	EPA	34	33	9
TURBID	turbidity	NTU	0.016			22	22	
FVANADI	vanadium, filtered	ppb	6.4			8	2	
FZINC	zinc, filtered	ppb	4.4	5000	EPAS	8	4	0

For explanation of this table, see Appendix A.

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Figure 2. January 1994 Distribution of Tritium (pCi/L) in Groundwater.

Figure 3. March 1994 Distribution of Tritium (pCi/L) in Groundwater.

Figure 4. Tritium Concentration Adjacent to K-East Basin.

Figure 5. Tritium Concentration Adjacent to K-East Basin (Lower Scale).

Figure 7. Tritium Baseline for K-East Basin.

Figure 8. Tritium Trends near K-West Basin.

Initial tritium analyses conducted on water samples from adjacent well 199-K-106A during drilling indicated concentrations in the 30,000 to 40,000 pCi/L range. Subsequent analyses after well completion do not corroborate these high levels.

4.0 GROUNDWATER ELEVATION MEASUREMENT RESULTS

Water level data in the 100-K Area are obtained via a monthly steel tape measurement program, whenever a well is sampled for water analyses, and from a network of automated water level recorders in selected wells. The manual measurement results are stored in GeoDAT and HEIS; the automated recorder results are maintained by CH2M-Hill Hanford Company Geosciences. A regional water table map for June and December conditions is prepared semiannually for the region north of Gable Mountain containing the 100 Areas (e.g., Kasza et al. 1994).

4.1 WATER TABLE MAPS AND HYDROGRAPHS

Water level measurements completed during the first quarter of 1994 in the 100-K Area are listed in Appendix B. Depth-to-water measurements recorded in the field are converted to elevations above mean sea level using various top-of-casing survey data available for the wells. Very little difference in resulting elevation is observed if either U.S. Army Corps of Engineers survey data (obtained in 1993) or results from recent surveys by ICF Kaiser Hanford are used. However, significant differences occasionally occur when undocumented top-of-casing elevations, such as those found in Hanford Wells (Chamness and Merz, 1993), HEIS, and GeoDAT, are used. The following water table maps and hydrographs have all been prepared using the measured depth-to-water and top-of-casing elevations from either the U.S. Army Corps of Engineers or ICF Kaiser Hanford surveys.

A water table map for February 1994 is presented in Figure 9. The distribution of 100-K Area wells is not optimal for describing the shape of the water table surface; i.e., the contour shapes are not tightly constrained.

Hydrographs for selected wells in the 100-K Area are shown in Figure 10 and demonstrate the seasonal changes that occur in the elevation of the water table. The influence of Columbia River fluctuations on water table elevations is shown in Figure 11, which shows hydrographs for wells located at progressively greater distances inland from the river.

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Figure 9. Water Table Elevation (ft), February 1994.

Figure 10. Seasonal Changes in 100-K Area Water Table.

Figure 11. Columbia River Hydrograph (100-B) and Wells in 100-K Area.

4.2 GROUNDWATER FLOW DIRECTION AND VELOCITY

Groundwater flow direction can be inferred from the water table map shown in Figure 9. Near the K-West basin, flow is generally north-northwesterly and perpendicular to the river shoreline. Near the K-East basin, flow is also generally towards the river, but with an indication of a more westerly component. This is contrary to what might be expected when the regional flow field is considered; it may be due to local variations in aquifer hydraulic properties.

Groundwater flow velocity is typically indicated as several feet per day. Estimates for the average interstitial flow velocity can be made using the Darcy equation: $V = (K)(1/n)(dh/dl)$ where K is hydraulic conductivity, n is effective porosity, and (dh/dl) is hydraulic gradient. For the 100-K Area, hydraulic conductivities determined from single well aquifer tests range between 8 and 48 ft/d, with a value of 25 being typical. The effective porosity for the sediments is assumed to be 10%, a value commonly associated with Ringold Formation gravely sands. Hydraulic gradients can be measured between pairs of wells located approximately parallel to flow direction.

Using these aquifer property estimates and gradients for April and June 1993, which represent low and high water table conditions, respectively, average interstitial flow velocities near each basin were calculated. The results are summarized in Table 4. Using the potential range of velocities, hypothetical travel times from the basins to downgradient wells near the Columbia River are shown in Table 5.

Table 4. Average Interstitial Flow Velocities Near Basins.

(Effective porosity assumed to be 10%)	Well K-34 to K-33: downgradient of K-West basin	Well K-30 to K-32A: downgradient of K-East basin
Low water table: (April 16, 1993)		
	Gradient 0.006888	Gradient 0.006277
K = 10 ft/d	0.7 ft/d	0.6 ft/d
K = 25 ft/d	1.7 ft/d	1.6 ft/d
K = 50 ft/d	3.4 ft/d	3.1 ft/d
High water table: (June 18, 1993)		
	Gradient 0.005062	Gradient 0.004209
K = 10 ft/d	0.5 ft/d	0.4 ft/d
K = 25 ft/d	1.3 ft/d	1.1 ft/d
K = 50 ft/d	2.5 ft/d	2.1 ft/d

Table 5. Hypothetical Travel Times from Basins to Near-River Wells.

		Flow rate:	
		0.5 ft/d	3.0 ft/d
<i>K-East basin to:</i>			
Well K-18 (2,250 ft)	12.3 yr	4.1 yr	2.1 yr
Well K-19 (2,333 ft)	12.8 yr	4.3 yr	2.1 yr
Well K-32A (1,017 ft)	5.6 yr	1.9 yr	0.9 yr
<i>K-West basin to:</i>			
Well K-33 (900 ft)	4.9 yr	1.6 yr	0.8 yr

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APPENDIX A

**CONSTITUENTS WITH AT LEAST ONE DETECTED VALUE FOR THE
100-K AREA FUEL STORAGE BASINS NETWORK.**

REPORTING PERIOD JANUARY 1 TO MARCH 31, 1994

EXPLANATORY NOTES TO ACCOMPANY DATA TABLES

This section describes the meaning of each table column heading, defines the abbreviations used, explains the data qualifiers and flags, and lists analysis method codes and relevant regulatory standards. The information has been extracted from the RCRA quarterly reporting system (e.g., DOE-RL 1994).

Constituent List and Summary of Results Table

The Constituent List and Summary of Results table (see Table 3) presents a summary of the complete data set for the reporting period. The data set consists of all analytical results that are associated with samples collected before the end of the current reporting quarter, and which have been reported to WHC before the cutoff date for the current quarterly report. Data collected during previous quarters that have not been reported as a result of the cutoff date may appear in the table. The fields in the Summary table are:

Constituent name--Name of the analyzed constituent being summarized; the Short name is an abbreviation used in the Constituents with at Least One Detected Value table (Section 1.4.3); the (Method), when present, is a code (Section 1.4.5) used to distinguish between different analytical methods for the same constituent.

Units--Units in which the method detection limit (MDL) and drinking water standards (DWS) are reported in this table.

Laboratory MDL--The MDL computed by the laboratory for a constituent. This field is blank for radionuclides where the MDL is defined as the value of the total error reported by the laboratory for each result.

DWS limit/agency--The DWS used for comparison to the reported results; see Section 1.4.5 for Agency definitions and a complete listing of standards used.

Number of samples--Total is the number of sample results from all wells in the project contained in the complete data set for that constituent; >MDL is the number of results that exceed the MDL; >DWS is the number of results that exceed the listed DWS.

Constituents are grouped as Contamination Indicator Parameters, Drinking Water Parameters, Groundwater Quality Parameters, and Site-Specific and Other Constituents, to correspond to language used in 40 CFR 265 regulations. Within groups, rows are ordered alphabetically by the full constituent name.

If a constituent has an MDL that exceeds the DWS, exceedance of the DWS cannot be determined, so an asterisk (*) is placed in the >DWS field.

Constituents with at Least One Detected Value Table

The Constituents with at Least One Detected Value table (Table A-1) is a subset of the complete data set. Only constituents that were detected above the MDL in at least one sample collected during the current reporting period are reported in this table. The first three column headings are:

Well name--Well from which sample was collected.

Collection date--Date sample was collected.

Sample number--Unique number assigned to a sample.

The remaining columns contain analytical results and qualifiers for the constituent. The structure of the column header is:

- Constituent short name
- Method code/reporting units
- MDL/DWS (suffix).

The Summary table (see Table 3) can be used to relate the full constituent name to the short name used in this table. The analytical method code is defined below, as are abbreviations used for reporting units. On the third line, a period appears in place of the MDL or DWS if a value does not exist. The one-letter suffix that may be added to the DWS identifies the regulation associated with the standard and is described below.

Analytical results are displayed with two digits to the right of the decimal point. This is a consequence of the table generating software and does not reflect the accuracy of the results. Laboratories normally report results with three significant digits. Radionuclide values may be negative because the laboratory subtracts a background reading from the measured result. The letter, or group of letters, that may follow the result are data qualifiers and flags. A complete explanation of what each flag means is provided below.

Contamination Indicator Parameters Table

The Contamination Indicator Parameters table (Table A-2) has a format similar to the Detected table (Table A-1) but includes only data for pH, specific conductance, total organic carbon (TOC), and total organic halogens (TOX). All results for these parameters, whether detected or not, are listed in the table. The analysis method code is not part of the column header in this report.

Abbreviations, Agency Codes, and Methods Codes

Common abbreviations used in the data tables are:

COL	coliform colonies per 100 milliliters
DWS	drinking water standard
ft	feet
MDL	method detection limit
msl	mean sea level
NTU	nephelometric turbidity unit
pCi/L	picocuries per liter
ppb	parts per billion
ppm	parts per million
μmho	micromhos per centimeter

Agencies and suffixes--Agency codes and DWS suffixes identify the regulatory origin of the standard of the DWS. Agency codes are used in the Summary table, and DWS suffixes are used in the Detected and Contamination indicator parameter tables. The codes are defined as follows:

<u>Agency</u>	<u>Suffix</u>	<u>Regulatory basis</u>
EPA	None	Maximum contaminant levels in 40 CFR 141, "National Primary Drinking Water Regulations."
EPAS	s	Secondary maximum contaminant levels in 40 CFR 143, "National Secondary Drinking Water Regulations."
EPAI	i	EPA interim primary drinking water standards in 40 CFR 265, Appendix III.

DWSs--DWSs are used in all of the chemistry tables to provide a standard with which to compare sample results. The DWSs are based on standards found in 40 CFR 265, 40 CFR 141, and 40 CFR 143. Where there is overlap in constituents addressed by these regulations, 40 CFR 265 takes precedence over 40 CFR 141, which, in turn, takes precedence over 40 CFR 143.

Data qualifiers and flags--Data qualifiers and flags used in the Detected and Contamination indicator parameter tables are assigned by the laboratory and by the WHC quality control team, respectively. Qualifiers reflect conditions occurring in the laboratory relating to the analytical procedure. Flags serve a wider function of alerting the data user to the

limitations of the reported value. Qualifiers and flags can be appended to each other to form a string of letters when several factors apply to a result. The qualifiers and flags used are as follows:

Laboratory qualifiers:

- B - Blank associated with analyte is contaminated
- D - Analyzed sample is diluted
- E - Concentration is out of instrument calibration range
- J - Concentration is estimated
- L - Concentration is below the CRQL but above the MDL
- U - Concentration is below the indicated value.

Data flags:

- D - Result associated with a documented laboratory nonconformance
- F - Suspect data currently under review
- H - Laboratory holding time exceeded
- G - Reviewed data that are considered valid
- P - Potential problem; see text associated with table
- Q - Result associated with suspect QC data
- R - Reviewed data that have been rejected
- Y - Reviewed data that continues to be suspect
- + - Suspect water level data
- * - CRQL is greater than DWS, so exceedance of DWS is undetermined.

Analysis method codes--Analysis method codes are used as an abbreviation for the laboratory method used to perform an analysis:

Analysis Method Code Definitions.

Method code	Method name
16	SW-846 8240 ^a
17	SW-846 8080 ^a
19	SW-846 8270 ^a
25	SW-846 8010/8020 ^a
29	SW-846 8140 ^a
30	SW-846 8040 ^a
34	SW-846 6010 ^a
36	ASTM D-1385 ^b
40	SW-846 7421 ^a
41	SW-846 7470 ^a
42	SW-846 7841 ^a
43	SW-846 7060 ^a
48	SW-846 7740 ^a

Analysis Method Code Definitions.

Method code	Method name
49	SW-846 8150 ^a
51	SW-846 8280 ^a
52	ASTM D-1067-A
54	ASTM D-1426-D
56	SW-846 9010 ^a
62	In-house ion chromatography
63	SW-846 9030 ^a
65	Standard Methods #209B ^c
67	SW-846 9020 ^a
69	SW-846 9131 ^a
73	ASTM D-1125-A
93	Field probe, pH
94	Field probe, conductivity
122	SW-846 9060 ^a
124	ASTM D-4327-88
125	ASTM D-1293
126	Standard Methods #214A ^c
127	ASTM D-2579-A
129	ASTM D-1426-C
130	EPA Method 300.0 ^d
135	SW-846 9310, Alpha ^a
136	SW-846 9310, Beta ^a
137	SW-846 9315, Radium ^a
139	ITAS ¹²⁹ I Low level
140	ITAS Gamma scan
141	ITAS ⁹⁰ Sr
142	ITAS H-3
143	ITAS ⁹⁹ Tc
144	SW-846 9132 ^a
145	ITAS Gross U
146	ITAS Isotopic Pu
147	ITAS ²⁴¹ Am
148	ITAS Isotopic U
168	USEPA HACH COD ^d
357	EPA 600, 310.2
358	SW-846 9012 ^a

^a(EPA 1986)

^b(ASTM 1991)

^c(EPA 1979)

^d(APHA 1989)

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Constituents with at Least One Detected Value for the 100-K Fuel Storage Basins
Data for Reporting Period January 1, 1994, through March 31, 1994.
(sheet 1 of 5)

Well Name	Collection Date	Sample Number	SB-125 140/pCi/L ./.	FBARIUM 34/ppb 1.3/1000i	BROMIDE 124/ppb 110/.	FCALCIU 34/ppb 47/.
199-K-106A	2/02/94	B09FH0	1.80 U			
199-K-106A	2/09/94	B09FH2	-2.57 U			
199-K-106A	2/15/94	B09FS6	-10.80 U			
199-K-107A	3/11/94	B0BKK3	8.37 U			
199-K-108A	3/28/94	B0BKK4	-5.62 U			
199-K-11	1/15/94	B09QM8	1.26 U		52.80 U	
199-K-11	1/15/94	B09QM9		22.00 B		31000.00 B
199-K-19	1/24/94	B09QN0	-11.70 U		70.00 L	
199-K-19	1/24/94	B09QN1		23.00 B		50000.00 B
199-K-27	1/25/94	B09F61	20.20		52.80 U	
199-K-27	1/25/94	B09F62		26.00 B		50000.00 B
199-K-28	1/19/94	B09F63	12.80 U		100.00 L	
199-K-28	1/19/94	B09F64		52.00		86000.00 B
199-K-29	1/19/94	B09F65	-10.60 U		52.80 U	
199-K-29	1/19/94	B09F66		26.00		48000.00 B
199-K-30	1/20/94	B09F67	-3.21 U		100.00 LH	
199-K-32A	1/18/94	B09QN2	-17.80 U		60.00 L	
199-K-32A	1/18/94	B09QN3		25.00 BQ		43000.00 BQ
199-K-33	1/25/94	B09QN4	13.50 U		200.00 L	
199-K-33	1/25/94	B09QN5		39.00		85000.00 B
199-K-34	1/21/94	B09QP0	9.16 U		100.00 L	
199-K-34	1/21/94	B09QP1		33.00		52000.00 B

Well Name	Collection Date	Sample Number	CS-137 140/pCi/L ./200	CHLORID 124/ppb 71/250000s	FCHROMI 34/ppb 11/50i	FLUORID 124/ppb 51/1400i
199-K-106A	2/02/94	B09FH0	3.30 U			
199-K-106A	2/09/94	B09FH2	.46 U			
199-K-106A	2/15/94	B09FS6	-2.40 U			
199-K-107A	3/11/94	B0BKK3	3.03 U			
199-K-108A	3/28/94	B0BKK4	-.96 U			
199-K-11	1/15/94	B09QM8	-.54 U	6900.00		600.00
199-K-11	1/15/94	B09QM9			5.42 U	
199-K-19	1/24/94	B09QN0	1.65 U	5400.00		600.00
199-K-19	1/24/94	B09QN1			120.00	
199-K-27	1/25/94	B09F61	.08 U	12000.00 D		500.00
199-K-27	1/25/94	B09F62			5.42 U	
199-K-28	1/19/94	B09F63	2.73 U	78000.00 D		600.00
199-K-28	1/19/94	B09F64			11.00 L	
199-K-29	1/19/94	B09F65	6.68	30000.00 D		500.00
199-K-29	1/19/94	B09F66			7.10 L	

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Constituents with at Least One Detected Value for the 100-K Fuel Storage Basins
Data for Reporting Period January 1, 1994, through March 31, 1994.
(sheet 2 of 5)

Well Name	Collection Date	Sample Number	CS-137 140/pCi/L ./200	CHLORID 124/ppb 71/250000s	FCHROMI 34/ppb 11/50i	FLUORID 124/ppb 51/1400i
199-K-30	1/20/94	B09F67	-5.12 U	3800.00 H		300.00 H
199-K-32A	1/18/94	B09QN2	- .27 U	3300.00		300.00
199-K-32A	1/18/94	B09QN3			26.00	
199-K-33	1/25/94	B09QN4	.61 U	10000.00 D		300.00
199-K-33	1/25/94	B09QN5			20.00 L	
199-K-34	1/21/94	B09QP0	1.04 U	7400.00		600.00
199-K-34	1/21/94	B09QP1			20.00	

Well Name	Collection Date	Sample Number	ALPHA 135/pCi/L ./15	BETA 136/pCi/L ./.	FIRON 34/ppb 18/300s	FMAGNES 34/ppb 25/.
199-K-106A	2/02/94	B09FH0	33.20	27.50		
199-K-106A	2/09/94	B09FH2	7.30	12.10		
199-K-106A	2/15/94	B09FS6	3.83	12.90		
199-K-107A	3/11/94	B0BKK3	8.72	96.60		
199-K-108A	3/28/94	B0BKK4	96.60	73.60		
199-K-11	1/15/94	B09QM8	2.04	6.28		
199-K-11	1/15/94	B09QM9			15.00 L	8400.00
199-K-19	1/24/94	B09QN0	.68 U	20.30		
199-K-19	1/24/94	B09QN1			14.00 L	7000.00
199-K-27	1/25/94	B09F61	3.04	26.60		
199-K-27	1/25/94	B09F62			22.00	11000.00
199-K-28	1/19/94	B09F63	3.57	5.61		
199-K-28	1/19/94	B09F64			20.00 B	19000.00
199-K-29	1/19/94	B09F65	2.61	5.35		
199-K-29	1/19/94	B09F66			30.00 B	12000.00
199-K-30	1/20/94	B09F67	3.55	8.59		
199-K-32A	1/18/94	B09QN2	1.70	7.24		
199-K-32A	1/18/94	B09QN3			21.00 Q	5000.00 Q
199-K-33	1/25/94	B09QN4	6.86	7.65		
199-K-33	1/25/94	B09QN5			35.00 B	11000.00
199-K-34	1/21/94	B09QP0	4.91	78.30		
199-K-34	1/21/94	B09QP1			24.00 B	10000.00

Well Name	Collection Date	Sample Number	FMANGAN 34/ppb 1/50s	NITRATE 124/ppb 96/45000	FPOTASS 34/ppb 890/.	FSODIUM 34/ppb 150/.
199-K-11	1/15/94	B09QM8		19000.00 BDH		

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Constituents with at Least One Detected Value for the 100-K Fuel Storage Basins
Data for Reporting Period January 1, 1994, through March 31, 1994.
(sheet 3 of 5)

Well Name	Collection Date	Sample Number	FMANGAN 34/ppb 1/50s	NITRATE 124/ppb 96/45000	FPOTASS 34/ppb 890/.	FSODIUM 34/ppb 150/.
199-K-11	1/15/94	B09QM9	1.35 U		5400.00	30000.00 B
199-K-19	1/24/94	B09QN0		20000.00 BDH		
199-K-19	1/24/94	B09QN1	1.35 U		2400.00	6100.00 B
199-K-27	1/25/94	B09F61		48000.00 BDH		
199-K-27	1/25/94	B09F62	1.35 U		4500.00	6700.00 B
199-K-28	1/19/94	B09F63		27000.00 D		
199-K-28	1/19/94	B09F64	1.35 U		7200.00	14000.00 B
199-K-29	1/19/94	B09F65		21000.00 D		
199-K-29	1/19/94	B09F66	1.35 U		4500.00	8500.00 B
199-K-30	1/20/94	B09F67		62000.00 DH		
199-K-32A	1/18/94	B09QN2		16000.00 BDH		
199-K-32A	1/18/94	B09QN3	1.35 UQ		1600.00 Q	6300.00 BQ
199-K-33	1/25/94	B09QN4		88000.00 D		
199-K-33	1/25/94	B09QN5	2.70 L		3900.00	15000.00 B
199-K-34	1/21/94	B09QP0		29000.00 D		
199-K-34	1/21/94	B09QP1	1.35 U		3300.00	17000.00 B

Well Name	Collection Date	Sample Number	SULFATE 124/ppb 89/250000s	TRITIUM 142/pCi/L ./20000	TURBID 126/NTU .016/.	FVANADI 34/ppb 6.4/.
199-K-106A	2/02/94	B09FH0		10400.00		
199-K-106A	2/04/94	B09FH1		21800.00		
199-K-106A	2/09/94	B09FH2		1710.00		
199-K-106A	2/15/94	B09FS6		2320.00		
199-K-107A	3/11/94	B0BKK3		2160.00		
199-K-108A	3/28/94	B0BKK4		108.00 U		
199-K-11	1/15/94	B09QM8	29000.00 BD	451.00	.71 H	
199-K-11	1/15/94	B09QM9				25.00 L
199-K-11	3/01/94	B09Z22		499000.00		
199-K-11	3/30/94	B0BHW0		393.00	4.90 H	
199-K-13	1/12/94	B09QM5		1070.00	.30	
199-K-13	3/01/94	B09Z23		1190.00	12.00 H	
199-K-13	3/10/94	B0BHW1		1240.00	26.00 Q	
199-K-18	12/14/93	B09NT7		12100.00		
199-K-18	1/24/94	B09QM6		13000.00	9.30 Q	
199-K-18	3/02/94	B09Z24		12300.00	24.00	
199-K-19	1/24/94	B09QN0	50000.00 BD	4010.00	.29 QH	
199-K-19	1/24/94	B09QN1				3.84 U
199-K-23	1/13/94	B09QM7		396.00	83.00 QH	
199-K-27	1/25/94	B09F61	18000.00 BD	407000.00	4.80 H	
199-K-27	1/25/94	B09F62				3.84 U

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Constituents with at Least One Detected Value for the 100-K Fuel Storage Basins
Data for Reporting Period January 1, 1994, through March 31, 1994.
(sheet 4 of 5)

Well Name	Collection Date	Sample Number	SULFATE 124/ppb 89/250000s	TRITIUM 142/pCi/L /20000	TURBID 126/NTU .016/.	FVANADI 34/ppb 6.4/.
199-K-27	3/30/94	B0BHW3		628000.00		
199-K-28	1/19/94	B09F63	24000.00 D	1930.00	.34	
199-K-28	1/19/94	B09F64				8.20 L
199-K-28	3/01/94	B09ZZ8		4310.00	19.00 H	
199-K-28	3/10/94	B0BHW4		2020.00	1.50 Q	
199-K-29	1/19/94	B09F65	23000.00 D	25800.00	5.60	
199-K-29	1/19/94	B09F66				3.84 U
199-K-29	3/01/94	B09ZZ9		25600.00	150.00 H	
199-K-30	1/20/94	B09F67	30000.00 DH	553000.00	.54 H	
199-K-30	3/01/94	B0B000		544000.00	16.00 H	
199-K-30	3/30/94	B0BHW6		448000.00		
199-K-32A	12/14/93	B09NV4		3330.00		
199-K-32A	1/18/94	B09QN2	32000.00 BD	3030.00	4.30 H	
199-K-32A	1/18/94	B09QN3				3.84 U
199-K-32A	3/02/94	B0B001		3210.00	3.10	
199-K-33	1/25/94	B09QN4	75000.00 D	6560.00	2.70 Q	
199-K-33	1/25/94	B09QN5				3.84 U
199-K-34	12/14/93	B09NV5		4680.00		
199-K-34	1/21/94	B09QP0	33000.00 D	4550.00	1.10	
199-K-34	1/21/94	B09QP1				3.84 U
199-K-34	3/02/94	B0B002		4380.00	19.00	

Well Name	Collection Date	Sample Number	FZINC 34/ppb 4.4/5000s
199-K-11	1/15/94	B09QM9	6.40 BL
199-K-19	1/24/94	B09QN1	48.00 B
199-K-27	1/25/94	B09F62	1.50 LB
199-K-28	1/19/94	B09F64	3.90 LB
199-K-29	1/19/94	B09F66	3.20 LB
199-K-32A	1/18/94	B09QN3	2.60 BL
199-K-33	1/25/94	B09QN5	14.00 B
199-K-34	1/21/94	B09QP1	7.80 LB

For explanation of this table, see Section 1.4 of report.

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Contamination Indicator Parameters for the 100-K Fuel Storage Basins
Data for Reporting Period January 1, 1994, through March 31, 1994.
(sheet 1 of 1)

Well Name	Collection Date	Sample Number	COND FIELD uMho 1/700w	COND LAB uMho 1/700w	pH FIELD .01/6.5-8.5s	pH LAB .01/6.5-8.5s	TOC ppb 320/	TOX ppb 5/
199-K-11	1/15/94	B09QM8	352	360	8.06			
199-K-13	3/10/94	B0BHW1	301		7.92			
199-K-19	1/24/94	B09QN0	290	340	8.42			
199-K-27	1/25/94	B09F61		360				
	2/23/94	B09ZZ7	365		7.34			
199-K-28	1/19/94	B09F63		670				
	3/10/94	B0BHW4	720		7.14			
199-K-29	1/19/94	B09F65		390				
199-K-30	1/20/94	B09F67		410 H				
199-K-32A	1/18/94	B09QN2	235	280	8.14			
199-K-33	1/25/94	B09QN4	567	580	7.28			
199-K-34	1/21/94	B09QP0	420	410	8.40			

For explanation of this table, see Section 1.4 of report.

APPENDIX B

**WATER LEVEL MEASUREMENTS FOR THE 100-K AREA
FUEL STORAGE BASINS NETWORK**

REPORTING PERIOD JANUARY 1 TO MARCH 31, 1994

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Well Number	Date	Type	Measured depth-to- water	Top-of-casing surveys:			Water table elevations:		
				COE/ TOC29	KAIS/ TOC29	HW/ TOC	COE- Head	KAIS- Head	HW- Head
199-K-11	1/06/94	W	76.35	466.50	466.55	467.66	390.15	390.20	391.31
199-K-13	1/06/94	W	74.89	465.60		464.00	390.71		389.11
199-K-18	1/06/94	W	24.02	409.95		409.00	385.93		384.98
199-K-18	1/24/94	S	23.93	409.95		409.00	386.02		385.07
199-K-19	1/06/94	W	35.68	422.09		422.17	386.41		386.49
199-K-20	1/06/94	W	36.78	421.94		422.57	385.16		385.79
199-K-21	1/06/94	W	37.08	421.68	421.73	421.73	384.60	384.65	384.65
199-K-22	1/06/94	W	39.44	424.46	424.51	421.68	385.02	385.07	382.24
199-K-23	1/06/94	W	75.69	468.17		405.00	392.48		329.31
199-K-27	1/06/94	W	74.33	466.67			392.34		
199-K-28	1/07/94	W	73.66	465.97			392.31		
199-K-30	1/06/94	W	73.59	466.20			392.61		
199-K-31	1/06/94	W	28.11	412.40			384.29		
199-K-32A	1/06/94	W	56.60		444.02	444.02		387.42	387.42
199-K-32B	1/06/94	W	49.10		445.27	445.27		396.17	396.17
199-K-33	1/05/94	W	58.48		443.64	443.64		385.16	385.16
199-K-33	1/25/94	S	57.74		443.64	443.64		385.90	385.90
199-K-34	1/06/94	W	78.65		468.09	468.09		389.44	389.44
199-K-34	1/21/94	S	78.54		468.09	468.09		389.55	389.55
199-K-35	1/06/94	W	99.74		494.55	494.55		394.81	394.81
199-K-36	1/06/94	W	98.50		494.07	494.07		395.57	395.57
199-K-37	1/06/94	W	55.78		441.80	441.80		386.02	386.02
699-70-68	1/07/94	W	128.50	526.07		526.21	397.57		397.71
699-72-73	1/07/94	W	87.24	482.59		482.57	395.35		395.33
699-73-61	1/07/94	W	133.64	531.43		531.53	397.79		397.89
699-78-62	1/06/94	W	75.84	469.69		469.88	393.85		394.04
199-K-11	2/10/94	W	74.94	466.50	466.55	467.66	391.56	391.61	392.72
199-K-13	2/10/94	W	73.87	465.60		464.00	391.73		390.13
199-K-18	2/10/94	W	22.57	409.95		409.00	387.38		386.43
199-K-19	2/10/94	W	34.42	422.09		422.17	387.67		387.75
199-K-20	2/10/94	W	34.79	421.94		422.57	387.15		387.78
199-K-21	2/10/94	W	34.99	421.68	421.73	421.73	386.69	386.74	386.74
199-K-22	2/10/94	W	37.76	424.46	424.51	421.68	386.70	386.75	383.92
199-K-23	2/10/94	W	75.33	468.17		405.00	392.84		329.67
199-K-27	2/10/94	W	74.20	466.67			392.47		
199-K-28	2/10/94	W	73.54	465.97			392.43		
199-K-29	2/10/94	W	74.72	467.39			392.67		
199-K-30	2/10/94	W	73.23	466.20			392.97		
199-K-31	2/10/94	W	24.34	412.40			388.06		
199-K-32A	2/10/94	W	55.09		444.02	444.02		388.93	388.93
199-K-32B	2/10/94	W	48.17		445.27	445.27		397.10	397.10
199-K-33	2/09/94	W	55.00		443.64	443.64		388.64	388.64
199-K-34	2/10/94	W	77.13		468.09	468.09		390.96	390.96
199-K-35	2/10/94	W	99.41		494.55	494.55		395.14	395.14
199-K-36	2/10/94	W	98.44		494.07	494.07		395.63	395.63
199-K-37	2/10/94	W	54.74		441.80	441.80		387.06	387.06
699-70-68	2/11/94	W	128.50	526.07		526.21	397.57		397.71
699-72-73	2/11/94	W	86.90	482.59		482.57	395.69		395.67

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Well Number	Date	Type	Measured depth-to- water	Top-of-casing surveys:			Water table elevations:		
				COE/ TOC29	KAIS/ TOC29	HW/ TOC	COE- Head	KAIS- Head	HW- Head
199-K-11	1/06/94	W	76.35	466.50	466.55	467.66	390.15	390.20	391.31
199-K-13	1/06/94	W	74.89	465.60		464.00	390.71		389.11
199-K-18	1/06/94	W	24.02	409.95		409.00	385.93		384.98
199-K-18	1/24/94	S	23.93	409.95		409.00	386.02		385.07
199-K-19	1/06/94	W	35.68	422.09		422.17	386.41		386.49
199-K-20	1/06/94	W	36.78	421.94		422.57	385.16		385.79
199-K-21	1/06/94	W	37.08	421.68	421.73	421.73	384.60	384.65	384.65
199-K-22	1/06/94	W	39.44	424.46	424.51	421.68	385.02	385.07	382.24
199-K-23	1/06/94	W	75.69	468.17		405.00	392.48		329.31
199-K-27	1/06/94	W	74.33	466.67			392.34		
199-K-28	1/07/94	W	73.66	465.97			392.31		
199-K-30	1/06/94	W	73.59	466.20			392.61		
199-K-31	1/06/94	W	28.11	412.40			384.29		
199-K-32A	1/06/94	W	56.60		444.02	444.02		387.42	387.42
199-K-32B	1/06/94	W	49.10		445.27	445.27		396.17	396.17
199-K-33	1/05/94	W	58.48		443.64	443.64		385.16	385.16
199-K-33	1/25/94	S	57.74		443.64	443.64		385.90	385.90
199-K-34	1/06/94	W	78.65		468.09	468.09		389.44	389.44
199-K-34	1/21/94	S	78.54		468.09	468.09		389.55	389.55
199-K-35	1/06/94	W	99.74		494.55	494.55		394.81	394.81
199-K-36	1/06/94	W	98.50		494.07	494.07		395.57	395.57
199-K-37	1/06/94	W	55.78		441.80	441.80		386.02	386.02
699-70-68	1/07/94	W	128.50	526.07		526.21	397.57		397.71
699-72-73	1/07/94	W	87.24	482.59		482.57	395.35		395.33
699-73-61	1/07/94	W	133.64	531.43		531.53	397.79		397.89
699-78-62	1/06/94	W	75.84	469.69		469.88	393.85		394.04
199-K-11	2/10/94	W	74.94	466.50	466.55	467.66	391.56	391.61	392.72
199-K-13	2/10/94	W	73.87	465.60		464.00	391.73		390.13
199-K-18	2/10/94	W	22.57	409.95		409.00	387.38		386.43
199-K-19	2/10/94	W	34.42	422.09		422.17	387.67		387.75
199-K-20	2/10/94	W	34.79	421.94		422.57	387.15		387.78
199-K-21	2/10/94	W	34.99	421.68	421.73	421.73	386.69	386.74	386.74
199-K-22	2/10/94	W	37.76	424.46	424.51	421.68	386.70	386.75	383.92
199-K-23	2/10/94	W	75.33	468.17		405.00	392.84		329.67
199-K-27	2/10/94	W	74.20	466.67			392.47		
199-K-28	2/10/94	W	73.54	465.97			392.43		
199-K-29	2/10/94	W	74.72	467.39			392.67		
199-K-30	2/10/94	W	73.23	466.20			392.97		
199-K-31	2/10/94	W	24.34	412.40			388.06		
199-K-32A	2/10/94	W	55.09		444.02	444.02		388.93	388.93
199-K-32B	2/10/94	W	48.17		445.27	445.27		397.10	397.10
199-K-33	2/09/94	W	55.00		443.64	443.64		388.64	388.64
199-K-34	2/10/94	W	77.13		468.09	468.09		390.96	390.96
199-K-35	2/10/94	W	99.41		494.55	494.55		395.14	395.14
199-K-36	2/10/94	W	98.44		494.07	494.07		395.63	395.63
199-K-37	2/10/94	W	54.74		441.80	441.80		387.06	387.06
699-70-68	2/11/94	W	128.50	526.07		526.21	397.57		397.71
699-72-73	2/11/94	W	86.90	482.59		482.57	395.69		395.67

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