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## THIRD QUARTER 1993

# F-AREA ACID/CAUSTIC BASIN GROUNDWATER MONITORING REPORT (U)

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Michele Bullington

WESTINGHOUSE SAVANNAH RIVER COMPANY
SAVANNAH RIVER SITE
AIKEN, SC 29808

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# Abstract

During third quarter 1993, samples from the six FAC monitoring wells at the F-Area Acid/Caustic Basin were collected and analyzed for indicator parameters, groundwater quality parameters, parameters indicating suitability as drinking water, and other constituents. One of the FAC piezometers was scheduled for these analyses but was dry. Analytical results that exceeded the final Primary Drinking Water Standards (PDWS) or the Savannah River Site (SRS) flagging criteria or turbidity standard during the quarter are the focus of this report.

Dichloromethane was detected above the final PDWS in four of the wells. Gross alpha exceeded the final PDWS in three wells. Aluminum exceeded its Flag 2 criterion in five wells. Manganese and iron exceeded standards in two wells each. Turbidity exceeded the SRS standard in wells FAC 3 and 8.

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# Executive Summary

The six monitoring wells at the F-Area Acid/Caustic Basin are sampled quarterly as part of the Savannah River Site (SRS) Groundwater Monitoring Program and to comply with South Carolina Hazardous Waste Management Regulations. One of the piezometers at the basin was scheduled for sampling during third quarter 1993, but was dry. During third quarter 1993, samples from the monitoring wells were analyzed for indicator parameters, groundwater quality parameters, parameters indicating suitability as drinking water, and other constituents. Monitoring results that exceeded final Primary Drinking Water Standards (PDWS), other SRS flagging criteria, or the SRS turbidity standard are the focus of this report.

During first quarter 1993, when a final PDWS was first applied, dichloromethane was elevated in four wells. During second quarter, this common laboratory contaminant was not detected in any of the wells. During third quarter, it was detected above its PDWS in the samples from four of the wells. In each case, the samples were associated with a contaminated blank.

Gross alpha exceeded its final PDWS in three of the wells during third quarter, with a maximum activity in FAC 3 of 3.9E+01 pCi/L. Since activities exceed standards in both upgradient and downgradient wells, these activity levels are not attributed to basin activity.

Aluminum was above its Flag 2 criterion in five of the six wells, with values up to 4,470 $\mu$g/L in FAC 8. Iron was elevated in two wells, with a high value of 13,100 $\mu$g/L in well FAC 8. Manganese exceeded the Flag 2 criterion in two wells, with a maximum concentration of 541 $\mu$g/L in well FAC 4.

Samples from wells FAC 3 and 8 exceeded the SRS standard for turbidity.

# Introduction

The F-Area Acid/Caustic Basin is located east of F Area at the Savannah River Site (SRS) on a slope that leads to an unnamed tributary of Upper Three Runs Creek. The basin, constructed in the early 1950s, is an unlined earthen pit that received dilute sulfuric acid and sodium hydroxide solutions and other wastes from several areas within SRS. The basin provided mixing and neutralization of the dilute solutions before their discharge to nearby streams. The F-Area Acid/Caustic Basin remained in service until new neutralization facilities became operational in 1982 (Heffner and Exploration Resources, 1991).

Four groundwater monitoring wells were installed at the F-Area Acid/Caustic Basin between August 1983 and July 1984. Under the terms of a consent decree signed May 26, 1988, by the U.S. District Court (District of South Carolina, Aiken Division), the basin became subject effective June 1, 1988, to requirements of Subtitle C of the Resource Conservation and Recovery Act (RCRA), the South Carolina Hazardous Waste Management Regulations (SCHWMR), and associated regulations. The monitoring wells were reevaluated during the summer of 1988 to ensure compliance with SCHWMR. As part of this compliance effort, four additional wells were installed at the F-Area Acid/Caustic Basin during third quarter 1988. Wells FAC 1 and 2 were abandoned in March 1989 because they were dry and were not included in the RCRA monitoring program.

Because the screen zone elevations of the monitoring wells vary, the pattern of water elevations has made interpretation of horizontal flow direction beneath the basin difficult. The revised Groundwater Quality Assessment Plan for the F-Area Acid/Caustic Basin (WSRC, 1991), submitted to the South Carolina Department of Health and Environmental Control (SCDHEC) on April 30, 1991, proposed the installation of six permanent piezometers to provide additional water-elevation data, to help define the groundwater flow direction, and to assess the current monitoring well network as required by SCHWMR. The piezometers were installed early in 1992. A water-elevation map and hydrograph based on piezometer data are included in this report. During first quarter 1993, one of the piezometers was added to the sampling schedule.

The Environmental Protection Department/Environmental Monitoring Section (EPD/EMS) samples the monitoring wells at the F-Area Acid/Caustic Basin quarterly as part of the SRS Groundwater Monitoring Program; to comply with SCHWMR, the Environmental Restoration Department provides a quarterly report to SCDHEC describing the monitoring results.

# Discussion

## Groundwater Monitoring Data

The groundwater sampling procedure was modified beginning fourth quarter 1992 in response to regulatory guidance and advances in sampling equipment design (EPD/EMS, 1992). The modified procedure requires evacuation of a minimum of two well volumes and stabilization of pH, specific conductance, and turbidity prior to sample collection. Stability is established when a minimum of three successive measurements, taken within a given time period, are within a specified tolerance range. If a well pumps dry before two well volumes are purged or before stabilization is achieved, it must be revisited within 24 hours for the data to be considered the result of a single sampling event. On the second visit within 24 hours, samples are taken without purging or measuring stability; thus, these samples may not be representative of the groundwater quality.

A further modification in the procedure is that samples collected for metals analyses are no longer filtered. Thus, the analyses are for total metals rather than dissolved metals. Roy F. Weston, Inc., performs a digestion before metals analyses to yield total recoverable quantities.

During third quarter 1993, samples from six monitoring wells at the F-Area Acid/Caustic Basin were analyzed for indicator parameters, groundwater quality parameters, parameters indicating suitability as drinking water, and other constituents. One piezometer was scheduled for sampling during second quarter 1993, but was dry. This report describes results that exceeded Safe Drinking Water Act final Primary Drinking Water Standards (PDWS) established by the U.S. Environmental Protection Agency (EPA) (Appendix A), the South Carolina final PDWS for lead (Appendix A), SRS Flag 2 criteria (Appendix B), or the SRS turbidity standard.

Beginning first quarter 1993, aluminum was added to the list of comprehensive analyses, and dichloromethane (methylene chloride) first was evaluated against a standard promulgated by EPA in July 1992 (enforceable beginning January 17, 1994). The status of radium isotopes was re-examined, and radium-228 is now flagged according to its proposed drinking water standard (DWS), while both radium-226 and total alpha-emitting radium (radium-223, -224, and -226 analyzed together) are flagged according to the proposed DWS for radium-226. The final PDWS for total radium (as the sum of radium-226 and -228 activities) is not used for flagging.

Generally, the SRS flagging criteria are based on final and proposed PDWS, secondary DWS, and method detection limits. Constituent levels that equal or exceed the final PDWS, screening levels, or other Flag 2 criteria are described as *elevated.*

The final PDWS for individual analytes presented in Appendix A may not always match the SRS flagging criteria presented in Appendix B. The final PDWS generally are used in

this compliance report as guidelines to meet regulatory requirements; the flagging criteria are used by EPD/EMS to identify relative levels of constituents in the groundwater and as guides for scheduling groundwater monitoring.

Illustrations of the monitored waste management unit at SRS (Figure 1), the individual monitoring wells (Figure 2), and the flow direction of the groundwater beneath the basin (Figures 3 and 4) appear in Appendix C; monitoring results are presented in Appendix D; data quality/useability assessment is discussed in Appendix E; and hydrographs are in Appendix F. In the past, Figures 2, 3, and 4 have been oriented along SRS grid coordinates; beginning second quarter 1993, they are oriented along Universal Transverse Mercator (UTM) coordinates. As in the past, Figure 1 is oriented along latitude/longitude coordinates; SRS grid coordinates are also presented.

## Analytical Results Exceeding Standards

Results for analytes that exceeded the final PDWS (see Appendix A) during third quarter 1993 are summarized in Table 1 (Appendix D). Gross alpha activity exceeded the final PDWS in three of the monitoring wells. Since activities exceed standards in both upgradient and downgradient wells, these activity levels are not attributed to basin activity. Dichloromethane exceeded its PDWS in four wells. In each case, the result is qualified with a *V* modifier, indicating that dichloromethane, a common laboratory contaminant, also was detected in an associated blank.

Constituents that exceeded other flagging criteria (see Appendix B) during third quarter are summarized in Table 2 (Appendix D). Aluminum exceeded its Flag 2 criterion in five wells, with a maximum value of 4,470 $\mu$g/L in well FAC 8. Iron exceeded its Flag 2 criterion in wells FAC 3 and 8, with a maximum concentration of 13,000 $\mu$g/L in well FAC 8. Manganese exceeded the Flag 2 criterion in wells FAC 4 and 8, with a maximum concentration of 541 $\mu$g/L in well FAC 4.

Table 3 (Appendix D) presents all of the results for individual wells and indicates those analyses that exceeded holding times or final PDWS. Modifiers (qualifiers) which may appear in the *Mod* column of Table 3 are defined on pp. D-3 and D-4. Certain analyses for endrin, lindane, methoxychlor, and toxaphene from wells FAC 3 and 8 were analyzed out of holding; in each case, duplicate analyses were performed within holding, and all results for both wells were below detection limits.

Table 3 also lists the number of well volumes purged from each well during third quarter 1993. Piezometer FAC 5P, which was scheduled for sampling, was dry. Well FAC 5 failed to produce two well volumes before running dry, and wells FAC 6 and 7 ran dry before stabilization was achieved; thus, they may not have produced representative groundwater samples. The samplers noted that the water was brown from wells FAC 3 and 8; very light brown from well FAC 6; and clear to very light brown from FAC 5.

Some of the values for earlier quarters presented in Table 1 of this report may differ from the values for those same quarters presented in previous reports because some reanalyses may have been performed by the laboratories after the quarterly reports had gone to press.

## Turbidity Results Exceeding Standards

A value of 5 nephelometric turbidity units (NTU), established by EPA (1986) as a general standard for acceptability of groundwater samples, is considered unrealistic for monitoring wells at SRS. Gass (1989) has documented turbidity measurements ranging up to 5,000 NTU from properly designed wells screened in poorly productive formations. During the 1989 RCRA Compliance Monitoring Evaluation Inspection, officials from EPA Region IV indicated that the SRS turbidity standard of 50 NTU is conservative. These officials also agreed that water-table wells in this area often correspond to nonaquifer formations, rendering development of these wells more difficult due to the low yield and high proportion of mobile fines typical of these formations (Bergren and Bennett, 1989).

During third quarter 1993, the turbidity in the samples from wells FAC 6 and 7 was between 5 NTU and the SRS turbidity standard of 50 NTU. Wells FAC 3 and 8 exceeded that standard, with values up to 360 NTU in FAC 8 (Tables 2 and 3, Appendix D).

## Water Elevations, Flow Directions, and Flow Rates

Because most of the FAC monitoring wells are screened into and through a clay confining layer (the tan clay) beneath the F-Area Acid/Caustic Basin, water-level measurements from the FAC monitoring wells do not provide a clear groundwater flow pattern and, thus, have made flow rate estimates uncertain. Piezometers screened above this clay layer were installed during 1992 to provide additional water elevations for more accurate determination of groundwater flow direction and rate estimates within the water table.

Figure 3 (Appendix C) was generated using only water elevations from the FAC monitoring wells, and Figure 4 (Appendix C) was generated using only water elevations from the FAC piezometers (1P–6P). Using UTM coordinates, the groundwater flow direction derived using FAC monitoring well water elevations is west, whereas the direction derived using the FAC piezometers is northwest.

The groundwater flow rate in the water table (Aquifer Zone $IIB_2$) beneath the F-Area Acid/Caustic Basin is estimated using the following equation:

$$\text{Flow (ft/day)} = \frac{\text{Hydraulic Conductivity (ft/day)}}{\text{Porosity (unitless)}} \times \frac{dh\ \text{(ft)}}{dl\ \text{(ft)}}$$

A hydraulic conductivity constant of 10 ft/day (Geraghty & Miller, Inc., 1990) is a conservative estimate (i.e., the actual hydraulic conductivity should be somewhat less than 10 ft/day). The effective porosity value is estimated at 20% (Killian et al., 1987), *dh* is the difference in head, and *dl* is the length of the flow path to the nearest foot. Flow rate estimates vary depending on the vertical gradient between wells, the size of the area under consideration, and the number of data points. For this reason, the estimation of flow rate should be considered accurate only to an order of magnitude.

Flow rate estimates are calculated as follows: flow rate per day is calculated to two significant figures using the above equation. This value is then multiplied by 365 and rounded to two significant figures for the flow rate per year.

Using the above equation with data from the FAC monitoring wells, with $dh$ = 4 ft and $dl$ = 27 ft (see Figure 3 in Appendix C), the flow rate estimate for groundwater in the water table beneath the F-Area Acid/Caustic Basin is as follows:

$$\frac{10}{0.20} \times \frac{4}{27} = 7.4 \text{ ft/day}$$

$$7.4 \text{ ft/day} \times 365 \text{ days} \approx 2{,}700 \text{ ft/yr}$$

Using the equation with data from the FAC piezometers, with $dh$ = 0.9 ft and $dl$ = 137 ft (see Figure 4 in Appendix C), the flow rate estimate for groundwater in the water table beneath the F-Area Acid/Caustic Basin is as follows:

$$\frac{10}{0.20} \times \frac{0.9}{137} = 0.33 \text{ ft/day}$$

$$0.33 \text{ ft/day} \times 365 \text{ days} \approx 120 \text{ ft/yr}$$

A comparison of recent calculated flow rates shows an order-of-magnitude difference.

| | 4Q92 | 1Q93 | 2Q93 | 3Q93 |
|---|---|---|---|---|
| Flow rate (ft/yr) (monitoring wells) | 3,200 | 2,600 | 3,000 | 2,700 |
| Flow rate (ft/yr) (piezometers) | 120 | 140 | 140 | 120 |

Water elevations for the FAC piezometers probably represent fully unconfined conditions, while water elevations for FAC monitoring wells intersecting the clay layer may have equilibrated with hydrostatic head below the clay layer. As a result, water-table conditions determined by piezometer water elevations are more representative of true water-table conditions than those determined by water elevations obtained at monitoring wells.

As can be seen in Figures 3 and 4 (Appendix C), the monitoring wells display a greater gradient over a shorter distance than do the piezometers. This is due to the variation in screening of the monitoring wells through and into the tan clay. The monitoring wells essentially are depicting a variation in head resulting from different pressure gradients.

Hydrographs for the FAC monitoring wells and the FAC piezometers are presented in Appendix F.

## Results for Upgradient vs. Downgradient Wells

Based on the groundwater flow direction determined from the piezometer data, wells FAC 3 and 5 are the upgradient wells at the F-Area Acid/Caustic Basin while FAC 4, 6, 7, and 8 are downgradient. During third quarter 1993, dichloromethane and gross alpha each were detected above their final PDWS in both upgradient wells. Dichloromethane also exceeded its final PDWS in downgradient wells FAC 4 and 8, and gross alpha also was elevated in downgradient well FAC 4. Both upgradient wells contained elevated levels of aluminum, while FAC 3 also contained elevated iron. Aluminum also was elevated in downgradient wells FAC 4, 7, and 8, and manganese was elevated in downgradient wells FAC 4 and 8. Iron was elevated in downgradient well FAC 8. Turbidity was above the SRS standard in upgradient well FAC 3 and downgradient well FAC 8. The maximum concentration of aluminum and iron occurred in downgradient well FAC 8 this quarter, and the highest concentration of manganese was found in downgradient well FAC 4.

# Conclusions

Gross alpha, dichloromethane, aluminum, iron, manganese, and turbidity exceeded final PDWS, other Flag 2 criteria, or the SRS turbidity standard in FAC wells at the F-Area Acid/Caustic Basin during third quarter 1993.

One or both of the upgradient wells, FAC 3 and 5, contained elevated levels of dichloromethane (a common laboratory contaminant), gross alpha, aluminum, and iron. The maximum result for gross alpha was obtained from upgradient well FAC 3. Manganese was elevated only in downgradient wells 4 and 8. Generally, elevated levels of constituents found in downgradient wells but not in upgradient wells at a waste management unit are considered products of the waste management unit.

Because historical records indicate that no radionuclides were disposed of at this waste management unit (Heffner and Exploration Resources, 1991), the elevated level of gross alpha in the FAC wells is not considered to be due to seepage from the F-Area Acid/Caustic Basin.

Water-table elevations from the FAC piezometers at the F-Area Acid/Caustic Basin indicate a northwest flow direction at a rate of approximately 120 ft/yr. The groundwater flow depicted from the piezometers is a more realistic projction of flow conditions in the water table than the flow rate and direction obtained from monitoring well data.

# References Cited

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WSRC (Westinghouse Savannah River Company), 1991. **F-, H-, K-, and P-Area Acid/Caustic Basins Groundwater Quality Assessment Plan**, WSRC-TR-91-178, Revision 1.0. Westinghouse Savannah River Company, Aiken, SC.

# Errata

Third Quarter 1992:

- Prior to third quarter 1992, the results of certain analyses for *nitrate-nitrite as nitrogen* were reported incorrectly by the General Engineering laboratory as *nitrate as nitrogen* results. The analyses in the results tables beginning with this report are reported correctly (*nitrate-nitrite* results have been separated from true *nitrate* results).

Fourth Quarter 1992 through Second Quarter 1993:

- No errata have been reported.

# Appendix A – Final Primary Drinking Water Standards

# Final Primary Drinking Water Standards

| Analyte | Unit | Level | Status | Source |
|---|---|---|---|---|
| Antimony | µg/L | 6 | Final | EPA, 1992b |
| Arsenic | µg/L | 50 | Final | EPA, 1992a |
| Asbestos | fibers/L | 7,000,000 | Final | EPA, 1992a |
| Barium | µg/L | 2,000 | Final | EPA, 1992a |
| Benzene | µg/L | 5 | Final | EPA, 1992a |
| Benzo[*a*]pyrene | µg/L | 0.2 | Final | EPA, 1992b |
| Beryllium | µg/L | 4 | Final | EPA, 1992b |
| Bis(2-ethylhexyl) phthalate | µg/L | 6 | Final | EPA, 1992b |
| Bromodichloromethane | µg/L | 100[a] | Final | EPA, 1992a |
| Bromoform | µg/L | 100[a] | Final | EPA, 1992a |
| 2-sec-Butyl-4,6-dinitrophenol | µg/L | 7 | Final | EPA, 1992b |
| Cadmium | µg/L | 5 | Final | EPA, 1992a |
| Carbon tetrachloride | µg/L | 5 | Final | EPA, 1992a |
| Chlordane | µg/L | 2 | Final | EPA, 1992a |
| Chlorobenzene | µg/L | 100 | Final | EPA, 1992a |
| Chloroethene (Vinyl chloride) | µg/L | 2 | Final | EPA, 1992a |
| Chloroform | µg/L | 100[a] | Final | EPA, 1992a |
| Chromium | µg/L | 100 | Final | EPA, 1992a |
| Copper | µg/L | 1,300 | Final | EPA, 1992a |
| Cyanide | µg/L | 200 | Final | EPA, 1992b |
| Dibromochloromethane | µg/L | 100[a] | Final | EPA, 1992a |
| Dibromochloropropane | µg/L | 0.2 | Final | EPA, 1992a |
| 1,2-Dibromoethane (Ethylene dibromide) | µg/L | 0.05 | Final | EPA, 1992a |
| 1,2-Dichlorobenzene | µg/L | 600 | Final | EPA, 1992a |
| 1,4-Dichlorobenzene | µg/L | 75 | Final | EPA, 1992a |
| 1,2-Dichloroethane | µg/L | 5 | Final | EPA, 1992a |
| 1,1-Dichloroethene | µg/L | 7 | Final | EPA, 1992a |
| 1,2-Dichloroethene | µg/L | 50 | Final | EPA, 1992b |
| cis-1,2-Dichloroethene | µg/L | 70 | Final | EPA, 1992a |
| trans-1,2-Dichloroethene | µg/L | 100 | Final | EPA, 1992a |
| Dichloromethane (Methylene chloride) | µg/L | 5 | Final | EPA, 1992b |
| 2,4-Dichlorophenoxyacetic acid | µg/L | 70 | Final | EPA, 1992a |
| 1,2-Dichloropropane | µg/L | 5 | Final | EPA, 1992a |
| Endrin | µg/L | 2 | Final | EPA, 1992b |
| Ethylbenzene | µg/L | 700 | Final | EPA, 1992a |
| Fluoride | µg/L | 4,000 | Final | EPA, 1992a |
| Gross alpha[b] | pCi/L | 1.5E+01 | Final | EPA, 1992a |
| Heptachlor | µg/L | 0.4 | Final | EPA, 1992a |
| Heptachlor epoxide | µg/L | 0.2 | Final | EPA, 1992a |
| Hexachlorobenzene | µg/L | 1 | Final | EPA, 1992b |
| Hexachlorocyclopentadiene | µg/L | 50 | Final | EPA, 1992b |
| Lead | µg/L | 50 | Final | SCDHEC, 1981 |
| Lindane | µg/L | 0.2 | Final | EPA, 1992a |
| Mercury | µg/L | 2 | Final | EPA, 1992a |
| Methoxychlor | µg/L | 40 | Final | EPA, 1992a |
| Nickel | µg/L | 100 | Final | EPA, 1992b |
| Nitrate as nitrogen | µg/L | 10,000 | Final | EPA, 1992a |
| Nitrate-nitrite as nitrogen | µg/L | 10,000 | Final | EPA, 1992a |
| Nitrite as nitrogen | µg/L | 1,000 | Final | EPA, 1992a |
| Nonvolatile beta[c] | pCi/L | 5E+01 | Final | EPA, 1977 |
| PCBs[d] | µg/L | 0.5 | Final | EPA, 1992a |
| Pentachlorophenol | µg/L | 1 | Final | EPA, 1992a |
| Radium, total (Radium-226 and -228) | pCi/L | 5E+00 | Final | EPA, 1992a |

| Analyte | Unit | Level | Status | Source |
|---|---|---|---|---|
| Selenium | µg/L | 50 | Final | EPA, 1992a |
| Strontium-89/90[e] | pCi/L | 8E+00 | Final | EPA, 1992a |
| Strontium-90 | pCi/L | 8E+00 | Final | EPA, 1992a |
| Styrene | µg/L | 100 | Final | EPA, 1992a |
| 2,3,7,8-TCDD | µg/L | 0.00003 | Final | EPA, 1992b |
| Tetrachloroethylene | µg/L | 5 | Final | EPA, 1992a |
| Thallium | µg/L | 2 | Final | EPA, 1992b |
| Toluene | µg/L | 1,000 | Final | EPA, 1992a |
| Total trihalomethanes | µg/L | 100 | Final | EPA, 1992a |
| Toxaphene | µg/L | 3 | Final | EPA, 1992a |
| 2,4,5-TP (Silvex) | µg/L | 50 | Final | EPA, 1992a |
| 1,2,4-Trichlorobenzene | µg/L | 70 | Final | EPA, 1992b |
| 1,1,1-Trichloroethane | µg/L | 200 | Final | EPA, 1992a |
| 1,1,2-Trichloroethane | µg/L | 5 | Final | EPA, 1992b |
| Trichloroethylene | µg/L | 5 | Final | EPA, 1992a |
| Tritium | pCi/mL | 2E+01 | Final | EPA, 1992a |
| Xylenes | µg/L | 10,000 | Final | EPA, 1992a |

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[a] This value is the drinking water standard for total trihalomethanes (the sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane).

[b] The standard given is for gross alpha including radium-226 but excluding radon and uranium.

[c] This is the screening level above which providers of public drinking water should perform analyses for specific man-made radionuclides. The standard for the total dose equivalent from all such radionuclides is 4 mrem per year.

[d] Analyses were conducted in 1992 for the following: PCB 1016, PCB 1221, PCB 1232, PCB 1242, PCB 1248, PCB 1254, and PCB 1260.

[e] For double radionuclide analyses where each separate radionuclide has its own standard, the more stringent standard is used.

## References

EPA (U.S. Environmental Protection Agency), 1977. **National Interim Primary Drinking Water Regulations**, EPA-570/9-76-003. Washington, DC.

EPA (U.S. Environmental Protection Agency), 1992a. *National Primary Drinking Water Regulations,* **Code of Federal Regulations**, Title 40, Part 141, pp. 589–729. Washington, DC.

EPA (U.S. Environmental Protection Agency), 1992b. *National Primary Drinking Water Regulations—Synthetic Organic Chemicals and Inorganic Chemicals; National Primary Drinking Water Regulations Implementation.* **Federal Register**, July 17, 1992, pp. 31776–31849. Washington, DC.

SCDHEC (South Carolina Department of Health and Environmental Control), 1981. **State Primary Drinking Water Regulations**, R.61-58.5. Columbia, SC.

# Appendix B – Flagging Criteria

## Flagging Criteria

The Savannah River Site Environmental Protection Department/Environmental Monitoring Section (EPD/EMS) flagging criteria are as follows:

- Flag 2 criteria for constituents equal the Safe Drinking Water Act (SDWA) final Primary Drinking Water Standard (PDWS), the SDWA proposed PDWS, or the SDWA Secondary Drinking Water Standard (SDWS). If a constituent does not have a drinking water standard, the Flag 2 criterion equals 10 times the method detection limit (MDL) calculated as the 90th percentile detection limit obtained recently by one of the primary analytical laboratories.

- Flag 1 criteria for constituents equal one-half of the final PDWS, one-half the proposed PDWS, or one-half the SDWS. If a constituent does not have a drinking water standard, the Flag 1 criterion equals 5 times the MDL calculated as the 90th percentile detection limit obtained recently by one of the primary analytical laboratories.

- Flag 0 criteria are assigned to constituent levels below Flag 1 criteria, constituent levels below the sample detection limits, or constituents having no flagging criteria.

The following parameters are not assigned flagging criteria: alkalinity, calcium, color, corrosivity, Eh, magnesium, odor, potassium, silica, sodium, total dissolved solids, total phosphates (as P), total phosphorus, and turbidity. In addition, common laboratory contaminants and cleaners including some phthalates, ketones, and toluene are not assigned flagging criteria.

| Analyte | Unit | Flag 1 | Flag 2 | Source[a] |
|---|---|---|---|---|
| Acenaphthene | µg/L | 50 | 100 | EPA Method 8270 |
| Acenaphthylene | µg/L | 50 | 100 | EPA Method 8270 |
| Acetone | µg/L | 500 | 1,000 | EPA Method 8240 |
| Acetonitrile (Methyl cyanide) | µg/L | 500 | 1,000 | EPA Method 8240 |
| Acetophenone | µg/L | 50 | 100 | EPA Method 8270 |
| 2-Acetylaminofluorene | µg/L | 50 | 100 | EPA Method 8270 |
| Acrolein | µg/L | 100 | 200 | EPA Method 8240 |
| Acrylonitrile | µg/L | 100 | 200 | EPA Method 8240 |
| Actinium-228 | pCi/L | 1.64E+03 | 3.27E+03 | Proposed PDWS (EPA, 1991) |
| Aldrin | µg/L | 0.25 | 0.5 | EPA Method 8080 |
| Alkalinity (as $CaCO_3$) | | No flag | No flag | Set by EPD/EMS |
| Allyl chloride | µg/L | 250 | 500 | EPA Method 8240 |
| Aluminum | µg/L | 25 | 50 | SDWS (EPA, 1992c) |
| Americium-241 | pCi/L | 3.17E+00 | 6.34E+00 | Proposed PDWS (EPA, 1991) |
| Americium-243 | pCi/L | 3.19E+00 | 6.37E+00 | Proposed PDWS (EPA, 1991) |
| 4-Aminobiphenyl | µg/L | 50 | 100 | EPA Method 8270 |
| Ammonia | µg/L | 500 | 1,000 | APHA Method 417B |
| Ammonia nitrogen | µg/L | 500 | 1,000 | EPA Method 350.1 |
| Aniline | µg/L | 50 | 100 | EPA Method 8270 |
| Anthracene | µg/L | 50 | 100 | EPA Method 8270 |
| Antimony | µg/L | 3 | 6 | Final PDWS (EPA, 1992b) |
| Antimony-125 | pCi/L | 1.5E+02 | 3E+02 | Final PDWS (EPA, 1977) |
| Aramite | µg/L | 50 | 100 | EPA Method 8270 |
| Arsenic | µg/L | 25 | 50 | Final PDWS (EPA, 1992a) |

| Analyte | Unit | Flag 1 | Flag 2 | Source[a] |
|---|---|---|---|---|
| Asbestos | Fibers/L | 3,500,000 | 7,000,000 | Final PDWS (EPA, 1992a) |
| Azobenzene | µg/L | 50 | 100 | EPA Method 625 |
| Barium | µg/L | 1,000 | 2,000 | Final PDWS (EPA, 1992a) |
| Barium-140 | pCi/L | 4.5E+01 | 9E+01 | Final PDWS (EPA, 1977) |
| Benzene | µg/L | 2.5 | 5 | Final PDWS (EPA, 1992a) |
| alpha-Benzene hexachloride | µg/L | 0.25 | 0.5 | EPA Method 8080 |
| beta-Benzene hexachloride | µg/L | 0.25 | 0.5 | EPA Method 8080 |
| delta-Benzene hexachloride | µg/L | 0.25 | 0.5 | EPA Method 8080 |
| Benzidine | µg/L | 250 | 500 | EPA Method 8270 |
| Benzo[*a*]anthracene | µg/L | 0.05 | 0.1 | Proposed PDWS (EPA, 1990) |
| Benzo[*b*]fluoranthene | µg/L | 0.1 | 0.2 | Proposed PDWS (EPA, 1990) |
| Benzo[*k*]fluoranthene | µg/L | 0.1 | 0.2 | Proposed PDWS (EPA, 1990) |
| Benzoic acid | µg/L | 250 | 500 | EPA Method 8270 |
| Benzo[*g,h,i*]perylene | µg/L | 50 | 100 | EPA Method 8270 |
| Benzo[*a*]pyrene | µg/L | 0.1 | 0.2 | Final PDWS (EPA, 1992b) |
| 1,4-Benzoquinone | µg/L | 50 | 100 | EPA Method 8270 |
| Benzyl alcohol | µg/L | 50 | 100 | EPA Method 8270 |
| Beryllium | µg/L | 2 | 4 | Final PDWS (EPA, 1992b) |
| Beryllium-7 | pCi/L | 3E+03 | 6E+03 | Final PDWS (EPA, 1977) |
| Bis(2-chloroethoxy) methane | µg/L | 50 | 100 | EPA Method 8270 |
| Bis(2-chloroethyl) ether | µg/L | 50 | 100 | EPA Method 8270 |
| Bis(2-chloroisopropyl) ether | µg/L | 50 | 100 | EPA Method 8270 |
| Bis(chloromethyl) ether | µg/L | 50 | 100 | EPA Method 8270 |
| Bis(2-ethylhexyl) phthalate | µg/L | 3 | 6 | Final PDWS (EPA, 1992b) |
| Bromide | µg/L | 5,000 | 10,000 | EPA Method 300.0 |
| Bromodichloromethane | µg/L | 50 | 100 | Final PDWS (EPA, 1992a) |
| Bromoform | µg/L | 50 | 100 | Final PDWS (EPA, 1992a) |
| Bromomethane (Methyl bromide) | µg/L | 5 | 10 | EPA Method 8240 |
| 4-Bromophenyl phenyl ether | µg/L | 50 | 100 | EPA Method 8270 |
| 2-sec-Butyl-4,6-dinitrophenol | µg/L | 3.5 | 7 | Final PDWS (EPA, 1992b) |
| Butylbenzyl phthalate | | No flag | No flag | Set by EPD/EMS |
| Cadmium | µg/L | 2.5 | 5 | Final PDWS (EPA, 1992a) |
| Calcium | | No flag | No flag | Set by EPD/EMS |
| Carbon disulfide | µg/L | 5 | 10 | EPA Method 8240 |
| Carbon tetrachloride | µg/L | 2.5 | 5 | Final PDWS (EPA, 1992a) |
| Carbon-14 | pCi/L | 1E+03 | 2E+03 | Final PDWS (EPA, 1977) |
| Carbonate | | No flag | No flag | Set by EPD/EMS |
| Cerium-141 | pCi/L | 1.5E+02 | 3E+02 | Final PDWS (EPA, 1977) |
| Cerium-144 | pCi/L | 1.31E+02 | 2.61E+02 | Proposed PDWS (EPA, 1991) |
| Cesium-134[b] | pCi/L | 4.07E+01 | 8.13E+01 | Proposed PDWS (EPA, 1991) |
| Cesium-137 | pCi/L | 1E+02 | 2E+02 | Final PDWS (EPA, 1977) |
| Chlordane | µg/L | 1 | 2 | Final PDWS (EPA, 1992a) |
| Chloride | µg/L | 125,000 | 250,000 | SDWS (EPA, 1992c) |
| 4-Chloroaniline | µg/L | 50 | 100 | EPA Method 8270 |
| Chlorobenzene | µg/L | 50 | 100 | Final PDWS (EPA, 1992a) |
| Chlorobenzilate | µg/L | 50 | 100 | EPA Method 8270 |
| Chloroethane | µg/L | 5 | 10 | EPA Method 8240 |
| Chloroethene (Vinyl chloride) | µg/L | 1 | 2 | Final PDWS (EPA, 1992a) |
| Chloroethyl vinyl ether | µg/L | 5 | 10 | EPA Method 8240 |
| 2-Chloroethyl vinyl ether | µg/L | 5 | 10 | EPA Method 8240 |
| Chloroform | µg/L | 50 | 100 | Final PDWS (EPA, 1992a) |
| 4-Chloro-m-cresol | µg/L | 50 | 100 | EPA Method 8270 |
| Chloromethane (Methyl chloride) | µg/L | 5 | 10 | EPA Method 8240 |
| 2-Chloronaphthalene | µg/L | 50 | 100 | EPA Method 8240 |
| 2-Chlorophenol | µg/L | 50 | 100 | EPA Method 8270 |

| Analyte | Unit | Flag 1 | Flag 2 | Source[a] |
|---|---|---|---|---|
| 4-Chlorophenyl phenyl ether | µg/L | 50 | 100 | EPA Method 8270 |
| Chloroprene | µg/L | 1,000 | 2,000 | EPA Method 8240 |
| Chromium | µg/L | 50 | 100 | Final PDWS (EPA, 1992a) |
| Chromium-51 | pCi/L | 3E+03 | 6E+03 | Final PDWS (EPA, 1977) |
| Chrysene | µg/L | 0.1 | 0.2 | Proposed PDWS (EPA, 1990) |
| Cobalt | µg/L | 20 | 40 | EPA Method 6010 |
| Cobalt-57 | pCi/L | 5E+02 | 1E+03 | Final PDWS (EPA, 1977) |
| Cobalt-58 | pCi/L | 4.5E+03 | 9E+03 | Final PDWS (EPA, 1977) |
| Cobalt-60 | pCi/L | 5E+01 | 1E+02 | Final PDWS (EPA, 1977) |
| Color | | No flag | No flag | Set by EPD/EMS |
| Copper | µg/L | 650 | 1,300 | Final PDWS (EPA, 1992a) |
| Corrosivity | | No flag | No flag | Set by EPD/EMS |
| m-Cresol (3-Methylphenol) | µg/L | 50 | 100 | EPA Method 8270 |
| o-Cresol (2-Methylphenol) | µg/L | 50 | 100 | EPA Method 8270 |
| p-Cresol (4-Methylphenol) | µg/L | 50 | 100 | EPA Method 8270 |
| Curium-242 | pCi/L | 6.65E+01 | 1.33E+02 | Proposed PDWS (EPA, 1991) |
| Curium-243 | pCi/L | 4.15E+00 | 8.3E+00 | Proposed PDWS (EPA, 1991) |
| Curium-243/244[c] | pCi/L | 4.15E+00 | 8.3E+00 | Proposed PDWS (EPA, 1991) |
| Curium-244 | pCi/L | 4.92E+00 | 9.84E+00 | Proposed PDWS (EPA, 1991) |
| Curium-245/246[c] | pCi/L | 3.12E+00 | 6.23E+00 | Proposed PDWS (EPA, 1991) |
| Curium-246 | pCi/L | 3.14E+00 | 6.27E+00 | Proposed PDWS (EPA, 1991) |
| Cyanide | µg/L | 100 | 200 | Final PDWS (EPA, 1992b) |
| p,p'-DDD | µg/L | 0.5 | 1 | EPA Method 8080 |
| p,p'-DDE | µg/L | 0.5 | 1 | EPA Method 8080 |
| p,p'-DDT | µg/L | 0.5 | 1 | EPA Method 8080 |
| Di-n-butyl phthalate | | No flag | No flag | Set by EPD/EMS |
| Di-n-octyl phthalate | | No flag | No flag | Set by EPD/EMS |
| Diallate | µg/L | 50 | 100 | EPA Method 8270 |
| Dibenz[*a,h*]anthracene | µg/L | 0.15 | 0.3 | Proposed PDWS (EPA, 1990) |
| Dibenzofuran | µg/L | 50 | 100 | EPA Method 8270 |
| Dibromochloromethane | µg/L | 50 | 100 | Final PDWS (EPA, 1992a) |
| 1,2-Dibromo-3-chloropropane | µg/L | 0.1 | 0.2 | Final PDWS (EPA, 1992a) |
| 1,2-Dibromoethane (Ethylene dibromide) | µg/L | 0.025 | 0.05 | Final PDWS (EPA, 1992a) |
| Dibromomethane (Methylene bromide) | µg/L | 5 | 10 | EPA Method 8240 |
| 1,2-Dichlorobenzene | µg/L | 300 | 600 | Final PDWS (EPA, 1992a) |
| 1,3-Dichlorobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| 1,4-Dichlorobenzene | µg/L | 37.5 | 75 | Final PDWS (EPA, 1992a) |
| 3,3'-Dichlorobenzidine | µg/L | 50 | 100 | EPA Method 8270 |
| trans-1,4-Dichloro-2-butene | µg/L | 150 | 300 | EPA Method 8240 |
| Dichlorodifluoromethane | µg/L | 5 | 10 | EPA Method 8240 |
| 1,1-Dichloroethane | µg/L | 5 | 10 | EPA Method 8240 |
| 1,2-Dichloroethane | µg/L | 2.5 | 5 | Final PDWS (EPA, 1992a) |
| 1,1-Dichloroethene | µg/L | 3.5 | 7 | Final PDWS (EPA, 1992a) |
| 1,2-Dichloroethene | µg/L | 25 | 50 | Final PDWS (EPA, 1992b) |
| cis-1,2-Dichloroethene | µg/L | 35 | 70 | Final PDWS (EPA, 1992a) |
| trans-1,2-Dichloroethene | µg/L | 50 | 100 | Final PDWS (EPA, 1992a) |
| Dichloromethane (Methylene chloride) | µg/L | 2.5 | 5 | Final PDWS (EPA, 1992b) |
| 2,4-Dichlorophenol | µg/L | 50 | 100 | EPA Method 8270 |
| 2,6-Dichlorophenol | µg/L | 50 | 100 | EPA Method 8270 |
| 2,4-Dichlorophenoxyacetic acid | µg/L | 35 | 70 | Final PDWS (EPA, 1992a) |
| 1,2-Dichloropropane | µg/L | 2.5 | 5 | Final PDWS (EPA, 1992a) |
| cis-1,3-Dichloropropene | µg/L | 5 | 10 | EPA Method 8240 |

| Analyte | Unit | Flag 1 | Flag 2 | Source[a] |
|---|---|---|---|---|
| trans-1,3-Dichloropropene | µg/L | 5 | 10 | EPA Method 8240 |
| Dieldrin | µg/L | 2.5 | 5 | EPA Method 8080 |
| Diethyl phthalate | | No flag | No flag | Set by EPD/EMS |
| Dimethoate | µg/L | 50 | 100 | EPA Method 8270 |
| p-Dimethylaminoazobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| p-(Dimethylamino)ethylbenzene | µg/L | 50 | 100 | EPA Method 8270 |
| 7,12-Dimethylbenz[a]anthracene | µg/L | 50 | 100 | EPA Method 8270 |
| 3,3'-Dimethylbenzidine | µg/L | 50 | 100 | EPA Method 8270 |
| a,a-Dimethylphenethylamine | µg/L | 50 | 100 | EPA Method 8270 |
| 2,4-Dimethyl phenol | µg/L | 50 | 100 | EPA Method 8270 |
| Dimethyl phthalate | | No flag | No flag | Set by EPD/EMS |
| 1,3-Dinitrobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| 2,4-Dinitrophenol | µg/L | 250 | 500 | EPA Method 8270 |
| 2,4-Dinitrotoluene | µg/L | 50 | 100 | EPA Method 8270 |
| 2,6-Dinitrotoluene | µg/L | 50 | 100 | EPA Method 8270 |
| 1,4-Dioxane | µg/L | 50 | 100 | EPA Method 8270 |
| Diphenylamine | µg/L | 50 | 100 | EPA Method 8270 |
| 1,2-Diphenylhydrazine | µg/L | 50 | 100 | EPA Method 8270 |
| Dissolved organic carbon | µg/L | 5,000 | 10,000 | EPA Method 9060 |
| Disulfoton | µg/L | 50 | 100 | EPA Method 8270 |
| Eh | | No flag | No flag | Set by EPD/EMS |
| alpha-Endosulfan | µg/L | 50 | 100 | EPA Method 8270 |
| beta-Endosulfan | µg/L | 50 | 100 | EPA Method 8270 |
| Endosulfan I | µg/L | 0.5 | 1 | EPA Method 8080 |
| Endosulfan II | µg/L | 0.5 | 1 | EPA Method 8080 |
| Endosulfan sulfate | µg/L | 0.5 | 1 | EPA Method 8080 |
| Endrin | µg/L | 1 | 2 | Final PDWS (EPA, 1992b) |
| Endrin aldehyde | µg/L | 0.5 | 1 | EPA Method 8080 |
| Endrin ketone | | No flag | No flag | Set by EPD/EMS |
| Ethylbenzene | µg/L | 350 | 700 | Final PDWS (EPA, 1992a) |
| Ethyl methacrylate | µg/L | 50 | 100 | EPA Method 8270 |
| Ethyl methanesulfonate | µg/L | 50 | 100 | EPA Method 8270 |
| Europium-152 | pCi/L | 3E+01 | 6E+01 | Final PDWS (EPA, 1977) |
| Europium-154 | pCi/L | 1E+02 | 2E+02 | Final PDWS (EPA, 1977) |
| Europium-155 | pCi/L | 3E+02 | 6E+02 | Final PDWS (EPA, 1977) |
| Famphur | µg/L | 50 | 100 | EPA Method 8270 |
| Fluoranthene | µg/L | 50 | 100 | EPA Method 8270 |
| Fluorene | µg/L | 50 | 100 | EPA Method 8270 |
| Fluoride | µg/L | 2,000 | 4,000 | Final PDWS (EPA, 1992a) |
| Gross alpha | pCi/L | 7.5E+00 | 1.5E+01 | Final PDWS (EPA, 1992a) |
| Heptachlor | µg/L | 0.2 | 0.4 | Final PDWS (EPA, 1992a) |
| Heptachlor epoxide | µg/L | 0.1 | 0.2 | Final PDWS (EPA, 1992a) |
| Heptachlorodibenzo-p-dioxin isomers | µg/L | 0.00325 | 0.0065 | EPA Method 8280 |
| 1,2,3,4,6,7,8-HPCDD | µg/L | 0.00325 | 0.0065 | EPA Method 8280 |
| Heptachlorodibenzo-p-furan isomers | µg/L | 0.00225 | 0.0045 | EPA Method 8280 |
| 1,2,3,4,6,7,8-HPCDF | µg/L | 0.00225 | 0.0045 | EPA Method 8280 |
| Hexachlorobenzene | µg/L | 0.5 | 1 | Final PDWS (EPA, 1992b) |
| Hexachlorobutadiene | µg/L | 50 | 100 | EPA Method 8270 |
| Hexachlorocyclopentadiene | µg/L | 25 | 50 | Final PDWS (EPA, 1992b) |
| Hexachlorodibenzo-p-dioxin isomers | µg/L | 0.00225 | 0.0045 | EPA Method 8280 |
| 1,2,3,4,7,8-HXCDD | µg/L | 0.00225 | 0.0045 | EPA Method 8280 |
| Hexachlorodibenzo-p-furan isomers | µg/L | 0.002 | 0.004 | EPA Method 8280 |
| 1,2,3,4,7,8-HXCDF | µg/L | 0.002 | 0.004 | EPA Method 8280 |

| Analyte | Unit | Flag 1 | Flag 2 | Source[a] |
|---|---|---|---|---|
| Hexachloroethane | µg/L | 50 | 100 | EPA Method 8270 |
| Hexachlorophene | µg/L | 250 | 500 | EPA Method 8270 |
| Hexachloropropene | µg/L | 50 | 100 | EPA Method 8270 |
| 2-Hexanone | µg/L | 50 | 100 | EPA Method 8240 |
| Indeno[1,2,3-*c,d*]pyrene | µg/L | 50 | 100 | EPA Method 8270 |
| Iodine | µg/L | 250 | 500 | APHA Method 415A |
| Iodine-129 | pCi/L | 5E-01 | 1E+00 | Final PDWS (EPA, 1977) |
| Iodine-131 | pCi/L | 1.5E+00 | 3E+00 | Final PDWS (EPA, 1977) |
| Iodomethane (Methyl iodide) | µg/L | 75 | 150 | EPA Method 8240 |
| Iron | µg/L | 150 | 300 | SDWS (EPA, 1992c) |
| Iron-55 | pCi/L | 1E+03 | 2E+03 | Final PDWS (EPA, 1977) |
| Iron-59 | pCi/L | 1E+02 | 2E+02 | Final PDWS (EPA, 1977) |
| Isobutyl alcohol | µg/L | 500 | 1,000 | EPA Method 8240 |
| Isodrin | µg/L | 50 | 100 | EPA Method 8270 |
| Isophorone | µg/L | 50 | 100 | EPA Method 8270 |
| Isosafrole | µg/L | 50 | 100 | EPA Method 8270 |
| Kepone | µg/L | 50 | 100 | EPA Method 8270 |
| Lanthanum-140 | pCi/L | 3E+01 | 6E+01 | Final PDWS (EPA, 1977) |
| Lead | µg/L | 7.5 | 15 | Final PDWS (EPA, 1992a) |
| Lindane | µg/L | 0.1 | 0.2 | Final PDWS (EPA, 1992a) |
| Lithium | µg/L | 25 | 50 | EPA Method 6010 |
| Magnesium | | No flag | No flag | Set by EPD/EMS |
| Manganese | µg/L | 25 | 50 | SDWS (EPA, 1992c) |
| Manganese-54 | pCi/L | 1.5E+02 | 3E+02 | Final PDWS (EPA, 1977) |
| Mercury | µg/L | 1 | 2 | Final PDWS (EPA, 1992a) |
| Methacrylonitrile | µg/L | 250 | 500 | EPA Method 8240 |
| Methapyrilene | µg/L | 50 | 100 | EPA Method 8270 |
| Methoxychlor | µg/L | 20 | 40 | Final PDWS (EPA, 1992a) |
| 3-Methylcholanthrene | µg/L | 50 | 100 | EPA Method 8270 |
| 2-Methyl-4,6-dinitrophenol | µg/L | 250 | 500 | EPA Method 8270 |
| Methyl ethyl ketone | | No flag | No flag | Set by EPD/EMS |
| Methyl isobutyl ketone | | No flag | No flag | Set by EPD/EMS |
| Methyl methacrylate | µg/L | 50 | 100 | EPA Method 8270 |
| Methyl methanesulfonate | µg/L | 50 | 100 | EPA Method 8270 |
| 2-Methylnaphthalene | µg/L | 50 | 100 | EPA Method 8270 |
| Molybdenum | µg/L | 250 | 500 | EPA Method 6010 |
| Naphthalene | µg/L | 50 | 100 | EPA Method 8270 |
| 1,4-Naphthoquinone | µg/L | 50 | 100 | EPA Method 8270 |
| 1-Naphthylamine | µg/L | 50 | 100 | EPA Method 8270 |
| 2-Naphthylamine | µg/L | 50 | 100 | EPA Method 8270 |
| Neptunium-237 | pCi/L | 3.53E+00 | 7.06E+00 | Proposed PDWS (EPA, 1991) |
| Nickel | µg/L | 50 | 100 | Final PDWS (EPA, 1992b) |
| Nickel-59 | pCi/L | 1.5E+02 | 3E+02 | Final PDWS (EPA, 1977) |
| Nickel-63 | pCi/L | 2.5E+01 | 5E+01 | Final PDWS (EPA, 1977) |
| Niobium-95 | pCi/L | 1.5E+02 | 3.E+02 | Final PDWS (EPA, 1977) |
| Nitrate as nitrogen | µg/L | 5,000 | 10,000 | Final PDWS (EPA, 1992a) |
| Nitrate-nitrite as nitrogen | µg/L | 5,000 | 10,000 | Final PDWS (EPA, 1992a) |
| Nitrite as nitrogen | µg/L | 500 | 1,000 | Final PDWS (EPA, 1992a) |
| 2-Nitroaniline | µg/L | 50 | 100 | EPA Method 8270 |
| 3-Nitroaniline | µg/L | 50 | 100 | EPA Method 8270 |
| 4-Nitroaniline | µg/L | 50 | 100 | EPA Method 8270 |
| Nitrobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| Nitrogen by Kjeldahl method | µg/L | 500 | 1,000 | EPA Method 351.2 |
| 2-Nitrophenol | µg/L | 50 | 100 | EPA Method 8270 |
| 4-Nitrophenol | µg/L | 50 | 100 | EPA Method 8270 |

| Analyte | Unit | Flag 1 | Flag 2 | Source[a] |
|---|---|---|---|---|
| 4-Nitroquinoline-1-oxide | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosodi-n-butylamine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosodiethylamine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosodimethylamine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosodiphenylamine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosodipropylamine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosomethylethylamine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosomorpholine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosopiperidine | µg/L | 50 | 100 | EPA Method 8270 |
| N-Nitrosopyrrolidine | µg/L | 50 | 100 | EPA Method 8270 |
| 5-Nitro-o-toluidine | µg/L | 50 | 100 | EPA Method 8270 |
| Nonvolatile beta | pCi/L | 2.5E+01 | 5E+01 | Proposed PDWS (EPA, 1986) |
| Octachlorodibenzo-p-dioxin isomers | µg/L | 0.005 | 0.01 | EPA Method 8280 |
| Octachlorodibenzo-p-furan isomers | µg/L | 0.005 | 0.01 | EPA Method 8280 |
| Odor | | No flag | No flag | Set by EPD/EMS |
| Oil & Grease | µg/L | 5,000 | 10,000 | EPA Method 413.1 |
| Parathion | µg/L | 0.25 | 0.5 | EPA Method 8080 |
| Parathion methyl | µg/L | 0.25 | 0.5 | EPA Method 8080 |
| PCB 1016 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1992a) |
| PCB 1221 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1992a) |
| PCB 1232 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1992a) |
| PCB 1242 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1992a) |
| PCB 1248 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1992a) |
| PCB 1254 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1992a) |
| PCB 1260 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1992a) |
| PCB 1262 | µg/L | 0.25 | 0.5 | Final PDWS (EPA, 1992a) |
| Pentachlorobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| Pentachlorodibenzo-p-dioxin isomers | µg/L | 0.00275 | 0.0055 | EPA Method 8280 |
| 1,2,3,7,8-PCDD | µg/L | 0.00275 | 0.0055 | EPA Method 8280 |
| Pentachlorodibenzo-p-furan isomers | µg/L | 0.00275 | 0.0055 | EPA Method 8280 |
| 1,2,3,7,8-PCDF | µg/L | 0.00275 | 0.0055 | EPA Method 8280 |
| Pentachloroethane | µg/L | 50 | 100 | EPA Method 8270 |
| Pentachloronitrobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| Pentachlorophenol | µg/L | 0.5 | 1 | Final PDWS (EPA, 1992a) |
| pH | pH | 8 | 10 | Set by EPD/EMS |
| pH | pH | 4 | 3 | Set by EPD/EMS |
| Phenacetin | µg/L | 50 | 100 | EPA Method 8270 |
| Phenanthrene | µg/L | 50 | 100 | EPA Method 8270 |
| Phenol | µg/L | 50 | 100 | EPA Method 8270 |
| Phenols | µg/L | 25 | 50 | EPA Method 420.1 |
| p-Phenylenediamine | µg/L | 50 | 100 | EPA Method 8270 |
| Phorate | µg/L | 0.5 | 1 | EPA Method 8080 |
| 2-Picoline | µg/L | 50 | 100 | EPA Method 8270 |
| Plutonium-238 | pCi/L | 3.51E+00 | 7.02E+00 | Proposed PDWS (EPA, 1991) |
| Plutonium-239 | pCi/L | 3.11E+01 | 6.21E+01 | Proposed PDWS (EPA, 1991) |
| Plutonium-239/240[c] | pCi/L | 3.11E+01 | 6.21E+01 | Proposed PDWS (EPA, 1991) |
| Plutonium-240 | pCi/L | 3.11E+01 | 6.22E+01 | Proposed PDWS (EPA, 1991) |
| Plutonium-241 | pCi/L | 3.13E+01 | 6.26E+01 | Proposed PDWS (EPA, 1991) |
| Plutonium-242 | pCi/L | 3.27E+01 | 6.54E+01 | Proposed PDWS (EPA, 1991) |
| Potassium | | No flag | No flag | Set by EPD/EMS |
| Potassium-40 | pCi/L | 1.5E+02 | 3E+02 | Proposed PDWS (EPA, 1986) |
| Pronamid | µg/L | 50 | 100 | EPA Method 8270 |
| Propionitrile | µg/L | 1,000 | 2,000 | EPA Method 8240 |
| Pyrene | µg/L | 50 | 100 | EPA Method 8270 |
| Pyridine | µg/L | 50 | 100 | EPA Method 8270 |

| Analyte | Unit | Flag 1 | Flag 2 | Source[a] |
|---|---|---|---|---|
| Radium (alpha-emitting)[d] | pCi/L | 1E+01 | 2E+01 | Proposed PDWS (EPA, 1991) |
| Radium-226 | pCi/L | 1E+01 | 2E+01 | Proposed PDWS (EPA, 1991) |
| Radium-228 | pCi/L | 1E+01 | 2E+01 | Proposed PDWS (EPA, 1991) |
| Radon-222 | pCi/L | 1.5E+02 | 3E+02 | Proposed PDWS (EPA, 1991) |
| Ruthenium-103 | pCi/L | 1E+02 | 2E+02 | Final PDWS (EPA, 1977) |
| Ruthenium-106 | pCi/L | 1.5E+01 | 3E+01 | Final PDWS (EPA, 1977) |
| Safrole | µg/L | 50 | 100 | EPA Method 8270 |
| Selenium | µg/L | 25 | 50 | Final PDWS (EPA, 1992a) |
| Silica | | No flag | No flag | Set by EPD/EMS |
| Total silica | µg/L | 500 | 1,000 | EPA Method 6010 |
| Silver | µg/L | 50 | 100 | SDWS (EPA, 1992c) |
| Sodium | | No flag | No flag | Set by EPD/EMS |
| Sodium-22 | pCi/L | 2.33E+02 | 4.66E+02 | Proposed PDWS (EPA, 1991) |
| Specific conductance | µS/cm | 250 | 500 | Set by EPD/EMS |
| Strontium-89 | pCi/L | 1E+01 | 2E+01 | Final PDWS (EPA, 1977) |
| Strontium-89/90[c] | pCi/L | 4E+00 | 8E+00 | Final PDWS (EPA, 1992a) |
| Strontium-90 | pCi/L | 4E+00 | 8E+00 | Final PDWS (EPA, 1992a) |
| Styrene | µg/L | 50 | 100 | Final PDWS (EPA, 1992a) |
| Sulfate | µg/L | 200,000 | 400,000 | Proposed PDWS (EPA, 1990) |
| Sulfide | µg/L | 5,000 | 10,000 | EPA Method 9030 |
| Sulfotepp | µg/L | 50 | 100 | EPA Method 8270 |
| Surfactants | | No flag | No flag | Set by EPD/EMS |
| 2,3,7,8-TCDD | µg/L | 0.000015 | 0.00003 | Final PDWS (EPA, 1992b) |
| 2,3,7,8-TCDF | µg/L | 0.002 | 0.004 | EPA Method 8280 |
| Technetium-99 | pCi/L | 4.5E+02 | 9E+02 | Final PDWS (EPA, 1977) |
| 1,2,4,5-Tetrachlorobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| Tetrachlorodibenzo-p-dioxin isomers | µg/L | 0.00225 | 0.0045 | EPA Method 8280 |
| Tetrachlorodibenzo-p-furan isomers | µg/L | 0.002 | 0.004 | EPA Method 8280 |
| 1,1,1,2-Tetrachloroethane | µg/L | 5 | 10 | EPA Method 8240 |
| 1,1,2,2-Tetrachloroethane | µg/L | 5 | 10 | EPA Method 8240 |
| Tetrachloroethylene | µg/L | 2.5 | 5 | Final PDWS (EPA, 1992a) |
| 2,3,4,6-Tetrachlorophenol | µg/L | 50 | 100 | EPA Method 8270 |
| Tetraethyl dithiopyrophosphate | µg/L | 50 | 100 | EPA Method 8270 |
| Thallium | µg/L | 1 | 2 | Final PDWS (EPA, 1992b) |
| Thionazin | µg/L | 50 | 100 | EPA Method 8270 |
| Thorium-228 | pCi/L | 6.25E+01 | 1.25E+02 | Proposed PDWS (EPA, 1991) |
| Thorium-230 | pCi/L | 3.96E+01 | 7.92E+01 | Proposed PDWS (EPA, 1991) |
| Thorium-232 | pCi/L | 4.4E+01 | 8.8E+01 | Proposed PDWS (EPA, 1991) |
| Thorium-234 | pCi/L | 2E+02 | 4.01E+02 | Proposed PDWS (EPA, 1991) |
| Tin | µg/L | 10 | 20 | EPA Method 282.2 |
| Tin-113 | pCi/L | 1.5E+02 | 3E+02 | Final PDWS (EPA, 1977) |
| Toluene | µg/L | 500 | 1,000 | Final PDWS (EPA, 1992a) |
| o-Toluidine | µg/L | 50 | 100 | EPA Method 8270 |
| Total carbon | µg/L | 5,000 | 10,000 | EPA Method 9060 |
| Total dissolved solids | | No flag | No flag | Set by EPD/EMS |
| Total hydrocarbons | µg/L | 5,000 | 10,000 | EPA Method 418.1 |
| Total inorganic carbon | µg/L | 5,000 | 10,000 | EPA Method 9060 |
| Total organic carbon | µg/L | 5,000 | 10,000 | EPA Method 9060 |
| Total organic halogens | µg/L | 25 | 50 | EPA Method 9020 |
| Total organic nitrogen | µg/L | 500 | 1,000 | APHA Method 420 |
| Total petroleum hydrocarbons | µg/L | 5,000 | 10,000 | EPA Method 418.1 |
| Total phosphates (as P) | | No flag | No flag | Set by EPD/EMS |
| Total phosphorus | | No flag | No flag | Set by EPD/EMS |

| Analyte | Unit | Flag 1 | Flag 2 | Source[a] |
|---|---|---|---|---|
| Toxaphene | µg/L | 1.5 | 3 | Final PDWS (EPA, 1992a) |
| 2,4,5-TP (Silvex) | µg/L | 25 | 50 | Final PDWS (EPA, 1992a) |
| Tributyl phosphate | µg/L | 50 | 100 | EPA Method 8270 |
| 1,2,4-Trichlorobenzene | µg/L | 35 | 70 | Final PDWS (EPA, 1992b) |
| 1,1,1-Trichloroethane | µg/L | 100 | 200 | Final PDWS (EPA, 1992a) |
| 1,1,2-Trichloroethane | µg/L | 2.5 | 5 | Final PDWS (EPA, 1992b) |
| Trichloroethylene | µg/L | 2.5 | 5 | Final PDWS (EPA, 1992a) |
| Trichlorofluoromethane | µg/L | 5 | 10 | EPA Method 8240 |
| 2,4,5-Trichlorophenol | µg/L | 50 | 100 | EPA Method 8270 |
| 2,4,6-Trichlorophenol | µg/L | 50 | 100 | EPA Method 8270 |
| 2,4,5-Trichlorophenoxyacetic acid | µg/L | 2.5 | 5 | EPA Method 8150 |
| 1,2,3-Trichloropropane | µg/L | 5 | 10 | EPA Method 8240 |
| O,O,O-Triethyl phosphorothioate | µg/L | 50 | 100 | EPA Method 8270 |
| 1,3,5-Trinitrobenzene | µg/L | 50 | 100 | EPA Method 8270 |
| Tritium | pCi/mL | 1E+01 | 2E+01 | Final PDWS (EPA, 1992a) |
| Turbidity | | No flag | No flag | Set by EPD/EMS |
| Uranium | µg/L | 10 | 20 | Proposed PDWS (EPA, 1991) |
| Uranium alpha activity | pCi/L | 1.5E+01 | 3E+01 | Proposed PDWS (EPA, 1991) |
| Uranium-233/234[c] | pCi/L | 6.9E+00 | 1.38E+01 | Proposed PDWS (EPA, 1991) |
| Uranium-234 | pCi/L | 6.95E+00 | 1.39E+01 | Proposed PDWS (EPA, 1991) |
| Uranium-235 | pCi/L | 7.25E+00 | 1.45E+01 | Proposed PDWS (EPA, 1991) |
| Uranium-238 | pCi/L | 7.3E+00 | 1.46E+01 | Proposed PDWS (EPA, 1991) |
| Vanadium | µg/L | 40 | 80 | EPA Method 6010 |
| Vinyl acetate | µg/L | 5 | 10 | EPA Method 8240 |
| Xylenes | µg/L | 5,000 | 10,000 | Final PDWS (EPA, 1992a) |
| Zinc | µg/L | 2,500 | 5,000 | SDWS (EPA, 1992c) |
| Zinc-65 | pCi/L | 1.5E+02 | 3E+02 | Final PDWS (EPA, 1977) |
| Zirconium-95 | pCi/L | 1E+02 | 2E+02 | Final PDWS (EPA, 1977) |
| Zirconium/Niobium-95[c] | pCi/L | 1E+02 | 2E+02 | Final PDWS (EPA, 1977) |

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[a] References for methods are found in Appendix E; references for dated sources are at the end of this appendix.
[b] EPD/EMS set this flagging criterion using the 1991 proposed PDWS because the final PDWS in 1977 may have been in error.
[c] When radionuclide analyses are combined, the lower PDWS of the two isotopes is used for flagging.
[d] The applied standard is for radium-226.

## References

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EPA (U.S. Environmental Protection Agency), 1992c. *National Secondary Drinking Water Regulations,* **Code of Federal Regulations**, Section 40, Part 143, pp. 772-776. Washington, DC.

# Appendix C – Figures

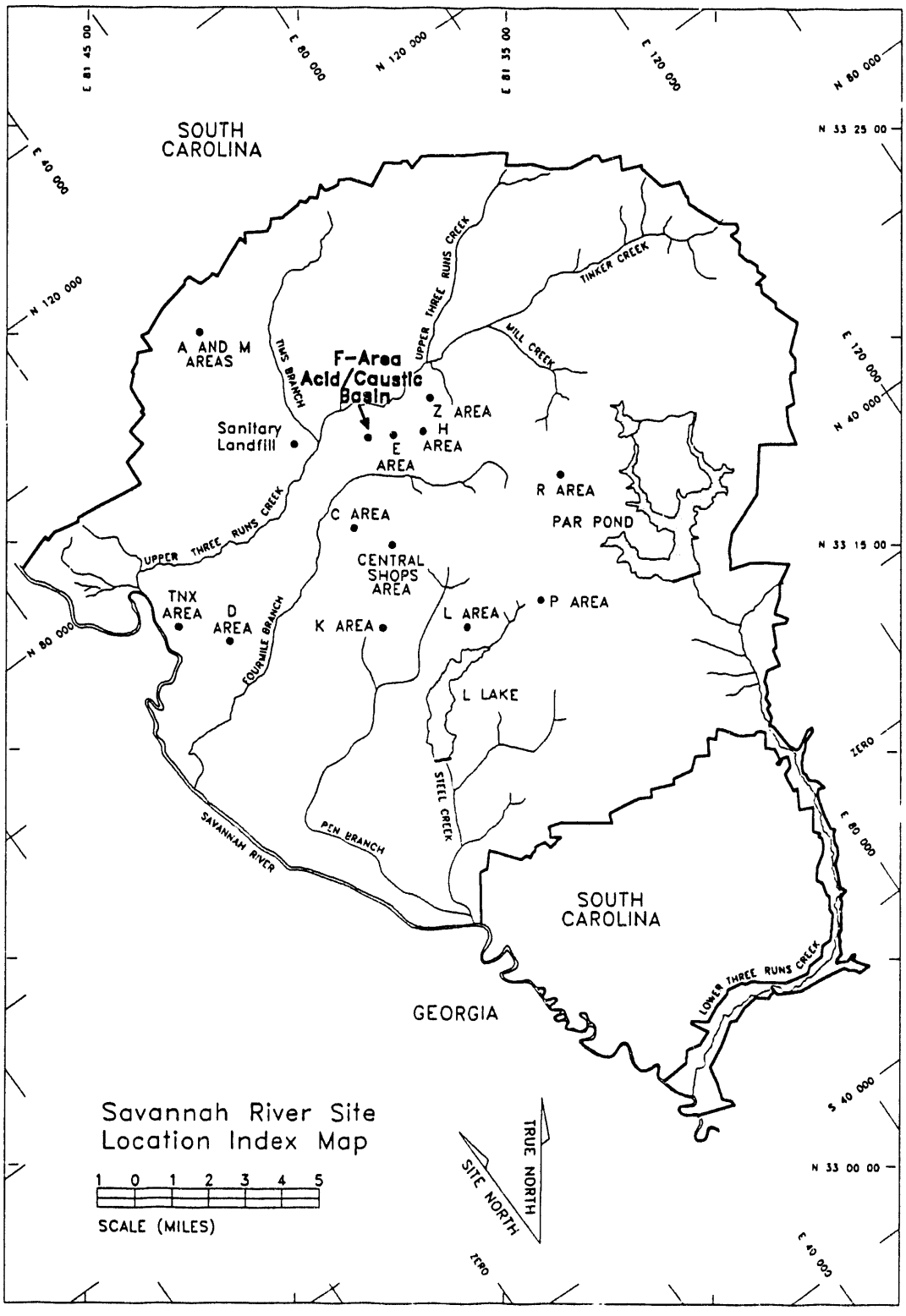


**Figure 1. Location of the F-Area Acid/Caustic Basin at the Savannah River Site**

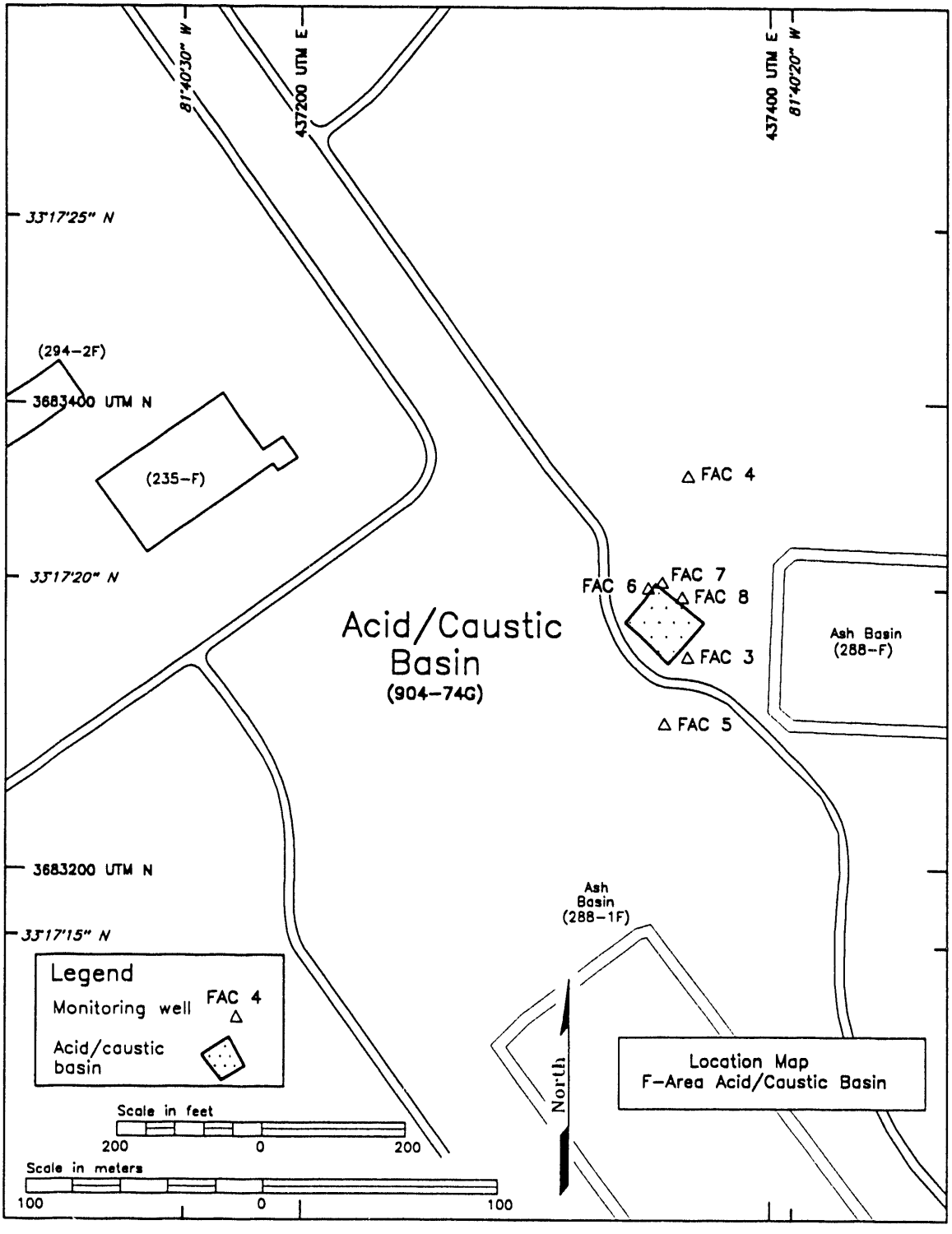


**Figure 2. Location of Groundwater Monitoring Wells at the F-Area Acid/Caustic Basin**

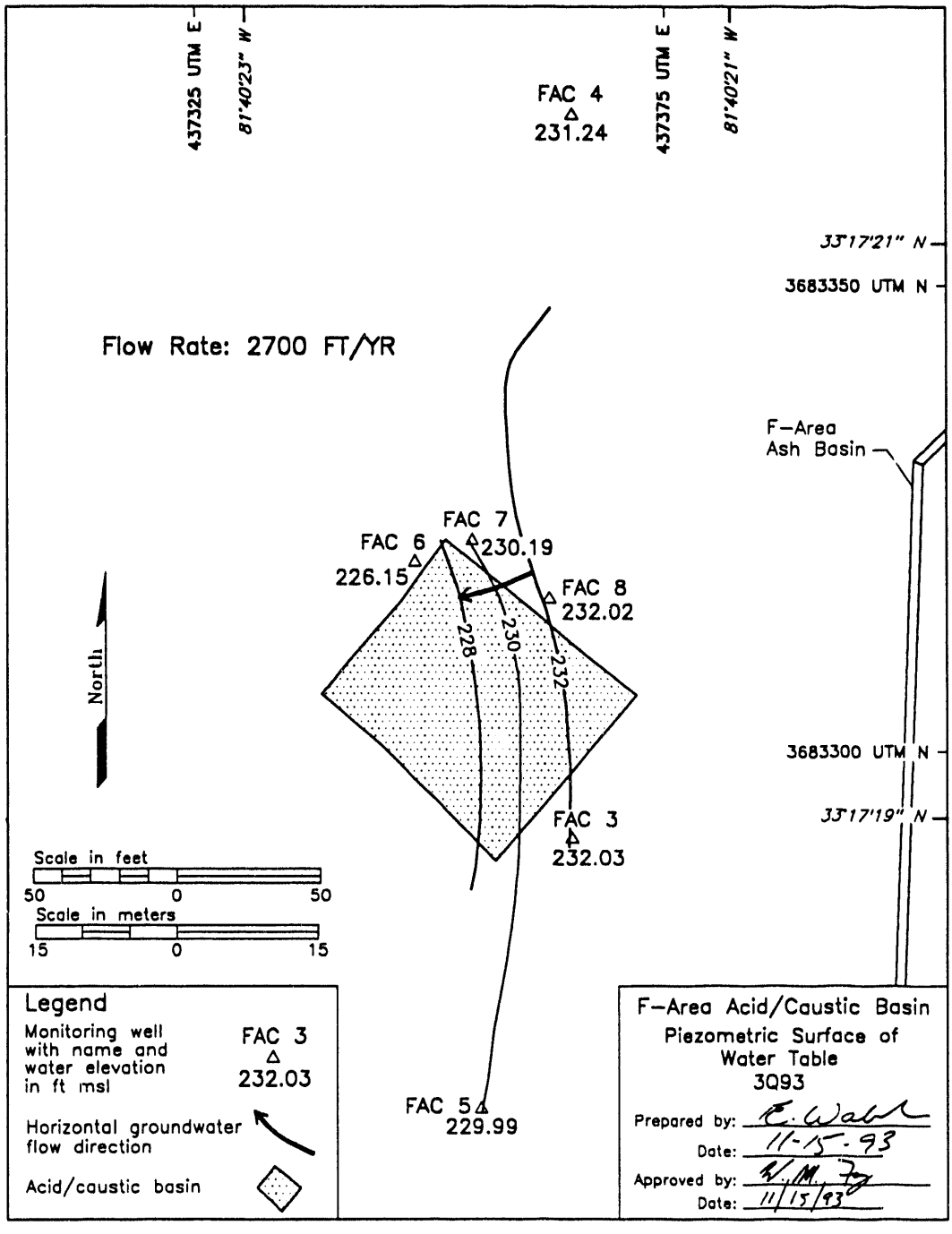


**Figure 3. Water-Elevation Contour Map of the Water Table at the F-Area Acid/Caustic Basin, Monitoring Well Data**

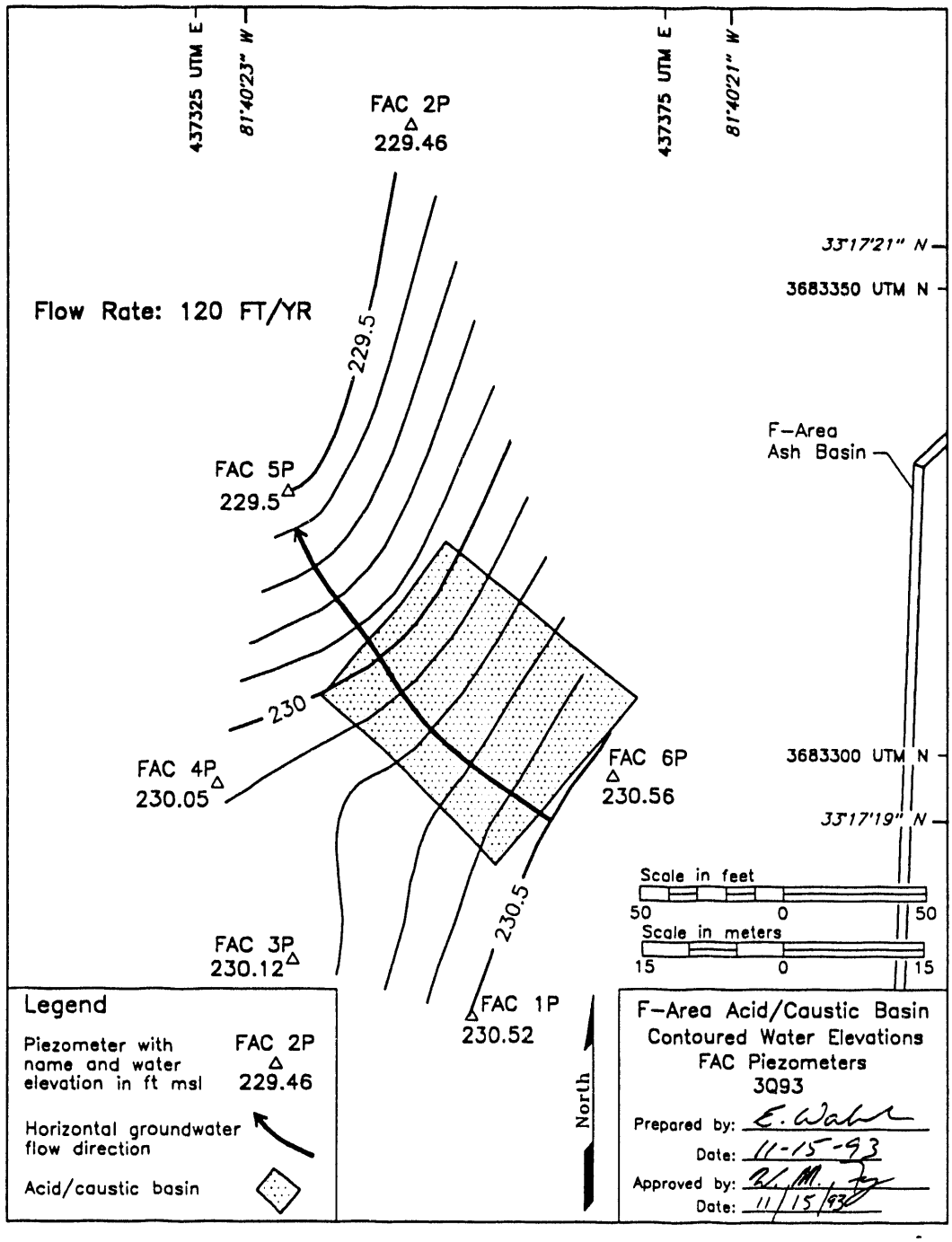


**Figure 4. Water-Elevation Contour Map of the Water Table at the F-Area Acid/Caustic Basin, Piezometer Data**

# Appendix D – Groundwater Monitoring Results Tables

## Key to Reading the Tables

The following abbreviations may appear in the tabular data:

B = sample collected from well using an open bucket bailer
BA = Barringer Laboratories, Inc.
CN = Clemson Technical Center, Inc.
CS = carbon steel
D = primary drinking water standard (PDWS)
E = exponential notation (e.g., 1.1E−09 = $1.1 \times 10^{-9}$ = 0.0000000011)
EM = Environmental Protection Department/Environmental Monitoring Section (EPD/EMS) Laboratory
GE = General Engineering Laboratories
GP = Environmental Physics, Inc.
H = holding time
1,2,3,4,6,7,8-HPCDD = 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin
1,2,3,4,6,7,8-HPCDF = 1,2,3,4,6,7,8-heptachlorodibenzo-p-furan
1,2,3,4,7,8-HXCDD = 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin
1,2,3,4,7,8-HXCDF = 1,2,3,4,7,8-hexachlorodibenzo-p-furan
Lindane = gamma-benzene hexachloride
mg/L = milligrams per liter
Mod = modifier
msl = mean sea level
MSL = million structures per liter
NTU = turbidity unit
P = sample collected from well using a bladder pump
PCB = polychlorinated biphenyl
1,2,3,7,8-PCDD = 1,2,3,7,8-pentachlorodibenzo-p-dioxin
1,2,3,7,8-PCDF = 1,2,3,7,8-pentachlorodibenzo-p-furan
pCi/L = picocuries per liter
pCi/mL = picocuries per milliliter
PDWS = primary drinking water standard
pH = pH unit
PVC = polyvinyl chloride
S = sample collected from well using a single-speed centrifugal downhole pump
Sp. conductance = specific conductance
SP = Spencer Testing Services, Inc.
TCDD = tetrachlorodibenzo-p-dioxin
TCDF = tetrachlorodibenzo-p-furan
TM = TMA/Eberline
TOC = top of casing
V = sample collected from well using a variable-speed pump
WA = Roy F. Weston, Inc.
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter

## Holding Times

Standard analytical methods include a limit, called holding time, on the maximum elapsed time between sample collection and extraction or analysis by the laboratory. In the data tables, a large dot (•) in the H (holding time) column indicates that holding time was exceeded. Analyses performed beyond holding time may not yield valid results.

The South Carolina Department of Health and Environmental Control allows only 15 minutes to elapse between sampling and analysis for pH. Thus, only field pH measurements can meet the holding time criterion; laboratory pH analyses always will exceed it.

The laboratory procedure used for the determination of specific conductance allows one day to elapse between sampling and analysis. Thus, laboratory specific conductance measurements may exceed the holding time criterion.

## Data Rounding

Constituent results in analytical results tables that appear to equal the final PDWS but are not marked in the *D* (exceeded the final PDWS or screening level) column are below the final PDWS in the database. Values stored in the database contain more significant digits than the reported results. Apparent discrepancies in the tables are due to the rounding of reported results.

## Data Qualification

The contract laboratories continually assess their own accuracy and precision according to U.S. Environmental Protection Agency (EPA) guidelines. They submit sample- or batch-specific quality assurance/quality control information either at the same time as analytical results or in a quarterly summary. Properly defined and used result modifiers (also referred to as qualifiers) can be a key component in assessing data useability. Result modifiers designed by Environmental Protection Department/Environmental Monitoring Section and provided to the primary laboratories are defined below. These modifiers appear in the data tables under the column "Mod." The lettered modifiers are based on EPA's STORET codes.

| Result modifier | Definition |
|---|---|
| (Blank) | Data are not qualified. Number should be interpreted exactly as reported. |
| A | Value reported is the mean of two or more determinations. |
| J | Value is estimated because quantitation in the sample or in associated quality control samples did not meet specifications. |
| L | Value is off-scale high. The actual value is not known but is known to be greater than the value shown. |
| M | Presence of the analyte is verified but not quantified. |

| Result modifier | Definition |
|---|---|
| R | Result was rejected because performance requirements in the sample analysis or associated quality control analyses were not met. |
| T | Analyte was not detected; if present, it was below the criteria for detection. |
| V | Analyte was detected in an associated method blank. |
| Y | Result was obtained from an unpreserved or improperly preserved sample. Data may not be accurate. |
| 1 | Result may be an underestimation of the true value due to analytical bias. |
| 2 | Result may be an overestimation of the true value due to analytical bias. |
| 3 | The associated result may be of poor precision (high variability) due to analytical bias. |
| 4 | Result is associated with QA results indicating matrix interference. |
| 6 | The associated result is from a reanalysis performed out of holding time due to problems with an earlier analysis. |

## Table 1. Maximum Results for Constituents Exceeding Final Primary Drinking Water Standards

| Well | Constituent | Unit | 4Q92 | 1Q93 | 2Q93 | 3Q93 | Mod |
|---|---|---|---|---|---|---|---|
| FAC 3 | Dichloromethane | µg/L | [a] | 8.9 | -[b] | 9.4 | V |
| | Gross alpha | pCi/L | - | 4.4E+01 | 5.2E+01 | 3.9E+01 | |
| | Nonvolatile beta | pCi/L | - | - | 5.3E+01 | - | |
| FAC 4 | Dichloromethane | µg/L | [a] | 9.9 | - | 12 | V |
| | Gross alpha | pCi/L | 4.2E+01 | 6.6E+01 | 4.1E+01 | 3.4E+01 | |
| FAC 5 | Dichloromethane | µg/L | [a] | 6.2 | - | 6.2 | V |
| | Gross alpha | pCi/L | - | - | 7.0E+01 | 3.2E+01 | |
| FAC 6 | Gross alpha | pCi/L | - | - | 1.9E+01 | - | |
| FAC 7 | Dichloromethane | µg/L | [a] | 5.5 | - | - | |
| FAC 8 | Dichloromethane | µg/L | [a] | - | - | 5.5 | V |
| | Gross alpha | pCi/L | - | - | 2.5E+01 | - | |

[a] The drinking water standard for dichloromethane (methylene chloride), a common laboratory contaminant, published in the Federal Register July 17, 1992, and effective January 17, 1994, was adopted by EPD/EMS effective first quarter 1993. The new standard was not applied to historical results, although those results may be higher than the new standard.

[b] - = not above PDWS.

## Table 2. Maximum Results for Constituents Exceeding Half their Final Primary Drinking Water Standards, Other Flag 1 or Flag 2 Criteria, or the SRS Turbidity Standard

| Well | Constituent | Unit | 3Q93 | Mod | Flag |
|---|---|---|---|---|---|
| FAC 3 | Aluminum | µg/L | 2,610 | | 2 |
| | Iron | µg/L | 8,590 | V | 2 |
| | Manganese | µg/L | 34 | | 1 |
| | *Nonvolatile beta* | pCi/L | 4.2E+01 | | 1 |
| | Turbidity | NTU | 69 | J | 0 |
| FAC 4 | Aluminum | µg/L | 312 | | 2 |
| | Manganese | µg/L | 541 | | 2 |
| | *Nitrate as nitrogen* | µg/L | 8,910 | | 1 |
| | *Nonvolatile beta* | pCi/L | 3.0E+01 | | 1 |
| | Radium-228 | pCi/L | 1.0E+01 | | 1 |
| | Specific conductance | µS/cm | 254 | J | 1 |
| FAC 5 | Aluminum | µg/L | 63 | | 2 |
| | *Nonvolatile beta* | pCi/L | 2.5E+01 | | 1 |
| | Radium-226 | pCi/L | 1.6E+01 | | 1 |
| | Total organic halogens | µg/L | 31 | | 1 |
| FAC 6 | Aluminum | µg/L | 34 | J3Y | 1 |
| | *Gross alpha* | pCi/L | 1.5E+01 | | 1 |
| FAC 7 | Aluminum | µg/L | 80 | Y | 2 |
| | *Gross alpha* | pCi/L | 8.5E+00 | | 1 |
| FAC 8 | Aluminum | µg/L | 4,470 | | 2 |
| | Iron | µg/L | 13,100 | V | 2 |
| | *Lead* | µg/L | 8.5 | J3 | 1 |
| | Manganese | µg/L | 95 | | 2 |
| | *Nitrate as nitrogen* | µg/L | 6,390 | µg/L | 1 |
| | Total organic halogens | µg/L | 48 | | 1 |
| | Turbidity | NTU | 360 | | 0 |

Note: Constituents exceeding half the final PDWS appear *italicized*. These results do not include field data results.

## Table 3. Groundwater Monitoring Results for Individual Wells

## WELL FAC 3

| SRS Coord. | Lat/Longitude | Screen Zone Elevation | Top of Casing | Casing | Pump | Formation |
|---|---|---|---|---|---|---|
| N78018.3<br>E55322.7 | 33.288592 °N<br>81.672674 °W | 254.8-224.8 ft msl | 311.8 ft msl | 4" PVC | B | Water table |

FIELD MEASUREMENTS

Sample date: 08/17/93
Depth to water: 79.77 ft (24.31 m) below TOC
Water elevation: 232.03 ft (70.72 m) msl
Sp. conductance: 245 µS/cm
Turbidity: 317 NTU
Water evacuated before sampling: 14 gal

Time: 12:42
pH: 6.6
Alkalinity: 11 mg/L
Water temperature: 21.8 °C

Volumes purged: 3.0 well volumes

LABORATORY ANALYSES

| H | D | Analyte | Result | Mod | Unit | Flag | Lab |
|---|---|---|---|---|---|---|---|
| ● | | pH | 5.7 | J | pH | 0 | WA |
| ● | | Specific conductance | 190 | J | µS/cm | 0 | WA |
| ● | | Turbidity | 69 | JQ2 | NTU | 0 | WA |
| | | Aluminum | 2,610 | | µg/L | 2 | WA |
| | | Arsenic | <2.0 | | µg/L | 0 | WA |
| | | Barium | 152 | | µg/L | 0 | WA |
| | | Benzene | <5.0 | | µg/L | 0 | WA |
| | | Bromodichloromethane | <5.0 | | µg/L | 0 | WA |
| | | Bromoform | <5.0 | | µg/L | 0 | WA |
| | | Bromomethane (Methyl bromide) | <10 | | µg/L | 0 | WA |
| | | Cadmium | <2.0 | | µg/L | 0 | WA |
| | | Calcium | 19,700 | | µg/L | 0 | WA |
| | | Carbon tetrachloride | <5.0 | | µg/L | 0 | WA |
| | | Chloride | 1,440 | | µg/L | 0 | WA |
| | | Chlorobenzene | <5.0 | | µg/L | 0 | WA |
| | | Chloroethane | <10 | | µg/L | 0 | WA |
| | | Chloroethene (Vinyl chloride) | <10 | | µg/L | 0 | WA |
| | | 2-Chloroethyl vinyl ether | <10 | | µg/L | 0 | WA |
| | | Chloroform | <5.0 | | µg/L | 0 | WA |
| | | Chloromethane (Methyl chloride) | <10 | | µg/L | 0 | WA |
| | | Chromium | 8.4 | | µg/L | 0 | WA |
| | | Dibromochloromethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1-Dichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,2-Dichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1-Dichloroethylene | <5.0 | | µg/L | 0 | WA |
| | | trans-1,2-Dichloroethylene | <5.0 | | µg/L | 0 | WA |
| | ■ | Dichloromethane (Methylene chloride) | 9.4 | V | µg/L | 2 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <1.1 | | µg/L | 0 | WA |
| | | 1,2-Dichloropropane | <5.0 | | µg/L | 0 | WA |
| | | cis-1,3-Dichloropropene | <5.0 | | µg/L | 0 | WA |
| | | trans-1,3-Dichloropropene | <5.0 | | µg/L | 0 | WA |
| ● | | Endrin | <0.11 | J | µg/L | 0 | WA |
| | | Endrin | <0.11 | | µg/L | 0 | WA |
| | | Endrin | <0.22 | | µg/L | 0 | WA |
| | | Ethylbenzene | <5.0 | | µg/L | 0 | WA |
| | | Fluoride | <100 | | µg/L | 0 | WA |
| | | Iron | 8,590 | V | µg/L | 2 | WA |

● = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL FAC 3 collected on 08/17/93, laboratory analyses (cont.)

| H | D | Analyte | Result | Mod | Unit | Flag | Lab |
|---|---|---|---|---|---|---|---|
| | | Lead | <3.0 | | µg/L | 0 | WA |
| • | | Lindane | <0.053 | J | µg/L | 0 | WA |
| | | Lindane | <0.054 | | µg/L | 0 | WA |
| | | Lindane | <0.11 | | µg/L | 0 | WA |
| | | Magnesium | 2,540 | | µg/L | 0 | WA |
| | | Manganese | 34 | | µg/L | 1 | WA |
| | | Mercury | 0.33 | | µg/L | 0 | WA |
| | | Methoxychlor | <1.1 | | µg/L | 0 | WA |
| | | Methoxychlor | <1.1 | | µg/L | 0 | WA |
| • | | Methoxychlor | <0.53 | J | µg/L | 0 | WA |
| | | Methoxychlor | <0.54 | | µg/L | 0 | WA |
| | | Nitrate as nitrogen | 397 | | µg/L | 0 | WA |
| | | Phenols | <5.0 | | µg/L | 0 | WA |
| | | Potassium | 3,610 | | µg/L | 0 | WA |
| | | Selenium | 2.6 | J3 | µg/L | 0 | WA |
| | | Silica | 13,600 | | µg/L | 0 | WA |
| | | Silver | <2.0 | | µg/L | 0 | WA |
| | | Sodium | 14,100 | V | µg/L | 0 | WA |
| | | Sulfate | 43,100 | | µg/L | 0 | WA |
| | | 1,1,2,2-Tetrachloroethane | <5.0 | | µg/L | 0 | WA |
| | | Tetrachloroethylene | <5.0 | | µg/L | 0 | WA |
| | | Toluene | <5.0 | | µg/L | 0 | WA |
| | | Total dissolved solids | 148,000 | V | µg/L | 0 | WA |
| | | Total organic carbon | <1,000 | | µg/L | 0 | WA |
| | | Total organic halogens | 9.8 | | µg/L | 0 | WA |
| | | Total phosphates (as P) | 469 | | µg/L | 0 | WA |
| • | | Toxaphene | <1.1 | J | µg/L | 0 | WA |
| | | Toxaphene | <1.1 | | µg/L | 0 | WA |
| | | Toxaphene | <2.2 | | µg/L | 0 | WA |
| | | Toxaphene | <2.2 | | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <0.56 | | µg/L | 0 | WA |
| | | 1,1,1-Trichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1,2-Trichloroethane | <5.0 | | µg/L | 0 | WA |
| | | Trichloroethylene | <5.0 | | µg/L | 0 | WA |
| | | Trichlorofluoromethane | <5.0 | | µg/L | 0 | WA |
| | ■ | Gross alpha | 3.9E+01 ± 7.8E+00 | | pCi/L | 2 | TM |
| | ■ | Gross alpha | 3.8E+01 ± 7.7E+00 | | pCi/L | 2 | TM |
| | | Nonvolatile beta | 4.2E+01 ± 8.6E+00 | | pCi/L | 1 | TM |
| | | Nonvolatile beta | 3.3E+01 ± 8.2E+00 | | pCi/L | 1 | TM |
| | | Radium-226 | 3.1E+00 ± 1.1E+00 | | pCi/L | 0 | TM |
| | | Radium-228 | 2.3E+00 ± 1.3E+00 | | pCi/L | 0 | TM |
| | | Tritium | 1.4E+00 ± 3.1E-01 | | pCi/mL | 0 | TM |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

## WELL FAC 4

| SRS Coord. | Lat/Longitude | Screen Zone Elevation | Top of Casing | Casing | Pump | Formation |
|---|---|---|---|---|---|---|
| N78223.8<br>E55472.9 | 33.289292 °N<br>81.672678 °W | 237.8-207.8 ft msl | 309.9 ft msl | 4" PVC | S | Water table |

FIELD MEASUREMENTS

Sample date: 08/04/93
Depth to water: 78.66 ft (23.98 m) below TOC
Water elevation: 231.24 ft (70.48 m) msl
Sp. conductance: 266 µS/cm
Turbidity: 5.7 NTU
Water evacuated before sampling: 263 gal
Time: 8:55
pH: 4.6
Alkalinity: 0 mg/L
Water temperature: 21.5 °C
Volumes purged: 17.1 well volumes

LABORATORY ANALYSES

| H | D | Analyte | Result | Mod | Unit | Flag | Lab |
|---|---|---|---|---|---|---|---|
| • | | pH | 4.7 | J | pH | 0 | WA |
| • | | pH | 4.8 | J | pH | 0 | WA |
| • | | Specific conductance | 254 | J | µS/cm | 1 | WA |
| • | | Specific conductance | 254 | J | µS/cm | 1 | WA |
| • | | Turbidity | 2.2 | J | NTU | 0 | WA |
| • | | Turbidity | 2.2 | J | NTU | 0 | WA |
| | | Aluminum | 312 | | µg/L | 2 | WA |
| | | Arsenic | <2.0 | | µg/L | 0 | WA |
| | | Barium | 72 | | µg/L | 0 | WA |
| | | Benzene | <5.0 | | µg/L | 0 | WA |
| | | Bromodichloromethane | <5.0 | | µg/L | 0 | WA |
| | | Bromoform | <5.0 | | µg/L | 0 | WA |
| | | Bromomethane (Methyl bromide) | <10 | | µg/L | 0 | WA |
| | | Cadmium | <2.0 | | µg/L | 0 | WA |
| | | Carbon tetrachloride | <5.0 | | µg/L | 0 | WA |
| | | Chloride | 4,500 | | µg/L | 0 | WA |
| | | Chlorobenzene | <5.0 | | µg/L | 0 | WA |
| | | Chloroethane | <10 | | µg/L | 0 | WA |
| | | Chloroethene (Vinyl chloride) | <10 | | µg/L | 0 | WA |
| | | 2-Chloroethyl vinyl ether | <10 | | µg/L | 0 | WA |
| | | Chloroform | <5.0 | | µg/L | 0 | WA |
| | | Chloromethane (Methyl chloride) | <10 | | µg/L | 0 | WA |
| | | Chromium | <4.0 | | µg/L | 0 | WA |
| | | Cobalt | <4.0 | | µg/L | 0 | WA |
| | | Dibromochloromethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1-Dichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,2-Dichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1-Dichloroethylene | <5.0 | | µg/L | 0 | WA |
| | | trans-1,2-Dichloroethylene | <5.0 | | µg/L | 0 | WA |
| | ■ | Dichloromethane (Methylene chloride) | 12 | V | µg/L | 2 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <1.1 | | µg/L | 0 | WA |
| | | 1,2-Dichloropropane | <5.0 | | µg/L | 0 | WA |
| | | cis-1,3-Dichloropropene | <5.0 | | µg/L | 0 | WA |
| | | trans-1,3-Dichloropropene | <5.0 | | µg/L | 0 | WA |
| | | Endrin | <0.11 | | µg/L | 0 | WA |
| | | Ethylbenzene | <5.0 | | µg/L | 0 | WA |
| | | Fluoride | <100 | | µg/L | 0 | WA |
| | | Fluoride | <100 | | µg/L | 0 | WA |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL FAC 4 collected on 08/04/93, laboratory analyses (cont.)

| H | D | Analyte | Result | Mod | Unit | Flag | Lab |
|---|---|---|---|---|---|---|---|
| | | Iron | 66 | | µg/L | 0 | WA |
| | | Lead | <3.0 | | µg/L | 0 | WA |
| | | Lindane | <0.055 | | µg/L | 0 | WA |
| | | Magnesium | 4,870 | | µg/L | 0 | WA |
| | | Manganese | 541 | | µg/L | 2 | WA |
| | | Mercury | 0.44 | | µg/L | 0 | WA |
| | | Methoxychlor | <0.55 | | µg/L | 0 | WA |
| | | Nitrate as nitrogen | 8,910 | | µg/L | 1 | WA |
| | | Phenols | <5.0 | | µg/L | 0 | WA |
| | | Phenols | <5.0 | | µg/L | 0 | WA |
| | | Potassium | 4,960 | | µg/L | 0 | WA |
| | | Selenium | 3.8 | J3 | µg/L | 0 | WA |
| | | Silica | 8,850 | | µg/L | 0 | WA |
| | | Silver | <2.0 | | µg/L | 0 | WA |
| | | Sodium | 22,800 | V | µg/L | 0 | WA |
| | | Sulfate | 58,100 | | µg/L | 0 | WA |
| | | 1,1,2,2-Tetrachloroethane | <5.0 | | µg/L | 0 | WA |
| | | Tetrachloroethylene | <5.0 | | µg/L | 0 | WA |
| | | Toluene | <5.0 | | µg/L | 0 | WA |
| | | Total dissolved solids | 161,000 | | µg/L | 0 | WA |
| | | Total organic carbon | <1,000 | | µg/L | 0 | WA |
| | | Total organic carbon | <1,000 | | µg/L | 0 | WA |
| | | Total organic halogens | 22 | | µg/L | 0 | WA |
| | | Total phosphates (as P) | <50 | | µg/L | 0 | WA |
| | | Toxaphene | <1.1 | | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <0.53 | | µg/L | 0 | WA |
| | | 1,1,1-Trichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1,2-Trichloroethane | <5.0 | | µg/L | 0 | WA |
| | | Trichloroethylene | <5.0 | | µg/L | 0 | WA |
| | | Trichlorofluoromethane | <5.0 | | µg/L | 0 | WA |
| | ■ | Gross alpha | 2.6E+01 ± 4.7E+00 | | pCi/L | 2 | TM |
| | ■ | Gross alpha | 3.4E+01 ± 5.2E+00 | | pCi/L | 2 | TM |
| | | Nonvolatile beta | 2.3E+01 ± 3.8E+00 | | pCi/L | 0 | TM |
| | | Nonvolatile beta | 3.0E+01 ± 4.2E+00 | | pCi/L | 1 | TM |
| | | Radium-226 | 9.6E+00 ± 1.3E+00 | | pCi/L | 0 | TM |
| | | Radium-226 | 9.1E+00 ± 1.2E+00 | | pCi/L | 0 | TM |
| | | Radium-228 | 6.4E+00 ± 2.5E+00 | | pCi/L | 0 | TM |
| | | Radium-228 | 1.0E+01 ± 2.7E+00 | | pCi/L | 1 | TM |
| | | Tritium | 6.1E+00 ± 5.6E-01 | | pCi/mL | 0 | TM |
| | | Tritium | 5.9E+00 ± 5.5E-01 | | pCi/mL | 0 | TM |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

## WELL FAC 5

| SRS Coord. | Lat/Longitude | Screen Zone Elevation | Top of Casing | Casing | Pump | Formation |
|---|---|---|---|---|---|---|
| N77960.3<br>E55241.3 | 33.288331 °N<br>81.672776 °W | 234.0-214.0 ft msl | 315.8 ft msl | 4" PVC | B | Water table |

FIELD MEASUREMENTS

Sample date: 08/17/93
Depth to water: 85.81 ft (26.16 m) below TOC
Water elevation: 229.99 ft (70.10 m) msl
Sp. conductance: 149 µS/cm
Turbidity: 6.1 NTU
Water evacuated before sampling: 20 gal
The well went dry during purging.

Time: 11:23
pH: 4.8
Alkalinity: 1 mg/L
Water temperature: 23.3 °C

Volumes purged: 1.9 well volumes

LABORATORY ANALYSES

| H | D | Analyte | Result | Mod | Unit | Flag | Lab |
|---|---|---|---|---|---|---|---|
| • | | pH | 5.0 | J | pH | 0 | WA |
| • | | Specific conductance | 134 | J | µS/cm | 0 | WA |
| • | | Turbidity | 4.1 | JQ2 | NTU | 0 | WA |
| | | Aluminum | 63 | | µg/L | 2 | WA |
| | | Arsenic | <2.0 | | µg/L | 0 | WA |
| | | Barium | 15 | | µg/L | 0 | WA |
| | | Benzene | <5.0 | | µg/L | 0 | WA |
| | | Bromodichloromethane | <5.0 | | µg/L | 0 | WA |
| | | Bromoform | <5.0 | | µg/L | 0 | WA |
| | | Bromomethane (Methyl bromide) | <10 | | µg/L | 0 | WA |
| | | Cadmium | <2.0 | | µg/L | 0 | WA |
| | | Calcium | 4,550 | | µg/L | 0 | WA |
| | | Carbon tetrachloride | <5.0 | | µg/L | 0 | WA |
| | | Chloride | 2,360 | J2 | µg/L | 0 | WA |
| | | Chloride | 2,440 | J2 | µg/L | 0 | WA |
| | | Chlorobenzene | <5.0 | | µg/L | 0 | WA |
| | | Chloroethane | <10 | | µg/L | 0 | WA |
| | | Chloroethene (Vinyl chloride) | <10 | | µg/L | 0 | WA |
| | | 2-Chloroethyl vinyl ether | <10 | | µg/L | 0 | WA |
| | | Chloroform | <5.0 | | µg/L | 0 | WA |
| | | Chloromethane (Methyl chloride) | <10 | | µg/L | 0 | WA |
| | | Chromium | <4.0 | | µg/L | 0 | WA |
| | | Dibromochloromethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1-Dichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,2-Dichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1-Dichloroethylene | <5.0 | | µg/L | 0 | WA |
| | | trans-1,2-Dichloroethylene | <5.0 | | µg/L | 0 | WA |
| | ■ | Dichloromethane (Methylene chloride) | 6.2 | V | µg/L | 2 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <1.1 | | µg/L | 0 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <2.1 | | µg/L | 0 | WA |
| | | 1,2-Dichloropropane | <5.0 | | µg/L | 0 | WA |
| | | cis-1,3-Dichloropropene | <5.0 | | µg/L | 0 | WA |
| | | trans-1,3-Dichloropropene | <5.0 | | µg/L | 0 | WA |
| | | Endrin | <0.12 | | µg/L | 0 | WA |
| | | Ethylbenzene | <5.0 | | µg/L | 0 | WA |
| | | Fluoride | <100 | | µg/L | 0 | WA |
| | | Iron | 27 | V | µg/L | 0 | WA |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL FAC 5 collected on 08/17/93, laboratory analyses (cont.)

| H | D | Analyte | Result | Mod | Unit | Flag | Lab |
|---|---|---|---|---|---|---|---|
| | | Lead | <3.0 | | µg/L | 0 | WA |
| | | Lindane | <0.060 | | µg/L | 0 | WA |
| | | Magnesium | 2,140 | | µg/L | 0 | WA |
| | | Manganese | 23 | | µg/L | 0 | WA |
| | | Mercury | 0.32 | | µg/L | 0 | WA |
| | | Methoxychlor | <0.60 | | µg/L | 0 | WA |
| | | Nitrate as nitrogen | 1,670 | | µg/L | 0 | WA |
| | | Phenols | <5.0 | | µg/L | 0 | WA |
| | | Potassium | 2,280 | | µg/L | 0 | WA |
| | | Selenium | 2.1 | J3 | µg/L | 0 | WA |
| | | Silica | 7,210 | | µg/L | 0 | WA |
| | | Silver | <2.0 | | µg/L | 0 | WA |
| | | Sodium | 8,780 | V | µg/L | 0 | WA |
| | | Sulfate | 34,500 | | µg/L | 0 | WA |
| | | 1,1,2,2-Tetrachloroethane | <5.0 | | µg/L | 0 | WA |
| | | Tetrachloroethylene | <5.0 | | µg/L | 0 | WA |
| | | Toluene | <5.0 | | µg/L | 0 | WA |
| | | Total dissolved solids | 142,000 | V | µg/L | 0 | WA |
| | | Total organic carbon | 2,540 | | µg/L | 0 | WA |
| | | Total organic carbon | 2,540 | | µg/L | 0 | WA |
| | | Total organic halogens | 31 | | µg/L | 1 | WA |
| | | Total phosphates (as P) | <50 | | µg/L | 0 | WA |
| | | Toxaphene | <1.2 | | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <1.1 | | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <0.57 | | µg/L | 0 | WA |
| | | 1,1,1-Trichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1,2-Trichloroethane | <5.0 | | µg/L | 0 | WA |
| | | Trichloroethylene | <5.0 | | µg/L | 0 | WA |
| | | Trichlorofluoromethane | 2.9 | J | µg/L | 0 | WA |
| | ■ | Gross alpha | 3.2E+01 ± 3.4E+00 | | pCi/L | 2 | TM |
| | | Nonvolatile beta | 2.5E+01 ± 2.8E+00 | | pCi/L | 1 | TM |
| | | Radium-226 | 1.5E+01 ± 4.7E+00 | | pCi/L | 1 | TM |
| | | Radium-226 | 1.6E+01 ± 5.6E+00 | | pCi/L | 1 | TM |
| | | Radium-228 | 3.6E+00 ± 1.4E+00 | | pCi/L | 0 | TM |
| | | Radium-228 | 3.4E+00 ± 1.9E+00 | | pCi/L | 0 | TM |
| | | Tritium | 4.4E+00 ± 4.9E-01 | | pCi/mL | 0 | TM |
| | | Tritium | 4.2E+00 ± 4.9E-01 | | pCi/mL | 0 | TM |

## WELL FAC 5P

| SRS Coord. | Lat/Longitude | Screen Zone Elevation | Top of Casing | Casing | Pump | Formation |
|---|---|---|---|---|---|---|
| N78175.7<br>E55314.8 | 33.288927 °N<br>81.673001 °W | 235.7-225.7 ft msl | 313 ft msl | 2" PVC | | Water table |

FIELD MEASUREMENTS

Sample date: 08/19/93 Time: 13:55
No water evacuated before sampling.
The well was dry.

● = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

## WELL FAC 6

| SRS Coord. | Lat/Longitude | Screen Zone Elevation | Top of Casing | Casing | Pump | Formation |
|---|---|---|---|---|---|---|
| N78129.0<br>E55335.5 | 33.288858 °N<br>81.672855 °W | 236.2-216.2 ft msl | 312.5 ft msl | 4" PVC | B | Water table |

FIELD MEASUREMENTS

Sample date: 08/20/93
Depth to water: 86.35 ft (26.32 m) below TOC
Water elevation: 226.15 ft (68.93 m) msl
Sp. conductance: 65 µS/cm
Turbidity: 1.2 NTU
Water evacuated before sampling: 15 gal
The well went dry during purging.

Time: 11:57
pH: 5.7
Alkalinity: 8 mg/L
Water temperature: 23.9 °C

Volumes purged: 2.3 well volumes

LABORATORY ANALYSES

| H | D | Analyte | Result | Mod | Unit | Flag | Lab |
|---|---|---|---|---|---|---|---|
| • | | pH | 5.6 | JY | pH | 0 | WA |
| • | | Specific conductance | 70 | JY | µS/cm | 0 | WA |
| • | | Turbidity | 14 | JY | NTU | 0 | WA |
| • | | Turbidity | 14 | JY | NTU | 0 | WA |
| | | Aluminum | 34 | J3Y | µg/L | 1 | WA |
| | | Arsenic | <2.0 | Y | µg/L | 0 | WA |
| | | Barium | 13 | Y | µg/L | 0 | WA |
| | | Benzene | <5.0 | Y | µg/L | 0 | WA |
| | | Bromodichloromethane | <5.0 | Y | µg/L | 0 | WA |
| | | Bromoform | <5.0 | Y | µg/L | 0 | WA |
| | | Bromomethane (Methyl bromide) | <10 | Y | µg/L | 0 | WA |
| | | Cadmium | <2.0 | Y | µg/L | 0 | WA |
| | | Calcium | 4,220 | Y | µg/L | 0 | WA |
| | | Carbon tetrachloride | <5.0 | Y | µg/L | 0 | WA |
| | | Chloride | 3,880 | Y | µg/L | 0 | WA |
| | | Chlorobenzene | <5.0 | Y | µg/L | 0 | WA |
| | | Chloroethane | <10 | Y | µg/L | 0 | WA |
| | | Chloroethene (Vinyl chloride) | <10 | Y | µg/L | 0 | WA |
| | | 2-Chloroethyl vinyl ether | <10 | Y | µg/L | 0 | WA |
| | | Chloroform | <5.0 | Y | µg/L | 0 | WA |
| | | Chloromethane (Methyl chloride) | <10 | Y | µg/L | 0 | WA |
| | | Chromium | <4.0 | Y | µg/L | 0 | WA |
| | | Dibromochloromethane | <5.0 | Y | µg/L | 0 | WA |
| | | 1,1-Dichloroethane | <5.0 | Y | µg/L | 0 | WA |
| | | 1,2-Dichloroethane | <5.0 | Y | µg/L | 0 | WA |
| | | 1,1-Dichloroethylene | <5.0 | Y | µg/L | 0 | WA |
| | | trans-1,2-Dichloroethylene | <5.0 | Y | µg/L | 0 | WA |
| | | Dichloromethane (Methylene chloride) | <5.0 | Y | µg/L | 0 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <1.1 | Y | µg/L | 0 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <2.3 | Y | µg/L | 0 | WA |
| | | 1,2-Dichloropropane | <5.0 | Y | µg/L | 0 | WA |
| | | cis-1,3-Dichloropropene | <5.0 | Y | µg/L | 0 | WA |
| | | trans-1,3-Dichloropropene | <5.0 | Y | µg/L | 0 | WA |
| | | Endrin | <0.11 | Y | µg/L | 0 | WA |
| | | Ethylbenzene | <5.0 | Y | µg/L | 0 | WA |
| | | Fluoride | <100 | Y | µg/L | 0 | WA |
| | | Fluoride | <100 | Y | µg/L | 0 | WA |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL FAC 6 collected on 08/20/93, laboratory analyses (cont.)

| H | D | Analyte | Result | Mod | Unit | Flag | Lab |
|---|---|---|---|---|---|---|---|
| | | Iron | 18 | VY | µg/L | 0 | WA |
| | | Lead | <3.0 | Y | µg/L | 0 | WA |
| | | Lindane | <0.053 | Y | µg/L | 0 | WA |
| | | Magnesium | 642 | Y | µg/L | 0 | WA |
| | | Manganese | 12 | Y | µg/L | 0 | WA |
| | | Mercury | 0.40 | Y | µg/L | 0 | WA |
| | | Methoxychlor | <0.53 | Y | µg/L | 0 | WA |
| | | Nitrate as nitrogen | 122 | Y | µg/L | 0 | WA |
| | | Phenols | <5.0 | Y | µg/L | 0 | WA |
| | | Potassium | 1,530 | Y | µg/L | 0 | WA |
| | | Selenium | <2.0 | Y | µg/L | 0 | WA |
| | | Silica | 8,310 | Y | µg/L | 0 | WA |
| | | Silver | <2.0 | Y | µg/L | 0 | WA |
| | | Sodium | 5,100 | VY | µg/L | 0 | WA |
| | | Sulfate | 8,740 | Y | µg/L | 0 | WA |
| | | 1,1,2,2-Tetrachloroethane | <5.0 | Y | µg/L | 0 | WA |
| | | Tetrachloroethylene | <5.0 | Y | µg/L | 0 | WA |
| | | Toluene | <5.0 | Y | µg/L | 0 | WA |
| | | Total dissolved solids | 69,000 | VY | µg/L | 0 | WA |
| | | Total organic carbon | 3,230 | Y | µg/L | 0 | WA |
| | | Total organic halogens | 11 | Y | µg/L | 0 | WA |
| | | Total phosphates (as P) | 105 | Y | µg/L | 0 | WA |
| | | Toxaphene | <1.1 | Y | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <1.1 | Y | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <0.57 | Y | µg/L | 0 | WA |
| | | 1,1,1-Trichloroethane | <5.0 | Y | µg/L | 0 | WA |
| | | 1,1,2-Trichloroethane | <5.0 | Y | µg/L | 0 | WA |
| | | Trichloroethylene | <5.0 | Y | µg/L | 0 | WA |
| | | Trichlorofluoromethane | <5.0 | Y | µg/L | 0 | WA |
| | | Gross alpha | 1.5E+01 ± 3.0E+00 | | pCi/L | 1 | TM |
| | | Gross alpha | 1.5E+01 ± 3.1E+00 | | pCi/L | 1 | TM |
| | | Nonvolatile beta | 1.5E+01 ± 3.1E+00 | | pCi/L | 0 | TM |
| | | Nonvolatile beta | 1.5E+01 ± 3.2E+00 | | pCi/L | 0 | TM |
| | | Radium-226 | 4.0E+00 ± 1.5E+00 | | pCi/L | 0 | TM |
| | | Radium-226 | 5.7E+00 ± 2.0E+00 | | pCi/L | 0 | TM |
| | | Radium-228 | 1.2E+00 ± 1.4E+00 | | pCi/L | 0 | TM |
| | | Radium-228 | 2.1E+00 ± 1.4E+00 | | pCi/L | 0 | TM |
| | | Tritium | 1.8E+00 ± 3.9E-01 | | pCi/mL | 0 | TM |
| | | Tritium | 1.1E+00 ± 3.4E-01 | | pCi/mL | 0 | TM |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

## WELL FAC 7

| SRS Coord. | Lat/Longitude | Screen Zone Elevation | Top of Casing | Casing | Pump | Formation |
|---|---|---|---|---|---|---|
| N78123.4<br>E55356.2 | 33.288879 °N<br>81.672790 °W | 235.7-215.7 ft msl | 312 ft msl | 4" PVC | B | Water table |

### FIELD MEASUREMENTS

Sample date: 08/20/93
Depth to water: 81.81 ft (24.94 m) below TOC
Water elevation: 230.19 ft (70.16 m) msl
Sp. conductance: 57 µS/cm
Turbidity: 8.6 NTU
Water evacuated before sampling: 25 gal
The well went dry during purging.

Time: 11:20
pH: 5.2
Alkalinity: 2 mg/L
Water temperature: 22.3 °C

Volumes purged: 2.6 well volumes

### LABORATORY ANALYSES

| H | D | Analyte | Result | Mod | Unit | Flag | Lab |
|---|---|---|---|---|---|---|---|
| • | | pH | 5.1 | JY | pH | 0 | WA |
| • | | Specific conductance | 42 | JY | µS/cm | 0 | WA |
| • | | Specific conductance | 42 | JY | µS/cm | 0 | WA |
| • | | Turbidity | 5.2 | JY | NTU | 0 | WA |
| | | Aluminum | 80 | Y | µg/L | 2 | WA |
| | | Arsenic | <2.0 | Y | µg/L | 0 | WA |
| | | Barium | 14 | Y | µg/L | 0 | WA |
| | | Benzene | <5.0 | Y | µg/L | 0 | WA |
| | | Bromodichloromethane | <5.0 | Y | µg/L | 0 | WA |
| | | Bromoform | <5.0 | Y | µg/L | 0 | WA |
| | | Bromomethane (Methyl bromide) | <10 | Y | µg/L | 0 | WA |
| | | Cadmium | <2.0 | Y | µg/L | 0 | WA |
| | | Calcium | 3,080 | Y | µg/L | 0 | WA |
| | | Carbon tetrachloride | <5.0 | Y | µg/L | 0 | WA |
| | | Chloride | 3,310 | Y | µg/L | 0 | WA |
| | | Chlorobenzene | <5.0 | Y | µg/L | 0 | WA |
| | | Chloroethane | <10 | Y | µg/L | 0 | WA |
| | | Chloroethene (Vinyl chloride) | <10 | Y | µg/L | 0 | WA |
| | | 2-Chloroethyl vinyl ether | <10 | Y | µg/L | 0 | WA |
| | | Chloroform | <5.0 | Y | µg/L | 0 | WA |
| | | Chloromethane (Methyl chloride) | <10 | Y | µg/L | 0 | WA |
| | | Chromium | <4.0 | Y | µg/L | 0 | WA |
| | | Dibromochloromethane | <5.0 | Y | µg/L | 0 | WA |
| | | 1,1-Dichloroethane | <5.0 | Y | µg/L | 0 | WA |
| | | 1,2-Dichloroethane | <5.0 | Y | µg/L | 0 | WA |
| | | 1,1-Dichloroethylene | <5.0 | Y | µg/L | 0 | WA |
| | | trans-1,2-Dichloroethylene | <5.0 | Y | µg/L | 0 | WA |
| | | Dichloromethane (Methylene chloride) | <5.0 | Y | µg/L | 0 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <1.1 | Y | µg/L | 0 | WA |
| | | 1,2-Dichloropropane | <5.0 | Y | µg/L | 0 | WA |
| | | cis-1,3-Dichloropropene | <5.0 | Y | µg/L | 0 | WA |
| | | trans-1,3-Dichloropropene | <5.0 | Y | µg/L | 0 | WA |
| | | Endrin | <0.11 | Y | µg/L | 0 | WA |
| | | Endrin | <0.22 | Y | µg/L | 0 | WA |
| | | Ethylbenzene | <5.0 | Y | µg/L | 0 | WA |
| | | Fluoride | <100 | Y | µg/L | 0 | WA |
| | | Iron | 120 | VY | µg/L | 0 | WA |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL FAC 7 collected on 08/20/93, laboratory analyses (cont.)

| H | D | Analyte | Result | Mod | Unit | Flag | Lab |
|---|---|---|---|---|---|---|---|
| | | Lead | <3.0 | Y | µg/L | 0 | WA |
| | | Lindane | <0.057 | Y | µg/L | 0 | WA |
| | | Lindane | <0.11 | Y | µg/L | 0 | WA |
| | | Magnesium | 321 | Y | µg/L | 0 | WA |
| | | Manganese | 11 | Y | µg/L | 0 | WA |
| | | Mercury | 0.45 | Y | µg/L | 0 | WA |
| | | Methoxychlor | <1.1 | Y | µg/L | 0 | WA |
| | | Methoxychlor | <1.1 | Y | µg/L | 0 | WA |
| | | Methoxychlor | <0.57 | Y | µg/L | 0 | WA |
| | | Nitrate as nitrogen | 138 | Y | µg/L | 0 | WA |
| | | Phenols | <5.0 | Y | µg/L | 0 | WA |
| | | Potassium | 1,340 | Y | µg/L | 0 | WA |
| | | Selenium | <2.0 | Y | µg/L | 0 | WA |
| | | Silica | 9,300 | Y | µg/L | 0 | WA |
| | | Silver | <2.0 | Y | µg/L | 0 | WA |
| | | Sodium | 5,570 | VY | µg/L | 0 | WA |
| | | Sulfate | 5,100 | Y | µg/L | 0 | WA |
| | | 1,1,2,2-Tetrachloroethane | <5.0 | Y | µg/L | 0 | WA |
| | | Tetrachloroethylene | <5.0 | Y | µg/L | 0 | WA |
| | | Toluene | <5.0 | Y | µg/L | 0 | WA |
| | | Total dissolved solids | 25,000 | VY | µg/L | 0 | WA |
| | | Total organic carbon | <1,000 | Y | µg/L | 0 | WA |
| | | Total organic halogens | 14 | Y | µg/L | 0 | WA |
| | | Total phosphates (as P) | 108 | Y | µg/L | 0 | WA |
| | | Toxaphene | <1.1 | Y | µg/L | 0 | WA |
| | | Toxaphene | <2.2 | Y | µg/L | 0 | WA |
| | | Toxaphene | <2.2 | Y | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <0.57 | Y | µg/L | 0 | WA |
| | | 1,1,1-Trichloroethane | <5.0 | Y | µg/L | 0 | WA |
| | | 1,1,2-Trichloroethane | <5.0 | Y | µg/L | 0 | WA |
| | | Trichloroethylene | <5.0 | Y | µg/L | 0 | WA |
| | | Trichlorofluoromethane | <5.0 | Y | µg/L | 0 | WA |
| | | Gross alpha | 8.5E+00 ± 2.6E+00 | | pCi/L | 1 | TM |
| | | Nonvolatile beta | 1.1E+01 ± 3.0E+00 | | pCi/L | 0 | TM |
| | | Radium-226 | 2.7E+00 ± 1.1E+00 | | pCi/L | 0 | TM |
| | | Radium-228 | 3.7E+00 ± 2.8E+00 | | pCi/L | 0 | TM |
| | | Tritium | 2.7E+00 ± 4.4E-01 | | pCi/mL | 0 | TM |

● = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

## WELL FAC 8

| SRS Coord. | Lat/Longitude | Screen Zone Elevation | Top of Casing | Casing | Pump | Formation |
|---|---|---|---|---|---|---|
| N78090.9<br>E55366.0 | 33.288823 °N<br>81.672701 °W | 236.0-216.0 ft msl | 311 ft msl | 4" PVC | B | Water table |

FIELD MEASUREMENTS

Sample date: 08/19/93
Depth to water: 78.98 ft (24.07 m) below TOC
Water elevation: 232.02 ft (70.72 m) msl
Sp. conductance: 67 µS/cm
Turbidity: 413 NTU
Water evacuated before sampling: 21 gal

Time: 13:17
pH: 5.6
Alkalinity: 6 mg/L
Water temperature: 21.8 °C

Volumes purged: 2.0 well volumes

LABORATORY ANALYSES

| H | D | Analyte | Result | Mod | Unit | Flag | Lab |
|---|---|---|---|---|---|---|---|
| • | | pH | 6.0 | J | pH | 0 | WA |
| • | | pH | 6.1 | J | pH | 0 | WA |
| • | | Specific conductance | 93 | J | µS/cm | 0 | WA |
| • | | Specific conductance | 93 | J | µS/cm | 0 | WA |
| | | Turbidity | 355 | | NTU | 0 | WA |
| | | Turbidity | 360 | | NTU | 0 | WA |
| | | Aluminum | 4,470 | | µg/L | 2 | WA |
| | | Arsenic | <2.0 | | µg/L | 0 | WA |
| | | Barium | 125 | | µg/L | 0 | WA |
| | | Benzene | <5.0 | | µg/L | 0 | WA |
| | | Benzene | <5.0 | | µg/L | 0 | WA |
| | | Bromodichloromethane | <5.0 | | µg/L | 0 | WA |
| | | Bromodichloromethane | <5.0 | | µg/L | 0 | WA |
| | | Bromodichloromethane | <5.0 | | µg/L | 0 | WA |
| | | Bromoform | <5.0 | | µg/L | 0 | WA |
| | | Bromoform | <5.0 | | µg/L | 0 | WA |
| | | Bromoform | <5.0 | | µg/L | 0 | WA |
| | | Bromomethane (Methyl bromide) | <10 | | µg/L | 0 | WA |
| | | Bromomethane (Methyl bromide) | <10 | | µg/L | 0 | WA |
| | | Bromomethane (Methyl bromide) | <10 | | µg/L | 0 | WA |
| | | Cadmium | <2.0 | | µg/L | 0 | WA |
| | | Calcium | 8,820 | | µg/L | 0 | WA |
| | | Carbon tetrachloride | <5.0 | | µg/L | 0 | WA |
| | | Carbon tetrachloride | <5.0 | | µg/L | 0 | WA |
| | | Carbon tetrachloride | <5.0 | | µg/L | 0 | WA |
| | | Chloride | 1,550 | | µg/L | 0 | WA |
| | | Chlorobenzene | <5.0 | | µg/L | 0 | WA |
| | | Chlorobenzene | <5.0 | | µg/L | 0 | WA |
| | | Chloroethane | <10 | | µg/L | 0 | WA |
| | | Chloroethane | <10 | | µg/L | 0 | WA |
| | | Chloroethane | <10 | | µg/L | 0 | WA |
| | | Chloroethene (Vinyl chloride) | <10 | | µg/L | 0 | WA |
| | | Chloroethene (Vinyl chloride) | <10 | | µg/L | 0 | WA |
| | | Chloroethene (Vinyl chloride) | <10 | | µg/L | 0 | WA |
| | | 2-Chloroethyl vinyl ether | <10 | | µg/L | 0 | WA |
| | | 2-Chloroethyl vinyl ether | <10 | | µg/L | 0 | WA |
| | | 2-Chloroethyl vinyl ether | <10 | | µg/L | 0 | WA |
| | | Chloroform | <5.0 | | µg/L | 0 | WA |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL FAC 8 collected on 08/19/93, laboratory analyses (cont.)

| H | D | Analyte | Result | Mod | Unit | Flag | Lab |
|---|---|---|---|---|---|---|---|
| | | Chloroform | <5.0 | | µg/L | 0 | WA |
| | | Chloroform | <5.0 | | µg/L | 0 | WA |
| | | Chloromethane (Methyl chloride) | <10 | | µg/L | 0 | WA |
| | | Chloromethane (Methyl chloride) | <10 | | µg/L | 0 | WA |
| | | Chloromethane (Methyl chloride) | <10 | | µg/L | 0 | WA |
| | | Chromium | 20 | | µg/L | 0 | WA |
| | | Dibromochloromethane | <5.0 | | µg/L | 0 | WA |
| | | Dibromochloromethane | <5.0 | | µg/L | 0 | WA |
| | | Dibromochloromethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1-Dichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1-Dichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1-Dichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,2-Dichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,2-Dichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,2-Dichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1-Dichloroethylene | <5.0 | | µg/L | 0 | WA |
| | | 1,1-Dichloroethylene | <5.0 | | µg/L | 0 | WA |
| | | trans-1,2-Dichloroethylene | <5.0 | | µg/L | 0 | WA |
| | | trans-1,2-Dichloroethylene | <5.0 | | µg/L | 0 | WA |
| | | trans-1,2-Dichloroethylene | <5.0 | | µg/L | 0 | WA |
| | | Dichloromethane (Methylene chloride) | <5.0 | | µg/L | 0 | WA |
| | ■ | Dichloromethane (Methylene chloride) | 5.4 | V | µg/L | 2 | WA |
| | ■ | Dichloromethane (Methylene chloride) | 5.5 | V | µg/L | 2 | WA |
| | | 2,4-Dichlorophenoxyacetic acid | <1.0 | | µg/L | 0 | WA |
| | | 1,2-Dichloropropane | <5.0 | | µg/L | 0 | WA |
| | | 1,2-Dichloropropane | <5.0 | | µg/L | 0 | WA |
| | | 1,2-Dichloropropane | <5.0 | | µg/L | 0 | WA |
| | | cis-1,3-Dichloropropene | <5.0 | | µg/L | 0 | WA |
| | | cis-1,3-Dichloropropene | <5.0 | | µg/L | 0 | WA |
| | | cis-1,3-Dichloropropene | <5.0 | | µg/L | 0 | WA |
| | | trans-1,3-Dichloropropene | <5.0 | | µg/L | 0 | WA |
| | | trans-1,3-Dichloropropene | <5.0 | | µg/L | 0 | WA |
| | | trans-1,3-Dichloropropene | <5.0 | | µg/L | 0 | WA |
| | | Endrin | <0.10 | | µg/L | 0 | WA |
| • | | Endrin | <0.11 | J | µg/L | 0 | WA |
| | | Ethylbenzene | <5.0 | | µg/L | 0 | WA |
| | | Ethylbenzene | <5.0 | | µg/L | 0 | WA |
| | | Ethylbenzene | <5.0 | | µg/L | 0 | WA |
| | | Fluoride | <100 | | µg/L | 0 | WA |
| | | Iron | 13,100 | V | µg/L | 2 | WA |
| | | Lead | 8.5 | J3 | µg/L | 1 | WA |
| | | Lindane | <0.050 | | µg/L | 0 | WA |
| • | | Lindane | <0.056 | J | µg/L | 0 | WA |
| | | Magnesium | 693 | | µg/L | 0 | WA |
| | | Manganese | 95 | | µg/L | 2 | WA |
| | | Mercury | 0.76 | | µg/L | 0 | WA |
| | | Methoxychlor | <0.50 | | µg/L | 0 | WA |
| • | | Methoxychlor | <0.56 | J | µg/L | 0 | WA |
| | | Nitrate as nitrogen | 6,390 | | µg/L | 1 | WA |
| | | Phenols | 5.3 | | µg/L | 0 | WA |
| | | Phenols | 5.8 | | µg/L | 0 | WA |
| | | Potassium | 1,110 | | µg/L | 0 | WA |
| | | Selenium | <2.0 | | µg/L | 0 | WA |
| | | Silica | 18,100 | | µg/L | 0 | WA |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

WELL FAC 8 collected on 08/19/93, laboratory analyses (cont.)

| H | D | Analyte | Result | Mod | Unit | Flag | Lab |
|---|---|---|---|---|---|---|---|
| | | Silver | <2.0 | | µg/L | 0 | WA |
| | | Sodium | 6,160 | V | µg/L | 0 | WA |
| | | Sulfate | 9,050 | | µg/L | 0 | WA |
| | | 1,1,2,2-Tetrachloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1,2,2-Tetrachloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1,2,2-Tetrachloroethane | <5.0 | | µg/L | 0 | WA |
| | | Tetrachloroethylene | <5.0 | | µg/L | 0 | WA |
| | | Tetrachloroethylene | <5.0 | | µg/L | 0 | WA |
| | | Tetrachloroethylene | <5.0 | | µg/L | 0 | WA |
| | | Toluene | <5.0 | | µg/L | 0 | WA |
| | | Toluene | <5.0 | | µg/L | 0 | WA |
| | | Total dissolved solids | 48,000 | | µg/L | 0 | WA |
| | | Total organic carbon | <1,000 | | µg/L | 0 | WA |
| | | Total organic halogens | 48 | | µg/L | 1 | WA |
| | | Total phosphates (as P) | 301 | | µg/L | 0 | WA |
| | | Toxaphene | <1.0 | | µg/L | 0 | WA |
| • | | Toxaphene | <1.1 | J | µg/L | 0 | WA |
| | | 2,4,5-TP (Silvex) | <0.51 | | µg/L | 0 | WA |
| | | 1,1,1-Trichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1,1-Trichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1,1-Trichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1,2-Trichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1,2-Trichloroethane | <5.0 | | µg/L | 0 | WA |
| | | 1,1,2-Trichloroethane | <5.0 | | µg/L | 0 | WA |
| | | Trichloroethylene | <5.0 | | µg/L | 0 | WA |
| | | Trichloroethylene | <5.0 | | µg/L | 0 | WA |
| | | Trichlorofluoromethane | <5.0 | | µg/L | 0 | WA |
| | | Trichlorofluoromethane | <5.0 | | µg/L | 0 | WA |
| | | Trichlorofluoromethane | <5.0 | | µg/L | 0 | WA |
| | | Gross alpha | 5.1E+00 ± 2.1E+00 | | pCi/L | 0 | TM |
| | | Gross alpha | 5.3E+00 ± 2.2E+00 | | pCi/L | 0 | TM |
| | | Nonvolatile beta | 6.8E+00 ± 2.7E+00 | | pCi/L | 0 | TM |
| | | Nonvolatile beta | 6.8E+00 ± 2.7E+00 | | pCi/L | 0 | TM |
| | | Radium-226 | 4.8E+00 ± 1.7E+00 | | pCi/L | 0 | TM |
| | | Radium-226 | 6.4E+00 ± 2.3E+00 | | pCi/L | 0 | TM |
| | | Radium-228 | 2.9E+00 ± 1.5E+00 | | pCi/L | 0 | TM |
| | | Radium-228 | 5.3E+00 ± 1.7E+00 | | pCi/L | 0 | TM |
| | | Tritium | 3.1E+00 ± 4.3E-01 | | pCi/mL | 0 | TM |
| | | Tritium | 2.4E+00 ± 3.8E-01 | | pCi/mL | 0 | TM |

• = exceeded holding time. ■ = exceeded screening level or final primary drinking water standard.

# Appendix E – Data Quality/Useability Assessment

## Data Quality/Useability Assessment

Quality assurance/quality control (QA/QC) procedures relating to accuracy and precision of analyses performed on groundwater samples are followed in the field and laboratory and are reviewed prior to publication of results. The Environmental Protection Department/ Environmental Monitoring Section's (EPD/EMS) review of the volume of analytical data acquired each quarter and presented in various reports is an ongoing process; its review of the QA/QC data cannot be completed in time to meet the deadlines for the reports required by the Resource Conservation and Recovery Act and associated regulations. Other site and regulatory personnel can obtain further information on the data quality and useability in a variety of ways, including those described below.

### *Data Qualification*

The contract laboratories continually assess their own accuracy and precision according to U.S. Environmental Protection Agency (EPA) guidelines. They submit sample- or batch-specific QA/QC information either at the same time as analytical results or in a quarterly summary. Properly defined and used result modifiers (also referred to as qualifiers) can be a key component in assessing data useability. Result modifiers designed by EPD/EMS and used by the primary laboratories are presented in Appendix D.

### *Assessment of Accuracy of the Data*

Accuracy, or the nearness of the reported result to the true concentration of a constituent in a sample, can be assessed in several ways.

A laboratory's general accuracy can be judged by analysis of results obtained from known samples. The non-radionuclide contract laboratories analyze commercial reference samples every quarter at EPD/EMS' request. The results of these analyses are presented in the EPD/EMS quarterly report, *The Savannah River Site's Groundwater Monitoring Program.* The primary laboratories also seek or maintain state certification by participating periodically in performance studies; reference samples and analysis of results are provided by EPA. Results of these studies also are published in the EPD/EMS quarterly reports.

Analysis of blanks provides a tool for assessing the accuracy of both sampling and laboratory analysis. Results for all field blanks for the quarter can be found in the EPD/EMS quarterly reports. Any field or laboratory blanks that exceeded established minimums are identified in the same reports, in tables associating them with groundwater samples analyzed in the same batches.

Surrogates, organic compounds similar in chemical behavior to the compounds of interest but not normally found in environmental samples, are used to monitor the effect of the matrix on the accuracy of analyses for organic parameters. For example, for analyses of volatile organics by EPA Method 8240, three surrogate compounds are added to all samples

and blanks in each analytical batch. In analyses of semivolatile organics, three to four acid compounds and three to four base/neutral compounds are used. Other surrogates are used in pesticides analyses. Percent recoveries for surrogate analyses are calculated by laboratory personnel, reported to EPD/EMS, reviewed, and entered into the database, but they are not published. If recoveries are not within specified limits, the laboratory is expected to re-run the samples or attach result qualifiers to the data identifying the anomalous results.

Sample-specific accuracy for both organic and inorganic parameters can be assessed by examination of matrix spike/matrix spike duplicate results. A sample is analyzed unspiked to determine a baseline set of values. A second portion of sample is spiked with known concentrations of compounds appropriate to the analyses being performed, typically 5 volatile organic compounds for volatile organics analyses, 11 semivolatile compounds for semivolatiles, 6 pesticide compounds for pesticides, all metals for metals analyses, and a known quantity of cyanide for cyanide analysis. The percentage of the spike compound that is recovered (i.e., measured in excess of the value obtained for the unspiked sample) is a direct measure of analytical accuracy. EPA requires matrix spike/matrix spike duplicates to be run at least once per 20 samples of similar matrix.

Matrix spike/matrix spike duplicate results are reported to EPD/EMS but are not published. For organic compounds, according to EPA guidelines, no action is taken on the basis of matrix spike/matrix spike duplicate data alone (i.e., no result modifiers are assigned solely on the basis of matrix spike results); however, the results can indicate if a lab is having a systematic problem in the analysis of one or more analytes.

In the case of inorganic compounds, such as metals, the matrix spike sample analysis provides information about the effect of each sample matrix on the digestion and measurement methodology. Data qualifiers can be assigned on the basis of the percentage of spike recovery and are reported in the published results tables.

### *Assessment of Precision*

Precision of the analyses, or agreement of a set of replicate results among themselves, is assessed through the use of duplicates (laboratory-initiated) and blind replicates (provided by EPD/EMS). The results of duplicate and replicate analyses are presented in the results tables of the first, second, and third quarter reports. Duplicate and replicate results are not presented in fourth quarter reports; the results tables present instead only the highest result for each analyte for each quarter of the year.

The laboratories assess precision by calculating the relative percent difference, or RPD, for each pair of laboratory-initiated duplicate results. During 1992, at least one of the contract laboratories used a data qualifier (J3) to modify metals analyses when the RPD for laboratory duplicates was greater than 20%.

Additional statistical comparisons of laboratory duplicate and blind replicate results, both intra- and interlaboratory, are presented in the EPD/EMS quarterly reports. The calculation used for these reports is the MRD, or mean relative difference, which is similar to EPA's RPD except that the MRD provides a single value for all of the analyses of a particular com-

pound, either inter- or intralaboratory, during one quarter. Because detection limits may vary among samples, the MRD requires calculation of a reference detection limit, which is the detection limit at the 90th percentile of the array of limits in the population of all replicate and duplicate analyses for a given analyte during a particular quarter. The MRD is not method-specific.

### *Method-Specific Accuracy and Precision*

The contract laboratories' EPA-approved laboratory procedures include QA/QC requirements as an integral part of the methods. Thus, knowledge of the method used in obtaining data is an important component of determining data useability. EPA has conducted extensive research and development on the methods approved for the analysis of water and waste water; information on the accuracy and precision of the method is available from EPA publications, as is full information on required QA/QC procedures. A listing of the methods used by the primary laboratories during first quarter 1992 is given below along with the source for the method description. Many, if not all, of these sources include presentations of representative accuracy and precision results.

| Method | Used to Analyze | Source |
|---|---|---|
| EPA120.1 | Specific conductance | EPA EMSL 1983 |
| EPA150.1 | pH | EPA EMSL 1983 |
| EPA160.1 | Filterable residue (total dissolved solids) | EPA EMSL 1983 |
| EPA160.2 | Nonfilterable residue | EPA EMSL 1983 |
| EPA180.1 | Turbidity | EPA EMSL 1983 |
| EPA200.7 | Trace elements | EPA EMSL 1983 |
| EPA206.2 | Arsenic | EPA EMSL 1983 |
| EPA208.2 | Barium | EPA EMSL 1983 |
| EPA239.2 | Lead | EPA EMSL 1983 |
| EPA245.1 | Mercury | EPA EMSL 1983 |
| EPA270.2 | Selenium | EPA EMSL 1983 |
| EPA279.2 | Thallium | EPA EMSL 1983 |
| EPA300.0 | Inorganics, non-metallics | EPA EMSL 1991 |
| EPA310.1 | Alkalinity | EPA EMSL 1983 |
| EPA325.2 | Chloride | EPA EMSL 1983 |
| EPA335.3 | Cyanide | EPA EMSL 1983 |
| EPA340.2 | Fluoride | EPA EMSL 1983 |
| EPA353.1 | Nitrogen, nitrate-nitrite | EPA EMSL 1983 |
| EPA353.2 | Nitrogen, nitrate, nitrite, or combined | EPA EMSL 1983 |
| EPA353.3 | Nitrogen, nitrate-nitrite, or nitrite only | EPA EMSL 1983 |
| EPA354.1 | Nitrogen, nitrite | EPA EMSL 1983 |
| EPA365.1 | Phosphorus, all forms (reported as total phosphates) | EPA EMSL 1983 |
| EPA365.2 | Phosphorus, all forms (reported as total phosphates) | EPA EMSL 1983 |
| EPA375.4 | Sulfate, turbidimetric | EPA EMSL 1983 |
| EPA376.2 | Sulfide | EPA EMSL 1983 |
| APHA403 | Alkalinity | APHA 1985 |
| EPA413.1 | Oil & grease | EPA EMSL 1983 |
| APHA415A | Iodine | APHA 1985 |
| EPA415.1 | Total organic carbon | EPA EMSL 1983 |
| EPA418.1 | Petroleum hydrocarbons | EPA EMSL 1983 |
| EPA420.1 | Phenolics | EPA EMSL 1983 |
| EPA420.2 | Phenolics | EPA EMSL 1983 |
| APHA705 | Total alpha-emitting radium | APHA 1985 |

| Method | Used to Analyze | Source |
|---|---|---|
| ASTMD3869C | Iodide | ASTM 1992 |
| APHA5320 | Dissolved organic halogen | APHA 1989 |
| EPA6010 | Metals | EPA 1986 |
| EPA7041 | Antimony | EPA 1986 |
| EPA7060 | Arsenic | EPA 1986 |
| EPA7421 | Lead | EPA 1986 |
| EPA7470 | Mercury | EPA 1986 |
| EPA7740 | Selenium | EPA 1986 |
| EPA7841 | Thallium | EPA 1986 |
| EPA8010 | Halogenated volatile organics | EPA 1986 |
| EPA8020 | Aromatic volatile organics | EPA 1986 |
| EPA8080 | Organochlorine pesticides and PCBs | EPA 1986 |
| EPA8140 | Organophosphorus pesticides | EPA 1986 |
| EPA8150 | Chlorinated herbicides | EPA 1986 |
| EPA8240 | GCMS VOA | EPA 1986 |
| EPA8270 | GCMS semivolatiles | EPA 1986 |
| EPA8280 | Dioxins and furans | EPA 1986 |
| EPA9012 | Total cyanide | EPA 1986 |
| EPA9020 | Total organic halides | EPA 1986 |
| EPA9030 | Sulfides | EPA 1986 |

An example of the available method-specific QA/QC information is that for the analysis of metals by EPA Method 6010/200.7 (EPA, 1986/EPA EMSL, 1983). The primary laboratories, General Engineering Laboratories (GE) and Roy F. Weston, Inc. (Weston), use this inductively coupled plasma (ICP) atomic emission spectrometric method.

The following precision and accuracy data are based on the experience of seven laboratories that applied the ICP technique to acid-distilled water matrices that had been dosed with various metal concentrates. (Note: not all seven laboratories analyzed all 14 elements.) The references give results for samples having three concentration ranges; the results here are for samples having the lowest values, similar to actual groundwater results for SRS.

*ICP Precision and Accuracy Data*

| Element | True value (µg/L) | Mean reported value (µg/L) | Mean percent RSD[a] |
|---|---|---|---|
| Aluminum | 60 | 62 | 33 |
| Arsenic | 22 | 19 | 23 |
| Beryllium | 20 | 20 | 9.8 |
| Cadmium | 2.5 | 2.9 | 16 |
| Chromium | 10 | 10 | 18 |
| Cobalt | 20 | 20 | 4.1 |
| Copper | 11 | 11 | 40 |
| Iron | 20 | 19 | 15 |
| Lead | 24 | 30 | 32 |
| Manganese | 15 | 15 | 6.7 |
| Nickel | 30 | 28 | 11 |
| Selenium | 6 | 8.5 | 42 |

| Element | True value (µg/L) | Mean reported value (µg/L) | Mean percent RSD[a] |
|---|---|---|---|
| Vanadium | 70 | 69 | 2.9 |
| Zinc | 16 | 19 | 45 |

Note: In EPA (1986), the column heading is Mean Standard Deviation (%).

[a] Relative standard deviation.

As another example, EPA Method 601/8010 (EPA, 1991/EPA, 1986) is used by both GE and Weston for analyses of halogenated volatile organics. In the presentation of the method in both references, the following table gives method-specific accuracy and precision as functions of concentration. Contract laboratories are expected to achieve or at least approach these limits.

*Accuracy and Precision as Functions of Concentration for EPA Method 601/8010*

| Parameter | Accuracy as recovery, X'[a] (µg/L) | Single analyst precision (µg/L)[b] | Overall precision (µg/L)[c] |
|---|---|---|---|
| Bromodichloromethane | $1.12C - 1.02$[d] | $0.11\bar{X} + 0.04$[e] | $0.20\bar{X} + 1.00$ |
| Bromoform | $0.96C - 2.05$ | $0.12\bar{X} + 0.58$ | $0.21\bar{X} + 2.41$ |
| Bromomethane | $0.76C - 1.27$ | $0.28\bar{X} + 0.27$ | $0.36\bar{X} + 0.94$ |
| Carbon tetrachloride | $0.98C - 1.04$ | $0.15\bar{X} + 0.38$ | $0.20\bar{X} + 0.39$ |
| Chlorobenzene | $1.00C - 1.23$ | $0.15\bar{X} - 0.02$ | $0.18\bar{X} + 1.21$ |
| Chloroethane | $0.99C - 1.53$ | $0.14\bar{X} - 0.13$ | $0.17\bar{X} + 0.63$ |
| 2-Chloroethyl vinyl ether[f] | $1.00C$ | $0.20\bar{X}$ | $0.35\bar{X}$ |
| Chloroform | $0.93C - 0.39$ | $0.13\bar{X} + 0.15$ | $0.19\bar{X} - 0.02$ |
| Chloromethane | $0.77C + 0.18$ | $0.28\bar{X} - 0.31$ | $0.52\bar{X} + 1.31$ |
| Dibromochloromethane | $0.94C + 2.72$ | $0.11\bar{X} + 1.10$ | $0.24\bar{X} + 1.68$ |
| 1,2-Dichlorobenzene | $0.93C + 1.70$ | $0.20\bar{X} + 0.97$ | $0.13\bar{X} + 6.13$ |
| 1,3-Dichlorobenzene | $0.95C + 0.43$ | $0.14\bar{X} + 2.33$ | $0.26\bar{X} + 2.34$ |
| 1,4-Dichlorobenzene | $0.93C - 0.09$ | $0.15\bar{X} + 0.29$ | $0.20\bar{X} + 0.41$ |
| 1,1-Dichloroethane | $0.95C - 1.08$ | $0.09\bar{X} + 0.17$ | $0.14\bar{X} + 0.94$ |
| 1,2-Dichloroethane | $1.04C - 1.06$ | $0.11\bar{X} + 0.70$ | $0.15\bar{X} + 0.94$ |
| 1,1-Dichloroethene | $0.98C - 0.87$ | $0.21\bar{X} - 0.23$ | $0.29\bar{X} - 0.40$ |
| trans-1,2-Dichloroethene | $0.97C - 0.16$ | $0.11\bar{X} + 1.46$ | $0.17\bar{X} + 1.46$ |
| 1,2-Dichloropropane[f] | $1.00C$ | $0.13\bar{X}$ | $0.23\bar{X}$ |
| cis-1,3-Dichloropropene[f] | $1.00C$ | $0.18\bar{X}$ | $0.32\bar{X}$ |
| trans-1,3-Dichloropropene[f] | $1.00C$ | $0.18\bar{X}$ | $0.32\bar{X}$ |
| Dichloromethane (Methylene chloride) | $0.91C - 0.93$ | $0.11\bar{X} + 0.33$ | $0.21\bar{X} + 1.43$ |
| 1,1,2,2-Tetrachlorethane | $0.95C + 0.19$ | $0.14\bar{X} + 2.41$ | $0.23\bar{X} + 2.79$ |
| Tetrachloroethylene | $0.94C + 0.06$ | $0.14\bar{X} + 0.38$ | $0.18\bar{X} + 2.21$ |
| 1,1,1-Trichloroethane | $0.90C - 0.16$ | $0.15\bar{X} + 0.04$ | $0.20\bar{X} + 0.37$ |
| 1,1,2-Trichloroethane | $0.86C + 0.30$ | $0.13\bar{X} - 0.14$ | $0.19\bar{X} + 0.67$ |
| Trichloroethylene | $0.87C + 0.48$ | $0.13\bar{X} - 0.03$ | $0.23\bar{X} + 0.30$ |
| Trichlorofluoromethane | $0.89C - 0.07$ | $0.15\bar{X} + 0.67$ | $0.26\bar{X} + 0.91$ |
| Vinyl chloride | $0.97C - 0.36$ | $0.13\bar{X} + 0.65$ | $0.27\bar{X} + 0.40$ |

[a] X' = expected recovery for one or more measurements of a sample containing a concentration of $C$, in µg/L.

[b] Expected single analyst standard deviation of measurements.
[c] Expected interlaboratory standard deviation of measurements.
[d] $C$ = true value for the concentration, in µg/L.
[e] $\bar{X}$ = average recovery found for measurements of samples containing a concentration of $C$, in µg/L.
[f] Estimates based on performance in a single laboratory.

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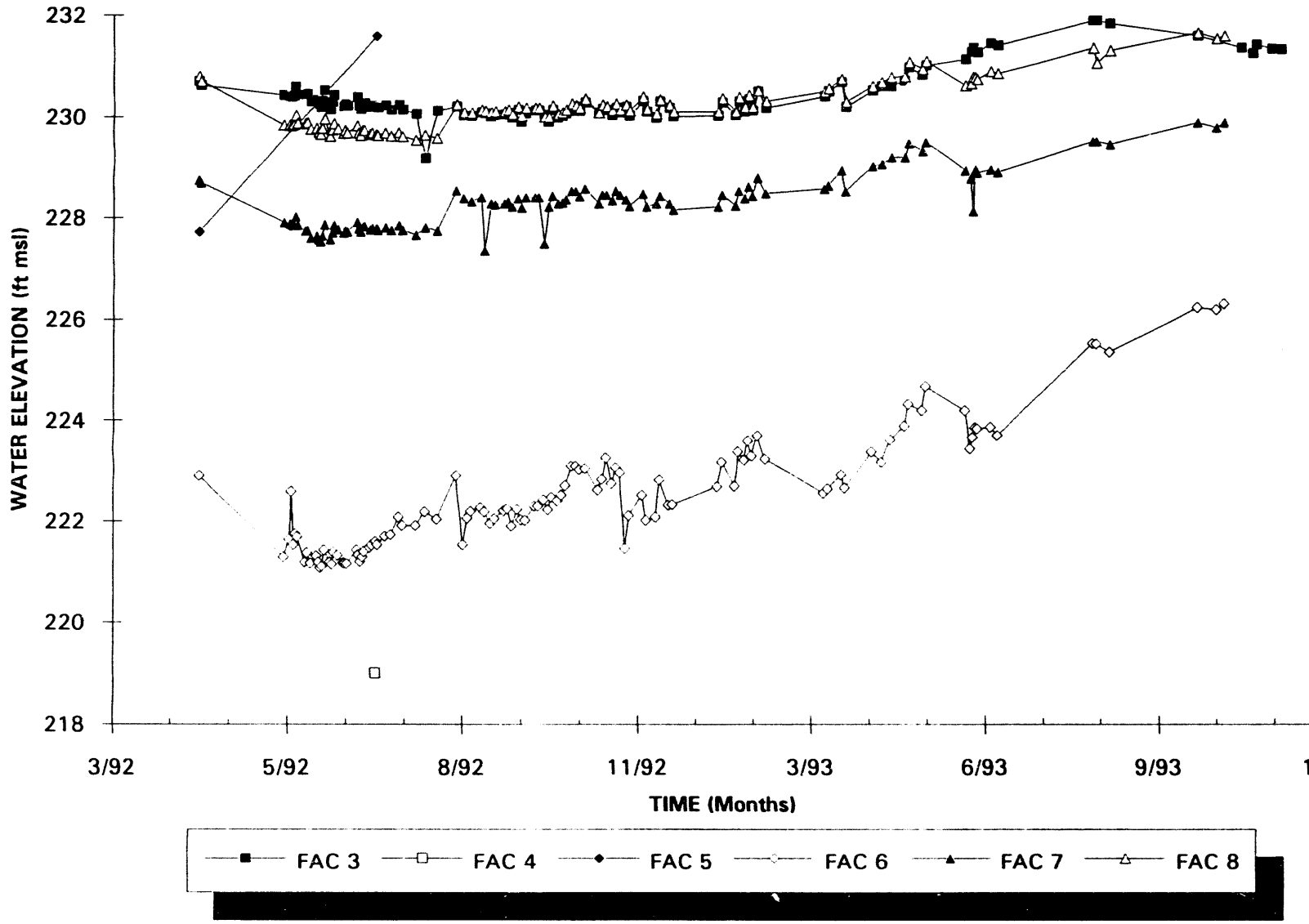
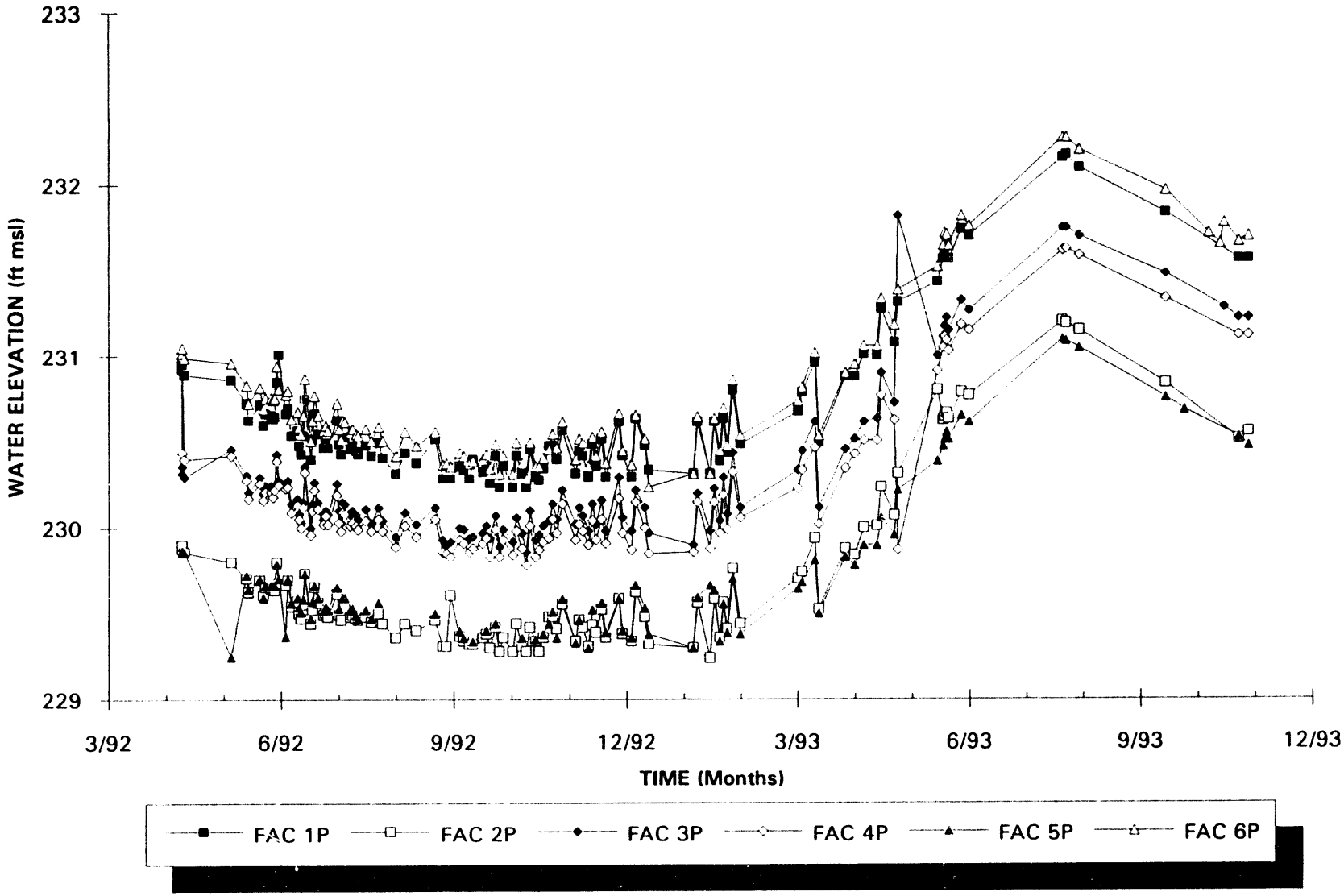
# Appendix F – Hydrographs

# Hydrograph - FAC Monitoring Wells
## Synchronous Water Level Data



# Hydrograph - FAC Piezometer Wells
## Synchronous Water Level Data



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