APPENDIX C

Groundwater Sample Collection Techniques
and
Quality Assurance Procedures

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Groundwater Sample Collection Techniques and Quality Assurance Procedures

Groundwater Sampling Procedures

The following groundwater sampling procedures are based on TVA's Field Engineering Procedures Manual, Section ES-41.6, "Groundwater Sample Collection Techniques". The pump handling procedures do not apply to the dedicated sampling equipment installed in wells 13B and 16A.

Prior to any sampling or pumping, the depth to water surface (Dws) will be measured from the top of each well casing measured to the nearest centimeter with a tape and plunker or electronic water level indicator. The depth of the well (Dw) will be measured with a tape and plunker. Data, observations, and computations will be recorded on the appropriate field worksheet. The volume of water in the well (Vw), in liters, is calculated using the formula shown below:

$$Vw = (Dm)^2 \times \pi/4 \times 10^{-3} \times (Dw - Dws) \text{ or}$$

$$= (Dm)^2 \times 7.854 \times 10^{-4} \times (Dw - Dws)$$

Dm = well casing internal diameter in millimeters (mm);

Dw = Depth of well in meters;

Dws = Depth to water surface in meters.

(Note: Dm of wells 4B and 6A is 102 mm; Dm of wells 13B and 16A is 51 mm.)

"Good housekeeping" practices will be employed to minimize the potential for contamination caused by contact of the ground with the pump and pump tubing. Any equipment that enters a well will be placed on a clean tarpaulin or sheet of plastic. Prior to placing the pump into the well, the outside of the pump and the first few feet of tubing will be rinsed with distilled water.

The pump will be lowered to approximately 0.5 meters below the water surface before pumping commences. The pump will be lowered with the drop in water surface. This ensures that no stagnant water remains in the well after pumping. Ideally, at least two well volumes of water should be purged before sampling. For wells with slow recharge, the pump rate will need to be reduced to minimize the drawdown of the level in the well. If possible, drawing the water level down below the level of the screen will be avoided. Pumping rate and distance to the

water surface will be recorded throughout the pumping procedure. If insufficient water for sampling exists after purging, the wells can be allowed to recover, but sampling should take place as soon after purging as possible. To lessen the chance of contamination, the same pump should be used for purging, monitoring of field parameters, and sampling. While pumping, temperature, pH, DO, ORP, and conductivity will be continuously monitored using a calibrated Hydrolab® flow through cell system to avoid air contact and recorded approximately every five minutes.

When the Hydrolab® readings have stabilized and at least two well volumes have been pumped, samples will be collected for the parameters listed in Table 1 of section II. B. 8. (3). The sample bottles must be labeled with the proper identification number. When filling the various sample bottles, care will be taken to minimize sample aeration by lowering the pumping rate if necessary. Some of the sample containers and bottles may contain a measured amount of chemical preservative. Consequently, the containers and bottles are <u>not</u> rinsed with sample water before filling. Care will be taken to avoid overfilling and diluting the preservative. It is especially important that TIC samples are collected with zero head space. Good technique includes filling the sample bottles one at a time and recapping before filling the next bottle.

Alkalinities will be titrated to pH 8.3 (phenolphthalein alk.) and pH 4.5 (total alk.); acidities will be titrated to pH 3.7 (mineral acidity) and pH 8.3 (CO_2 acidity). All values will be reported as mg $CaCO_3$/L.

Normally, 100 ml of sample are titrated with 0.02 N H_2SO_4 and 0.02 N NaOH. For highly alkaline or acidic samples, sample volume may be decreased or titrant strength increased. Note that 0.02 N NaOH is stable for only about three days.

Immediately after purging and sampling, the water surface depth will be measured. After the pumps are removed from a well, they should be rinsed and the sampling lines should be purged with clean water. Then any remaining water left in the pump and tubing will be pumped out before proceeding to the next well.

Any problem observed that might affect the quality of these procedures will be identified and noted in the project field notebook and on the appropriate field data sheet with the action(s) taken to resolve it. Problems which might affect quality include clogged sampling tubes, highly turbid samples, defective material or equipment, failure to comply with quality procedures, or other similar deficiencies.

Quality Assurance/Quality Control

Appropriate procedures regarding sample containers, preservation techniques, and holding times will be followed. Properly cleaned sample containers with pre-added preservative (where appropriate) will be used. Immediately following collection, samples will be placed in plastic bags and on ice. All shipping containers will be sealed and closed with strapping tape. Samples will be shipped to the analytical laboratory by an appropriate carrier to ensure that all holding times are met.

The sample collector will be responsible for the care and custody of all samples until they are properly dispatched to the receiving laboratory. When samples are dispatched to the laboratory for analysis, a completed Environmental Chemistry Analysis Request and Custody Record form, and copies of the field worksheets will accompany the samples. The sample collector will retain a copy of these forms. Note that the number and kind of sample bottles being sent to the laboratory are indicated. Sample identification numbers (tag numbers) shown on the Custody record will be clearly and permanently marked on all sample bottles. These sample tag numbers will also be cross-referenced on the field worksheets which record information about well location, date and time of collection, name of sample collector(s), water quality field data (physical and chemical), etc. All field and laboratory results are referenced to their unique sample tag numbers, thus maintaining sample traceability. The Sample Custody Record will also record the name and telephone number of the sample collector/shipper. The carrier's shipping record receipts for will be retained by the sample collector/shipper as part of permanent chain of custody documentation. Upon receipt, the laboratory will inspect for broken seals on shipping containers and will inspect the samples for breakage, missing samples, tampering, etc. The laboratory will verify by cross-referencing tag numbers between the Sample Custody Record and the sample bottles received that samples have been received complete and intact. The sample collector will be immediately notified by telephone of any discrepancies.

All samples will be analyzed by the Environmental Chemistry Laboratory for the constituents identified in the Sampling and Analysis Plan in section II. B. 8. (3). The analyses will be conducted according to the methods listed in Table 1 below.

The Laboratory will adhere to all quality assurance measures stated in the document, "TVA Environmental Chemistry Quality Assurance Program Operating Procedures Manual, Revision 1", December 1993. This manual is available for review upon request.

A sample Environmental Chemistry Analysis Request and Custody Record form is included in Appendix C.

Table 1. Sample Analysis Methods

Samples will be analyzed according to the methods listed below:

Parameter	Instrument	Method
Total Inorganic Carbon	Carbon Analyzer	OI 0524B
Chloride	Colorimeter	1-EPA 326.1
Sulfate	Colorimeter	1-EPA 375.1
Total Dissolved Solids		1-EPA 160.1
Al, B, Ba, Be, Ca, Cu,	ICP	2-EPA 6010
Fe, Mg, Mn, Sr, V, Zn	ICP	"
As	GFAA	2-EPA 7060
Sb	GFAA	2-EPA 7041
Cd	GFAA	2-EPA 7131
Cr	GFAA	2-EPA 7191
Pb	GFAA	2-EPA 7421
Ni	FAA	1-EPA 249.1
K	FAA	2-EPA 7610
Na	FAA	2-EPA 7770

Method Key

Code	Reference
OI 0524B	Instruction and Procedures Manual. Oceanography International Corporation. Section VII-IX, 1976.
1-EPA	Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Revised March 1983.
2-EPA	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Revision 2, June 1990.

TENNESSEE VALLEY AUTHORITY WATER MANAGEMENT
ENVIRONMENTAL CHEMISTRY ANALYSIS REQUEST AND CUSTODY RECORD

FORM CONTROL # 10810

ROJECT ID _____

REFERENCE: ☐ WORKPLAN ☐ OTHER

ACCT NO. _____

DATE REQUIRED _____

ESULTS TO _____

LAB USE ONLY

TEST IDC'S _____

DATE RECEIVED _____ DAYS DUE _____

PROJECT LEADER _____ NO. LABELS _____

LAB USE ONLY LAB ID	FIELD ID	SAMPLE DESCRIPTION	SAMPLE MATRIX	DATE/TIME COLLECTED	NO. OF BOTTLES	ADDITIONAL IDC'S

FIELD COMMENTS _____

ANALYSIS REQUESTED _____

SUBMITTED BY _____ DATE/TIME _____ LABORATORY COMMENTS _____

RECEIVED BY _____ DATE/TIME _____

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