

**SAMPLING AND ANALYSIS PLAN  
NORTH FORK RANCH AREA  
RATON BASIN, COLORADO**

Submitted to:  
**PIONEER NATURAL RESOURCES USA, INC  
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# **1 INTRODUCTION**

This Sampling and Analysis Plan (SAP) has been prepared to document the methods and procedures used to investigate groundwater conditions in the North Fork Ranch area of the Raton Basin in south-central Colorado. The SAP includes a field sampling and analysis plan and a quality assurance plan and is supported by Standard Operating Procedures.

## **1.1 PROJECT BACKGROUND**

Pioneer Natural Resources, Inc. (Pioneer) has agreed to investigate alleged impacts to two domestic water supply wells located in the vicinity of Pioneer's Molokai coal-bed methane (CBM) well. As cited in the Colorado Oil and Gas Conservation Commission's (COGCC) Notices of Alleged Violation (NOAV) dated July 28, 2006, the well owners noted water level rises and diminished water quality in their wells at the time the Molokai well was first being drilled. The well was subsequently plugged and abandoned and a replacement well was drilled and completed. The COGCC issued the NOAVs requiring Pioneer to investigate and, if necessary, remediate the water well problems. Norwest Applied Hydrology (NAH) submitted a work plan on behalf of Pioneer in response to the NOAVs.

In order to assure residents of the North Fork Ranch that future coal bed methane development would not impact drinking water supplies, Pioneer voluntarily offered to sample other domestic water wells in the area and initiated a program to locate, install, and sample monitoring wells in the area. This Sampling and Analysis Plan is intended to provide a consistent methodology for monitoring groundwater conditions in the North Fork Ranch area and to describe the procedures for the installation, development and sampling of groundwater monitoring wells and the sampling of domestic water supply wells.

## **1.2 PROJECT SCOPE AND OBJECTIVES**

### **1.2.1 Water Well Investigation**

The objectives of the water well investigation are to determine if the drilling of the original Molokai CBM well impacted the domestic water wells belonging to Mr. and Mrs. Virgil Dolores and Ms. Gopa KA Ross and, if so, provide data for remedial action. The scope of investigation activities include: sampling both domestic wells and a nearby spring for laboratory analysis; removing pumps and testing the wells; and compiling information on area background water quality and hydrogeology.

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### **1.2.2 Area Groundwater Monitoring**

Pioneer has offered to sample and analyze water from the domestic water wells in the area and, concurrently, establish a groundwater monitoring network to provide data on background groundwater quality in the North Fork Ranch area. An analyte list has been developed that will be used to characterize the groundwater prior to and during coal bed methane development in the area. The analyte list with laboratory methods, required reporting limits, and applicable standards, is shown in Table 1.1.

The objectives of the groundwater monitoring program are to:

- Determine the baseline chemical quality of groundwater in areas where coal-bed methane development is planned;
- Determine whether impacts to groundwater are occurring in real time during CBM drilling, construction, fracing, completion, and production operations;
- Monitor groundwater quality changes over time and evaluate whether any changes observed are the result of coalbed methane development

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## **2 FIELD SAMPLING AND ANALYSIS**

### **2.1 MONITORING WELL INSTALLATION**

Monitoring wells will be installed in areas where CBM wells are planned and shallow groundwater is being used or may be used in the future for domestic water supply. The following procedures will be used to locate, drill, and complete groundwater monitoring wells. Further detail is provided in the SOP in Appendix A.

#### **2.1.1 Site locate and utility clearance**

Preliminary well site locations will be plotted on a map based on proximity to existing water wells and surface water drainages as well as planned coalbed methane well pads. To the extent possible accessibility by road and surface topography will be considered using aerial photos and topographic maps. Landowners will be contacted to obtain access agreements and the preliminary locations will be field-verified to assure access and optimum location relative to existing water wells and CBM well pads. Landowners, pipeline owners, and utility companies will be consulted to determine the presence of underground lines and, if necessary, utility locates will be conducted.

#### **2.1.2 Well permitting**

Monitoring well permits will be obtained from the Colorado State Engineers office prior to the commencement of drilling.

#### **2.1.3 Well drilling**

A licensed, professional drilling contractor experienced in drilling groundwater monitoring wells will be contracted to drill and install the wells. Since the wells will be drilled through sandstone and shale bedrock a contractor capable of drilling with air rotary or equivalent methods will be chosen. NAH will have a professional geologist on site during setup, drilling, and well completion to keep a field log and assure the wells are completed appropriately. A field log sheet such as the one included with the well installation SOP (Appendix A) will be used to describe the lithology and keep field notes.

Boreholes of at least six inches in diameter will be drilled to provide sufficient annular space for a gravel-pack emplacement around four-inch well screens. The wells will be drilled to a depth that will allow the hydrostratigraphic zone that is used by nearby water wells to be sampled.

#### **2.1.4 Well completion**

All wells will be completed with four-inch diameter PVC casing and screen. The screens will be set at depths that correspond to the completed depths of nearby water wells. The wells will be gravel-packed the full screen length to a depth two feet above the top of the screen. A bentonite seal at least two feet thick will be placed above the gravel pack and hydrated. The annular space will then be grouted to the surface. Steel protective casing will be set in cement grout at the surface and fitted with a locking cap and padlock.

#### **2.1.5 Well development**

All wells will be developed after the grout has set to assure the well screen is open to the aquifer. The wells will be developed by pumping and/or surging until the water clears and measurement of field parameters has stabilized.

### **2.2 GROUNDWATER MONITORING PROGRAM**

The following data will be collected at each well location; the frequency for each data set is included in parentheses:

- Depth to groundwater (continuously with a downhole probe and data logger and manually prior to sampling at each sampling event);
- Field parameters (continuously with a downhole probe and datalogger and manually during well purging and prior to sampling at each event);
- Major ion and metal concentrations, dissolved gases, TDS, TSS, and pH (each sampling event);
- Bacteriological and stable isotope analyses (initially after monitoring well installation and, subsequently, if needed to assess water quality problems).

A description of procedures for the collection and analysis of samples from existing wells is included in the SOP found in Appendix B.

#### **2.2.1 Groundwater Level Measurement**

Each monitoring well will be equipped with a pressure transducer and data logger to record potentiometric head in the well every 6 hours. The pressure readings will be calibrated during each sampling event with manual water level measurements made using a decontaminated water level indicator. Each manual measurement will be made from the reference mark, and

measurements will be recorded to the nearest 0.01-foot. Fluid level and total well depth measurements will be taken immediately before purging and sampling each well. The water level probe will be placed in and removed from the well so the lead does not rub against the top of the casing and scrape off the depth markings. Pressure data will be downloaded at each sampling event or more frequently, if needed, during nearby CBM well drilling, fracing, and initial production.

### **2.2.2 Field Meter Calibration**

The meters used to measure field parameters prior to sampling will be calibrated following the manufacture's protocol. Each field meter used during purging (pH, specific conductance, and temperature) will be calibrated at the start of each day, and checked immediately after calibration, after every 20 samples, and at the end of each day. All calibration check readings will be recorded on the field calibration form; a copy of the calibration form is included in Appendix B. The meter will be recalibrated when the reading is not within  $\pm 5\%$  of the standard solution or  $\pm 0.05$  pH units of the buffer solution. If the meter cannot be recalibrated, it will not be used, and it will be sent to the manufacturer/distributor for repair.

The conductance meter will be calibrated using either the 1,413 uS/cm or 12,880 uS/cm standard solution depending on the wells to be sampled. The 1,413 uS/cm solution will be used for groundwater investigation wells and domestic wells. The 12,880 uS/cm will only be used if very high total dissolved solids (TDS) is anticipated.

The pH meter will be calibrated using a two point calibration (4.00 and 7.00 or 7.00 and 10.00) if all the readings for that day will be acidic or alkaline. If the pH values are unknown, or some readings will be above 7.0 and some will be below 7.0, then a three point calibration (4.00, 7.00 and 10.00) will be performed.

Fresh calibration solutions will be used for calibration at the start of each sampling event. The solutions may be saved for calibration checks and subsequent calibrations provided there is no question as to each solution's integrity. If any solution is suspected of being contaminated, it will be discarded and fresh solution will be used. Solutions will be saved in clean containers clearly marked with their contents.

### **2.2.3 Well Purging**

All measurements of field parameters, including temperature, pH, and specific conductance, will be recorded during purging to determine when stabilization has occurred and representative formation water is being sampled. Measurements will be taken at regular intervals, and purging

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will continue until the field parameters have stabilized to the following criteria or the maximum purge volume/time is met:

- +/- 0.2 for pH;
- +/- 10% for conductivity and temperature.

Water level measurements will be taken at regular intervals during purging to ensure that drawdown does not reach the pump intake. Each well will be purged until three well volumes have been removed and the discharge water yields stable measurements for field parameters. The volume pumped from each well will be recorded in the field notebook with the field parameter measurements. In the case that five casing volumes have been pumped from the well and the field parameters have not stabilized, the samples will be taken and comments will be written in the field notebook. If the well is pumped dry, it should be sampled when the water level returns to 80% of its pre-development level or within 24 hours.

Purge water will be discharged on the ground at a distance from the well so as not to affect the samples being collected. If field measurements or observations during well purging suggest that the water is not safe to discharge on the ground the purged water will be containerized and sampled to determine the appropriate disposal options.

#### **2.2.4 Sample collection**

Groundwater samples will be collected from the pump discharge line in laboratory-supplied containers appropriate for the specific analysis being conducted. Table 2.1 lists the recommended sample containers, preservation methods, and holding times for all analytes that are expected to be analyzed for as part of this sampling program. Sample containers will be immediately capped, labeled and placed in an iced cooler and entered onto a chain of custody form. If there is any question regarding the number of bottles to fill for a sample or sample preservation/handling procedures, the sampler will immediately call the project manager or the laboratory for clarification. Duplicate samples and laboratory quality control samples will be collected after collecting the primary sample following the same techniques. Field parameters including temperature, pH, and specific conductance will be measured on a sample collected in the same manner as the primary sample.

#### **2.2.5 Domestic Well Sampling**

Domestic wells will be sampled at the outside spigot closest to the well whenever possible. The sampler will let at least 20 gallons of water flow from the spigot before sampling. Field parameters will be monitored at domestic well locations, and these will be stable before procuring



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samples. The samples will be taken directly from a spigot; all hoses will be removed before sampling begins. Samples from domestic wells will not be filtered.

### **2.2.6 Quality Assurance/Quality Control Sampling**

Samples will be taken at regular intervals for quality control and assurance purposes. These samples include duplicate, replicate, and blank samples.

Duplicate samples are used to compare the results from two separate samples taken from the same location and will be taken at every tenth location with a minimum of one per day. A duplicate sample is a second set of bottles filled exactly the same way as the original sample. These bottles will be given different sample identification and a different sample time. The duplicate bottles will be filled after the original sample bottles. Wells selected for duplicate analysis will change with each sampling event and will be identified on the sampling log.

Replicate samples are used for laboratory control and for verification of data quality objectives. These samples are taken from 10% of the well locations. A replicate sample entails filling twice the number of bottles as a regular sample; all bottles are given the same sample identification and the filter is not changed between bottles. Replicate samples should be noted on the chain of custody. Wells selected for replicate analysis will change with each sampling event and will be identified on the sampling log. Replicate samples will be collected only at the request of the analytical laboratory.

Two types of blank samples may be taken during each sampling event: field blanks and equipment rinsate blanks. Blank samples are used to determine if any procedures have introduced chemicals to the samples that would not be indicative of the water being sampled. Each blank sample is a full bottle set with unique sample identification. The sample bottles are filled with laboratory-supplied deionized (DI) water. A field blank will be taken every 20 samples; field blanks are filled at one of the well locations. Trip blanks are field blanks that have been filled in the laboratory and are taken to the field and returned to the lab without opening. At least one set of trip blanks will accompany each set of samples sent to the laboratory.

Equipment rinsate blanks will be taken daily from all equipment used after the equipment has been decontaminated; the DI water is pumped through the pump and the hose reel and the discharge is sampled. Dedicated sampling pumps are not used in more than one well; therefore, a rinsate blank will not be taken. Rinsate blanks will be taken from the non-dedicated sampling pumps, if used, at the end of the sampling event after the equipment has been decontaminated. If the sampling order is changed and a pump must be decontaminated, a rinsate blank will also be taken at that time.

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## **2.3 SAMPLING HANDLING AND DOCUMENTATION**

Samples obtained for volatile organic analyses will be collected in three 40-milliliter (ml) glass VOA vials with Teflon-lined caps, filled to the top with no headspace, and preserved with hydrochloric acid. Samples to be analyzed for major ion and trace metal analyses will be collected in one-liter glass or polyethylene bottles supplied by the laboratory with appropriate preservative. All samples will be stored on ice prior to and during shipment to the analytical laboratory.

### **2.3.1 Sample Containers and Preservation**

Table 2.1 lists the analytes, containers, preservatives, storage requirements, and holding times for the groundwater samples to be collected from the monitoring wells and domestic wells. All samples will be taken using laboratory supplied new (unused) bottles. Any preservative will be added by the laboratory. Each preserved container will be clearly marked with the appropriate preservative by the laboratory. The laboratory will check the pH of preserved samples as they are submitted and adjust the pH as warranted.

### **2.3.2 Sample Identification**

Collected samples will be labeled in water-proof ink with the following information:

- Field sample identification number.
- Date and time of collection.
- Initials of person collecting the sample.
- Other information pertinent to the sample.

Similar information is also entered on the chain-of-custody form, which will remain with the collected samples through delivery to the contract analytical laboratory.

### **2.3.3 Sample Packing and Transport**

The following procedures are recommended when packing and transporting collected samples from the field to the analytical laboratory.

- Place a layer of plastic bubble wrap on the bottom and sides of a hard-sided ice chest.
- Package sample containers in individual re-sealable plastic bags and place in the ice chest.

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- Package ice into two sealed plastic bags to prevent leakage and place ice packages around, among and on top of the packaged sample containers.
  - Fill ice chest with cushioning material such as plastic bubble wrap.
  - Place chain of custody form in a waterproof plastic bag and place on top of the cushioning material inside the ice chest.
  - Secure the lid and drain plug of the ice chest with tape.
  - Secure shipping label to top of ice chest with tape.

The cooler(s) containing the groundwater sample containers and chain of custody form(s) to the analytical laboratory should be transported so that the samples arrive prior to the shortest hold time expiring and prior to the ice melting. If applicable, the courier or persons (other than the sampler) involved with the delivery of samples to the analytical laboratory will be noted on the chain of custody form(s).

#### **2.3.4 Chain of Custody Procedures**

All necessary sample information will be transcribed to the chain of custody form. Each sampler will be responsible for updating his/her chain of custody form and for maintaining proper possession of his/her samples until they are relinquished. The chain of custody forms will be updated after each sample is procured. A sample is considered to be under a person's custody if:

- The sample is in the person's physical possession;
- The sample is in view of the person after that person has taken possession of the sample;
- The sample is secured by that person so that no individual can tamper with the sample;
- The sample is secured by that person in an area that is restricted to authorized personnel.

Completed chain of custody forms will be delivered with the samples to the appropriate contract analytical laboratory. Each chain of custody form must match the samples included in the associated cooler. The chain of custody forms will include the following information:

- Project name.
- Unique sample identification number.
- Sample collection date and time.
- Preservation method, if applicable.
- Analyses requested for each sample.
- Special handling or analysis requirements.
- Number and type of containers submitted.
- Dated signature of the person collecting the samples.

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- Dated signature(s) of persons, other than the sampler, involved in the delivery of the samples to the contract analytical laboratory.
  - Dated signature of the contract analytical laboratory acknowledging receipt of the collected samples.

The chain of custody form will be filled out and signed in blue or black indelible ink. A chain of custody form will be included with each cooler; the contents of the cooler will match that chain of custody form. The chain of custody tracking number and the date and time of delivery to the contract analytical laboratory will be noted in the Field Notebook. A copy of the chain of custody form will be delivered to and retained by the Contract Project Manager.

Prior to sealing a cooler with tape, the bottles in the cooler should be double-checked against that cooler's chain of custody form.

## **2.4 WASTE MANAGEMENT**

### **2.4.1 Drill cuttings**

Rock and soil cuttings generated during the drilling of the monitoring wells will be contained on site. After drilling is concluded the cuttings will be removed from the site and disposed of properly or, with the property owners permission, spread on site in a manner that minimizes surface impacts. It is not anticipated that any cuttings will be generated that pose a risk of exposure to site workers or residents.

### **2.4.2 Disposal of Waste Water**

Wastewater will be discharged on the ground at a distance from the well so as not to affect the samples being collected. If field measurements or observations during well sampling suggest that the water is not safe to discharge on the ground the wastewater will be containerized and sampled to determine the appropriate disposal options.

## **2.5 DECONTAMINATION PROCEDURES**

All fluid level monitoring and groundwater sampling equipment that comes in contact with the subsurface or groundwater at the site will be cleaned prior to use and between sampling locations.

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The procedures include:

- Washing all equipment with a solution of non-phosphate detergent and potable water
- Rinsing with sufficient potable water to remove all detergent
- Rinsing with distilled/deionized water
- Allowing equipment to air dry for 10 minutes
- Storing and transporting equipment so that it does not get recontaminated

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### **3 QUALITY ASSURANCE PROJECT PLAN**

#### **3.1 DATA QUALITY OBJECTIVES**

Data quality assurance begins in the field with the NAH Field QA/QC requirements. Field QC lists any field duplicate, replicate, and/or blanks that were collected and specifies any out of the ordinary characteristics such as relative percent differences (RPD)s over the specified limits.

Laboratory QC procedures follow field QC. Laboratory QC ensures holding times are met as per the Table 2.1, contaminants in any blank samples are accounted for, laboratory control samples and RPD's are within the control range, and calibration and tuning is done properly. Laboratory QC ensures that any problems with the sample analysis is accounted for. An example of laboratory QC is shown in the narrative section of the laboratory report in Appendix D from Severn Trent Laboratories, Inc., the contract laboratory that is expected to do most of the analytical work for this project.

Finally, the project manager must verify the legitimacy of the sample results and recommend any corrective actions to be taken.

Field measurement and sample collection will be conducted in accordance with established quality assurance procedures. These include the use of Standard Operating Procedures (SOPs), audits, and corrective action.

##### **3.1.1 Standard Operating Procedures**

Groundwater sampling SOPs (Appendix B) are detailed, written procedures that will be followed during the collection of field measurements and samples. The use of SOPs is meant to ensure consistency across multiple sampling events that may be conducted by different personnel.

##### **3.1.2 Sample Analysis Validation**

The type and reliability of methods used to analyze samples is very important in ensuring that the data are of a known and acceptable quality and that the data can be used for their intended purpose. The following sections describe the analytical methods that are likely to be used, and the standards and procedures that will be followed to ensure that data are acceptable.

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### **3.1.3 Data Quality Objectives and Measurement Performance Criteria**

The QAPP contains a discussion and summary of data quality objectives and measurement performance criteria for laboratory and field work. Specifically, these include precision, accuracy, comparability, and sensitivity of data. These are generally described below.

Precision refers to the degree to which repeated measurements are similar to one another. It measures the reproducibility among individual measurements, obtained under prescribed similar conditions. Measurements, which are precise, are in close agreement. The QAPP identifies the measurements that are precise as well as the formula used to determine precision. Precision is generally assessed by the measurement of sample duplicates, matrix spike/matrix spike duplicates (MS/MSD), and laboratory control sample/laboratory control sample duplicates (LCS/LCSD) relative percent differences (RPDs).

Accuracy is defined as the measurement of the closeness of an individual reading, or the average of a number of readings, to the true value. The accuracy measurement is generally determined by the percent recovery (%R) of a known value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations. The variance from the true value represents the bias associated with the accuracy.

Comparability is generally defined as a measure of the confidence with which one data set or method can be compared to another. Comparability of data is achieved by ensuring samples have been collected and analyzed following the same protocols.

Sensitivity is defined as the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. The QAPP includes a definition of method detection limits and reporting limits, and identifies how MDLs and Reporting Limits (RLs) have been determined.

### **3.1.4 Quality Assurance Procedures For Sample Analysis**

The analysis of all samples will use USEPA-approved quality assurance procedures. These include the development and use of QAPPs, the collection and analysis of QA/QC samples, the performance of data validation, laboratory audits, and the development and implementation of corrective actions.

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#### **3.1.4.1 Collections/Analysis Of QA/QC Samples**

The number of QA/QC samples to be collected during sampling will vary somewhat by how long the sampling takes. The purpose of these samples is to ensure that contamination of samples from external sources has not occurred and that samples are representative of the media that is being sampled. In general, duplicate samples will be collected at the rate of one for every ten primary samples or ten percent. One field blank will be collected at every twentieth well location. One equipment blank per day will be collected from each piece of sampling equipment after it has been decontaminated and before use for collection of samples. Ten percent of the samples will be subject to data validation; this requires a second set of bottles to be filled during sampling. All QA/QC samples will be sent “blind” to the lab meaning their sample identifications will be similar to the sample identifications for the actual groundwater samples.

### **3.2 DATA REDUCTION, VALIDATION AND REPORTING**

The NAH QA/QC data validation requirement ensures that all samples are properly listed on the chain of custody (COC) and preserved as per Table 2.1. It will also ensure that all samples which have not been listed or tracked on the COC will be tracked for future validation. Validation also ensures that all sample labeled names coincide with the chain of custody names as well as field book notes. Data validation will be performed to verify whether an analytical method has been performed according to method and program specifications as specified in the QAPP. Data validation will involve reviewing the documentation, instrument output, and analytical reports associated with selected samples or groups of samples. Full validation will be conducted on 10 percent of the samples; the samples chosen for validation will be identified on the chains of custody and extra bottles will be filled for these samples. Samples and analyses representative of the entire sampling effort, both detected and non-detected concentrations, will be included for validation. The analysis results will be verified for 100% of the samples.



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## **APPENDIX A**

### **STANDARD OPERATING PROCEDURES FOR MONITORING WELL INSTALLATION**

**APPENDIX B**  
**STANDARD OPERATING PROCEDURE FOR WELL SAMPLING**

**APPENDIX C**

**QUALITY CONTROL CHECKLIST**

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**APPENDIX D****EXAMPLE LABORATORY REPORT  
SEVERN TRENT LABORATORIES, INC.**

**TABLE 1.1**  
**BASELINE ANALYTICAL PARAMETERS**

Major Ions	Reporting Limit	Units	Methods
Fluoride	0.2	mg/L	EPA 300.0
Chloride	1.0	mg/L	EPA 300.0/325.2
Nitrite	0.1	mg/L	EPA 300.0
Bromide	0.2	mg/L	EPA 300.0
Nitrate	0.1	mg/L	EPA 300.0
Sulfate	5.0	mg/L	EPA 300.0
Carbonate	5.0	mg/L	EPA 310.1
Bicarbonate	5.0	mg/L	EPA 310.1
Alkalinity	5.0	mg/L	EPA 310.1
Sulfide	0.05	mg/L	EPA 376.2
Sodium	250	ug/L	EPA 200.8
Potassium	250	ug/L	EPA 200.8
Magnesium	250	ug/L	EPA 200.8
Calcium	250	ug/L	EPA 200.7
METALS			
Arsenic	2.5	ug/L	EPA 200.8
Barium	5	ug/L	EPA 200.8
Boron	5	ug/L	EPA 200.8
Cadmium	5	ug/L	EPA 200.7
Chromium	10	ug/L	EPA 200.7
Copper	2.5	ug/L	EPA 200.8
Iron	100	ug/L	EPA 200.8
Lead	1.5	ug/L	EPA 200.8
Manganese	5	ug/L	EPA 200.8
Selenium	4	ug/L	EPA 200.8
Silver	10	ug/L	EPA 200.7
Zinc	20	ug/L	EPA 200.7
PHYSICAL PROPERTIES			
pH	0.1		EPA 150.1
Temperature			
Specific Conductance			
TDS (Total Dissolved Solids)	10	mg/L	EPA 160.1
TSS (Total Suspended Solids)	4	mg/L	EPA 160.2

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Major Ions	Reporting Limit	Units	Methods
DISSOLVED GASES			
Methane	5	ug/L	RSK SOP-175 <sup>a</sup>
Ethane	5	ug/L	RSK SOP-175
Ethene	5	ug/L	RSK SOP-175
HYDROCARBONS			
Diesel Range Organics	250	ug/L	SW846 8015B
Benzene	0.5	ug/L	SW846 8021B
Toluene	0.5	ug/L	SW846 8021B
Ethylbenzene	0.5	ug/L	SW846 8021B
Total Xylenes	0.5	ug/L	SW846 8021B

Notes: a) Concentration in water calculated based on partitioning from the aqueous into the gas phase in helium-filled headspace

**TABLE 2.1**  
**CONTAINERS, PRESERVATION, AND HOLDING TIMES**

Parameter	Method	Container	Lid	Preservation	Maximum Holding Times Extraction <sup>a</sup>	Analysis <sup>b</sup>
Metals (total)	200.7/200.8	500 ml polyethylene	Cap with Teflon® seal	HNO <sub>3</sub> to pH<2; Ice to 4°C	-	6 months (Hg: 28 days)
Anions (Cl, F, Br, NO <sub>2</sub> -N, NO <sub>3</sub> -N, & SO <sub>4</sub> )	300.0	250 ml polyethylene	Teflon®-lined lids	Ice to 4°C	-	6 months (Hg: 28 days)
Alkalinity (CO <sub>3</sub> , HCO <sub>3</sub> , total)	310.1	250 ml polyethylene	Teflon®-lined lids	Ice to 4°C	-	14 days
Chloride	325.2	250 ml polyethylene	Teflon®-lined lids	none	-	28 days
Sulfide	376.2	500 ml polyethylene	Cap with Teflon® seal	ZnAc/NaOH to pH>9; Ice to 4°C	-	7 days
pH	150.1	250 ml polyethylene	Teflon®-lined caps	none	-	immediate
Specific conductance	120.1	250 ml polyethylene	Teflon®-lined caps	Ice to 4°C	-	28 days
Total Dissolved Solids	160.1	500 ml polyethylene	Cap with Teflon® seal	Ice to 4°C	-	7 days
Total Suspended Solids	160.2	500 ml polyethylene	Cap with Teflon® seal	Ice to 4°C	-	7 days
Dissolved gases	RSK SOP-175	40 ml glass vials X 3	Cap with Teflon® septum	H <sub>2</sub> SO <sub>4</sub> to pH<2; Ice to 4°C		14 days
Volatile organics (BTEX)	8021B	40 ml glass vials X 3	Cap with Teflon® septum	HCl to pH<2; Ice to 4°C	-	14 days
Diesel Range Organics	8015B	40 ml glass vials X 3	Cap with Teflon® septum	HCl to pH<2; Ice to 4°C		14 days

Abbreviations:

ml = milliliter

oz = ounce

Sources:

a = Starting from the date of collection

b = Starting from the date of extraction; if no extraction is involved, starting from the date of collection

c = Extraction may occur any time prior to analysis. Only the analysis holding time is monitored.

1) Methods for Chemical Analysis of Water and Wastes, U.S. EPA-600/4-79-020, March 1983

2) Routine Containers, Preservation, and Hold Times for Drinking Water-In-House Parameters, Severn Trent Laboratories, 2006

3) Analysis of Dissolve Methane, Ethane, and Ethylene in Ground Water by a Standard Gas Chromatographic Technique, Journal of Chromatographic Science, May 1998