Quality Assurance Technical Document 8

Bryte Chemical Laboratory Quality Assurance Manual

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State of California The Resources Agency Department of Water Resources

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APPENDIX H

1. Introduction

The Bryte Chemical Laboratory's primary role within the Department of Water Resources is to provide analytical, chemical, and biological laboratory services for DWR. As a secondary role, the laboratory provides these same services to other governmental agencies. This manual addresses the quality assurance and quality control measures used by the laboratory in determining the organic, inorganic, and biological entities found in California waters.

This QA manual addresses all activities that are essential in the operation of the analytical laboratory. The principles presented in this manual are used to ensure the laboratory is providing information that is factual, precise, accurate, reliable, and adequate for its intended use.

This manual is designed to meet the U.S. Environmental Protections Agency policy guidelines as outlined in the *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, QAMS-005/80, and also to meet the California Department of Health Services, Environmental Laboratory Accreditation Program.

3. Organization and Responsibility

Executing an effective QA program in the laboratory demands the commitment and attention of both management and staff. All laboratory personnel within the organization play a vital role in assuring a continued commitment to the quality of work accomplished. (See Figure 1, Bryte Chemical Laboratory Organizational Chart). The laboratory staff is highly qualified and trained in the following areas:

- Gas chromatography/mass spectrometry (GC/MS)
- Gas chromatography (GC)
- High performance liquid chromatography (HPLC)
- Purge and trap techniques
- Ion chromatography (IC)
- Flame atomic absorption spectroscopy (AA)
- Graphite furnace atomic absorption spectroscopy
- Colorimetric analytical techniques
- Carbon analysis (TOC, DC)
- Wet chemical analysis
- Analytical method development
- Emission spectroscopy (ICP, ICP/MS)
- Sample preparation
- Fecal coliform
- Chlorophyll and pheophytin
- Phytoplankton

Chief of the Bryte Chemical Laboratory

The Chief of the Bryte Chemical Laboratory is responsible for all operational activities within the laboratory and is accountable for all data generated by the laboratory. QA responsibilities consist of:

- Final review of all data generated by the laboratory
- Final authority to release data to requestor
- Final authority on all analytical procedures and SOPs used by laboratory personnel
- Coordinates with the Laboratory QA Officer in implementing the laboratory QA plan and its policies, revisions, and any corrective action to ensure compliance
- Periodic audits of the QA plan to ensure the objectives and procedures are being followed

Laboratory QA Officer

The Laboratory QA Officer is independent and reports only to the Chief of the Bryte Chemical Laboratory. The Laboratory QA Officer:

- Recommends QA policy to the Chief of the Bryte Chemical Laboratory
- Develops and manages the laboratory QA plan, revises it as needed
- Oversees QC practices in the laboratory and data management
- Helps develop analytical procedures
- Develops precision and accuracy guidelines/criteria
- Reviews data quality and laboratory performance audits
- Conducts data quality and laboratory performance audits
- Prescribes and monitors corrective actions
- Recommends QC training for personnel
- Coordinates all QC/QA activities
- Approves SOPs
- Monitors laboratory performance, turnaround, and holding times

Data Control Section

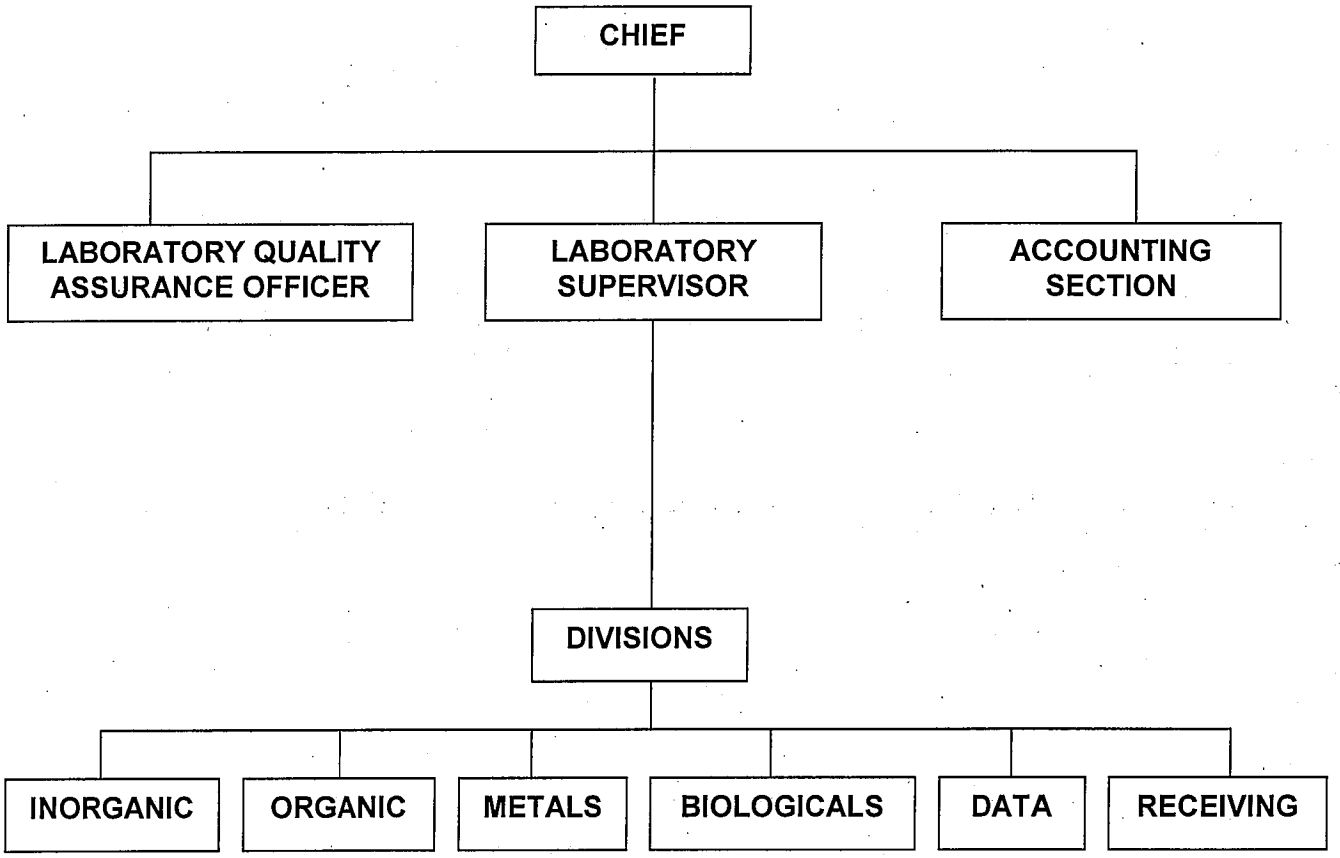
The Data Control Section is responsible for all data coordination and review. Staff performs the following:

- Reviews all analysis report forms for completeness
- Reviews all analysis request forms to ensure compliance within contractual obligations
- Ensures requestor receives the final completed data report
- Maintains records and archives of all data reports

Laboratory Staff

Since the greatest amount of responsibility for a successful QA program rests with the analysts, it is important that they be highly qualified and competent. New and experienced laboratory personnel shall be carefully trained for new specific work assignments. Laboratory personnel have on-site access to technical journals and textbooks as well as access to the Resources Agency Library services. Combined administrative and technical staff meetings will be held to help provide a good

Figure 1. Bryte Chemical Laboratory Organizational Chart



5. Sample Custody Procedures

A Chain of Custody form must be completed for samples received by the laboratory which may be used as evidence for enforcement purposes. Once a sample is received, the Chain of Custody Officer or the alternate is notified. All information is then transcribed to the Chain of Custody form and the sampler signs the form, witnessed by the Chain of Custody Officer or alternate. The sample is then transferred to the appropriate location to wait for analysis. For each transfer of physical custody, an entry of disposition and one of receipt is made on the custody form.

While in the laboratory, samples are stored in a secure area under appropriate preservation and environmental conditions. Following the completion of the analysis, the samples are stored until the results are submitted to the Program Manager and permission to discard has been received. A notation of completion is made on the Chain of Custody form, and the document is then filed with the analysis report. Copies of the files are maintained in the DWR archives.

7. Analytical Procedures

Analytical methods are derived from the latest editions of one of the following references:

- *Methods for Chemical Analyses of Water and Wastes*, EPA-600/4-79-020 (revised March 1983) (Not used for drinking water.)
- *Standard Methods for the Examination of Water and Wastewater*, 19th Edition or later, APHA, American Water Works Association, Water Pollution Control Federation, Washington, D.C. (1992)
- *Methods for Determination of Inorganic Substances in Water and Fluvial Sediments, Techniques of Water Resources Investigations*, USGS, Book 5, Washington, D.C. (1985)
- *Annual Book of American Society for Testing and Material Standards*, Volumes 11.01 and 11.02, ASTM, Philadelphia, Pennsylvania (1988)
- *Official Methods of Analysis*, 14th Edition, AOAC International, Arlington, Virginia (1984)
- *Methods for Organic Chemical Analysis and Municipal and Industrial Wastes*, EPA 600/4-82-057, (1982)
- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under Clean Water Act*, Federal Register, EPA, 40 CFR, Part 136, (1984)
- *Biological Field and Laboratory Methods*, EPA-670/4-73-001, (1973)
- *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods*, EPA, SW846, Volumes 1A, 1B, 1C, and II, (1986)

For a specific analytical method used, see Appendix F.

Standard Operating Procedure

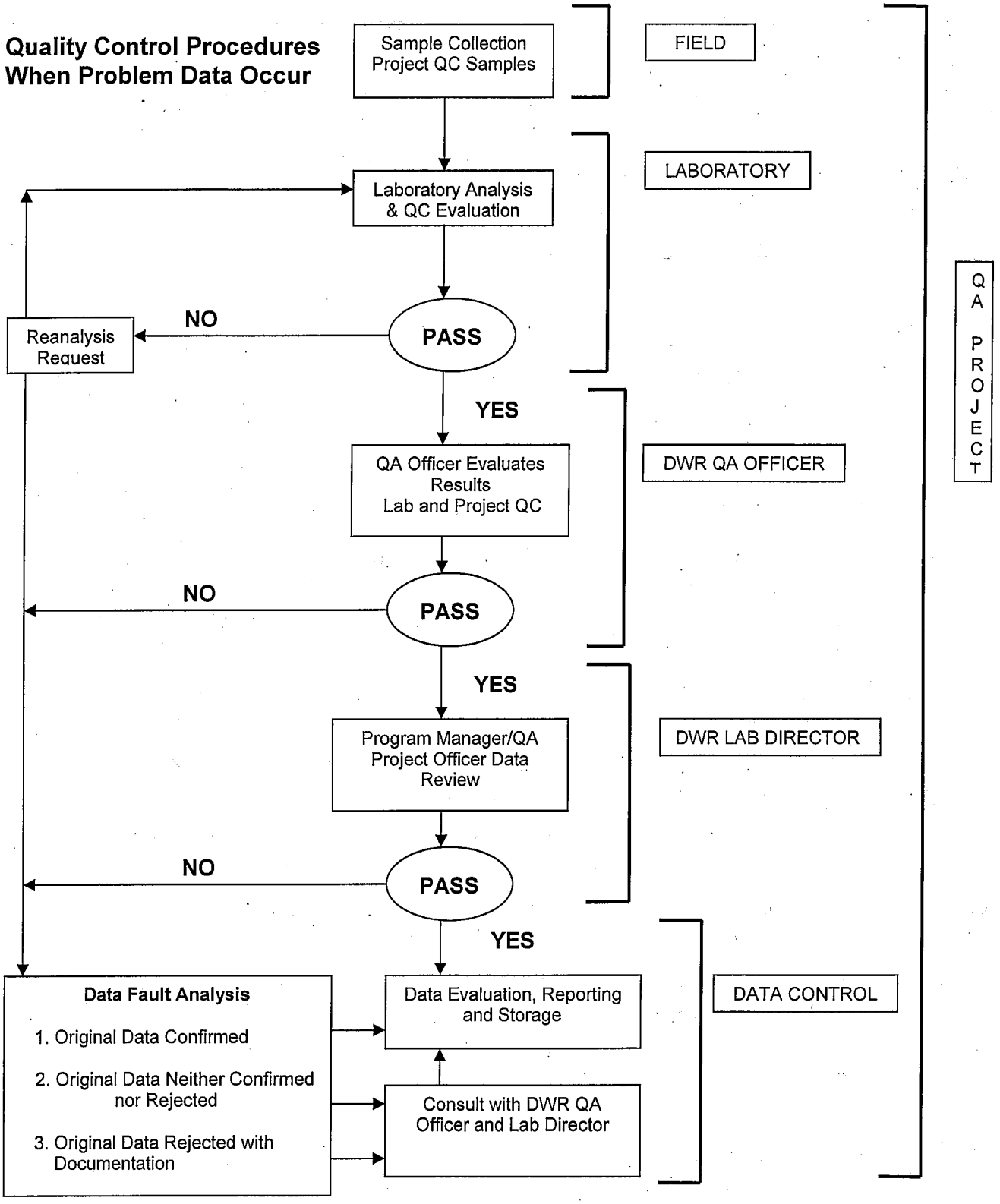
Analytical methods chosen are dependent upon certain objectives, some of which consist of precision and accuracy, type of sample matrix, and quantitative sensitivity. Each analytical method routinely used is documented in the form of a SOP which contains complete detailed instructions to standardize the expected performance of the analytical method. Contents of a laboratory SOP are given in Appendix B. Any deviations from published methodology are documented in the SOP.

Analytical Methodology Verification

Before any analytical method is routinely used to generate data, the method is validated. Criteria used to validate a method consist of the following:

- Method selection by senior staff
- Testing of method verifying reporting limits, dynamic range, matrix effects, precision, and accuracy criteria
- Data acceptance criteria must be approved by the Laboratory QA Officer and Chief of the Bryte Chemical Laboratory
- Final documentation of the method in a written SOP

Figure 2. Data Validation Flowchart



C_s = Concentration of the reference analyte to be measured (µg/L)

The concentration of the analyte is calculated by:

$$C_a = (A_a/A_{is})(C_{is}/RF)$$

where:

C_a = Concentration of the analyte in sample (µg/L)
A_a = peak area of the analyte
RF = Response factor

The monitoring of the internal standards area counts is also used as a continuing check on instrument system performance. An average area count is established for each internal standard and any analytical run in which the internal standard area count falls outside the established criteria, the run is aborted, the cause is corrected, and the sample is reanalyzed.

Surrogate Compounds

Surrogate compounds are used in the analysis of organic compounds by gas chromatography (GC) and/or by a combination of gas chromatography and mass spectrometry (GC/MS). Like the internal standard, the surrogate compounds are similar in analytical behavior to the compounds of interest and are added to all samples, standards, and blanks. A known amount of surrogate is added to monitor the analytical performance of the method. The results of the surrogate compounds must fall within the established QC criteria for the analytical method. Samples that are outside the QC limits are reprepped and analyzed. If the reanalysis confirms the original analysis, both sets of data are reported with a flag attributing the out of control data to matrix interference.

Samples Duplicates

Duplicates are environmental samples divided into two separate aliquots analyzed independently to determine the repeatability or precision of the analytical method. The difference in the duplicate results must be within established control limits to ensure the generated data meet the quality assurance objectives for the particular analytical method.

Matrix Spike/Matrix Spike Duplicates

A spiked environmental sample is used to check for any matrix effects on the precision and accuracy of an analytical measurement. One out of every 20 samples or one per batch is spiked twice with a known concentration of the analyte of interest, and then analyzed in a normal manner. The percent recovery and relative percent difference are calculated and the results must fall within established control limits to ensure the generated data meets the QA objectives for the particular analytical method used.

Performance Evaluation Samples

PE samples are routinely issued to the analyst to monitor both the analyst's work and analytical procedure. The recorded results are reviewed by both the Laboratory QA Officer and senior staff. If any problems occur, follow-up corrective action is taken. PE samples may be in the form of blanks, previously analyzed environmental samples, split samples, or standard reference materials such as EPA, USGS, etc.

Standard Method of Additions

Standard method of additions is the practice of adding known concentrations of analyte to a sample so that matrix effects (interferences) are minimized. Whenever sample interference is suspected, the method of standard additions is employed to verify the quality of the data.

Bracketing

Bracketing is the use of standards to bracket the apparent concentration of the analyte in the sample. The sample is bracketed between a high and low standard, the standards being as close to the measured sample value as possible, usually ±10 percent. The calculated results are then done by interpolation as follows:

$$C_s = [((R_s-R_{ls})(C_{hs}-C_{ls})/(R_{hs}-R_{ls}))+C_{ls}](\text{dilution})$$

where:

C_s = Sample concentration
R_s = Response of sample
R_{hs} = Response of High Standard
R_{ls} = Response of Low Standard
C_{hs} = Concentration of High Standard
C_{ls} = Concentration of Low Standard

Normally, bracketing is used where precision of the methodology is poor. By bracketing, verification of the data quality can be obtained.

11. Preventative Maintenance

Preventative maintenance is routinely performed on all analytical equipment and instruments to minimize the amount of downtime and to maintain data quality. Equipment manuals, troubleshooting guides, and log books are available for maintenance support. Critical spare parts are kept on hand for laboratory instrumentation that is routinely repaired by laboratory staff. The inventory is monitored and maintained to avoid extended periods of downtime.

Service Contracts

The laboratory maintains service contracts with manufacturers and specialty companies for complex analytical equipment (i.e., GC and ICP/MS).

General Maintenance

Chemists are responsible for the routine daily maintenance of their instruments per the manufacturer's recommendations and for documenting repairs in the equipment maintenance log books. Designated laboratory personnel are trained and responsible for more complex maintenance procedures. All necessary repairs are performed by trained staff or factory service engineers. The Chief of the Bryte Chemical Laboratory will be informed of the need for, and the performance of all major maintenance activities that may directly impact sample analysis schedules.

Equipment Log Books

Equipment log books are maintained for all analytical instruments and equipment used in the laboratory. Each entry in the log book includes the date, the nature of the entry, and the name of the individual responsible for the entry. The following information is recorded in the log books:

- Results of all sensitivity checks (verifying the equipment is operating according to QA criteria for the method and/or meets the manufacturer's specifications)
- All scheduled maintenance performed
- Any major or minor problem encountered, a brief description, corrective action required, and a list of any parts replaced
- Verification of equipment operation after any maintenance is performed by designated laboratory staff

The equipment log books are periodically reviewed by the Laboratory QA Officer for compliance and problem areas in the equipment.

Practical Quantification Limit

Definition: The minimum level that can be reliably achieved by the analytical method within specified limits of precision and accuracy during routine laboratory operating conditions.

Measurement: The PQL is 5 to 10 times the MDL.

Reporting Limits

The reporting limit is the PQL value of the specific analytical method. For specific reporting limits, see Appendix F.

13. Corrective Action

When errors, deficiencies, or out of control conditions are encountered, corrective actions are necessary. The need for corrective action may be identified in any number of ways:

- QC data outside acceptable limits for a given sample set
- Rising or falling trends that are detected in spike recovery or duplicate control charts
- Unacceptable levels of contamination in blanks and reagents
- Unusual changes in detection limits
- Calibration standards with low sensitivity
- Nonlinear or misshapen calibration curves
- Deficiencies detected by Laboratory QA Officer or senior staff reviewing analytical data
- Deficiencies detected during internal or external audits by Laboratory QA Officer, outside agency, or from performance evaluation studies

Since each analytical SOP has a QA section that outlines corrective actions to be taken, problems which may arise are usually handled at the analyst's level. If the problem persists and cannot be handled by the analyst, the matter is referred to the Laboratory QA Officer. The following corrective action steps are then taken:

- Identification of the problem
- Investigation and determination of the cause of the problem
- Corrective action determined to eliminate the problem
- Assigning responsibility for implementing corrective action
- Evaluation of the effectiveness of the corrective action
- Verification that the corrective action has eliminated the problem
- Documentation of the problem and corrective action needed

All suspect analytical results will be evaluated. The Laboratory QA Officer will not permit the analysis to go on-line until the corrective action has been completely successful. Corrective action documentation is routinely reviewed by the Laboratory QA Officer and Chief of the Bryte Chemical Laboratory for recurring problems which may require changes in analytical procedures, methods, or additional training of analysts.

15. Facilities and Laboratory Equipment

The Bryte Chemical Laboratory, located in West Sacramento, California contains a fully equipped 8,700 square foot facility. The fully air conditioned laboratory contains one large main room and smaller individual rooms with adequate hood area that is appropriately spaced with sufficient room to accommodate all personnel and equipment. The laboratory is divided into sections to handle the wide spectrum of chemical analyses performed on waters and wastewaters. The major sections consist of receiving, volatile organics, semi-volatile organics, trace metals, wet chemistry, nutrients, biological, and storage. Most of the instrumentation used in the chemical laboratory is fully automated and computerized (see Appendix H, Laboratory Equipment).

Water Sample Collection Information

Determination	Method	Container	Sample Prep	Sample Size	Preservative	Hold Time
Alkalinity	SM 2320B	Polyethylene	Filtered	500 mL	4°C	14 days
BOD	EPA 405.1	Polyethylene	Unfiltered	2000 mL	4°C	48 hours
Carbamate Pesticides	EPA 531.1	Glass, Clear	Unfiltered	125 mL, teflon septa	4°C, chloroacetic Acid	28 days
COD	SM 5220A	Glass, Clear	Unfiltered	100 mL	4°C, H_2SO_4, pH<2	28 days
Chlorinated Pesticides	EPA 608	Glass, Amber	Unfiltered	1000 mL, teflon septa	4°C	7d ext, 40d after ext
Chlorinated Phenoxyacid Herbicides	EPA 615	Glass, Amber	Unfiltered	1000 mL, teflon septa	4°C	7d ext, 28d after ext
Chlorophyll	SM 10200H	Manila Envelope	Filtered	1000 mL	-20°C, dark	28 days
Chromium, hexavalent	EPA 218.6	Glass, Clear VOA	Unfiltered	40 mL	4°C	24 hours
Coliform, Fecal (Escherichia)	SM 9223 Colilert	Plastic, Sterile	Unfiltered	100 mL	4°C, $Na_2S_2O_3$	6 hours
Color	EPA 110.2	Polyethylene	Filtered	500 mL	4°C	48 hours
EDB/DBCP	EPA 504	Glass, Amber VOA	Unfiltered	40 mL x 2, teflon, no air	4°C, HCl, pH<2	28 days
Electrical Conductivity (EC)	SM 2510B	Polyethylene	Filtered	500 mL	4°C	28 days
Glyphosate	EPA 547	Glass, Amber	Unfiltered	125 mL, teflon septa	4°C	28 days
Haloacetic Acids (HAA)	EPA 552.2	Glass, Amber VOA	Unfiltered	40 mL x 2, teflon, no air	4°C	7d ext, 14d after ext
Haloacetic Acids Formation Potential (HAAFP)	EPA 510.1	Glass, Amber VOA	Filtered	40 mL x 3, teflon, no air	4°C	7d ext, 14d after ext
Hardness by Calculation	SM 2340B	Polyethylene	Filtered	250 mL	HNO_3, pH<2	6 months
Hardness, Total by Calculation	SM 2340B	Polyethylene	Unfiltered	250 mL	HNO_3, pH<2	6 months
ICP Cations, Dissolved – Na, Ca, Mg, K, B, Si	EPA 200.7	Polyethylene	Filtered	250 mL	HNO_3, pH<2	6 months
ICP Cations, Total – Na, Ca, Mg, K, B, Si	EPA 200.7	Polyethylene	Unfiltered	250 mL	HNO_3, pH<2	6 months
ICP/MS Trace Metals, Dissolved	EPA 200.8	Polyethylene, Acid Washed	Filtered	500 mL	HNO_3, pH<2	6 months
ICP/MS Trace Metals, Total	EPA 200.8	Polyethylene, Acid Washed	Unfiltered	500 mL	HNO_3, pH<2	6 months
IC Anions – Cl, SO_4, NO_3, Br, F	EPA 300.0	Polyethylene	Filtered	500 mL	4°C	28 days
Mercury by Cold Vapor	EPA 245.1	Polyethylene, Acid Washed	Unfiltered	500 mL	4°C, HNO_3, pH<2	28 days
Mercury by ICP/MS	EPA 200.8	Polyethylene, Acid Washed	Filtered	500 mL	4°C, HNO_3, pH<2	28 days

Water Sample Collection Information

Appendix B
Standard Operating Procedure

Analytical methods SOP must include:

1. Title
2. Scope and application
   - 2.1. Analytes
   - 2.2. Reporting limits
   - 2.3. Applicable matrices
   - 2.4. Calibration range
   - 2.5. Analysis time
3. Method Summary
4. Comments (interference or helpful hints)
5. Safety issues
6. Sample collection, preservation, containers, and holding times
7. Apparatus
8. Reagents and standards
9. Procedure
10. QA/QC requirements (QC samples, acceptance criteria, and corrective action)
11. Calculations
12. Reporting requirements (units, limits, significant figures, data entry)
13. References (method source, deviations from method source, and rationale for deviation)
14. Additional information as appropriate

Appendix D
Precision and Data Accuracy

Precision – precision will be expressed in terms of RPD of the duplicate results from the original results. The equation for expressing precision is:

$$RPD = \frac{[A-B]\times 100}{\left(\frac{(A+B)}{2}\right)}$$

where RPD = Relative Percent Difference
A = First sample value
B = Second sample value (duplicate)

Accuracy – accuracy will be expressed in terms of spiked samples. Recovery of the spike will be used to assess the data accuracy. Recovery is calculated as follows:

$$Rec = \frac{(CD-D)x100}{C}$$

where Rec = Relative Percent Recovery
C = Amount of spike added
D = Sample concentration
CD = Value of sample with spike

Determination	Control Limit %REC	RPD
METALS-EPA 1638 (DISSOLVED)		
Aluminum	78-121	20
Arsenic	86-113	20
Cadmium	84-111	20
Chromium	86-108	20
Copper	84-107	20
Iron	76-121	20
Lead	80-106	20
Manganese	81-109	20
Nickel	84-106	20
Selenium	86-117	20
Silver	79-108	20
Zinc	86-110	20
METALS-EPA 1638 (TOTALS)		
Aluminum	81-119	20
Arsenic	89-112	20
Cadmium	87-109	20
Chromium	87-110	20
Copper	86-108	20
Iron	84-115	20
Lead	82-109	20
Manganese	82-112	20
Nickel	88-107	20
Selenium	89-115	20
Silver	87-105	20
Zinc	88-111	20

Determination	Control Limit %REC	RPD
METALS EPA 200.8 (TOTALS)		
Chromium	85-111	20
Cobalt	84-109	20
Copper	88-107	20
Iron	80-124	20
Lead	85-107	20
Manganese	78-118	20
Molybdenum	88-109	20
Nickel	86-109	20
Selenium	85-110	20
Silver	89-104	20
Strontium	75-116	20
Thallium	87-105	20
Vanadium	86-111	20
Zinc	88-109	20
Mercury (Total) EPA 245.1	83-121	20
VOLATILE ORGANICS		
Benzene	86-108	20
Chlorobenzene	92-110	20
1,1-Dichloroethene	82-102	20
MTBE	86-112	20
Toluene	86-108	20
Trichloroethene	86-109	20
Chloroform	84-124	20
Chlorodibromoethane	84-106	20
Bromodichloroethane	78-111	20
Bromoform	94-116	20

Appendix F
Acceptable Quality Control Limits
Laboratory Control Samples

Determination	Control Limit %REC	RPD
MINERALS		
Calcium	85-125	20
Magnesium	85-125	20
Sodium	85-125	20
Potassium	85-125	20
Alkalinity	85-125	20
Sulfate	85-125	20
Chloride	85-125	20
Nitrate	85-125	20
Fluoride	85-125	20
Boron	85-125	20
Turbidity	85-125	20
Total Dissolved Solids	85-125	20
Specific Conductance	-	20
Silica	85-125	20
pH	85-125	20
Bromide	85-125	20
Suspended Solids	-	20
Volatile Suspended Solids	-	20
TOC	85-125	20
Oil and Grease	70-130	30
ORGANICS		
Volatile Organics (VOA, THM, EDB, DBCP)	80-120	20
Semivolatile Organics (OCP, OPP, NPP, HERB)	60-140	40
Carbamate, Glyphosate	70-130	30

Appendix G
Analytical Methods and Reporting Limits

Constituent		Method	Reporting Limit (mg/L)
MINERAL			
Calcium	EPA	200.7 ICP	1
Magnesium	EPA	200.7 ICP	1
Sodium	EPA	200.7 ICP	1
Potassium	EPA	200.7 ICP	0.5
Sulfate	EPA	300.0 Ion Chromatography	1
Chloride	EPA	300.0 Ion Chromatography	1
Nitrate	EPA	300.0 Ion Chromatography	0.1
Bromide	EPA	300.0 Ion Chromatography	0.01
Fluoride	EPA	300.0 Ion Chromatography	0.1
Boron	EPA	200.7 ICP	0.1
Silica	EPA	200.7 ICP	0.1
Total Dissolved Solids	Std Methods EPA	2540-C Gravimetric, Dried at 180°C 160.1 Gravimetric, Dried at 180°C	1 1
Alkalinity	Std Methods EPA	2320-B Titrimetric 310.1 Titrimetric	1 1
pH	Std Methods EPA	4500-H+ Electrometric 150.1 Electrometric	0.1 pH Unit 0.1 pH Unit
Specific Conductance	Std Methods EPA	2310-B Wheatstone Bridge 120.1 Wheatstone Bridge	1 umhos/cm 1 umhos/cm
Turbidity	Std Methods EPA	2130-B Nephelometric 180.1 Nephelometric	1 NTU 1 NTU
UV Absorbance	Std Methods	5910-B UV-Absorbing Organics	0.001 abs/cm at 254 nm

Constituent		Method	Reporting Limit (mg/L)
Chromium (All valencies)	EPA	200.7 ICP 200.8 ICP/MS 1638	0.01 0.005 0.05 ug/L
Cobalt	EPA	200.7 ICP 200.8 ICP/MS	1 0.005
Copper	EPA	200.7 ICP 200.8 ICP/MS 1638	0.01 0.001 0.05 ug/L
Iron	EPA	200.7 ICP 200.8 ICP/MS 1638	0.01 0.005 0.10 ug/L
Lead	EPA	200.7 ICP 200.8 ICP/MS 1638	0.050 0.001 0.04 ug/L
Lithium	EPA	200.7 ICP 200.8 ICP/MS	0.01 0.005
Manganese	EPA	200.7 ICP 200.8 ICP/MS 1638	0.010 0.005 0.05 ug/L
Mercury	EPA	245.1 AA Flameless, Cold Vapor 200.8 ICP/MS	0.001 0.0002
Molybdenum	EPA	200.7 ICP 200.8 ICP/MS	0.01 0.005
Nickel	EPA	200.7 ICP 200.8 ICP/MS 1638	0.025 0.001 0.10 ug/L

Constituent		Method	Reporting Limit (mg/L)
Organic Carbon (TOC)	Std Methods	5310-D Wet Oxidation, IR, Automated	0.50
	EPA	415.1 Wet Oxidation, IR, Automated	0.50
		415.1 Combustion, IR, Automated	0.50
Tannin & Lignin	Std Methods	5550-B Colorimetric	1
Volatile Suspended Solids	Std Methods	2540-E Gravimetric, 500°C	1
	EPA	160.4 Gravimetric, 500°C	1
ORGANICS			(ug/L)
Trihalomethane Potentials (THMFP)	EPA	510.1 (Modified) GC, Purge and Trap	10.0
1,2-Dibromoethane (EDB)	EPA	504 Gas Chromatography (GC)	0.02
1,2-Dibromo-3-Chloropropane (DBCP)	EPA	504 Gas Chromatography (GC)	0.01
Volatile Organics	EPA	502.2 Purge and Trap	0.5
Carbamates	EPA	531.1 High Pressure Liquid Chromatography (HPLC)	2.0-4.0
Glyphosate	EPA	547 HPLC	25.0
Haloacetic Acids	EPA	552.2 Gas Chromatography (GC)	1.0
Chlorinated Pesticides	EPA	608 Gas Chromatography (GC)	0.01-1.0
Nitrogen/Phosphorus Pesticides	EPA	614 Gas Chromatography (GC)	0.01-5.0
Chlorinated Phenoxy Acids (Herbicides)	EPA	615 Gas Chromatography (GC)	0.1-1.0

Inorganic Section (cont.)	Quantity
Thermo Konelab Aqua20 discrete analyzer with an autosampler	1
Braun & Luebbe Traccs 800 continuous flow system with an autosampler	1
Brinkmann Metrohm autotitrilyzer with a 712 conductometer, 719 titrator, and 745 autosampler	1
Fisher Scientific Model 400 computer aided autotitrimeter with a multisampler	1
Dionex DX500 ion chromatograph (IC) with an A540 autosampler	2
Dionex ICS2000 ion chromatograph (IC) with an AS autosampler	2
Dionex DX4 ion chromatograph (IC) with a BioRad AS48 autosampler	1
Thermo Separation Products 3200 mercury analyzer with an autosampler	1
Bausch and Lomb Spectronic 88 UV/VIS spectrophotometer	1
Hach DR/4000U spectrophotometer	1
Hach 2100N turbidimeter	1
CEM Mars 5 microwave digestion unit	1
Thermo Orion 4 Star electroconductivity meter	1
Beckman sigma 63 pH meter	1
Fisher Scientific Accumet 25 pH/ion meter	2

Biological Section	
Perkin Elmer Lambda UV/VIS spectrophotometer	1
Colilert total and fecal coliform testing equipment – quanti-tray, sealer, incubator and UV lamp	1
Wild Heerbrugg inverted microscope with a Nikon camera attachment	1

Additional copies of this report may be obtained from

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