

Summary of Analysis Methods for the Rocky Mountain Research Station Biogeochemistry Laboratory

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2018 RMRS Biogeochemistry Laboratory Methods

Analyte	Reference Method	Method Description
pH	EPA 150.1	Mettler Toledo InMotion Pro
Conductivity	EPA 120.1	Mettler Toledo InMotion Pro
Acid Neutralizing Capacity (ANC)	EPA 310.1	Mettler Toledo InMotion Pro
Anions: Br, Cl, F, NO ₃ , PO ₄ , SO ₄	EPA 300.0	Thermo Fisher Integrion Ion Chromatograph
Cations: Na, NH ₄ , K, Mg, Ca	ASTM D6919-03	Thermo Fisher Integrion Ion Chromatograph
Total Dissolved Nitrogen	ASTM D5176	Shimadzu TOC-V Combustion Analyzer
Dissolved Organic Carbon	EPA 415.1	Shimadzu TOC-V Combustion Analyzer

Detection Limits & Reporting Levels

A **method detection limit (MDL)** is defined as the minimum concentration that can be measured and reported with 99 percent confidence that the concentration is greater than zero, but the exact concentration cannot be reliably quantified. As per the EPA guidelines, the method detection limit (MDL) is defined by Equation 1 (Glaser et al. 1981):

Equation 1:

$$MDL = s \times t_{(n-1, 1-\alpha=0.99)} \quad (1)$$

Where

n = number of replicate spike determinations at 1 to 5 times the estimated MDL.

s = standard deviation of measured concentrations of n spike determinations

t = Student's t at $n-1$ degrees of freedom and $1-\alpha$ (99%) confidence level.

The MDL concentration does not relate to the accuracy or precision of the quantitative measurement.

The **minimum level (ML)** is defined as the smallest measured concentration of a constituent that may be reliably reported using a given analytical method. In many cases, the MRL is used when documentation for the method detection limit is not available. The EPA defines the minimum level (ML) as 3.18 times the MDL for 7 nonconsecutive reagent or calibration blank analyses (USEPA, 1993).

The **practical quantitation limit (PQL)** is defined as the minimum concentration of an analyte that can be measured with a high degree of confidence that the analyte is present at the reported concentration. As per the EPA, the RMRS Forest Sciences Laboratory practical quantitation limits (PQLs) are five times the MDL (USEPA, 1985).

The PQL concentration does relate to the accuracy of the quantitative measurement. Concentrations at or above the PQL are accurate to within 10% of the true value.

Analyte	Method Detection	Practical Quantitation	Minimum
	Limit	Limit	Level
Na	0.01 ppm	0.03 ppm	0.02 ppm
NH4	0.01 ppm	0.03 ppm	0.02 ppm
K	0.01 ppm	0.03 ppm	0.02 ppm
Mg	0.01 ppm	0.04 ppm	0.02 ppm
Ca	0.02 ppm	0.10 ppm	0.04 ppm
F	0.01 ppm	0.03 ppm	0.01 ppm
Cl	0.01 ppm	0.05 ppm	0.03 ppm
Br	0.02 ppm	0.06 ppm	0.04 ppm
NO2	0.01 ppm	0.01 ppm	0.01 ppm
NO3	0.01 ppm	0.02 ppm	0.01 ppm
PO4	0.01 ppm	0.06 ppm	0.04 ppm
SO4	0.01 ppm	0.01 ppm	0.01 ppm
Conductivity	0.35 μ S/cm	1.75 μ S/cm	1.0 μ S/cm
ANC	2.0 μ E/L	4.5 μ E/L	3.0 μ E/L
Diss. Organic C	0.1 ppm	0.5 ppm	0.3 ppm
Total Nitrogen	0.02 ppm	0.1 ppm	0.1 ppm

Method Detection Limit & Reporting Level Diagram Example



Method Detection Limit (MDL): Minimum concentration that can be measured and reported with 99 percent confidence that the concentration is greater than zero, but the exact concentration cannot be reliably quantified

Minimum Level (ML): The smallest measured concentration of a constituent that may be reliably reported using a given analytical method.

Practical Quantitation Limit (PQL): Minimum concentration of an analyte that can be measured with a high degree of confidence (90%) that the analyte is present at the reported concentration.

Environment Canada Proficiency Testing Program

Environment Canada provides accredited proficiency testing (PT) studies for a wide range of inorganic constituents in water. These PT Studies are designed to quantify laboratory performance and improve the quality of environmental data. Reports provide a powerful tool for the continual improvement of the quality of analytical results. Further information can be found on the [Environment Canada website](#).

The table below provides the RMRS Biogeochemistry Laboratory testing results. The testing program requires the analysis of 10 low ionic strength precipitation or meltwater samples. Accuracy is based on the median analysis accuracy of all samples above minimum detection limits.

Environment Canada Proficiency Testing Results – 2018

Analyte	RMRS Laboratory Accuracy (% recovery of unknown concentration)
Sodium	99%
Ammonia	98%
Potassium	99%
Magnesium	99%
Calcium	98%
Chloride	99%
Nitrate	98%
Sulfate	98%

Dissolved Organic Carbon	96%
Total Dissolved Nitrogen	98%
Conductivity	99%
Alkalinity (ANC)	99%
pH	99%

U.S. Geological Survey Standard Reference Sample (SRS) Testing Results

The U.S. Geological Survey (USGS) conducts an inter-laboratory comparison study semiannually that provides Standard Reference Samples (SRS) for laboratory quality assurance testing. The majority of samples are prepared with water from Colorado streams and spiked with reagent grade chemicals to measurable concentrations. Ammonium and nitrate are not included in the precipitation reference sample. Further information can be found at: <http://bqs.usgs.gov/srs/>

The SRS Testing Program uses the median value of submitted testing results to determine the “Most Probable Value” for each individual analyte. Unlike the Environment Canada Proficiency Testing Program, USGS does not provide a certified, accurate value for the analytes tested. Comparison of reported laboratory values to the USGS most probable values should be done casually and may only be used to judge the similarity between the RMRS laboratory values and other participating laboratories. For this program, percent difference values are provided as a simple ballpark measure, but are not sufficient to infer true laboratory analysis and precision. Please refer to our Environment Canada Proficiency Testing results for more accurate and detailed information relating to our laboratory analysis capabilities.

RMRS Forest Sciences Laboratory results dating back to 2003 can be found online at: http://bqs.usgs.gov/srs_study/reports/index.php

*The RMRS Forest Sciences Laboratory is coded as Lab 2.

References

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