ARKANSAS WATER
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Laboratory Quality Control Report:
Why is it Important?

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The Arkansas Water Resources Center (AWRC) maintains a fee-based water quality lab that is certified through the Arkansas Department of Environmental Quality (ADEQ). The AWRC Water Quality Lab analyzes water samples for a variety of constituents, using standard methods for the analysis of water samples (APHA 2012). Whether you have one or several water samples tested, the lab generates a report of values for each parameter that you have analyzed, which is provided to the client.

Included with every water quality report is a Lab Quality Control (QC) report for each of the parameters analyzed within the package. The Lab QC report provides important information about the performance of the methods used to test your water sample(s).

What is Quality Control?

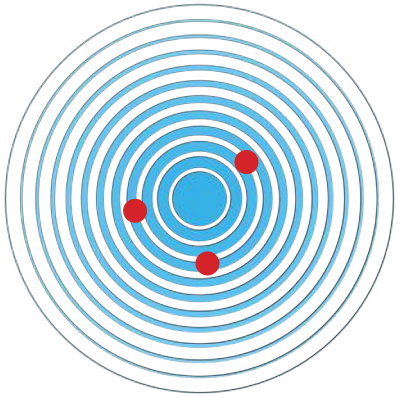
Quality control consists of the lab techniques that demonstrate the precision or repeatability and accuracy of each specific analytical method; and in doing so, provides confidence that the values reported in your water quality report are correct. These techniques include incorporating blanks, standards, sample duplicates, and laboratory sample spikes into every group of samples analyzed at the Water Quality Lab. Below in table 1 you will find a list of terms that will be helpful in understanding the rest of this fact sheet.

Term	Definition
Analyte	This is the parameter of concern.
Concentration	This is the measure of the amount of analyte contained per unit of volume in your sample.
Method Detection Limit	Minimum concentration measured with 99% confidence that the true value is greater than zero (see fact sheet FS-2016-01).
Reagent Grade Water	Water that is free of all analytes that your sample is being tested for.
Reporting Limit	The lowest quantified level within an analytical methods operational range (see fact sheet FS-2016-01).
Sample Blank	This is a sample of reagent grade water. Blanks are used to assess for possible contamination.
Standard	This is a sample that has a known concentration of the analyte that your water is being tested for. Standards are used to test for the accuracy of the method.
Sample Digestion	Process by which all nitrogen and phosphorus in a sample are converted to nitrate and soulble reactive phosphorus, respectively.
Sample Duplicate	This is a re-analysis of your sample, and is used to determine the precision of the method.
Sample Matrix	This is a sample with a known concentration of analyte added to it prior to lab processing and analysis.
Sample Spike	This is a sample with a known concentration of analyte added to it prior to lab processing and analysis.
Standard	This is a sample that has a known concentration of the analyte that your water is being tested for. Standards are used to test for the accuracy of the method.

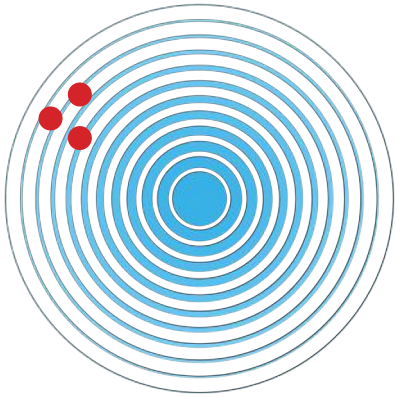
So, What is the Difference Between Accuracy and Precision?

Accuracy of an analysis describes how close the measured values are to the true values. If you think about accuracy in the form of target shooting, having high accuracy means hitting the target as close to the bullseye as possible.

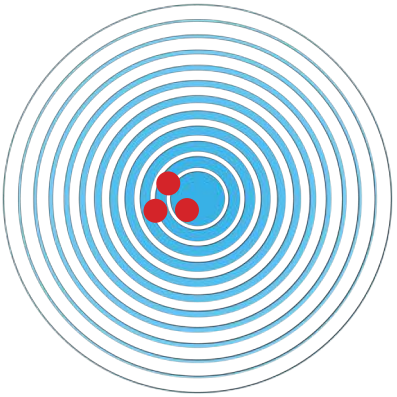
Precision of an analysis describes how similar measured values are to each other, regardless of how accurate or inaccurate the analysis may be. Staying with the target analogy, having high precision means having a tight grouping of all of your shots.



High Accuracy | Low Precision



Low Accuracy | High Precision



High Accuracy | High Precision

In order to provide you with the most reliable data possible, the goal for water quality lab is to be both as accurate and precise as possible. The different tables in the Lab QC Report allow you to see the labs performance with respect to accuracy and precision while testing the different parameters in your water sample

Blank Data Table

Sample blanks are used to look for possible sources of contamination to your sample from the collection of the sample to the analysis of your sample in the lab. There are several blanks listed below which are defined by what stage of sample processing they are included.

Digested Blank: A digested blank is a sample of reagent grade water that goes through all the steps of sample preparation in the lab before the samples are analyzed. This blank is used to assess for possible contamination introduced during sample preparation activities. The AWRC Water Quality Lab only includes this blank when analyzing samples for total nitrogen and total phosphorus.

Method Blank: The method blank is a sample of reagent grade water that is analyzed with your water samples. This blank is included to assess for possible contamination associated with the analytical instrumentation. Other water quality labs may refer to this blank as the "**Instrument Blank**". Almost all AWRC Water Quality Lab analyses include a method blank.

There is variability in every laboratory method and while a value of zero is preferred for blanks, the blanks reported in your lab QC report should be less than the reporting limit (APHA 2012). The reporting limit is the lowest quantified level within an analytical method; this value is specific to each analyte and can be found in the analytical report next to the value determined for your sample.

Sample blanks are used to look for possible sources of contamination to your sample.

Standards Data Table

As indicated earlier, the goal of the AWRC Water Quality Lab is to provide you with accurate data, or values as close to the true value as possible. Standards provide a way for the lab to have samples with a known concentration. Then by comparing the known concentration with the measured concentration the Lab can assess the accuracy of their measurement. There are three types of standards which may or may not be digested depending on the method.

Calibration Standard: Calibration standards are incorporated throughout the sample run to verify that the analytical equipment's performance has not changed significantly since the initial calibration.

Quality Control Standard (QCS): The QCS is made from stock solution different from that of the calibration standard and is used to help verify the accuracy of the calibration standard; this also helps verify the accuracy of the value(s) reported for your sample(s).

Digested Standards: In analyses where your sample goes through a digestion process, such as total nitrogen and total phosphorus, both the calibration standards and QCS standards are also digested following the same process as your sample. This process helps assess the efficiency of the digestion method.

For a sample run to be approved, the measured value of each of the standards analyzed must be no more than +/- 10% of the expected value. From the standpoint of the table provided in the Lab QC Report, both the lower and higher limits are listed to either side of the value obtained as a quick reference to whether or not the obtained values are acceptable. The percent recovery column describes the accuracy of the analysis and should be between 90 and 110% of the expected concentration. What this means with respect to your sample(s) is that if the method and analytical equipment are accurately measuring the standards to within +/- 10% of the expected value, then the same is true for your sample(s).

Duplicate Data Table

Sample duplicates are used to assess the repeatability or precision of sample collection and analysis procedures. For duplicates the lab analyzes your sample twice and the closer the two measured values are, the more precise the analysis is.

Lab Duplicate: A lab duplicate is used to assess the precision of the laboratory methods and analytical equipment. Which sample is analyzed for the duplicate is chosen randomly throughout the full sample run, so in your Lab QC Report you may not likely find a duplicate data table for every parameter analyzed.

Within the duplicate data table you will find the value measured the first time in the "Result" column followed by the value measured the second time in the "Duplicate" column. The last column of the table is labeled "% RPD" which stands for Relative Percent Difference. The %RPD is calculated as the absolute difference in the result and duplicate, divided by the average of the two values then multiplied by 100.

When examining this value, the closer to zero the better as this indicates a high level of precision. Overall, a %RPD value of 30% or less should be viewed as acceptable. Samples with reported values below the reporting limit can produce greater variability, which may result in %RPD values much greater than 30%; but this does not mean that your data is not meaningful.

$$\%RPD = \frac{|Result - Duplicate|}{(Result + Duplicate)/2} \times 100$$

Recovery Data Table

The recovery data table shows results for sample spikes. The sample spike is used to evaluate analyte recovery in a sample matrix and is similar to a calibration or QC standard. The calibration and QC standards are made with a pure stock solution, so no chemical component of the stock solution should interfere with the analysis of the analyte of concern. However, this is not necessarily the case for actual water samples. Chemical constituents that occur in your water sample may influence the ability of the analytical instruments to accurately detect and measure the concentrations of the analyte of concern; this is known as a matrix effect.

A laboratory sample spike can be used to detect a matrix effect. For the sample spike, calibration standard is added to a duplicate sample to achieve a known spike level, or increase in analyte concentration. Following the analysis the Result (value obtained from the un-altered sample) is compared to the Result+Spike "spike" (value of the sample spike). The % Recovery is calculated as the Result+Spike "spike" minus the Result, divided by the spike level, and then multiplied by 100.

As with the standards the % Recovery should be no more than 110% and no less than 90%. Values outside this range might suggest other analytes in your water sample are creating a matrix effect and the reported value(s) should be viewed with caution.

$$\%RPD = \frac{Spike - Result}{Spike\ Level} \times 100$$

What is Quality Assurance?

Quality control is just part of the overall Quality Assurance and Quality Control (QA/QC) protocol. Quality Assurance refers to laboratory protocols that specify the measures that are taken by the lab personnel to produce defensible data with known precision and accuracy (APHA 2012). Essentially QA is the steps that the AWRC Water Quality Lab takes to ensure the values they report in your water quality analytical report are as close to the actual values as possible.

Following the analysis of your water sample both the analytical and Lab QC reports are reviewed by two individuals. The first individual verifies that the numbers in the report were correctly entered in from the original analysis, and looks for errors in the analysis. The QA/QC Reviewer provides a second set of eyes to look over your water quality report to ensure that the data provided is accurate.

Literature Cited

APHA (American Public Health Association). 2012. Standard Methods for the Examination of Water and Wastewater (22nd edn.). American Public Health Association: Washington D.C. 1496 pp.

Austin, B.J., J.T. Scott, M. Daniels, B.E. Haggard. 2016. Water Quality Reporting Limits, Method Detection Limits, and Censored Values: What Does it All Mean?. Arkansas Water Resources Center, Fayetteville, Arkansas, FS-2016-01: 8 pp.

How to Cite This Fact Sheet

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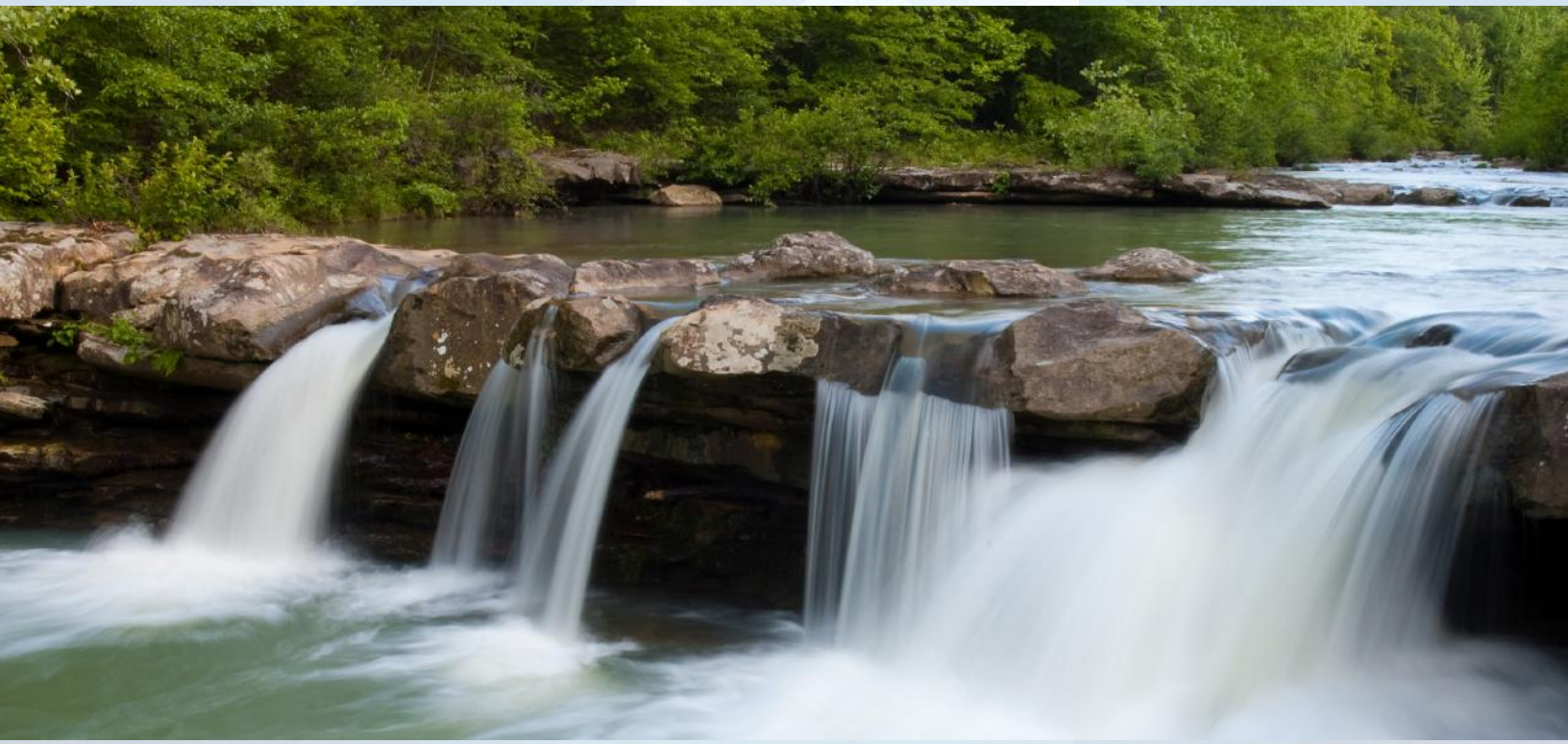

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