



A BRIEF GUIDE FOR UNDERSTANDING TAP WATER CHEMICAL ANALYSIS REPORTS

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Because there is and continues to be a large amount of tap water chemical analysis data being reported in West Virginia, a discussion of how to understand laboratory reports is warranted. The information below provides a guide for persons looking to better understand how to read laboratory chemical analysis reports that are part of the WV TAP Project.

Laboratory data reports typically use a number of terms for reporting such as MDL, MRL, PQL, LOQ that are not always determined in the same way by different laboratories. Thus, it is important to understand what such terms mean in lab reports that you may see. This is particularly important if measurement results are at very low levels. This document specifically defines the reporting limits and other relevant terms used by the laboratories participating in the WV TAP project. The information described below also defines some other terms that may show up on laboratory reports. Please see the graph below for a general assessment of the differences among the terms.

Was the chemical present and at what concentration did it exist?

1.0 Reporting limit terms

1.1 Reporting Limit – Minimum Reporting Limit (MRL) – Limit of Quantification (LOQ) – Practical Quantification Limit (PQL)

For laboratory reports, the MRL, LOQ, and PQL terms generally mean the same thing. These terms reflect the lowest level (concentration) at which laboratories feel they can achieve quantitative data. For the WV TAP reports, this always reflects the lowest point to which the laboratories calibrated the instruments. **For example, the chemical was detected and was confirmed to be present at a specific numerical value.** Please note that there is always still some uncertainty to the actual results, which is why the WV TAP team collected multiple samples at each location during the initial assessment to minimize the overall uncertainty.

1.2 Method detection limit or method detection level (MDL)

The MDL is a calculated value at which the laboratory can theoretically differentiate a value from zero. This means that the laboratory could claim that a chemical is at least present if above the MDL. The “official” MDL is typically determined annually, and is not verified by seeing if a sample at the MDL will actually yield a positive result. It may vary day to day, depending upon a number of factors, such as instrument background. Values between the MRL and the MDL are considered to be qualitative results. **For example, the chemical was detected by the laboratory, but the exact value of how much chemical was present could not be determined. The laboratory however could confirm that the chemical was present.**

VISUAL EXAMPLE OF TERMS AND THE RELATIVE CONCENTRATION OF A CHEMICAL

Terms:	Non-detect	-----MDL-----	MRL/PQL/LOQ
Relative concentration:	0 to 10	10	50 to 100

How reliable are the laboratory results? Did the water samplers or laboratory mess up?

2.0 Quality Control (QC) Terms

2.1 Laboratory Control Standard / Laboratory Fortified Blanks (LCS/LFB)

Each laboratory uses laboratory control standards (LCS) or laboratory fortified blanks (LFB), which are two terms for the same type of QC, which is a blank water sample spiked with the compound at a mid-level to verify overall lab performance. Sometimes the LCS/LFB is done in duplicate (LCSD or LFBSD) and sometimes the concentration is changed to rotate through different parts of the calibration curve. The LCS/LFB recoveries are compared to compound specific acceptance limits and if results are outside those limits the samples analyzed with that QC must be re-analyzed.

2.2 Reporting Limit Spike (MRL check, low level LCS)

Both Eurofins labs include a reagent water sample spiked daily at one to two times the MRL level to verify that results at the MRL level are accurate and precise.

2.3 Matrix Spike (MS) or Matrix Spike Duplicate (MSD)

A matrix spike or matrix spike duplicate is the same as an LCS except that instead of spiking blank water, the spike is performed on a field sample (e. g., tap water) to ensure that there are not any interferences from the field sample that would enhance or decrease the recovery of the compound. If results are outside of the acceptance limits the associated sample is flagged as having a matrix effect.

2.4 Method Blank

Each analysis includes a sample of reagent water (i.e., deionized or distilled) that is analyzed like a sample. The sample must have a result that is below the reporting limit for a group of samples to be considered reliable.

2.5 Field Blank

A field blank is a sample of reagent water that is processed in the field at the same time as samples are collected to be sure there is no external environmental contamination that could have accidentally gotten into samples bottles and created false positives.

3.0 More Detailed Discussion of Terms Above

Normally, the MDL is determined through a statistical protocol where seven replicates of a blank water are spiked with a known amount of the compound and the MDL is calculated as $3.14 \times$ the standard deviation of the spikes. The actual spike level must be < 10 times the calculated MDL or the procedure must be repeated. If spikes are completed at too high a level you can get much better reproducibility (precision) than at lower levels and calculate an MDL that is artificially low. The MDL does not reflect the accuracy of the measurement as it is determined solely by the standard deviation of the replicates. Thus, the MDL also may not be what a laboratory could really see in a sample (that is, the method is so precise that an artificially low MDL is calculated and the lab may not really be able to detect the compound as low as the MDL).

In the case of 4-MCHM and PPH measurements performed by Eurofins Lancaster Laboratories (ELLE), the MDL shown on the report (here called an R-MDL) is actually a more conservative value that is confirmed by spiking a sample at the MDL and verifying a positive response (e. g., determining that the lab can indeed detect the compound if it is present at the MDL level).

Data that are reported below the MRL but above the MDL or R-MDL are typically reported with a “J” flag, signifying that they are not as accurate or precise as values above the MRL (there is the potential for more variability if you ran the sample multiple times).

This document was prepared for the WV TAP project led by Dr. Whelton, University of South Alabama and Mr. Jeffrey S Rosen, President of Corona Environmental Consulting. The project website can be found at <http://www.wvtaprogram.com>.