GLOSSARY OF TERMS

The intent of this glossary is to define terms, commonly used in association with detection and quantitation and in environmental laboratories, which may be unfamiliar to the lay person. The definitions are taken from various sources. Where available, citations are provided following the definition. A list of acronyms for the citations is included at the end of the document.

A-posteriori Detection – A binary detection decision based upon the observed (net) signal and a definite criterion of detection. It corresponds to the critical level, L_C. (Lloyd A. Currie, "Limits for Qualitative Detection and Quantitative Determination", Analytical Chemistry, 586-593, 1968)

A-priori Detection – An estimate, based on a knowledge of the probability distribution of a net signal, of the detection capabilities of a given measurement process. It corresponds to the detection limit, L_D. (Lloyd A. Currie, "Limits for Qualitative Detection and Quantitative Determination", Analytical Chemistry, 586-593, 1968)

Accuracy – The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components, which are due to sampling and analytical operations; a data quality indicator. (NELAC)

Alpha, (α) – The tolerated probability of a “false positive” (i.e. Type I error). See False Positive.

Analyst – The designated individual who performs the “hands-on” analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (NELAC)

Analytical Response – A numerical observation whose magnitude is related to the amount or concentration of the analyte in a sample. One or more analytical responses (as specified by a method) are used, in conjunction with a calibration curve or factor), to produce an analytical result. (D.T.E. Hunt and A.L. Wilson. “The Chemical Analysis of Water”)

Analytical Result - A numerical estimate of the concentration of an analyte in a sample, which is obtained by carrying out once the procedure specified in an analytical method. Note that a method may specify analysis of more than one portion of a sample in order to produce one analytical result. (D.T.E. Hunt and A.L. Wilson. “The Chemical Analysis of Water”)

Audit – A systematic evaluation to determine the conformance to quantitative and qualitative specifications of some operational function or activity. (EPA-QAD)

Batch – Environmental samples that are prepared and/or analyzed together with the same process and personnel and using the same lot(s) of reagents. (NELAC)

Beta, (β) – The tolerated probability of a "false negative" (i.e. Type II error). See False Negative.

Bias – The constant or systematic distortion of a measurement process, different from random error, which manifests itself as a persistent positive or negative deviation from the known or true value. This can result from improper data collection, poorly calibrated analytical or sampling equipment, or limitations or errors in analytical methods and techniques. (EPA-QAD)

Blank – A specimen that is intended to contain none of the analytes of interest and which is subjected to the usual analytical or measurement process to establish a zero baseline or background value. (NELAC) Blanks include:

1 Equipment Blank: a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)

2 Field Blank: blank prepared in the field by filling a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)

3 Instrument Blank: a clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

4 Method Blank: a sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (NELAC)

5 Reagent Blank: (method reagent blank): a sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (QAMS)

Blind Sample – A sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process. (NELAC)

Calibration – Set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by material measure or a reference material, and the corresponding values realized by standards. (VIM)

Calibration Curve – The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (NELAC)

Calibration Method – A defined technical procedure for performing a calibration. (NELAC)

Calibration Standard – A substance or reference material used to calibrate an instrument. (QAMS)

Censored Data – Date reported only as below or above some threshold. (USGS)

Censored Method – See Method.

Data Quality Objectives – Qualitative and quantitative statements derived from the DQO Planning Process that clarify the purpose of the study, define the most appropriate type of information to collect, determine the most appropriate conditions from which to collect that information, and specify tolerable levels of potential decision errors. (EPA-QAD)

Degrees of freedom – A statistical parameter, based on the amount of data (number of samples) used in a calculation.

Detection – To have obtained experimental evidence that the analyte concentration is greater than zero. (D.T.E. Hunt and A.L. Wilson. "The Chemical Analysis of Water," 2nd edition, 1986, page 289. The Royal Society of Chemistry, Burlington House, London W1V OBN)

Effluent Limitation (EL) – Restrictions established by a state or EPA on quantities, rates, and concentrations in pollutant discharges. (EPA-TRS)

Environmental Laboratory Advisory Board (ELAB) – A Federal Advisory Committee, with members appointed by EPA and composed of a balance of non-state, non-federal representatives, from the environmental laboratory community, and chaired by an ELAB member. (NELAC)

False Negative Quality Control Sample – The false negative quality control sample (FNQS) is a method blank (e.g., reagent water) or "clean" sample that is spiked at (or near) L_D with the analyte of interest and processed through the entire analytical procedure to verify that such a spike will produce a detection. (Osborn, Kenneth and Thomas Georgian. "The Limits of Method Detection Limits," *Water Environment & Technology* (December, 2004)).

False Negative – Concluding that the analyte is absent when in fact it is present.

False Positive – Concluding that the analyte is present when in fact it is absent.

Holding Times (Maximum Allowable Holding Times) – The maximum times that samples may be held, after the sample is taken, prior to analysis and still be considered valid or not compromised. (40 CFR Part 136)

Hypothesis Test – A statistical procedure for determining if a sample provides sufficient evidence to reject or accept one statement regarding the population of interest in favor of an alternative statement. (EPA-QAD)

Inter-laboratory Procedure Study – A study where a centralized study design coordinator sends identical samples to multiple different laboratories for analysis. The resulting raw data are analyzed by the study design coordinator by a given procedure to provide estimates of L_C, L_D and/or L_Q. The laboratories would generate only data that would be submitted to the study design coordinator who would compile the date, evaluate it and generate on inter-laboratory L_C, L_D and/or L_Q.

Inter-laboratory Test Comparison – Organization, performance and evaluation of tests on the same or similar items or materials by two or more laboratories in accordance with predetermined conditions. (ASTM)

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample) – A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (NELAC)

Laboratory Duplicate – Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC)

Matrix – The material of which the sample is composed or the substrate containing the analyte of interest, such as waste water, stormwater, and biosolids. Also called medium or media. (EPA-QAD)

Matrix Effects – Manifestations of non-target analytes or physical/ chemical characteristics of a sample that prevents the quantification of the target analyte (i.e., the compound or element of interest being quantified by the test method) as it is routinely performed, typically adversely impacting the reliability of the determination. For example, a matrix effect can give rise to a high or low bias. (EPA-QAD)

Matrix Spike (spiked sample or fortified sample) – A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. (QAMS)

Maximum Contaminant Level (MCL) – This is a contaminant-specific standard for acceptable drinking water under SDWA. MCLs also may be used for purposes of RCRA (Resource Conservation and Recovery Act) ground water monitoring to reach contaminant-specific clean-up levels.

Measurement Quality Objectives – Qualitative and quantitative statements of the overall level of uncertainty that a decision maker is willing to accept in results or decisions derived from measurements. MQOs/DQOs provide the statistical framework for planning and managing measurement plans consistent with the data user's needs. (EPA-QAD)

Median – The middle number or center value of a set of data in which all the data are arranged in sequence. (www.asq.org/info/glossary/a.html)

Method – 1. See Test Method. 2. Logical sequence of operations, described generically, used in the performance of measurements. (EPA-QAD)

> **Censored Method –** Analytical methods that frequently produce non-numerical results for blanks (i.e. ND for "non-detect"). (EPA-QAD)
>
> **Uncensored Method –** Analytical methods that nearly always produce numerical values for method blanks. (EPA-QAD)

Method Blank – For aqueous analysis, an unspiked or non-fortified reagent water sample which proceeds through the entire testing method, including all preparatory and determinative steps. (EPA-QAD) NELAC states that this should be the same matrix as samples, already addressed under "Blank".

Multi-laboratory Procedure Study – A study where multiple laboratories individually perform a L_C, L_D and/or L_Q estimation procedure (usually using self-selected spiking concentrations) and those individual estimates are summarized in some fashion (e.g. averaging, upper or lower confidence intervals) to characterize some measure of how well the analytical method performs in qualified laboratories. The multi-lab procedure study would include two steps:

First, each individual lab would conduct the analysis and generate their unique L_C, L_D and/or L_Q level. Second, those levels would then be compiled from all laboratories, evaluated, and based on criteria, used to propose multi-lab L_C, L_D and/or L_Q levels, where appropriate.

National Environmental Laboratory Accreditation Conference (NELAC) – A voluntary organization of State and Federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. (NELAC Appendix A, Glossary, July 2005)

National Environmental Laboratory Accreditation Program (NELAP) – The overall National Environmental Laboratory Accreditation Program of which NELAC is a part. (NELAC Appendix A, Glossary, July 2005)

Numeric Target – A measurable value determined for the pollutant of concern which, if achieved, is expected to result in the attainment of water quality standards in the listed waterbody. (EPA-TRS)

Outlier – An observation that is shown to have a low probability of belonging to a specified data population; any item rejected by the sampler, analyst, or data reviewer, usually accompanied by an attendant explanation.

Performance Based Measurement System (PBMS) – A set of processes wherein the data quality needs, mandates, or limitations of a program or project are specified, and serve as criteria for selecting appropriate methods to meet those needs in a cost-effective manner. (October 6, 1997 62 FR 52098)

Power – the probability of reporting an analyte as detected at a given true concentration when the analyte is actually present. Statistical power equals one minus the Type II error. The power is dependent on the true concentration of a sample. (Note: if L_C is defined in terms of the blank rather than a concentration of zero, this definition is inappropriate. The definition would be the probability of reporting the level of analyte in a sample is greater than that observed in a blank, given that the true concentration in the sample is greater than that of the blank.)

Practical Quantitation Level (PQL) – Means the lowest concentration that can be reliably measured within specified limits of precision and accuracy for a specific laboratory analytical method during routine laboratory operating conditions. (EPA-TRS)

Precision – The consistency of measurement values quantified by measures of dispersion such as the sample standard deviation. Precision must be defined in context – e.g., for a certain analyte, matrix, method, perhaps concentration, lab or group of labs. (NELAC)

Protocol – A detailed written procedure for field and/or laboratory operation

(e.g., sampling, analysis), which must be strictly followed. (EPA-QAD)

Quality Assurance – An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (QAMS)

Quality Assurance [Project] Plan (QAPP) – A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EPA-QAD)

Quality Control – The overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users. (QAMS)

Quality Control Sample – An uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (EPA-QAD)

Quantification Limit – A performance characteristic that marks the ability of a Chemical Measurement Process to adequately "quantify" an analyte. (IUPAC)

Quantitation versus Quantification – These are considered equivalent and can be used interchangeably. Both are commonly used in the literature.

Range – The difference between the minimum and the maximum of a set of values. (EPA-QAD)

Recovery – The degree to which a methodology measures all of the analyte contained in a sample, often expressed in percent recovered.

Relative Standard Deviation (RSD) – The standard deviation expressed as a percentage of the mean (i.e., the coefficient of variation). Mathematically, it is the mean divided by the standard deviation times one hundred percent.

Replicate Analyses – The measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval. (NELAC)

Reporting Limit – The minimum value below which data are documented as non-detects. (EPA-QAD)

Sample – A representative part or a single item from a larger whole or group especially when presented for inspection or shown as evidence of quality. (Webster's)

Sensitivity – Sensitivity generally refers to the capability of a method or instrument to discriminate between small differences in analyte concentration.

Spike – A known quantity of an analyte added to a sample for the purpose of determining recovery or efficiency (analyst spikes), or for quality control (blind spikes).

Standard Deviation – A computed measure of variability indicating the spread of the data set around the mean.

Standard Operating Procedures (SOPs) – A written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks. (QAMS)

Standard Uncertainty – Uncertainty of the result of a measurement expressed as a standard deviation. (NIST)

Test Method – An adoption of a scientific technique for a specific measurement problem, as documented in a laboratory SOP or published by a recognized authority. (NELAC)

Type I Error – See Alpha and False Positive.

Type II Error – See Beta and False Negative.

Uncensored Method – See Method.

Uncertainty – The range of values that contains the true value of what is being evaluated at some level of confidence.

Uncertainty (of measurement) – A parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand. (NIST)

Variability During Routine Operations – Changes during the routine running of samples that might contribute to variability of results. This might include instrument drift through the course of the day due to changes in the ion source (such as contamination from running samples), differences in performance of instruments used for the same analysis, difference in technique for different analysts, etc.

Water Quality Based Effluent Limit (WQBEL) – Effluent limitations applied to dischargers when mere technology-based limitations would cause violations of water quality standards. Usually WQBELs are applied to discharges into small streams. (EPA-TRS)

List of Acronyms

ASTM - ASTM Dictionary of Engineering Science and Technology, 9th Edition
EPA OSWER - US EPA Office of Surface Water
EPA-QAD - US EPA Quality Assurance Division
EPA-TRS – EPA Terminology Reference System
G&C - Gibbons and Coleman textbook
IUPAC – International Union of Pure and Applied Chemistry
NELAC - National Environmental Laboratory Accreditation Conference
NIST - National Institute of Standards and Testing
QAMS - US EPA Quality Assurance Management Section
USGS - US Geological Survey
VIM - International Vocabulary of Basic and General Terms in Meteorology
Webster's - Webster's Dictionary