STATE OF CONNECTICUT

DEPARTMENT OF ENVIRONMENTAL PROTECTION

LABORATORY QUALITY ASSURANCE and QUALITY CONTROL GUIDANCE

REASONABLE CONFIDENCE PROTOCOLS

GUIDANCE DOCUMENT

November 2007
Revised December 2010

Amey Marella, Commissioner

79 Elm Street, Hartford, CT 06106
http://www.ct.gov/dep/remediation
(860) 424-3705

Laboratory Quality Assurance and Quality Control Guidance
Reasonable Confidence Protocols

(Effective November 19, 2007)

PREAMBLE

The Connecticut Department of Environmental Protection (CTDEP) has been working to improve the quality and consistency of analytical data used to support environmental investigation and remediation projects statewide. The CTDEP Quality Assurance/Quality Control Work Group (the Work Group) was established in 2004 to assist and advise the CTDEP in these efforts. The Work Group is comprised of licensed environmental professionals, data validators, and representatives from private laboratories, the Connecticut Department of Public Health, the U.S. Environmental Protection Agency, and the CTDEP. The CTDEP gratefully acknowledges the contributions and assistance of those individuals who volunteered their time and effort to help develop and prepare this document.

The Remediation Standard Regulations, sections 22a-133-1 to 22a-133k-3 of the Regulations of Connecticut State Agencies ("RSRs"), include numeric criteria in Appendices A through F ("RSR criteria") which are used to determine if a potential risk to human health or the environment may exist. The results of analyses performed on environmental media are used to determine if remediation is needed. Because of the nature of environmental media, limitations of analytical methods, characteristics of analytes, and human error, the results of environmental analysis may contain an element of uncertainty and in some cases may be significantly biased, and therefore may not be representative of the actual concentrations of the analytes in the environmental media. Thus, an evaluation of the quality of the analytical data in relation to the intended use is important in order for the environmental professional to make decisions which are supported by data of known and adequate quality.

To assist responsible parties and environmental professionals in evaluating the quality of analytical data, the Work Group developed the Reasonable Confidence Protocols (RCPs). The RCPs are analytical procedures that include specific laboratory quality assurance and quality control (QA/QC) criteria that produce analytical data of known and documented quality. Improvements in analytical data quality and consistency will help environmental professionals and responsible parties make sound technical decisions regarding analytical data quality and usability. These improvements will also promote CTDEP's acceptance of the analytical data, thereby reducing the need for additional sampling and analysis to support and/or confirm the analytical data and the environmental professional's decisions.

There are many ways to obtain data of known and documented quality. Use of the RCPs will provide consistency in evaluation and presentation of data quality information that will facilitate review. If alternative analytical procedures are used, such procedures should be documented in order to demonstrate that the analytical data produced is of known and documented quality. Such a demonstration may involve a commitment of significant resources.

TABLE OF CONTENTS

LIST OF ACRONYMS

C	Celsius
CTDEP	Connecticut Department of Environmental Protection
CTDPH	State of Connecticut Department of Public Health
DQA	Data Quality Assessment
DQO	Data Quality Objective
DUE	Data Usability Evaluation
ELCP	Environmental Laboratory Certification Program
EP	Environmental Professional
EPA	United States Environmental Protection Agency
EPH	Extractable Petroleum Hydrocarbons
EPTH	Extractable Total Petroleum Hydrocarbons
ESA	Environmental Site Assessment
GC/MS	Gas Chromatography/Mass Spectrometry
GWPC	Groundwater Protection Criteria
IDOC	Initial Demonstration of Capability
ID(s)	Sample Identification Number(s)
LCS	Laboratory Control Sample
LFB	Laboratory Fortified Blank
ND	Not Detected
PAH	Polycyclic Aromatic Hydrocarbons

LIST OF ACRONYMS

PCBs	Polychlorinated Biphenyls
PP	Priority Pollutants as defined by the Clean Water Act
QA/QC	Quality Assurance/Quality Control
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
RCP(s)	Reasonable Confidence Protocol(s)
RCSA	Regulations of Connecticut State Agencies
RCRA	Resource Conservation and Recovery Act
RL	Reporting Limit
RPD	Relative Percent Difference
RSRs	Remediation Standard Regulations of the Regulations of Connecticut State Agencies, Sections 22a-133k-1 through 22a-133-3, inclusive
SCGD	*Site Characterization Guidance Document*, effective September 2007, Connecticut Department of Environmental Protection
SVOC	Semi Volatile Organic Compound
SPLP	Synthetic Precipitation Leaching Procedure
SW-846	*Test Methods for Evaluating Solid Wastes, Physical /Chemical Methods, EPA Publication SW*-846, United State Environmental Protection Agency
TAT	Turn-Around Time
TICs	Tentatively Identified Compounds
VOCs	Volatile Organic Compounds
VPH	Volatile Petroleum Hydrocarbons

DEFINITION OF TERMS

Term	Definition
Accuracy	Describes the closeness of agreement between an observed value and an accepted reference value (true value). Accuracy is typically evaluated by the use of laboratory control samples, check standards, matrix spike and matrix spike duplicate, or any other standard subjected to the entire analytical process. Accuracy is usually reported as a percentage of the observed value divided by the known value (percent recovery) using the following equation: $$\%R = \frac{\text{observed value}}{\text{true value}} \times 100$$ Where %R = percent recovery
Analyte	Analyte means the substance being measured by an analytical procedure.
Analytical Batch	A group of samples that are processed and analyzed as a unit. For quality control purposes, the maximum number of samples in a batch is 20 per matrix.
Area of Concern	Defined in *State of Connecticut, Department of Environmental Protection, Site Characterization Guidance Document,* effective September 2007, page v.
Bias	The deviation of the measured value from a known spiked amount. This can be analytical bias within the analytical procedure, or it can be due to matrix effects. There is inherent bias within all analytical procedures, but most do not have a significant effect on the data being evaluated. This measurement is noted in laboratory control samples, check standards, matrix spikes and matrix spike duplicates, or any other standards used for analysis.
Calibration Curve/Initial Calibration	A calibration curve is generated by analyzing a series of standards and plotting instrument response versus concentration. A calibration curve used to calibrate an analytical system. Calibration criteria are specified in each analytical method.
Check Standard	A solution of one or more analytes that is used to document laboratory performance. This check standard can go by many different names including laboratory control samples, and laboratory fortified blank. Consult with the laboratory to understand the naming scheme used to identify such standards. This standard can also be used to check the validity of a purchased stock or calibration standard.
Comparability	Comparability refers to the equivalency of two sets of data. This goal is achieved through the use of standard or similar techniques to collect and analyze representative samples. Comparable data sets must contain the same variables of interest and must possess values that can be converted to a common unit of measurement. Comparability is normally a qualitative parameter that is dependent upon the other data quality elements. For example, if the detections limits for a target analyte were significantly different for two different methods, the two methods would not be comparable.
Conceptual Site Model	Defined in *State of Connecticut, Department of Environmental Protection, Site Characterization Guidance Document*, effective September 2007.

Term	Definition
Constituent of Concern	Defined in *State of Connecticut, Department of Environmental Protection, Site Characterization Guidance Document,* effective September, 2007, page v.
Control Sample	Control Sample means a quality control sample introduced into a process to monitor the performance of a system.
Data Quality Objectives	Defined in *State of Connecticut, Department of Environmental Protection, Site Characterization Guidance Document, e*ffective September 2007, page v.
Environmental Professional	An environmental professional is anyone, including a licensed environmental professional, who conducts environmental site assessments or collects soil, sediment, water, soil vapor, or air samples for environmental investigation and remediation projects. This term is also further defined in *State of Connecticut, Department of Environmental Protection, Site Characterization Guidance Document,* effective September, 2007, page vi.
Environmental Site Assessment	Defined in S*tate of Connecticut, Department of Environmental Protection, Site Characterization Guidance Document*
Equipment-Rinsate Blank	A sample of analyte-free water that is used to rinse the sampling equipment. An equipment-rinsate blank is collected after decontamination to assess potential contamination from inadequate decontamination of field equipment. An equipment-rinsate blank can also be used to evaluate the potential for field sampling equipment to leach contaminants into a sample and cause cross contamination.
Field Blank	Analyte-free media, usually water, prepared in the laboratory and transported to the site along with the empty sample containers. At the site the media is used to fill randomly selected sample containers, and then returned to the laboratory for analysis. The field blank is treated as a sample in all respects, including exposure to sampling site conditions, storage, preservation, and all analytical procedures. Field blanks are used to assess any contamination contributed from sampling site conditions, and the transport, handling, and storage of the samples.
Field Duplicate	A field duplicate is a replicate or split sample collected in the field and submitted to the laboratory as a sample.
Field Reagent Blank	See Field Blank
GA Pollutant Mobility Criteria	Defined in Remediation Standard Regulations, Section 22a-133k-1(a) of the Regulations of Connecticut State Agencies.
Gas Chromatography/ Mass Spectrometry	An analytical procedure in which a gas chromatograph is connected to a mass spectrometer. The technique allows for both accurate identification and quantitation of analytes.
GB Pollutant Mobility Criteria	Defined in Remediation Standard Regulations, Section 22a-133k-1(a) of the Regulations of Connecticut State Agencies.

Term	Definition
Groundwater Protection Criteria	Defined in Remediation Standard Regulations, Section 22a-133k-1(a) of the Regulations of Connecticut State Agencies.
Holding Time	The maximum amount of time a sample may be stored between collection and analysis is referred to as the holding time. Samples analyzed past the holding time are compromised and may be considered invalid, depending on the intended use of the data.
Industrial Commercial Direct Exposure Criteria	See Remediation Standard Regulations, Section 22a-133k-1(a) of the Regulations of Connecticut State Agencies.
Initial Demonstration of Capability	The analysis of a set of known concentration samples or standards used to document an analyst's ability to perform an analytical procedure correctly. The results of the analyses must meet the precision and accuracy criteria of the method.
Instrument Blank	An instrument blank is analyte free media that is introduced into the analytical instrumentation to verify the instrumentation is not contaminated. Typically instrument blanks for gas chromatography are pure solvent, while those for metals or wet chemistry techniques are reagent water or acidified reagent water.
Internal Standards	Internal standards are compounds that are added, prior to analysis, at a known concentration to every standard, blank, sample, and quality control sample at a known concentration. Internal standards are used to calibrate the analytical system by plotting the response of the internal standards versus the compound(s) of interest. Internal standards should closely match the chemical behavior of the compound(s) of interest and be known not to be present in the sample.
Laboratory Control Sample	A laboratory control sample (LCS) is a purchased reference standard or reagent water or clean soil spiked by the laboratory with compound(s) representative of the target analytes. The LCS is analyzed in an identical manner as a sample and is used to document laboratory performance. The results of the LCS are used to document accuracy, and precision of the analytical methodology. LCSs are sometimes called a laboratory fortified blank.
Laboratory Fortified Blank	See Laboratory Control Sample
Laboratory Fortified Sample Matrix	See Matrix Spike
Laboratory Reagent Blank	See Method Blank
Matrix Duplicate	A matrix duplicate refers to the replicate analysis of a sample prepared in the laboratory. Duplicates are used to evaluate precision, sample homogeneity, and field sample collection activities.

Term	Definition
Matrix Effects	The overall effect of the sample matrix on the analytical results. Severe matrix effects are usually called matrix interference and can significantly affect the accuracy of an analytical measurement. For example, some matrices including silt, clay, coal, ash, and peat effectively bind analytes leading to low biased results for certain extraction procedures.
Matrix Interference	See Matrix Effects
Matrix	The component or substrate (e.g. surface water, drinking water, soil) that may, or may not, contain an analyte of interest.
Matrix Spike	An aliquot of an environmental sample to which known quantities of analytes are added in the laboratory. The matrix spike is analyzed in an identical manner as a sample. The purpose of a matrix spike sample is to determine whether the sample matrix contributes bias to the analytical results.
Matrix Spike Duplicate	An intra-laboratory split sample, with both aliquots spiked with identical concentrations of method analytes. The spiking occurs prior to sample preparation and analysis. The results are used to document the precision and bias of a method in a given sample matrix. See also "matrix spike."
Media	See Matrix
Method Blank	An analyte-free matrix to which all reagents are added in the same proportions as used in sample processing. The method blank should be carried through the entire sample preparation and analytical procedure. It is used to determine if method analytes or other analytes are present in the laboratory environment, the reagents, or the apparatus.
Non-conformance	An occurrence during the processing or analysis of a sample that is not in conformance with the quality control criteria of the analytical method. Examples of non-conformances include, but are not limited to: missed holding times, temperature excursions, recoveries of surrogates or matrix spikes outside of criteria, initial or continuing calibration failures, et cetera.
Performance Evaluation Sample	See Proficiency Test Sample
Petroleum	Used in this document as the term is defined in Section 22a-449a of the Connecticut General Statutes

Term	Definition
Precision	The agreement among a set of replicate measurements without assumption of knowledge of the true value. Precision is estimated by means of duplicate/replicate analyses and illustrates the reproducibility of a laboratory's analysis. Field duplicates are used to assess precision for the entire measurement system including sampling, handling, shipping, storage, preparation and analysis. Laboratory data precision analysis is evaluated through the use of matrix spike/matrix spike duplicate sample results. The precision of data is measured by the calculation of the relative percent difference (RPD) by the following equation: $RPD = \frac{|A-B|}{((A+B)/2)} \times 100$ Where: A = Analytical results from first duplicate measurement B = Analytical results from the second duplicate measurement
Proficiency Test Sample	A reference sample provided to a laboratory for the purpose of demonstrating that the laboratory and the individual analyst performing the test can successfully analyze the sample within acceptable limits. The true value of the sample is unknown by the laboratory.
Proficiency Testing	A program in which performance evaluation samples are used to evaluate the analytical performance of the laboratory.
Quality Assurance Plan	An orderly assemblage of detailed procedures designed to produce data of sufficient quality to meet the data quality objectives for a specific data collection activity.
Quality Assurance/Quality Control	Quality Assurance (QA) involves planning, implementation, assessment, reporting, and quality improvement to establish the reliability of laboratory data. Quality Control (QC) procedures are the specific tools that are used to achieve this reliability. QC procedures measure the performance of an analytical method in relation to the QC criteria specified in the analytical method. QC information documents the quality of the analytical data.
Reagent water	Reagent water is generally, water that has been generated by any method, which would achieve the performance specifications for American Society for Testing Materials Type II water. For organic analyses, reagent water is free from contamination of the analytes of interest.
Reasonable Confidence	When "Reasonable Confidence" is achieved for a particular data set, the environmental professional will have "Reasonable Confidence" that the laboratory has followed the Reasonable Confidence Protocols, has described non-conformances, if any, and has adequate information to make judgments regarding data quality.
Reasonable Confidence Protocols	The Reasonable Confidence Protocols are analytical methods that include specific laboratory quality assurance and quality control (QA/QC) criteria that produce analytical data of known and documented quality. The Reasonable Confidence Protocols methods are published on the CTDEP web site at http://www.ct.gov/dep/remediation.

Term	Definition
Release	Defined in Remediation Standard Regulations, Section 22a-133k-1(a) of the Regulations of Connecticut State Agencies and the *State of Connecticut, Department of Environmental Protection, Site Characterization Guidance Document,* effective September, 2007, page vi.
Release Area	Defined in Remediation Standard Regulations, Section 22a-133k-1(a) of the RCSA and the *State of Connecticut, Department of Environmental Protection, Site Characterization Guidance Document,* effective September 2007, page vi.
Remediation Standard Regulation 15 Metals	Antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc
Reporting Limit	Reporting limit means the concentration of the lowest calibration standard of a calibration curve used for analysis of a given sample by a specific method, corrected for specific sample weight or volume, dilutions, and for soil and sediment samples moisture content. This term is further defined in the Remediation Standard Regulations, Section 22a-133k-1(a) of the Regulations of Connecticut State Agencies.
Residential Direct Exposure Criteria	Defined in Remediation Standard Regulations, Section 22a-133k-1(a) of the Regulations of Connecticut State Agencies.
Sensitivity	Sensitivity refers to the ability of an analytical procedure to detect and quantify an analyte at a given concentration.
Significant Data Gap	Defined in *State of Connecticut, Department of Environmental Protection, Site Characterization Guidance Document,* effective September 2007, page vi.
Spike	To spike a sample is to fortify a sample in the laboratory with known concentrations of analytes.
Split Sample	Aliquots of sample taken from the same container and analyzed independently. Split samples are usually taken after mixing or compositing and are used to document intra- or inter-laboratory precision.
Standard of Care	Defined in *State of Connecticut, Department of Environmental Protection, Site Characterization Guidance Document,* effective September 2007, page vi.
Standards	Standards are solutions that contain known concentration of target analytes. Examples include stock standards, calibration standards, et cetera.
Substance	Defined in Remediation Standard Regulations, Section 22a-133k-1(a) of the Regulations of Connecticut State Agencies.

Term	Definition
Surface Water Protection Criteria	Defined in Remediation Standard Regulations, Section 22a-133k-1(a) of the Regulations of Connecticut State Agencies.
Surrogate Analyte	An organic compound, which is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but is not normally found in environmental samples. The surrogate concentration is measured using the same procedures used to measure other analytes in the sample. Surrogate recoveries are used to evaluate the performance of the analysis.
Target Analytes	Target analytes are the compounds included on the list of analytes for an analytical method.
Tentatively Identified Compounds	Tentatively identified compounds are unknown compounds for which a possible identification was made by comparing the mass spectra of the unknown to a library of known mass spectra. Concentrations may also be estimated by assuming a response factor.
Trip Blank	Trip blanks originate within the laboratory. Trip blanks are sample containers that have been filled with analyte-free reagent water, or soil and carried with other sample containers out to the field, and back to the lab without being exposed to sampling procedures. Trip blanks are used to ascertain if sample containers may have been contaminated during transportation and storage.
Turn-Around Time	The amount of time it takes for the laboratory to report the analytical results to the customer following the submittal of the samples to the laboratory.

1. INTRODUCTION

The Reasonable Confidence Protocols (RCPs) are analytical methods that were developed to standardize the minimum Quality Assurance/Quality Control (QA/QC) and reporting documentation expected for analytical laboratory data used by environmental professionals.

This document provides general information and guidance regarding the RCPs. The RCPs are a collection of analytical methodologies that are based on analytical methods published by the United States Environmental Protection Agency (EPA) and others. RCPs have been developed for the most commonly used analytical methods, and RCPs may be developed for other methods in the future. The RCP methods are published on the CTDEP web site at http://www.ct.gov/dep/remediation.

The primary function of the RCPs is to describe specific quality assurance and quality control procedures that will be performed by the laboratory to provide analytical data of known and documented quality. Other components of this guidance include a RCP Laboratory Analysis QA/QC Certification Form that the laboratory uses to certify whether the data meets the guidelines for "Reasonable Confidence," and a narrative that describes QA/QC non-conformances. When "Reasonable Confidence" is achieved for a particular data set, the environmental professional will have confidence that the laboratory has followed the RCPs, has described non-conformances, if any, and has adequate information to make judgments regarding data quality. When the RCP methods are followed, the environmental professional can have confidence that the data are of known and documented quality. This will enable the environmental professional to subsequently evaluate whether the quality of the data is sufficient for its intended purpose.

A basic premise of the RCPs is that good communication and the exchange of information between the environmental professional and the laboratory will increase the likelihood that the quality of the analytical data will meet project-specific Data Quality Objectives (DQOs), and therefore, be suitable for the intended purpose. To this end, an example laboratory communication form was developed to provide guidance regarding the specific information that the laboratory should have prior to analyzing the associated samples.

The process of obtaining analytical data that is of sufficient quality for the intended purpose and evaluating the quality of analytical data in relation to project-specific DQOs occurs throughout the course of a project. This process includes:

- Development of project-specific DQOs in accordance with the CTDEP's Site Characterization Guidance Document effective September 2007 (SCGD).

- Communication with the laboratory regarding project-specific DQOs and the selection of appropriate analytical methods in accordance with section 4.2.3 of the CTDEP's (SCGD).

- Performance of quality assurance and quality control activities during the analysis of the samples and reporting of QC results by the laboratory.

- Performance of a data quality assessment (DQA) of the laboratory quality control data, and laboratory narrative by the environmental professional to identify QC non-conformances.

- Performance of a data usability evaluation (DUE) by the environmental professional to determine if the analytical data is of sufficient quality for the intended purpose. The DUE uses the results of the DQA and evaluates the quality of the analytical data in relation to the project-specific DQOs.

Additional information concerning DQAs and DUEs is presented in CTDEP's *Laboratory Quality Assurance and Quality Control Guidance Data Quality and Usability Evaluations*, which is presented as supplemental guidance to the SCGD.

2. BACKGROUND

Section 19a-29a of the Connecticut General Statutes requires that all environmental laboratories be certified by the Connecticut Department of Public Health (CTDPH). CTDPH currently offers certification in three broad matrices (drinking water, non-potable water/wastewater, and soil/solid waste) for a variety of analytes. Parties who procure laboratory services must verify that the laboratory is approved by the CTDPH for the specific analytes in the specific matrices for which analysis is requested. Connecticut Regulations require laboratories that analyze samples in Connecticut be approved by the CTDPH.

The Environmental Laboratory Certification Program (ELCP) certifies laboratories that meet the minimum requirements of the Connecticut General Statutes, the Regulations of the Connecticut State Agencies, and the EPA. The ELCP evaluates laboratories based upon the qualifications of the laboratory personnel, the results of triennial on-site inspections, facilities, equipment, methods employed, annual proficiency test samples, and QA/QC practices. Certification alone cannot guarantee the validity of data produced by a laboratory.

The RCPs are based upon the latest promulgated methods appearing in *Test Methods for Evaluating Solid Wastes,* SW-846 (SW-846) published by the United States Environmental Protection Agency (EPA), which provides recommended test procedures and guidance. As such, the QA/QC requirements in SW-846 are guidelines. When SW-846 methods were developed, it was anticipated that most projects utilizing these methods would have an associated Quality Assurance Project Plan (QAPP), which would document the specific QA/QC requirements for the project. However, in practice most projects do not have a QAPP, and SW-846 methods are routinely used by the environmental laboratories, each with its own interpretation of the QA/QC requirements of SW-846.

In contrast, the RCPs provide a minimum set of QA/QC criteria. If the laboratory follows the RCP methods, the associated data set is given a "Reasonable Confidence" status. Environmental professionals must understand that the "Reasonable Confidence" status does not mean that data will automatically meet their needs. "Reasonable Confidence" only means the laboratory followed the recommendations in the RCPs. The environmental professional must evaluate the associated laboratory report to ascertain whether the data is of sufficient quality to meet the project-specific DQOs and support the environmental decisions to be made.

3. REASONABLE CONFIDENCE PROTOCOL STRUCTURE

Each RCP method is written using the same general format. Each method contains a list of holding times, containers, preservatives, target analytes, QC criteria, and required report deliverables. Environmental professionals should note that the RCPs do not list laboratory reporting limits, with the exception of RCP Method 8260, low-level volatile organics. It is the responsibility of the environmental professional to request the reporting limits that the laboratory should meet for each data set. The following sub-sections describe several important aspects of the RCPs.

3.1 Holding Times, Containers, and Preservatives

The maximum amount of time a sample may be stored between collection and analysis is referred to as the holding time. Samples analyzed past the holding time are compromised and may be considered invalid, depending on the target analytes and the intended use of the data. The target analytes may have been lost due to volatilization, chemical or microbial degradation, or other processes. In order to retard these processes, certain analytes require chemical preservation and/or cooling. In order to preserve samples, the preservative should be added to the sample container prior to, or at, the time of collection. The appropriate types of sample containers for specific analytes are listed in each RCP method, along with recommended sample volumes. Environmental professionals should consult with the laboratory to identify the minimum volume of sample necessary for the desired analysis. This practice should help ensure that an adequate volume of sample is collected and sent to the laboratory.

The RCPs require that any holding time exceedances, issues related to improper containers, or issues related to sample preservation be described as a non-conformance in the narrative that must accompany each laboratory analytical report.

3.2 Target Analytes

The target analytes are specified for each RCP method. The RCPs require laboratories to report all target analytes, except when otherwise requested by the environmental professional. If an environmental professional requests that not all analytes be reported, the environmental professional must justify and document this decision in the report that uses the data.

Environmental professionals should specify to the laboratory any additional site-specific analytes that are needed. The laboratory must demonstrate that the additional analyte(s) can be determined using the RCP method through an initial demonstration of capability (IDOC). The laboratory must calibrate and evaluate the additional analytes in accordance with the method QA/QC requirements. For scheduling

purposes, the environmental professional must take into account that the laboratory may need several weeks to complete the IDOC.

3.3 Reporting Limits

The reporting limit is defined as the concentration of the lowest standard in the calibration curve. If an instrument does not allow for a calibration curve, than a low-level check standard may be analyzed as described in the specific RCP method. In general reporting limits are not specified, except for the low-level option for RCP Method 8260. It is expected that reporting limits will be at or below any regulatory criteria. Reporting limits are not to be artificially raised by the laboratory.

Reporting Limits must meet the requirements for Reporting Limits that are specified in the Remediation Standard Regulations of the Regulations of Connecticut State Agencies, Sections 22a-133k-1 through 22a-133k-3, inclusive (RSRs).

3.4 Quality Control/Quality Control Criteria

Each RCP method includes a table listing specific QA/QC performance criteria. If any of the QA/QC criteria are not met, the laboratory is required to narrate in detail the failed criteria, including which analytes and which samples are affected. Some methods with an extremely long list of target analytes, such as volatile organics by RCP Method 8260, will routinely have a limited number of analytes that do not meet the QA/QC criteria. This is not unexpected and should not be a cause of concern unless the number of analytes not meeting criteria is excessive (e.g. >10%) or the analytes are a specific concern at the site. The environmental professional should always communicate to the laboratory, prior to sampling, if there are specific constituents of concern at a site that are not typically found at most sites. The Project Communication Form in Appendix B can be used for this purpose.

3.5 Report Deliverables

Every laboratory analytical report should consist of the same deliverables, although the laboratory determines the exact format of the laboratory analytical report. The environmental professional should work with the laboratory to obtain reports in a format that meets their needs. When no detection of an analyte was noted, or when results for analytes were below the reporting limit, the laboratory report will indicate the result as “ND,” along with the sample-specific reporting limit. Results for total or mass analysis of soil and sediments results must be reported on a dry-weight basis. In order for “Reasonable Confidence” to be achieved, the RCP Laboratory Analysis QA/QC Certification Form and required narrative must accompany each report. A copy of the RCP Laboratory Analysis QA/QC Certification

Form is included in Appendix B. This form includes a series of questions that the laboratory must answer, and a responsible official of the laboratory must sign and date the form. Failure to include with the sample delivery group a completed, signed and dated RCP Laboratory Analysis QA/QC Certification Form, and required narrative automatically means the data set cannot be presumed to meet the requirements for Reasonable Confidence; and additional documentation will be needed to demonstrate that the quality control for the specific sample delivery group is at least equivalent to, or better than, that specified in the RCPs.

The narrative is a critical part the laboratory report deliverable. In the narrative, laboratories must note all QC non-conformances required by the specific RCP method. Further information on report narratives is provided in Section 4. Environmental professionals must evaluate the entire laboratory report deliverable in order to evaluate if the data is suitable for its intended use.

3.6 Modification of the Reasonable Confidence Protocol Method 8260 to Meet the Groundwater Protection Criteria

The RCP for Method 8260 includes provisions for modification of the method to achieve reporting limits that meet the Groundwater Protection Criteria (GWPC). It is the responsibility of the Environmental Professional to request that the laboratory use the Low-Level Modification of the RCP Method 8260 to meet the GWPC.

3.7 Project-Specific Laboratory Quality Assurance/Quality Control

The types and/or frequency of project-specific laboratory QA/QC data are determined by the project-specific data quality objectives (DQOs). Reasonable Confidence refers to laboratory procedures, not project-specific QA/QC samples. Therefore, Reasonable Confidence status is not related to the collection of project-specific QA/QC samples.

The environmental professional must plan to collect additional sample volume for the analysis of project-specific QA/QC samples in order to meet the project's DQOs. Project-specific QA/QC samples include, but are not limited to, field duplicates, matrix spikes, matrix spike duplicates, trip blanks, field blanks, and equipment-rinsate blanks. The environmental professional should contact the laboratory for sample volume requirements. The Project Communication Form in Appendix B can be used for this purpose.

3.8 Tentatively Identified Compounds

The evaluation of Tentatively Identified Compounds (TICs) in conjunction with Gas Chromatography/Mass Spectrometry (GC/MS) analyses is a powerful and cost-effective analytical tool that can be utilized by the Environmental Professional to satisfy the standard of care requirements of the SCGD when evaluating the constituents of concern at an area of concern, or at a release area as part of an Environmental Site Assessment (ESA). The use of TICs is particularly effective at locations with suspect disposal practices, complex or uncertain site history, and/or sites that require detailed evaluation of critical exposure pathways. When GC/MS analytical methods are utilized, an analysis of TICs is:

- **Always expected** when potable* water samples are analyzed;
- **Not usually expected** at sites where petroleum products are the only constituents of concern;
- **Not usually expected** when the constituents of concern have been identified and understood;
- **Not usually expected** when determining the extent and magnitude of contamination associated with a release when the constituents of concern have been adequately identified and understood; and/or,
- **Should be considered** at the discretion of the environmental professional, in support of an ESA for releases at locations with complex and/or uncertain history to address a significant data gap in the Conceptual Site Model.

*Refers to water directly consumed from either public or private supplies. Only drinking water methods should be used to characterize drinking water or other potable water supplies (Methods from 40 CFR Part 141).

It is the responsibility of the environmental professional to request that the laboratory report TICs. Depending on specific site circumstances, re-sampling/re-analysis with analyte-specific calibration and quality control may be required to confirm both the identity and concentration of the TICs. No regulatory judgments or remedial decisions should be made without re-analysis of samples for the TICs using a five-point, analyte-specific calibration and appropriate quality control, as described in the applicable RCP method. This may require re-sampling in order to meet analytical holding times.

4. LABORATORY REPORTS

The RCPs specify that the following information be included in the laboratory report along with the sample results. The exact format of the laboratory report is not specified.

4.1 Index of Samples

A table listing field sample identification numbers that are cross-referenced to laboratory sample identification numbers, matrix, date of collection, and date of receipt at the laboratory must be included with the laboratory report.

4.2 Methodology

The laboratory report must state the methods used to analyze the samples. An example could be "volatile organics were determined using guidance from EPA Methods 5030A/8260B for aqueous samples and 5035/8260B for soil samples in accordance with the Connecticut Reasonable Confidence Protocols."

4.3 Subcontracting Information

Laboratory reports must clearly state what tests (if any) were subcontracted to another laboratory and identify the laboratory. The subcontracted laboratory's Connecticut Public Health registration number, and a copy of the subcontracted laboratory's report, narrative, and RCP Laboratory Analysis QA/QC Certification Form must be included.

4.4 Laboratory Narrative Describing Non-Conformances

The RCPs require that the laboratory include, as part of the laboratory report, a narrative that provides a detailed explanation of all non-conformances that occurred. The narrative provides detailed documentation of any QC, sample, shipment, or analytical problems encountered in the processing of the samples in the data set reported. Narratives must list specific compounds and associated samples for which non-conformances are noted. For example, the narrative should not simply state that two compounds failed to meet the RCP recovery limits for RCP Method 8270. The narrative should state something similar to "compounds A and B recovered below the 40% QC limit for laboratory control sample X (Compound A recovered at 28% and Compound B at 18%). The following samples were affected: Sample 1, Sample 2, Sample 3....."

4.5 Reporting of Analytical Results

Laboratory reports must include sampling date, sample identification numbers, analytical results, sample specific reporting limits, preparation date, and analysis date for each sample. Results for soil and sediment samples must be reported on a dry-weight basis unless the results are from a leaching method, such as the RCP for the Synthetic Precipitation Leaching Procedure (SPLP). When an analyte is not detected or when the result for an analyte is below the reporting limit, the RCPs call for reporting the result as "ND," along with the sample-specific reporting limit. Reporting limits must be corrected to take into account any dilutions that were performed, the exact sample weight or volume of the sample, the percent solids of the sample, and any other factors that would affect the actual reporting limit for specific sample(s). The reasons for any dilutions that were performed must be reported in the narrative.

4.6 Quality Control Results

The RCPs require that all non-conformances be reported in a narrative in the laboratory report. Additionally, all QC results specified as a report deliverable by the RCP method must be included in the report. Table 1A of each of the RCP Methods provides information regarding the QC deliverables that must be reported in narrative. For non-RCP methods, the laboratory should report similar QC results as those required in the RCPs. For example, if a laboratory analyzed for organophosphorus pesticides using EPA Method 8141, which is a non-RCP method at the time of the publication of this document, the QC information and limits for RCP Method 8081 would be appropriate. This information must be included in the report narrative.

5. REASONABLE CONFIDENCE PROTOCOL FORMS

The CTDEP has developed several forms to assist documenting the RCP process. These forms are described below and included in Appendix B. These forms are also available in electronic format on the CTDEP website at http://www.ct.gov/dep/remediation.

5.1 Project Communication Form

Use of the Project Communication Form is optional and may be modified by the user to facilitate communication with the laboratory. The Project Communication Form, which is completed by the environmental professional and provided to the laboratory, includes in most cases, information the laboratory will need to analyze the samples. The Project Communication Form should include such information as: analytical methods, constituents of concern, applicable regulatory criteria, project-specific QA/QC requirements, required report deliverables, and scheduling.

5.2 Reasonable Confidence Protocol Laboratory Analysis Quality Assurance/Quality Control Certification Form

The RCPs require the laboratory director or their designee to complete, sign and date, the RCP Laboratory Analysis QA/QC Certification Form. The RCP Laboratory Analysis QA/QC Certification Form may not be altered and all questions must be answered. A signed and dated RCP Laboratory Analysis QA/QC Certification Form, and required narrative must be received with the laboratory reports for "Reasonable Confidence" status to be achieved for the data set. If the answer to question #1, #1A, or #1B on the form is "No", the data package does not meet the requirements for "Reasonable Confidence." If the laboratory does not meet the QA/QC performance criteria specified in any RCP method for the data set, then response to question #4 is "No." The laboratory must narrate all non-conformances.

5.3 Reasonable Confidence Protocol Equivalency Determination Form

After September 1, 2007, when a laboratory uses a non-RCP method for an analysis for which there is an existing RCP method, the RCP Equivalency Determination Request Form must be submitted to the CTDEP by the environmental professional with the analytical data submittal.

The RCP Equivalency Determination Request Form is not required for analytical methods for which no RCP method has been published.

6. DEMONSTRATING EQUIVALENCY WITH THE REASONABLE CONFIDENCE PROTOCOLS

No prior approval is required to use non-RCP methods. Environmental professionals and responsible parties are advised that the use of non-RCP methods in place of published RCP methods for analysis of samples collected on or after September 1, 2007 may involve the commitment of significant resources to demonstrate an equivalency with the RCPs.

Data generated by methods other than the RCPs, when an RCP method exists, must be supported by appropriate documentation and opinions as to how the methods are equivalent to, or exceed, the level of quality control and documentation in the RCP methods. At a minimum, the laboratory report must include the information identified in Section 4.0 of this document.

In order to demonstrate equivalency with the RCPs, the laboratory must generate data that has quality control elements for assessing accuracy, precision, and sensitivity. In addition, the laboratory is expected to have and implement a standard operating procedure for the method and an IDOC. For example, if an environmental professional or laboratory chooses to determine polynuclear aromatic hydrocarbons by EPA Method 8310 (high-pressure liquid chromatography), which is a non-RCP method at the time of the publication of this document, the data submitted to the environmental professional must contain the QC elements equivalent to the RCP method, in this case RCP Method 8270, GC/MS excluding the QC elements specific to mass spectrometery. The laboratory QC submittal would need to include the same elements specified in Table 1A of the RCP method. In addition, the laboratory QC submittal must include the laboratory's standard operating procedure and IDOC. These last two items should be kept on file by the environmental professional for possible submission to the CTDEP.

7. ANALYTICAL PROCEDURES FOR WHICH NO REASONABLE CONFIDENCE PROTOCOL METHOD IS PUBLISHED

There are many valid analytical methods for which no RCP method has been established. As stated in Section 6.0 of this document, if these methods are used, the laboratory is expected to submit QC data deemed equivalent to a similar RCP method. In general, the QC data should include the following, as appropriate to the method:

- Method blank results;
- Sample duplicate results, identified as a duplicate;
- Matrix spike results;
- Matrix spike duplicate results;
- Surrogate recovery results; and
- Laboratory control sample results.

In addition, the laboratory should follow the reporting guidelines outlined in Section 4.0. The environmental professional should be aware that not all methods would have all the QC data listed. For example, in determining the pH of a sample, there would be no surrogate, method blank, or matrix spike results. Surrogate recoveries would only be appropriate for organic analytes. If the environmental professional is unsure of what QC data is appropriate, or if additional clarification on any aspect of the RCPs is needed, the environmental professional should contact the CTDEP Remediation Division for guidance.

APPENDIX A

REASONABLE CONFIDENCE PROTOCOL FORMS

PROJECT COMMUNICATION FORM

Client Name:

Project Name: ***Project Number:***

Project Manager: ***Contact info:***

Field Manager:

Sample Matrix: ☐ groundwater or surface water, ☐ soil, ☐ sediment, ☐ drinking water, ☐ air, ☐ other

RCP Analyses/Methods:

☐ VOC 8260, ☐ VOC 8021, ☐ Aromatics 8021/8260,

☐ Halocarbons 8021/8260, ☐ Pesticides 8081, ☐ PCB 8082, ☐ PAH 8270,

☐ SVOC 8270, ☐ RCRA 8 Metals, ☐ PP13 Metals, ☐ RSR 15 Metals

☐ CTDPH ETPH, ☐Other tests:

TAT Required: Standard: Other:

Constituents of Concern: Please *note any known or suspected contaminants in high concentrations or any non-standard analytes not contained in routine target lists (see notes).*

Regulatory Criteria:

☐ Residential Direct Exposure Criteria, ☐ Industrial/Commercial Direct Exposure Criteria,

☐ GA Pollutant Mobility Criteria, ☐ GB Pollutant Mobility Criteria, ☐ Other:

☐ Groundwater Protection Criteria, ☐ Surface Water Protection Criteria, ☐ Aquatic Life Criteria (specify applicable criteria below) ☐ Other:

Quality Control Requirements: *Indicate if your project will have Project specific field quality control samples. Check all that apply. Also specify if special QA/QC site requirements exist: i.e., QAPP*

☐ Matrix Spike, ☐ Matrix Spike Dup, ☐ Trip Blank(s),

☐ Other Field QC:

☐ Project QAPP (send appropriate section(s) to lab)

Report Deliverables Requirements: *Indicate any reporting requirements other than routine lab data sheets such as electronic formats:*

☐ Excel Tables, ☐ GISKey, ☐ Envirodata, ☐ Equis, ☐ Other:

Expected Sampling Date(s): *Indicate expected number of sampling events or duration*

Total Number of Samples and Expected Sample Load Per Day: *(indicate number of each matrix if applicable)*

Sample Pick Up: ☐ office(s), ☐ site (address), ☐ other

Special Instructions:

☐ Report TICs

Notes:

There are standard target analytes for organic analysis. Refer to the methods for a list of specific compounds. If a contaminant of concern is not contained on the target list of a method, it is important that the laboratory know this prior to sampling. Prior notification will allow the laboratory to obtain standards and perform necessary instrument calibration to insure proper identification and quantification. ***If requesting non-routine compounds that have no regulatory criteria, indicate required reporting limit for each compound.***

REASONABLE CONFIDENCE PROTOCOL

LABORATORY ANALYSIS QA/QC CERTIFICATION FORM

Laboratory Name: ***Client:***

Project Location: ***Project Number:***

Laboratory Sample ID(s): ***Sampling Date(s):***

List RCP Methods Used (e.g., 8260, 8270, et cetera)

1	For each analytical method referenced in this laboratory report package, were all specified QA/QC performance criteria followed, including the requirement to explain any criteria falling outside of acceptable guidelines, as specified in the CTDEP method-specific Reasonable Confidence Protocol documents?	□Yes □ No
1A	Were the method specified preservation and holding time requirements met?	□Yes □ No
1B	***VPH and EPH Methods only***: Was the VPH or EPH method conducted without significant modifications (see Section 11.3 of respective RCP methods)	□Yes □ No □N/A
2	Were all samples received by the laboratory in a condition consistent with that described on the associated chain-of-custody document(s)?	□Yes □ No
3	Were samples received at an appropriate temperature (<6° C°)?	□Yes □ No □N/A
4	Were all QA/QC performance criteria specified in the CTDEP Reasonable Confidence Protocol documents achieved?	□Yes □ No
5	a) Were reporting limits specified or referenced on the chain-of-custody? b) Were these reporting limits met?	□Yes □ No □Yes □ No
6	For each analytical method referenced in this laboratory report package, were results reported for all constituents identified in the method-specific analyte lists presented in the Reasonable Confidence Protocol documents?	□Yes □ No
7	Are project-specific matrix spikes and laboratory duplicates included in this data set?	□Yes □ No

Notes: For all questions to which the response was "No" (with the exception of question #7), additional information must be provided in an attached narrative. If the answer to question #1, #1A, or #1B is "No", the data package does not meet the requirements for "Reasonable Confidence." This form may not be altered and all questions must be answered.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete.

Authorized Signature: _____ Position: _____

Printed Name: _____ Date: _____

Name of Laboratory_____

This certification form is to be used for RCP methods only.

State of Connecticut
Connecticut Department of Environmental Protection

REASONABLE CONFIDENCE PROTOCOL EQUIVALENCY DETERMINATION FORM

(to be used for samples collected on or after September 1, 2007)

Site Name: _____

Address: _____

Town: _____

Directions: Submit this form to CTDEP when a non-RCP method is used for an analysis for which there is a published RCP method. This form must be submitted for environmental investigation and remediation projects. This form must be submitted with the analytical data, appropriate documentation, and opinions as to why the non-RCP method(s) used are equivalent to, or exceed, the level of quality control and documentation required by the RCPs.

Analyte	**Sample Identification Number(s)**	**Analytical Methods Used**

Prepared by:
Title:
Firm:
Date: