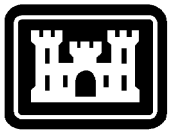

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EM 200-1-6
10 October 1997

ENVIRONMENTAL QUALITY

CHEMICAL QUALITY ASSURANCE FOR HTRW PROJECTS

ENGINEER MANUAL

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DEPARTMENT OF THE ARMY
U. S. Army Corps of Engineers
Washington, D. C. 20314-1000

EM 200-l-6

CEMP-RT

Manual
No.200-1-6

10 October 97

Environmental Quality
CHEMICAL QUALITY ASSURANCE FOR HAZARDOUS, TOXIC AND RADIOACTIVE WASTE (HTRW) PROJECTS

1. Purpose. This Engineer Manual (EM) provides specific guidance, procedures, criteria, and tools for chemical implementation of the U. S. Army Corps of Engineers (USACE) HTRW Quality Assurance (QA) Program. Chemical QA is required to ensure analytical data generated for all projects meet the criteria prescribed by the technical project planning (TPP) team. This EM is intended for use by USACE personnel as a critical companion document to ER 1110-l-263.

2. Applicability. This manual applies to all USACE commands having responsibility for HTRW projects.

3. References. References are provided in Appendix A.

4. Distribution Statement. Approved for public release, distribution unlimited.

5. Discussion. This manual provides guidance for implementation of analytical chemistry aspects of the USACE HTRW QA program. The manual provides detailed guidance on meeting the requirements of ER 1110-l-263 and ER 1180-l-6. Included are suggestions for establishment of quality control (QC) and QA protocols needed to ensure fulfillment of chemical quality requirements in support of project specific data quality objectives (DQOS) .

FOR THE COMMANDER:

OTIS WILLIAMS
Colonel Corps of Engineers
Chief of Staff

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Chapter 1
U.S. ARMY CORPS OF ENGINEERS CHEMICAL DATA QUALITY MANAGEMENT PROCEDURES AND NOTIFICATIONS

1-1. Introduction. Execution of the USACE Chemical Data Quality Management (CDQM) program for HTRW contamination requires the interface and coordination of several Corps personnel. Procedures and responsibilities for USACE staff performing government CDQM activities are defined and detailed in this Chapter. The USACE project manager (PM) is responsible for initiating and coordinating the defined CDQM activities.

1-2. Goals of the CDQM Program. The goals of the USACE CDQM program are to: 1) generate data of acceptable quality for the intended use; 2) satisfy the needs of the customer and the regulators; 3) generate sufficient data of known quality on the first attempt; and 4) provide an historical record for potential future use. When CDQM is used properly, the PM can readily measure the success of the team in meeting the project-specific DQOs. The USACE CDQM program consists of activities presented in ER 1110-1-263, CDQM for Hazardous Toxic and Radioactive Waste Remedial Activities, Engineer Manual (EM) 200-1-1, Validation of Analytical Chemistry Laboratories, EM 200-1-2, Technical Project Planning Guidance for HTRW Data Quality Design, and EM 200-1-3, Requirements for the Preparation of Sampling and Analysis Plans (SAPs).

1-3. Technical Project Planning. Each district is responsible for assessment of chemical data quality, including determination of data useability and DQO attainment. The district project chemist is a critical team member for this effort, and must be involved in preparation and review of project documents including scopes of work, SAPs, contract specifications, and final chemical data reports. The district project chemist must be involved at each step of an HTRW project, so that adequate data quality is maintained. The TPP process for design of DQOs is described in EM 200-1-2.

1-4. CDQM Activities. All HTRW projects require a comprehensive and multifaceted approach to QC and QA in order to achieve and document attainment of appropriate quality for the intended data usage. The district project chemist is the focal point to ensure that chemical data meet DQOs for each HTRW project. The district project chemist has several techniques to monitor and ensure the quality of chemical data. The district project chemist in conjunction with other members of the TPP team determine the appropriate level of compliance monitoring as discussed in ER 1110-1-263, Appendix A. This determination should be based upon the intended use of the data and the degree of confidence needed in the quality of the data. Compliance monitoring may consist of a combination of activities. Described below are twelve (12) activities that may be applied on a project-specific basis to assist in generating data of known quality. The twelve CDQM activities, their relative cost, and typical use are summarized in Table 1-1.

a. Validation of Primary and QA Laboratories. In general, commercial and government laboratories that support the USACE HTRW program should obtain a USACE laboratory validation prior to field studies or sample analysis. The QA laboratory is defined as the Chemistry and Materials Quality Assurance Laboratory (CMQAL), located in Omaha, Nebraska or a subcontracted agent that is responsible for analysis of the project QA samples. For some data uses, other programs (*i.e.*, State Fuel Storage Tank Program, A2LA, Navy and Air Force Installation Restoration Program (IRP) Audits) can be utilized. Projects should not be implemented without utilization of information from some accreditation authority. Validation should be maintained throughout the duration of the project. The USACE laboratory validation program is project specific. The validation is a parameter, method, and matrix-specific approval. For each new contract or delivery order awarded during the validation period, a project-specific request for validation should be sent to CENWO-HX-C (Corps of Engineers, Northwestern Division, Missouri River Region, HTRW-Center of Expertise, Chemical Data Quality Management Branch) for verification of laboratory status regardless of their expiration date on the list of validated laboratories. The primary objectives of the USACE laboratory validation program are to communicate to analytical service providers the USACE QC/QA requirements, verify the laboratories are performing specified analytical methods, and to ensure these laboratories meet the USACE requirements prior to sample analysis. Laboratory validations are performed under the administration of the HTRW-CX applying guidance outlined in EM 200-1-1. The USACE validation program is primarily based on SW-846 methods. The first step of the validation program is a paper review of the laboratory's capabilities to ensure that the proposed laboratory has the facility, equipment and personnel to meet the project required analyses. The laboratory must demonstrate capabilities by providing acceptable standard operating procedures (SOP) and successfully analyzing project required performance evaluation (PE) samples. The final step of the validation program is an on-site inspection of the laboratory's facility. Validation can be terminated at any step of the process due to inadequate laboratory documentation performance and/or execution. No notice or short notice on-site audits of facilities listed as USACE validated are available, but require the participation of at least one member of the project planning team.

b. Technical Document Review. The roles and responsibilities for document review are defined in the Environmental Cleanup and Protection Management Plan for Military Programs, 17 January 1996 and Corps of Engineers, Military Programs Directorate, Environmental Division, Policy and Technology Branch (CEMP-RT) Memoranda: 1) Environmental Cleanup and Protection Management Plan for Military programs, 17 January 1996; and 2) Technical Roles and Responsibilities for the USACE HTRW Program, 23 September 1997 (herein referred to as the HTRW Management Plan).

(1) HTRW Project Technical Verification Process. It is the responsibility of the contractor and the district to produce a quality product. Rather than employing multiple levels of detailed document review to ensure quality, the technical verification process transfers project

responsibility to the district and its contractors. In general, the HTRW design district is responsible for a QC review of the prime contractor's QC Plan and all project-specific deliverables. QC Plans, scopes of work, and other project documents completed in-house should be reviewed by an independent technical review function established by the design district. The Major Subordinate Command (MSC) will provide oversight of the district's QC process. Only inventory project reports for the FUDS program require approval at the division level. Districts may request HTRW-CX participation in a design district's independent technical review process. The MSCs may request HTRW-CX support in performing QA oversight and audits of HTRW design districts QC processes. HTRW-CX review is required on Category B projects (see below).

(2) HTRW Project Technical Categories. The HTRW design district screens each HTRW project against the decision tree criteria provided in Attachments 1 and 2 of the Management Plan to determine the appropriate review process. Category A includes all routine HTRW (as defined in the Management Plan), and all projects in the Preliminary Assessment(PA) phase and those beyond the Site Inspection (SI) or Resource Conservation Recovery Act (RCRA) Facility Assessment (RFA) phase. Category A excludes, however, National Priorities List (NPL) sites, Base Realignment and Closure (BRAC) sites, sites where innovative technologies are used, and sites with construction estimates greater than $5 million. Category B includes all projects not in Category A, and any projects of special district, MSC, or HQ concern.

(3) Roles and Responsibilities for Review of Specific HTRW Products. Review responsibilities will vary depending on the category (Category A or Category B) of projects. The HTRW design district is responsible for all reviews of projects in Category A (Attachments 1, 2, and 3 of the Management Plan). Key documents for projects in Category B will be reviewed and approved by the HTRW design district and reviewed by the HTRW-CX. The PM provides appropriate technical documents to the HTRW-CX and QA laboratory for their information or review. Technical chemistry review by the HTRW-CX will be completed within two weeks for a Scope of Work and within three weeks for all other documents from time of receipt. If shorter review times are required, the PM coordinates with the Technical Liaison Manager (TLM) at the HTRW-CX. Comments from the HTRW-CX will be provided to the PM for all projects reviewed. A copy of all review comments and responses is placed in the permanent project file. Districts/centers with insufficient staff chemist resources to provide in-house review should rely upon the military design district, CMQAL or the HTRW-CX for document review. Note only certain key documents have been identified for HTRW-CX review as Category B projects; these are identified in Table 2 of the Management Plan. In addition, Chemical Quality Assurance Reports (CQARs)(Chapter 4) and Chemical Data Quality Assessment Reports (CDQARs) (Chapter 5) from all projects will be sent to the HTRW-CX. The HTRW-CX is responsible for 10% review of both CQARs and CDQARs. A summary of the reviews will be sent quarterly to CEMP-RT by the HTRW-CX.

c. Sample Handling Quality Assurance. The QA laboratory provides quick feedback regarding problems with sample shipments. The QA laboratory is responsible for checking the sample shipment for temperature, proper preservatives, correct containers *etc.* The Technical Manager (TM) or district project chemist is then notified within 24 hours regarding the status of the sample shipment via facsimile, electronic mail or telephone call. For most projects, this is beneficial because problems are detected and resolved while the sampling team is still in the field. This approach reduces the re-mobilizations to the field. The CMQAL or contract QA laboratory, and the primary laboratory complete and report a “Cooler Receipt Checklist" for all shipments sent to the laboratory. An example cooler receipt checklist is found in EM 200-1-1. A chain-of-custody (CoC) record must be initiated at the sampling stage and maintained throughout the analysis and reporting stages of the process. Sample reports must be easily traceable to CoC records. All documentation pertaining to sample receipt or analysis should be included in the laboratory's data report. If this function is performed without analysis of QA samples, samples must either be shipped back to the project site or additional funds provided to properly dispose of samples.

d. QA Sample Collection and Analysis. QA sample collection and analysis is the main tool to determine that the data generated by primary laboratories is technically valid and of adequate quality for the intended data usage. Based on the needs of the project, a percentage of samples are homogenized (except samples for volatiles testing, which are co-located), split, given a unique sample identification (ID) and sent to a primary contract laboratory and to a QA laboratory for analysis. QA sample collection does not have to be performed at the same frequency or rate for all test parameters, on all matrices, during all project phases, nor for any one type of project. General considerations should include: 1) the data use and users as defined by the project-specific DQOs; 2) the total number of samples being generated (*e.g.*, a larger number of total samples collected may lower the percentage of QA samples needed); and 3) the need for statistically significant information from QA sample data. Ideally, the USACE QA sample collection and analysis program is an interactive process whereby the QA laboratory in conjunction with the TM or district project chemist detects and solves problems as sampling and analysis occurs to ensure that the data generated for the project meets the project DQOs. The “value added” by this program can be divided into two areas.

(1) Detecting Analytical Problems. A primary function of the QA laboratory is to analyze samples as prescribed by the project and produce a data package that is reviewed real-time (at the bench during the time of analysis) for later comparison to the primary laboratory’s data. Analysis and comparison of the QA sample data to the primary sample data can reveal problems with primary laboratory data even when all other data quality measurements are in control. A common problem is over-dilution of semi-volatile organic analytes by the contract laboratories. Analysis by the QA laboratory can help in deciding whether this was due to actual matrix effect or due to inadequate sample cleanup by the primary laboratory.

(2) Salvaging Data Useability. When the data comparison shows good correlation between the QA laboratory and primary laboratory data, this may bolster the credibility and useability of the data generated by the primary laboratory. This is especially true in cases where primary laboratory data comes under close scrutiny and fails some data quality criteria. Good correlation also reflects consistency in the sampling process, the lack of which is a major source of error or variation. The criteria that establish acceptable correlation between project, QC and QA sample results are described in Chapter 4.

e. Chemical Quality Assurance Reports (CQARs). CQARs are usually prepared by the CMQAL. The CQAR documents review of the QA laboratory data and the corresponding primary laboratory data. Data for project samples, QC samples and QA samples are compared, and the impact on the primary laboratory's data is documented. CQAR format is discussed in Chapter 4.

f. Chemical Data Quality Assessment Reports (CDQARs). CDQARs are prepared by the district project chemist. The CDQAR documents data useability, DQO attainment, and contract compliance. CDQAR format is discussed in Chapter 5.

g. Single or Double Blind PE Sample Analysis. Another means of testing the analyst’s proficiency in identifying and quantifying analytes of interest is the use of single or double blind PE samples. The composition of PE samples is known to the originator, but not the analyst. In a single blind PE sample, both the originator and the analyst know that the sample is a PE sample. The USACE uses single blind PE samples as part of the process to validate laboratories. In a double blind PE, the sample is containerized, labeled, and submitted as an environmental sample. The analyst does not know that the sample is a PE sample; ideally, the PE sample will be indistinguishable from the other project samples. The use of double blind PE samples is considered a more effective way of detecting problems, since the laboratory would not be aware that it was being evaluated. However, it may be difficult to disguise a standard reference sample as a project sample. PE sample data are evaluated for compound ID, quantitation, and sample contamination. PE samples are recommended for sites that have the potential for a majority of non-detects, or for sites where the contaminants of concern have already been identified. Currently, the complete range of organic and inorganic PE samples are available for water only. Selected organic and inorganic PE samples are available for soil.

h. Review of Primary Laboratory Data. An independent data review of the entire primary data set should be performed by the prime contractor for contracted projects. In addition, the district project chemist or QA laboratory should review a portion of the primary laboratory data. The percentage of primary laboratory data reviewed by the government depends upon the project-specific DQOs. The district project chemist or CMQAL should review all the primary laboratory data for in-house projects. Data review is conducted to ensure that: 1) QC data provided in the laboratory deliverables are scientifically sound, appropriate to the method, and

completely documented; 2) QC samples are within established guidelines; 3) data were appropriately flagged by the laboratory; 4) documentation of all anomalies in sample preparation and analysis is complete and correct; 5) corrective action forms, if required, are complete; 6) holding times and preservation are documented; 7) data are ready for incorporation into the final report; and 8) data package is complete and ready for data archive. Details of the data review process are described in Chapter 3.

i. Validation of Data. Data validation is the process of data assessment in accordance with EPA regional or national functional guidelines or project-specific guidelines. Data validation includes assessment of the whole raw data package from the laboratory.

j. Field Audits. Sample collection field oversight is discussed in detail in Chapter 6. Audits should be performed on both an announced and unannounced basis, and should be coordinated with government geotechnical personnel, as appropriate. Audits may be performed during any stage of the project.

(1) Procedures. The auditor is responsible for checking that samples are collected and handled in accordance with the approved project plans and for confirming that documentation of work is adequate and complete. Specifically, the auditor should ensure that performance of field activities satisfies the project DQOs. Original records generated for all audits are retained within permanent project files. Records may include audit reports, written responses, record of the completed corrective actions, and documents associated with the conduct of audits that support audit findings and corrective actions. Checklists included in Chapter 6 can be used to guide performance of a field audit. For construction activities, the audit should assess the prime contractor's implementation of the three-phase chemical data control process. Details on contractor QC of field activities are found in EM 200-1-3.

(2) Personnel. Trained and experienced personnel should perform the field audits. These personnel should be knowledgeable in the subjects necessary for assessing the quality of the work being observed, including thorough knowledge of the contractual requirements. Preferably, field audits should be carried out by government personnel. The field audits may be performed by contract personnel with some objective relationship to the work being conducted in the field (*e.g.*, a prime contractor auditing its subcontractors).

(3) Desk Audit of Field Activities. Another mechanism for auditing field activities as they occur is to include government technical review of Daily QC Reports and field logs while the contractor is in the field. Desk audits of field activities require that these reports be supplied on a periodic basis (*e.g.*, daily or weekly) to the USACE technical staff. The requirement for periodic reporting must be included in the contract specifications or project delivery order, as well as in the project work plans. Since the contractor knows of this reporting requirement, it is not possible to perform an unannounced desk audit of field work.

k. Laboratory Audits. The primary and QA laboratories are responsible for maintaining detailed procedures to support the validity of all analytical work. Laboratory audits may consist of on-site inspections and/or analysis of PE samples. The audit verifies the laboratory's continuing ability to produce acceptable analytical data. If a performance problem is identified for sample analysis or data reporting, the HTRW-CX reserves the right to audit the laboratory anytime during the eighteen month period of validation. Laboratory audits may be carried out on either an announced or unannounced basis. More detail on this type of audit is found in EM 200-1-1.

l. Tape Audits. The purpose of a raw data review (tape audit) is to assess the quality of the data and to evaluate the overall laboratory performance. This information is then used by the data user to evaluate data quality and make a determination on the acceptability and the useability of the data. The tape audit is designed to independently verify the data reduction practices of an individual laboratory. All of the raw data from a given batch is recalculated by the evaluator and is compared to the results reported by the laboratory. The data quality is measured by laboratory compliance with the required methods and acceptable laboratory practices for analysis and for data reduction. Tape audits can only be performed when a specific analytical instrumental raw data output has been stored electronically. To implement this type of audit the contract must require the laboratory to provide electronic data (*i.e.*, magnetic tapes) needed to perform the audit. In addition, a means to read the data must be made available.

1-5. Primary CDQM Activities. While all twelve of the CDQM activities discussed in the previous section may be used on a project, six of the twelve should be used on most projects. The six primary CDQM activities for USACE HTRW projects are 1) validation of primary and QA laboratories, 2) technical document review, 3) sample handling QA, 4) QA sample collection and analysis, 5) preparation of CQARs by a qualified entity, and 6) preparation of CDQARs by the district project chemist. These elements should routinely be considered as candidates for inclusion in each project's set of CDQM activities.

a. Documentation of Selected CDQM Activities. The CDQM activities selected for each project shall be documented in the project-specific DQOs. A recommended procedure for documentation of the CDQM process is presented in American National Standard, Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs (ANSI/ASQC E-4-1994).

b. Waiver of CDQM Activities. ER 1110-1-263 allows for any aspect of the program to be waived except for the DQO element specified in ER 1110-1-263 Section 7.b. ER 1110-1-263 states that all other CDQM elements may be waived for a specific project by the district PM with concurrence from the technical project team as defined in EM 200-1-2. The intent of ER 1110-1-263 is to provide a flexible CDQM program that produces data of known quality to satisfy the project-specific DQOs.

c. Documentation of Waiver. If the district project chemist in conjunction with the PM and technical project team decides not to use all of the six primary CDQM elements discussed above, a memorandum for record (MFR) is required. The district PM must document in the MFR what procedures will replace the waived compliance monitoring activity and demonstrate the concurrence of the technical project team including the district project chemist. The district project chemist will typically be tasked by the PM to prepare this documentation. The MFR should include the PM's signature and the project team's concurrence along with the following elements: 1) brief description of the project; 2) summary of the project objective; 3) description of the waived CDQM activities; and 4) description of alternate procedures to ensure data quality. Districts with insufficient staff chemist resources to provide technical team support should rely upon other HTRW design districts, the CMQAL, or the HTRW-CX for chemistry support.

1-6. Use of QA Samples by Project Phase. The use of QC and QA samples is a particularly powerful tool for maintenance of data quality. With primary, QC and QA data for a single sampling point one may perform both inter-laboratory and intra-laboratory data comparisons. In addition, QA samples may provide unique indications about the quality of the primary laboratory's data. The following sections describe the use of QA samples in various project phases.

a. Investigative Phase. The use of QA samples during the investigative phase adds value by verifying the analytes of concern and quantifying the levels of contamination. In general, QA samples are targeted in locations of known or expected contamination. If the primary and QA laboratory data are comparable, then this provides an additional level of confidence that the correct action was taken. If the primary laboratory data does not compare with the associated QA laboratory data, then this assures that the data from the site will be completely evaluated prior to a decision. In addition, the QA laboratory data yields information regarding the spatial heterogeneity of the soil contamination.

b. Pre-Design Phase. The pre-design phase of the HTRW program consists of bench and pilot scale studies. If data generated from these activities are used to size the system, accuracy of results is critical. Any false positive or false negative from the bench or pilot study could result in costly changes following construction of the completed system. QA sample collection provides a verification of the prime contractor's results for use in their design.

c. Remedial Action Phase. The remedial action phase of the HTRW program consists of treatment system analytical support. Verification of results from the actual treatment operations is a critical check for long-term operation of the system. QA samples would be useful during the early stages of the project when the system is optimized or at stages of major equipment changes. Many treatment systems focus on discharge quality, and verification of the results aids in the acceptability by the regulators.

d. Post-Remedial Action Monitoring. The post-remedial action phase of the HTRW program typically includes post-excavation confirmation sampling and/or treatment system analytical support. QA sample checks on post-excavation samples can bolster regulator's confidence in the effectiveness of remediation. Analytical support during the operation and maintenance (O&M) phase can last up to thirty years in the case of long-term monitoring. In all likelihood, the primary laboratory would change several times during the course of a long-term monitoring project. Use of the same QA laboratory would be instrumental in providing continuity from one laboratory's results to another and for resolving problems that inevitably arise when a large volume of data is collected over a long period of time.

1-7. Omission of QA Samples. For certain projects, QA samples may not be the best method of ensuring attainment of DQOs. The decision to omit QA samples for a given project must be made by the district project chemist in conjunction with the PM and technical project team. Omission of QA samples should be based on meeting project objectives and goals, rather than simply to reduce cost. The district chemist must balance the need to maintain quality with the need to perform work for a reasonable cost. The project categories that may not be good candidates for QA sample collection are described below.

a. Underground Storage Tank (UST) Removals. Samples collected to meet state or federal requirements pertaining to UST removals may omit QA samples if regulatory deadlines preclude the QA process.

b. Lead Paint Testing. Construction building material and debris sampling to test for leaded paint is not generally considered to be HTRW work. Samples of building materials or debris collected solely to test for the presence of leaded paint will not typically benefit from use of QA samples.

c. Asbestos Testing. Construction building material and debris sampling to test for asbestos is not generally considered to be HTRW work. Samples of building materials or debris collected solely to test for the presence of asbestos will not typically benefit from use of QA samples.

d. Process Monitoring. Samples collected to demonstrate the day-to-day efficacy of intermediate steps during a treatment process will not typically employ QA samples. However, collection of QA samples from the treatment system influent and discharge locations is recommended on an occasional basis.

e. Waste Characterization. Samples collected of drummed materials, tank contents, barrels, and similar materials for hazardous waste profiling do not usually employ QA samples.

f. Treatability Studies. Samples collected as part of a treatability study to demonstrate the efficacy of a remedial process do not usually employ QA samples. QA samples are

recommended for optimization studies.

g. Air Samples. Samples collected as part of an ambient air monitoring program usually do not employ QA sample collection. Specifically, this would apply to co-located air samples for both gas phase and particulate related components since co-located samples are not homogeneous. Gas phase samples collected with a split sampling device are likely to be homogeneous, and QA samples may provide added value.

h. Wipe Samples. Wipe samples (*i.e.*, for polychlorinated biphenyls (PCB) analysis) will not usually benefit from QA sample collection since co-located wipe samples are not identical.

i. Non-routine Methods. Certain methods are experimental, or laboratory-specific, and it is not possible to replicate them in a QA laboratory. If duplication of the method is difficult, QA samples are not usually employed.

j. Screening Data. Samples collected as part of a screening program usually do not employ QA sample collection. This would include screening data generated from immunoassay test kits, x-ray fluorescence, colormetric, or field gas chromatography analyses.

1-8. Fraud Deterrence. Although not specifically designed to detect fraud, the USACE QC/QA program of laboratory validation, auditing (laboratory and field), sample receipt inspections, and review, verification, and/or validation of project, QC and QA data serves as a creditable deterrent to fraud.

1-9. Training. A number of training sessions are available (both internal and external to USACE) to provide the needed understanding of the principles and proper execution of the USACE CDQM program. USACE staff are encouraged to avail themselves of this training as appropriate.

1-10. Procedures for CDQM by Project Phase. The following outlines the procedures for CDQM for the investigative, pre-design and design, and remedial or removal action phases of the USACE HTRW program. The outlined activities demonstrate use of the six primary CDQM activities described in Section 1-5 and the technical document review process for Category A projects described in Section 1-4.b.

a. Investigative Phase. The investigative phase of the HTRW program consists of site characterization, engineering analysis, risk assessment, potentially responsible party (PRP) data gathering, and regulatory analysis. The investigative phases from the CERCLA process are the PA/SI and the Remedial Investigation/Feasibility Study (RI/FS). The investigative phase from the RCRA process are the RCRA Facility Assessment (RFA), RCRA Facility Investigation (RFI) and the Corrective Measures Study (CMS). The investigative phase of the FUDS program is

executed consistent with, but not identical to, the CERCLA process. For non-time critical removal actions, a PA/SI is performed initially and is followed by an Engineering Evaluation/Cost Analysis (EE/CA). The EE/CA takes the place of the RI/FS.

(1) HTRW design district writes Scope of Services. For Category B projects (see paragraph 1-4.b.(2)), the HTRW design district submits Scope of Services to HTRW-CX for review.

(2) HTRW design district solicits prime contractor services.

(3) HTRW design district negotiates and awards contract or delivery order.

(4) Prime contractor identifies primary laboratory to the district.

(5) The PM, TM or district project chemist requests validation of the primary laboratory by the HTRW-CX via electronic mail or facsimile.

(6) The HTRW-CX follows the process described in EM 200-1-1 to validate the laboratory. If the laboratory has not previously been validated by the HTRW-CX, the district project chemist should screen the laboratory to determine if its technical capabilities merit validation. Depending on the laboratory's validation status, some or all of the following procedures may be omitted. If requested by the HTRW-CX, the primary laboratory submits its Laboratory Quality Management Manual (LQMM) or Quality Assurance Plan (QAP), a representative SOP; to demonstrate the laboratory has the capability to run the required methods, and petroleum hydrocarbon SOPs (if necessary) to the HTRW-CX. Based on satisfactory review of the QAP and SOPs, PE samples are sent if available. The laboratory is then inspected by HTRW-CX. Personnel from the HTRW design district and CMQAL will be notified of a scheduled inspection and may assist with this process. If the laboratory fails to become validated, another laboratory should be selected.

(7) The prime contractor submits the SAP, consisting of a Quality Assurance Project Plan (QAPP) and a Field Sampling Plan (FSP), for HTRW design district's approval. Other environmental regulatory programs may require different documentation than a SAP. For Category B projects (see paragraph 1-4.b.(2)), the HTRW design district sends SAP to HTRW-CX and HTRW-CX reviews the SAP and makes recommendations to HTRW design district.

(8) From the SAP, the HTRW design district or the CMQAL makes an estimate of the cost of QA sample analysis. The budgeted amount must be funded by the HTRW design district to the CMQAL prior to sending samples for QA analysis. The QA laboratory must also be notified that QA samples will be sent. The HTRW design district must provide the QA laboratory with the following information: 1) project name; 2) approximate sampling dates; 3) number of samples; 4) matrix (matrices); 5) analyses; 6) DQOs; and 7) turnaround time. An example checklist to

submit this information is included as Figure 1-1.

(9) Field work begins after SAP is approved by the HTRW design district.

(10) The TM or district project chemist coordinates with the prime contractor for field and laboratory activities. Samples are collected in the field with project and QC samples sent to the primary laboratory and QA samples sent to the QA laboratory. QA samples are sent to the QA laboratory throughout the duration of the sampling effort or as defined by the project objectives.

(11) The primary and QA Labs should be notified upon final shipment of project samples.

(12) Prime contractor's analytical results are submitted to the HTRW design district within the time frame identified in the contract. The analytical results that correlate with the QA samples are sent to the CMQAL at the same time.

(13) The QA laboratory or another qualified entity prepares the CQAR and submits it to the HTRW design district and the HTRW-CX. The HTRW design district provides the CQAR to the prime contractor for inclusion in the project report.

(14) Prime contractor prepares the draft project report and submits it to the HTRW design district. The project report should include the CQAR, as well as the contractor's assessment of the primary laboratory data. The report is reviewed by the same office(s) that reviewed the SAP.

(15) District project chemist writes the CDQAR addressing data useability and DQO attainment from information received from the prime contractor and the CQAR. CDQARs must be prepared for all in-house and contractor executed projects. CDQARs will be sent by the HTRW design district to the HTRW-CX for all projects.

b. Pre-Design and Design Phase. The pre-design and design phase of the HTRW program consists of remedial action selection and design. The CERCLA design phase is remedial design (RD). The corresponding RCRA phase is called the Corrective Measures Design (CMD). The following outline applies when the design is prepared by a contractor. Modifications will be required if the design is performed in-house.

(1) Design district writes Scope of Services. For Category B projects (see paragraph 1-4.b.(2)), the HTRW design district submits Scope of Services to HTRW-CX for review.

(2) Design district solicits prime contractor services.

(3) Design district negotiates and awards prime contractor design contract or delivery order.

(4) If investigative activities are included in the design contract, steps 4-15 of paragraph 1-10.a. should be followed.

(5) Prime contractor submits Design Analysis Reports that contains a section that specifically addresses chemical quality management concerns. The prime contractor also submits plans and specifications which include chemical quality management at the preliminary, intermediate, and final phases. For the Total Environmental Restoration Contract (TERC), the prime contractor submits a Work Plan for each delivery order. All these documents are submitted by the prime contractor for HTRW design district's approval. The chemical section of the plans and specifications or work plan should give the construction contractor instructions for writing the SAP in addition to including all necessary site-specific chemical detail. For Category B projects (see paragraph 1-4.b.(2)), the HTRW design district submits these documents (to include the design analysis, plans and specifications, and the work plan) to the HTRW-CX for technical review, and comments are sent back to the design district.

(6) Design district assures that appropriate comments are addressed and incorporated into the documents. Revised documents and annotated comments are sent to the offices generating comments at the next submittal stage.

(7) Final (100%) plans and specifications are approved by the design district. From the contract specifications, a preliminary estimate is made of the funding required to support specified QA activities. The district advertises and awards the construction contract. For a Request for Proposal (RFP), the district solicits proposals from construction contractors. The district technical team evaluates the proposals and selects a contractor. Several other contracting mechanisms (*i.e.*, Invitation for Bid (IFB), cost-plus, *etc.*) exist that could be used instead of the RFP.

c. Remedial or Removal Action Phase. Many construction offices do not have sufficient chemistry training to make the decisions necessary to support the HTRW program. These construction offices should rely on basic chemistry support from resources at their HTRW design district, CMQAL or the HTRW-CX. Several guidance documents integrate chemical data QA for remedial actions into existing QA procedures for construction:

ER 415-1-10 Contractor Submittal Procedures

ER 1180-1-6 Quality Management

EP 715-1-2 A Guide to Effective Contractor Quality Control

CEGS 01451 Contractor Quality Control

CEGS 01450 Chemical Data Quality Control

(1) District representative requests validation of the primary laboratory by the HTRW-CX via electronic mail or facsimile.

(2) See paragraph 1-10.a(6) for the process and procedures for laboratory validation.

(3) The designated HTRW design district, CMQAL or HTRW-CX (depending upon which organization is providing the basic chemistry support for the project) assists the Construction District in reviewing the SAP and makes recommendations to the construction district. Construction district approves or disapproves the prime contractor's SAP.

(4) See paragraph 1-10.a.(8) for estimating and funding QA analysis.

(5) Construction begins after SAP and prime contractor's laboratory are approved.

(6) The construction representative coordinates with the prime contractor for field and laboratory activities. See paragraph 1-10.a.(10) for laboratory coordination and shipment. QA samples are sent to the QA laboratory throughout the duration of the sampling effort or as defined by the contract specifications.

(7) Prime contractor notifies the primary laboratory and the CMQAL when the final project samples have been sent.

(8) Prime contractor's analytical results are submitted to the construction office for transmittal to the CMQAL within the time frame identified in the contract.

(9) The QA laboratory or another qualified entity prepares the CQAR and submits it to the construction district, associated HTRW design district and the HTRW-CX. The construction district provides the CQAR to the prime contractor for inclusion in the project report.

(10) The prime contractor submits the project report to the construction district. The project report includes the CQAR, as well as the contractor's evaluation of the primary laboratory data. The report is reviewed by the construction representative with assistance from HTRW design district, CMQAL, or HTRW-CX staff, if requested.

(11) Construction district writes the CDQAR addressing contract compliance, data useability and DQO attainment from information provided by the construction contractor and the CQAR. CDQARs will be sent by the construction district to the associated HTRW design district, and HTRW-CX for all projects.

1-11. Data Management and Archive Process. The prime contractor and laboratories are responsible for generating, controlling and archiving laboratory and field records for all projects. This information should be maintained with a system that is effective for retrieval of any documentation that affects the reported results. The TM determines whether supporting data should be transferred from the prime contractor to the USACE upon contract completion or remain the prime contractor's responsibility for archiving the data. This includes record generation and control, security, and maintenance of all project related documents. The duration of laboratory data and field record retention should be specified as part of the project DQOs.

a. Laboratory. The laboratory prepares and retains full analytical and QC documentation that can be tracked from initiation to disposal for each sample. The following minimum records should be stored for each project: 1) original work order, CoC, and other pertinent documents received with the samples, 2) communications between the laboratory, field, and the customer, 3)any associated corrective actions, 4) laboratory data packages, 5) finalized data report, 6) laboratory log books, and 7) electronic data. The laboratory should also maintain its QAP and relevant SOPs for the methods performed.

b. Field. Project-specific records that relate to field work performed should also be retained. These records may include correspondence, CoC records, field notes, and reports issued as a result of the work. In addition, records that document all field operations should be retained. This may include equipment performance records, maintenance logs, personnel files, general field procedures, and corrective action reports. For field operations hard copy records are acceptable.

Laboratory Notification Information Checklist

__ project name
__ project location
__ general project objectives
__ intended use(s) of data
__ name and address of sampler's firm
__ approximate sampling dates
__ approximate number of samples, by matrix
__ required data package turnaround time
__ funding source (contract number and/or MIPR number)
__ name, phone and facsimile numbers for person to be contacted by the laboratory if there are problems with the sample shipment
__ name and address of primary (contractor's) laboratory (to be included in notification to CMQAL)
__ project specific requirements

- analysis method(s)
- matrices
- extraction method(s)
- required sensitivity (reporting limits)
- required precision
- required accuracy
- required comparability

__ sample retention after analysis is complete
__ disposition of samples after required retention time
__ special data reporting requirements
__ any special needs or comments (*i.e.*, unusual target analytes)
__ revision number of notification

Figure 1-1

Table 1-1 CDQM Activities

QA Activity	Characteristics	Cost	Project Phase(s) In Which Commonly Used					
			PA	SI or RFA	RI/FS or RFI/ CMS	RD or CMD	RA or CMI	O&M
Lab Validation	Provides assurance that lab has necessary personnel & equipment to produce data of known and adequate quality	*	X	X	X	X	X	X
Document Review	Checks technical adequacy of project documents and monitors program compliance	$ to $$	X	X	X	X	X	X
Sample Handling QA	Quick feedback regarding problems with sample shipments	$	X	X	X		X	X
QA Sample Collection & Analysis	Detects analytical problems and may salvage data usability	$$ to $$$$$	X	X	X		X	X
CQAR Preparation	Monitors intra- and inter-laboratory data comparability	$ to $$$$	X	X	X		X	X
CDQAR Preparation	Checks contract compliance, data usability, and DQO attainment	$ to $$	X	X	X		X	X
Performance Evaluation Samples	Provides assurance that lab correctly identifies and quantitates analytes of interest	$ to $$$$$	X		X			
Primary Lab Data Review	Monitors precision, accuracy, completeness, reproducibility, and sensitivity of primary data	$ to $$$	X	X	X		X	
Data Validation	Rigorous evaluation of data according to explicit EPA or other agency guidelines	$$ to $$$$	X		X			
Field Audits	Real-time oversight of accuracy & adequacy of field activities	$ to $$	X		X		X	
Laboratory Audits	Unannounced audits verify lab's ability to produce acceptable data	$ to $$			X			X
Tape Audits	Raw data review verifies data reduction procedures of lab	$$$$ to $$$$$			X			

Cost ratings range from $ to $$$$$. $ corresponds to <$1000, while $$$$$ corresponds to >$10,000.
* For most programs, the cost of laboratory validation is funded by the HTRW-CX, not by the district or division. If laboratory validation is requested for a project that is outside those programs for which there is validation funding by the HTRW-CX, validation costs would typically be in the range $$ to $$$.

Chapter 2
CHEMISTRY DATA REPORTING REQUIREMENTS AND DATA PACKAGE DELIVERABLES

2-1. Data Reporting Requirements. The chemistry data package should contain enough information to demonstrate that the project's DQOs have been fulfilled. In general, one should be able to determine the precision, accuracy, representativeness, comparability, and sensitivity of the data from information contained in the data package. This description applies to both primary and QA laboratory packages. The amount of information required to demonstrate attainment of DQOs depends upon the acceptable level of uncertainty for the intended data use. In general, the type of data package required will fall into one of three general categories.

a. Screening Data Package. Screening data are generated by methods of analysis that tend to be relatively rapid, are performed in the field (as opposed to an off-site laboratory), and have less rigorous sample preparation. Screening data provide analyte ID, but tend to report false positives. Their ability to quantitate analytes is in general less precise and less accurate than "definitive" type methods (see below). Screening data must be confirmed by sending at least 10% of the samples for definitive analysis.

(1) The screening data package will depend on the screening method used. A typical screening data package will include the following:

- sample ID number
- preparation method
- analysis method
- detection limits
- identity and quantity of analyte(s) present
- date and time of sample collection
- date of sample analysis
- field equipment calibration

(2) More sophisticated field screening methods will involve QC samples such as duplicate samples, calibration standards, spiked samples, and/or blank samples. Results for these associated QC samples should also be included in the screening data package.

b. Definitive Data Package. Definitive data are produced using rigorous analytical methods, such as EPA reference methods. Analyte presence and quantitation are confirmed through extensive QC procedures at the laboratory, which may be on-site or off-site. The definitive data package should include a cover sheet; Table of Contents; case narrative; the analytical results; sample documentation information; and internal laboratory QC/QA information. The data package should have sequentially numbered pages.

(1) Cover Sheet. The cover sheet should specify the following information:

- name and location of laboratory
- contract number
- project name & site location
- statement of data authenticity and official signature of release

(2) Table of Contents. Laboratory data packages should be organized in a format that allows for easy ID and retrieval of information. An index and/or table of contents should be included for this purpose.

(3) Case Narrative. A case narrative should be included in each report, outlining any problems with analysis. The case narrative should also list all methods used. The case narrative should contain a table correlating field sample numbers and laboratory sample numbers, and indicate which analytical test methods were performed and by which laboratories. Samples that were received but not analyzed should also be identified. Extractions or analyses that are performed out of holding times should be appropriately noted. The case narrative should define all data qualifiers or flags. Deviations of QC sample results from laboratory acceptance limits should be noted and associated corrective actions taken by the laboratory should be addressed. Any other factors that could affect the sample results (*e.g.*, air bubbles in VOC sample vials, excess headspace in soil VOC containers, the presence of multiple phases, inappropriate sample temperature, pH, container type or volume, *etc.*) Should be discussed.

(4) Analytical Results. The results for each sample should contain the following information at a minimum:

- project name and unique ID number
- field sample ID number as written on custody form
- laboratory name and location (city and state)
- laboratory sample ID number
- preparation and analysis batch numbers
- date sample collected
- date sample received
- date sample extracted or prepared
- date sample analyzed
- analysis time when holding time limit is less than forty-eight hours
- method numbers for all preparation and cleanup procedures
- analysis procedure including method numbers
- analyte or parameter
- detection limits (DL) - Estimated sample detection limits based on method detection limits adjusted for sample-specific factors (*e.g.*, aliquot size, dilution or concentration

factors, moisture content of a soil or sediment)
- quantitation limits (QL)
- analytical results with correct number of significant figures (Results for solid matrices should be reported on a dry weight basis)
- concentration units
- dilution factor: All reported data shall reflect any dilutions and/or concentrations. The dilution factor, if applicable, should be noted on the analytical report. If dilution is required for organic analytes, data from both runs should be recorded and reported.
- matrix (soil, water, oil, *etc*.)
- percent moisture or percent solids
- chromatograms, as needed
- sample aliquot analyzed
- final extract volume
- sample preservation

(5) Lower Limit Reporting. The laboratory may use a reporting limit (RL) expressed in terms of DL, QL, regulatory action level, or project-specific threshold limit, however the laboratory's use of these terms must be well defined. In addition, if the non-detect "ND", "U" ,"<", or other lower limit reporting convention is used, then these terms must also be defined.

(6) Sample Documentation. Original CoC record, shipping documents, and sample cooler receipt forms should be attached to each data package.

(7) QC/QA Information. The minimum data package must include internal laboratory QC/QA data with their respective acceptance criteria. The data package should also include the laboratory's method detection limits for project-specific parameters. The data package should correlate the method QC data with the corresponding environmental samples on a per batch basis. Method QC data include all spike recoveries, including surrogate spike recoveries; all measures of precision, including relative percent difference (RPD); and all control limits for accuracy and precision. This would include laboratory performance information such as results for method blanks (MBs), recoveries for Laboratory Control Standard (LCS) and Laboratory Control Standard Duplicate (LCSD), RPD for LCS/LCSD pairs, and recoveries for QC sample surrogates; and matrix-specific information such as sample duplicate RPDs, MS and MSD recoveries, MS/MSD RPDs, and field sample surrogate recoveries, serial dilutions, and post-digestion spikes. At a minimum, internal QC samples should be analyzed and reported at rates specified in the specific methods or as specified in the contract, whichever is greater. Any deviations from the control limits should be noted. For example, the data package should document the matrix spike(MS) and duplicate spike level, the MS and duplicate spike sample result, the percent recovery of the MS and duplicate, the respective RPD, and the acceptance criteria for spike recovery and RPD.

c. Comprehensive Data Package. A comprehensive data package contains sufficient information to completely reconstruct the analyses that were performed. Hence, comprehensive data packages include all batch QC results, instrument QC results (*e.g.*, initial calibration verification and continuing calibration verification), method detection limit studies, and raw data (*e.g.*, run logs, sample preparation logs, standard preparation logs, and printed instrumental output such as chromatograms). Typically, comprehensive data packages are required if third-party data validation is to be performed. EPA national functional guidelines, EPA regional functional guidelines, and project-specific guidelines for validation may all have distinct reporting formats. The appropriate validation guidelines should be consulted to determine what type of data package is required.

2-2. Data Reporting Format. Definitive data should be reported as hard copy and electronic deliverables with no discrepancies between the two. It is recommended that hard copy data reports and electronic data deliverables be generated from the same electronic database. Hard copy analytical data should be reported using a standard format.

2-3. Data Package Deliverable Time Schedule. A schedule for data delivery should be established so that data packages are provided as needed for chemical QA assessment.

2-4. Sample Identification Table. The sample ID table is used to provide the CMQAL with the necessary sample ID information for preparation of the CQAR. The sample ID table correlates field sample numbers and laboratory sample numbers. It relates field, QC, and QA samples to one another where the relationship is not obvious, and identifies field QC samples (*i.e.*, trip blanks (TBs), equipment blanks (EBs), background samples) where their identity has been concealed. See Table 2-1 for an example table format.

Table 2-1
Sample Identification Table

Project Name and Number:_____ **Date:**_____
Sampling Leader/Team:_____ **Laboratory Order Number(s):**_____

Project Sample Number	QC Duplicate Sample Number	QA Duplicate Sample Number	Lab Sent to	Date Collected	Matrix	Sample Type (QA/QC samples, trip blank, etc.)

Chapter 3
DATA ASSESSMENT

3-1. Data Assessment. Any time chemical data are generated, their quality must be assessed prior to use. The type and degree of assessment required depends upon the project DQOs. Several different levels of data assessment exist, including data verification, data review, data evaluation, and data validation.

a. Data Verification. Data verification is the most basic assessment of data. Data verification is a process for evaluating the completeness, correctness, consistency, and compliance of a data package against a standard or contract. In this context, "completeness" means all required hard-copy and electronic deliverables are present. Data verification should be performed by the government or independent entity for QA laboratory deliverables, and by the laboratory contract holder for primary laboratory deliverables.

b. Data Review. Data review is the next step in the data assessment hierarchy. Data review is the process of data assessment performed to produce the CQAR. Data review includes an assessment of summary QC data provided by the laboratory. CQAR preparation is described in detail in Chapter 4. Data review may include examination of primary and QA laboratory data and the internal QC and QA sample results to ascertain the effects on the primary laboratory's data.

c. Data Evaluation. Data evaluation is the process of data assessment done by district project chemists to produce a CDQAR. Data evaluation is performed to determine whether the data meet project-specific DQOs and contract requirements. CDQAR preparation is described in Chapter 5. To prepare a CDQAR, the district project chemist relies upon the DQO summary from the SAP, the CQAR, field oversight findings, laboratory audits, PE sample results, and any other data quality indicators available.

d. Data Validation. Data validation may be required for certain projects. Validation is a process of data assessment in accordance with EPA regional or national functional guidelines, or project-specific guidelines. Data validation includes assessment of the whole raw data package from the laboratory.

e. Special Requirements. Often, the requirements for data assessment will depend upon the project phase. In particular, data for use in a risk assessment will have specific quality requirements. There are several excellent references on this topic, including Chapter 3 of EM 200-1-4, ["Risk Assessment Handbook: Human Health Evaluation"]; and "Guidance for Data Useability in Risk Assessments (Parts A and B) [Office of Emergency and Remedial Response, EPA Directive 9285.7-09A, 1992].

3-2. Required Level of Data Assessment. The degree of data assessment will be different for screening level data than for definitive data. Screening level data are typically characterized by less stringent QC/QA procedures. Assessment of screening level data consists of checking whatever QC/QA indicators are available, and confirming the results with definitive analyses, usually at a 10% frequency.

3-3. Assessment of Definitive Data. Definitive data are characterized by rigorous QA/QC procedures. The following set of general procedures should be applied to the extent possible for all definitive data sets.

a. Data Verification. Definitive data assessment begins at the primary and QA laboratories. General processes for data quality management at the laboratory are described in EM 200-1-1 as well as EM 200-1-2. Once the data have met the laboratory's standards, data verification is performed to determine if the data package is correct and complete.

b. Data Review. See the attached Table 3-1 for more details on the specifics of data review. Data review documents possible effects on the data that result from various QC failures. It does not determine data useability, nor does it include assignment of data qualifier flags.

(1) The initial inspection of the data screens for errors and inconsistencies. The chemist checks the chain of custody forms, sample handling procedures, analyses requested, sample description and ID, and cooler receipt forms. The chemist then verifies that the data were checked by the laboratory manager or QA officer. Sample holding times and preservation are checked and noted.

(2) The next phase of data quality review is an examination of the actual data. By examining data from laboratory matrix duplicates, blind duplicates, TBs, EBs, laboratory MBs, LCSs, LCSDs, MS samples, matrix spike duplicate (MSD) samples, surrogate recoveries, and field samples, the chemist can determine whether the data are of acceptable quality.

(a) Both laboratory control samples (LCSs) and matrix duplicates are examined during data review. The precision of the data is quantified by the RPD between two results obtained for the same sample. The samples may be either internal laboratory QC samples (*i.e.*, LCSs) or field samples. A high RPD in an LCS/LCSD pair is an indication of overall method failure, and may result in the rejection of an entire data set. Laboratory matrix duplicates and MSDs are also assessed by their RPD values. High RPD values for matrix duplicates indicate a lack of reproducibility, and such data may be qualified or rejected. Any such results should be noted in the assessment of data quality.

(b) Data from blank samples are examined to determine if sample contamination occurred either during or after the sample collection. Equipment or rinsate blanks consist of reagent water

passed through or over sampling equipment following sample collection and sample equipment decontamination. Contaminated EBs indicate inadequate decontamination between samples, and the strong likelihood of cross-contamination between samples. MBs are blank samples prepared in the laboratory and analyzed along with project samples. If analytes are detected in a MB, it is a strong indication of laboratory contamination. This would raise the possibility that project sample aliquots were contaminated in the laboratory as well. TBs are samples of pure water that accompany the project samples from the field to the laboratory. TBs accompany each shipment of water samples to be analyzed for volatile organic compounds. Analysis of the TBs indicate whether sample contamination occurred during shipment and/or storage.

(c) Surrogate recoveries are scrutinized to ensure they fall within an acceptable range. Adequate surrogate recoveries in QC samples (blanks and LCSs) indicate that sample extraction procedures were effective, and that overall instrument procedures were acceptable. Surrogate recoveries in field samples are a measure of possible matrix effects and can indicate complete digestion or extraction of a sample. Surrogate recoveries outside control limits may result in qualified or rejected data.

(d) A LCS is an aliquot of a clean matrix (*i.e.*, clean water or sand) which contains a known quantity of an analyte. Good recoveries from an LCS indicate that the analytical method is in control and that the laboratory is capable of generating acceptable data. The evaluation of possible matrix effects and accuracy of the data are monitored by analysis of MS/MSD samples. A MS sample is prepared by adding a known quantity of an analyte to a field sample. The MSD is prepared in an identical manner. MS/MSD should be analyzed at least once per every twenty samples, or once per preparation batch, whichever is greater. Recovery of the MS indicates the absence of a matrix effect and is another measure of data accuracy. Comparison of the MS/MSD results provides an indication of data precision. All MS/MSD data should be examined. Low or high spike recoveries are evidence of matrix effects and poor accuracy; a high RPD for duplicates is evidence of low precision; all such results should be reported in the data review.

(e) A blind duplicate QC sample is submitted to the primary laboratory, which analyzes the majority of the samples. Analysis of the QC duplicate sample provides a measure of sample homogeneity and intra-laboratory variations. An additional replicate sample is provided to an independent QA laboratory, to provide a further test of sample homogeneity and a test of inter-laboratory accuracy. QC and QA samples effectively provide triplicate analysis of a subset of the total project samples. The three results for each set are carefully compared and tabulated. Data comparison criteria for evaluation of data comparability are described in Chapter 4. If two of three data sets agree, each laboratory's internal QC/QA data should be reassessed to determine which set of data is the most accurate. Data from related analyses may be inspected to determine which set of data is more accurate.

c. Data Evaluation. Data evaluation follows data review. During data evaluation, the district

project chemist uses the results of the data review as summarized in the CQAR to determine the useability of the data. The CQAR documents the potential effects of QC/QA failures on the data, and the district project chemist assesses their impact on attainment of DQOs and contract compliance.

d. Data Qualifiers. Data assessment will result in documentation of the quality and useability of the data. Data qualifiers, called flags, will be applied as appropriate to alert the data user of deficiencies in the data. Data qualifiers are applied by the district project chemist, taking into account the project-specific DQOs. The qualifiers may be different depending on the type of data evaluation performed. Data validation by EPA functional guidelines procedures may employ different flags than project-specific validation data qualifiers. Despite the data assessment flags used, the qualifiers serve the same purpose. The flags are used to delimit the useability of the data, generally because of QC failures.

Table 3-1
Data Evaluation
(Note 1)

QC Element (Sample Type, Analysis Condition, or Characteristic)	Type of Failure	Possible Causes (Note 2)	Major PARCCS Parameters Affected (Note 3)	Possible Effect on Data (Documented in CQAR)	Worst Case Data Evaluation (Documented in CDQAR) (Note 4)
Chain of custody	Chain broken or not kept	***Missing signatures***; missing seals; missing dates/times.	Completeness	Incomplete data	Data not legally defensible.
Sample labeling	Sample labels unreadable, missing or not attached to containers	***Failure to protect from moisture***; failure to use appropriate marker or labels; improper SOP	Representativeness Completeness	Incomplete data False positives False negatives	Invalidates all sample results.
Sample labeling	Samples mislabeled	***Sampler error***; improper SOP.	Representativeness	Incomplete data False positives False negatives	Invalidates all sample results.
Sample containers	Plastic container for organic analytes	***Samplers unaware of requirement***; improper SOP; failure to read SAP; SAP incorrect; insufficient containers.	Representativeness Accuracy Completeness	False positives False negatives High or low bias Phthalate interference	Invalidates all sample results.
Sample containers	Glass containers for boron, silica, & fluoride	***Samplers unaware of requirement***; improper SOP; failure to read SAP; SAP incorrect; insufficient containers.	Representativeness Accuracy Completeness	False positives High bias	Invalidates all sample results.
Headspace	Bubbles in water VOC vial > 6 mm; visible headspace in soil VOC container.	***Poor sampling technique***; caps not sealed tight; septum caps not used; dirt between cap and rim; soil not packed tight; improper SOP	Representativeness Accuracy Completeness	False negatives Low bias	Invalidates all sample results. Sample results > DL considered as minimum values only.

QC Element (Sample Type, Analysis Condition, or Characteristic)	Type of Failure	Possible Causes (Note 2)	Major PARCCS Parameters Affected (Note 3)	Possible Effect on Data (Documented in CQAR)	Worst Case Data Evaluation (Documented in CDQAR) (Note 4)
Preservation	No preservative or wrong pH	***No preservative added*** or improper amount of preservative added.	Representativeness Accuracy Completeness	False negatives Low bias	Invalidates sample results. Affects legal defensibility of data. Sample results > DL considered as minimum values only.
Preservation	Wrong preservative	***Improper SOP***; failure to read SAP; SAP incorrect; correct preservative unavailable.	Representativeness Accuracy Completeness	Incomplete data False positives False negatives	Invalidates or qualifies some or all sample results. Affects legal defensibility of data.
Preservation	Too warm (> 6 °C; Note (5))	***Insufficient ice***; shipping container inadequately insulated; samples not pre-chilled prior to shipping; transit time too long.	Representativeness Accuracy Completeness	False negatives Low bias	Invalidates sample results. Affects legal defensibility of data. Sample results > DL considered as minimum values only.
Preservation	Too cold (< 2 °C; Note (6))	***Shipping container inadequately insulated***; use of dry ice.	Representativeness Accuracy Completeness	False negatives Low bias	Invalidates sample results. Affects legal defensibility of data. Sample results > DL considered as minimum values only.

QC Element (Sample Type, Analysis Condition, or Characteristic)	Type of Failure	Possible Causes (Note 2)	Major PARCCS Parameters Affected (Note 3)	Possible Effect on Data (Documented in CQAR)	Worst Case Data Evaluation (Documented in CDQAR) (Note 4)
Sample filtration	Samples not filtered and preserved in field for dissolved metals.	***Samplers avoided time consuming step***; samplers unaware of requirement; improper SOP; failure to read SAP; SAP incorrect; filtration apparatus not available.	Representativeness Accuracy Completeness	False positives False negatives High bias Low bias	Invalidates sample results for dissolved metals.
Laboratory status	Laboratory not validated by HTRW-CX	Validation request not made by A/E, PM, or TM; laboratory not validated for one or more parameters; laboratory validation lapsed.	All may be affected	Various	Invalidates all or part of data set.
Holding times	Holding times exceeded	***Excessive analysis time; tardy ship date***; inappropriate shipping method.	Representativeness Accuracy Completeness	False negatives Low bias (Note 7)	Invalidates all sample results. Sample results > DL considered as minimum values only.
Analysis method	Wrong method	***Incorrect COC***; laboratory/analyst unaware of requirement; failure to read SAP; SAP incorrect.	Representativeness Comparability Completeness Accuracy Sensitivity	False negatives Low or high bias Low or high sensitivity	Invalidates or qualifies some or all sample results.
Detection limit (DL)	DL too high	***Insufficient measures to combat interferences (i.e., cleanup, background correction)***; insufficient sample; high dilution factor; wrong or inappropriate method.	Comparability Completeness Sensitivity	False negatives Low sensitivity	Invalidates sample results < DL

QC Element (Sample Type, Analysis Condition, or Characteristic)	Type of Failure	Possible Causes (Note 2)	Major PARCCS Parameters Affected (Note 3)	Possible Effect on Data (Documented in CQAR)	Worst Case Data Evaluation (Documented in CDQAR) (Note 4)
Method blank (MB)	Method blank absent (Note 8)	Improper SOP; lost during analysis.	Representativeness Accuracy Completeness	False positives	Invalidates all sample results > DL; sample results < DL are valid.
Method blank (MB)	Contamination > DL	***Contaminated reagents, gases, glassware; ambient contamination***; poor laboratory technique.	Representativeness Accuracy Completeness	False positives High bias	Invalidates all sample results where MB contamination is > 5% of sample concentration.
Equipment blank (EB) (rinsate blank)	Contamination > DL	***Improper decontamination of field sampling equipment***; contaminated rinsate water, containers, or preservatives.	Representativeness Accuracy Completeness	False positives High bias	Invalidates all sample results where EB contamination is > 5% of sample concentration.
Trip blank (TB) (travel blank) Applies to volatile-type analyses only (VOCs, BTEX, & GRO)	Trip blank absent	***Improper SOP***; broken during shipment; lost during analysis.	Representativeness Accuracy Completeness	False positives	Invalidates all sample results > DL; sample results < DL are valid.
Trip blank (TB) (travel blank) Applies to volatile-type analyses only (VOCs, BTEX, & GRO)	Contamination > DL	***Cross-contamination during shipment or storage***; contaminated reagent water, glassware, or preservatives.	Representativeness Accuracy Completeness	False positives High Bias	Invalidates all sample results where TB contamination is > 5% of sample concentration.

QC Element (Sample Type, Analysis Condition, or Characteristic)	Type of Failure	Possible Causes (Note 2)	Major PARCCS Parameters Affected (Note 3)	Possible Effect on Data (Documented in CQAR)	Worst Case Data Evaluation (Documented in CDQAR) (Note 4)
LCS	LCS absent (Note 9)	***Improper SOP***	Accuracy Completeness Comparability	False positives False negatives Poor precision (high or low bias)	Invalidates all sample results.
LCS and/or LCSD (also blank spike (BS) and/or blank spike duplicate (BSD))	Low recoveries	***Method failure***; improper spiking; degraded spiking solution; failed spiking device.	Accuracy Completeness Comparability	False negatives Low bias	Invalidates all sample results.
LCS and/or LCSD (also BS and/or BSD)	High recoveries	***Method failure***; improper spiking; degraded spiking solution; failed spiking device; contaminated reagents, gases, glassware, etc.	Accuracy Completeness Comparability	High bias Possible false positives	Invalidate all sample results.
LCS/LCSDs	High RPDs	***Method failure***; improper spiking; failed spiking device; contaminated reagents, gases, glassware, etc.	Representativeness Precision Completeness Comparability	Poor precision (high variability)	Invalidate all sample results.
Surrogates in MB, LCS, and LCSD (or BS and/or BSD)	Low recoveries	***Method failure***; improper spiking; degraded spiking solution; failed spiking device.	Accuracy Completeness	False negatives Low bias	Invalidates all sample results.
Surrogates in MB, LCS, and LCSD (or BS and BSD)	High recoveries	***Method failure***; improper spiking; degraded spiking solution; failed spiking device; contaminated reagents, gases, glassware, etc.	Accuracy Completeness	High bias Possible false positives	Invalidate all sample results.

QC Element (Sample Type, Analysis Condition, or Characteristic)	Type of Failure	Possible Causes (Note 2)	Major PARCCS Parameters Affected (Note 3)	Possible Effect on Data (Documented in CQAR)	Worst Case Data Evaluation (Documented in CDQAR) (Note 4)
Surrogates in samples	Low recoveries	***Matrix effects***; inappropriate method; method failure; improper spiking; degraded spiking solution; failed spiking device.	Accuracy Completeness	False negatives Low bias	Qualifies all sample results (i.e., possible matrix effects); rejection of individual sample results
Surrogates in samples	High recoveries	***Matrix effects***; inappropriate method; method failure; improper spiking; degraded spiking solution; failed spiking device; contaminated reagents, gases, glassware, etc.	Accuracy Completeness	High bias False positives	Qualifies all sample results (i.e., possible matrix effects); rejection of individual sample results
MS and/or MSD	MS and/or MSD missing	***Insufficient sample***; improper SOP; lost during analysis.	Representativeness Accuracy Precision	False negatives Low bias High bias	Qualifies all sample results (i.e., no measure of matrix effects)
MS and/or MSD	Low recoveries (Note 10)	***Matrix effects***; inappropriate method; method failure; inadequate cleanup; inadequate background correction; failure to use method of standard additions; improper spiking; degraded spiking solution; failed spiking device.	Accuracy	False negatives Low bias	Qualifies all sample results (i.e., possible matrix effects)

QC Element (Sample Type, Analysis Condition, or Characteristic)	Type of Failure	Possible Causes (Note 2)	Major PARCCS Parameters Affected (Note 3)	Possible Effect on Data (Documented in CQAR)	Worst Case Data Evaluation (Documented in CDQAR) (Note 4)
MS and/or MSD	High recoveries (Note 10)	***Matrix effects***; inappropriate method; method failure; inadequate cleanup; inadequate background correction; failure to use method of standard additions; improper spiking; degraded spiking solution; failed spiking device; contaminated reagents, gases, glassware, etc.	Accuracy	High bias False positives	Qualifies all sample results > DL (i.e., possible matrix effects).
MS/MSD	High RPDs	***Sample inhomogeneity***; inadequate sample mixing in laboratory; samples misidentified; method failure; improper spiking; failed spiking device; contaminated reagents, gases, glassware, etc.	Representativeness Precision	Non-Representative Sample Poor precision (high variability)	Qualifies all sample results > DL (i.e., possibly highly variable results).
Dilution factors	Extremely high dilution factors.	***High concentrations of interferences or analytes***; inappropriate method.	Accuracy Comparability Completeness	Low sensitivity False negatives Poor accuracy.	Invalidates samples with high DLs. May qualify sample results as "estimated".
Field QC sample	Field and QC sample concentrations do not compare within acceptable limits.	***Sample inhomogeneity***; insufficient mixing in field; samples not split but collocated (Note 11); insufficient mixing in laboratory.	Representativeness Precision	Non-representative sample Poor precision (high and /or low bias)	Qualifies all sample results > DL (i.e., possible highly variable results). Sample results < DL are valid.

QC Element (Sample Type, Analysis Condition, or Characteristic)	Type of Failure	Possible Causes (Note 2)	Major PARCCS Parameters Affected (Note 3)	Possible Effect on Data (Documented in CQAR)	Worst Case Data Evaluation (Documented in CDQAR) (Note 4)
Field QA sample (Note 12)	QA sample results do not agree with project and/or QC sample results.	Improper SOP (QA and primary laboratories used different analytical methods), inadequate cleanup; inadequate background correction; laboratory contamination; preservative problem; sample misidentification; method failure; etc.; sample inhomogeneity (no agreement with both project and QC sample results).	All may be affected	Various	Invalidates all or part of data set.

Notes:

(1) This table can be applied to both QA laboratory and primary laboratory sample results. Entries in the Possible Causes, PARCCS Parameters Affected, Effect on Data, and Possible Data Evaluation columns assume only one type of failure occurring at any one time. The cumulative or synergistic effects of more than one failure type occurring simultaneously make data evaluation more complex. Data evaluation involving multiple failure types is beyond the scope of this table.

(2) Most common cause in bold, *italic* and underline type.

(3) PARCCS parameters most affected are listed; one could almost argue that Representativeness, Completeness, and Comparability are affected by all of these failures, but only the most obvious are listed. Any failure that results in invalid data affects Completeness.

(4) All data evaluations are subject to discretion of district project chemist taking into account project DQOs and other factors.

(5) Refrigeration not required for trace metals (excluding mercury), bromide, chloride, fluoride, hexavalent chromium, gross alpha, gross beta, and total radium.

(6) Applies to silica in water. Also may apply to fresh and marine water sediments.

(7) Exceeding holding times on some analyses can produce false positives (i.e., carbonates, dissolved oxygen, etc.) and high bias (i.e., pH, carbonates, dissolved oxygen, etc.). High bias and false positives can also occur when degradation products of contaminants are also themselves analytes, i.e., when 4,4'-DDT is present and holding times are exceeded, high

bias and false positives for the degradation products 4,4'-DDD and 4,4'-DDD can occur.

(8) Method blanks are not appropriate for all analyses, i.e., pH, conductivity, % solids, etc.

(9) Laboratory Control Samples (LCSs) are not appropriate for all analyses, i.e., pH, % solids, total suspended solids (TSS), etc.

(10) Note that when native sample concentrations are significantly greater than the effective spike concentration that the conclusion of a matrix effect is only tentative. As a general rule of thumb, the native sample concentration should be no more than four times higher than the effective matrix spike concentration for the matrix effect to be considered probably present.

(11) Conventional sampling protocols for some analyte classes (i.e., VOCs, BTEX, and GRO) prohibit sample mixing and splitting because it results in the loss of major fractions of the analytes. Field and QC samples for these analytes are more appropriately collected as collocated sample pairs.

(12) Use of field QA sample data to evaluate project sample data assumes that field QA sample data is supported by a complete set of in-control laboratory quality control data.

Chapter 4
CHEMICAL QUALITY ASSURANCE REPORTS

4-1. Purpose. The purpose of the CQAR is to provide the data user with a timely review of chemical data quality. This is achieved through the inspection and analysis of QA samples, and through an examination of the corresponding project sample data. The exact format of the document is not as important as its content. The CQAR author should feel free to arrange the document in whatever format he/she is comfortable with as long as the essential information is conveyed in a succinct and timely fashion. The following format is suggested as a guide only. Whatever format is chosen should encompass at a minimum the same content that is specified below.

4-2. Cover Memorandum. The purpose of this attachment to the CQAR is to route the CQAR to its primary audience (the PM or TM). The standard memorandum format usually is adequate, which would identify the office symbol of the originating organization; the date of the transmittal; the facility name and project feature; major findings; and a point-of-contact (POC) and telephone number. The cover memorandum should be signed by the QA director whenever possible. Where local requirements for routing signed documents through the chain of command would delay delivery of the CQAR to the client, it is recommended that an unsigned advanced copy be sent to the client while the formal signed copy proceeds through channels. The cover memorandum should always refer the reader to the text for details (*i.e.*, to find out explicitly which sample results were affected), and should always advise the reader to have the district project chemist evaluate the data useability using the project DQOs.

4-3. Cover Page. The cover page should identify the title of the document, the report status (*i.e.*, draft, interim, final), its origin (*i.e.*, the name of the firm producing it), the project facility name (*i.e.*, Fort Green), project feature involved (*i.e.*, Lagoon Area), the date of preparation, and the name and signature of the responsible party.

4-4. Report Contents. The CQAR should contain the items listed below, although not necessarily in the format nor in the order presented. The format should present the information in an organized fashion which the reader can easily comprehend. The information below assumes that QA samples were collected and analyzed as part of the project QA effort.

a. Project Information. This section should contain any pertinent reference information to aid the reader in assessing the relevance of this report. This could include such things as funding documents (*i.e.*, MIPR Nos.), related report numbers and dates for the primary and QA laboratory data, sample receipt dates, and previous CQARs. The name, office symbol, and telephone number of a POC is also helpful.

b. Executive Summary.

(1) A summary description of the QA/QC effort expended on this data should be presented. Suggest citing the number, matrices, and types of samples tested (*i.e.*, 10 soils, 1 TB, 2 EBs, 1 QC soil, 1 QA soil), as well as the tests performed. Example statements might be, "Five soil samples were collected and analyzed in triplicate (project, QC, and QA); one for lead, one for mercury, and five for PCBs. A complete assessment of the data quality could not be made because there were no QC or QA samples collected for explosives and pesticides." The identities of the laboratories performing the various project tests should be cited. Any tables and/or attachments provided in the report which are not specifically referred to in later text should be referenced here (*i.e.*, all tables and attachments should be referenced somewhere in the text). Suggest referring to the Sample List, Analytical Methods List, and Data Comparison Tables here if this information is not provided elsewhere.

(2) The content and format of this section is mostly left up to the author, keeping in mind that the intent is to succinctly convey the overall results of the QA effort to the reader. Any major findings should be summarized here. State the possible effects upon the project sample data based upon: 1)a review of QA sample inspection results; 2)a comparison of QA sample data with project sample data; 3)a comparison of QC sample data with project sample data; 4)a review of primary and CMQAL QC data; and 5)a review of field QC data (*i.e.*, TB and EB results). Use the Data Evaluation Table in Chapter 3 for guidance in making this data review. State when a data review revealed no potential effects upon the project data. Also state when a complete data review could not be performed, *i.e.*, "A complete data review could not be performed because there were no QC or QA samples collected for pesticides." Potential effects on project data which might require immediate response or corrective action by the reader (*i.e.*, resampling) should be highlighted in some fashion (*i.e.*, bold print or underlined). Avoid, however, the use of strong adjectives to describe data with potential effects. The determination of data quality and usefulness lies solely with the district project chemist. The district project chemist is usually a district chemist, but may also be a HTRW-CX chemist or an CMQAL chemist when a district project chemist is not available. Do not use adjectives such as "invalid", "unacceptable", "suspicious", or "unreliable". The use of these or similar terms in the CQAR may be interpreted as contradictory by a regulator in the situation where a district project chemist determines that the data may be useful for project purposes, or may meet project DQOs in spite of weaknesses in laboratory or field QC measurements. For analogous reasons, avoid applying such terms as “valid”, “acceptable” “reliable”, *etc.* in describing data. The CQAR instead only should comment concerning the potential effects upon sensitivity (false negatives), precision (variability), accuracy (bias, false negatives, and false positives), representativeness, completeness (loss of data), and comparability (specified methods). Use statements such as, "The volatiles data may have an apparent negative bias because of improper preservation."; or, "The zinc values may contain false positives because of MB contamination."; or, "The explosives results were not corroborated by the method-required second column confirmation and may contain false positives."; or, "The low LCS recoveries for all semivolatile analytes may have caused some false negatives and probably a negative bias to detected analyte results. Any

positive semivolatile results should be considered as minimum values only."; or, "The disagreement between the field, QC, and QA sample results for metals may indicate sample inhomogeneity and a non-representative sample."; or, "The PCB results may be subject to false negatives because of elevated sample detection limits."; or, "The project data may not be legally defensible since the chains of custody were never signed in the field". Some indication of what portion of the data was affected should be given, *i.e.*, "EB contamination may indicate false positives and/or high bias in five of the nine sample results for mercury."

c. Sample List. List all QC, QA, and corresponding project samples with descriptive information including matrices, sample dates, field IDs, and laboratory IDs. A comprehensive list of all project samples is not required. Only those project samples which are part of a QC/QA/project sample set will be listed. This may not be necessary if there is only one set of QC/QA samples, or if there is relatively little data for each sample (*i.e.*, if the only analysis performed was for lead). However, where there is a large amount of data on multiple samples, a sample list is highly recommended to aid the reader in grasping what data is available to examine.

d. Analytical Methods List. This information can be presented in tabular form and at a minimum should specify the analytical method numbers and preferably (if known) the preparation method numbers as well. Note that this information may alternatively be provided in the data comparison tables.

e. Review of QA Sample Data. One of the purposes of this section is to assure the reader of the quality of the QA sample results, since the QA sample results will be the benchmark against which the project sample results will be judged. A second purpose is to evaluate the sample handling of the QA samples, since that has implications on how the project samples may have been handled.

(1) Review of QA Laboratory Quality Control Data. At a minimum, the following laboratory QC data should be reviewed: holding times, methods utilized, the results for MBs, LCS/LCSDs, MS/MSDs, matrix duplicates, and surrogates (see also Paragraph 4-4.g(1) below). This may be accomplished through tables summarizing laboratory QC data, or through descriptive statements such as, "The data package from XYD laboratory was complete with all required QC information. All MBs were free from contamination. All analyses were performed using specified methods within proper holding times. The majority of the duplicates, RPDs, laboratory control, surrogate, and MS recoveries were within laboratory control limits with the following exceptions..." Any excursions beyond laboratory control limits could then be listed. Since the QA data should be of high quality to begin with (implying that excursions should be few), it may be more efficient to just list the deviations from acceptable limits, rather than to tabulate all of the QC data in some kind of statistical format. The actual evaluation criteria could be the laboratory's own control limits, or could be set by the project DQOs. Project DQO evaluation

criteria sometimes may include USACE validation guidelines, or EPA national or regional functional guidelines, depending upon regulator requirements. See the Data Evaluation Table in Chapter 3 for general guidelines on evaluating data.

(2) Review of QA Sample Handling. Review of sample handling is performed at sample log-in and includes looking for correct sample containers, sampling procedures, sample preservation (*i.e.*,temperature, pH, *etc.*), packaging, labeling, and chain of custody procedures. Deficiencies noticed on QA samples at the QA laboratory imply that the project samples possessed similar deficiencies upon arrival at the primary laboratory. The QA laboratory should notify the district project chemist or TM of any serious deficiencies upon arrival. The project POC should be apprised of the implications of the deficiencies when notified, and asked for a decision on whether to proceed with the analyses. If the samples are analyzed in spite of the deficiencies, then the possible effects upon the QA and project sample data should be discussed in this section, highlighting any potential negative effects upon the data.

f. Data Comparison Tables. These tables compare the project, QC, and QA sample results in a matrix-type presentation. The header information should include project, sample, and analysis information, including facility name, project feature, sample date, field and laboratory ID numbers, sample description, method numbers, dates analyzed, dilution factors percent moisture, and concentration units. The primary and QA laboratories should be identified here as well. The body of the table should list any detected analytes, estimated detection limits (DLs) and quantitation limits (QLs) for detected analytes and a range of DLs and QLs for non-detected analytes from both the primary and QA laboratories; results from the project, QC, and QA samples, including the number of tentatively identified compounds (TICs) and the sum of the TIC concentrations; and an indication of agreement or disagreement in the data. A separate page detailing the agreement criteria and explaining any qualifiers used in the tables (*i.e.*, <, J, U, B, *etc.*) should be attached. Sensitivity (*i.e.*, DLs and RLs) should be evaluated only to verify that project-specific DQOs were satisfied. The agreement criteria shall be as shown in Table 4-1.

Table 4-1
Criteria for Comparing Field QC and QA Sample Data
(see text)

Matrix	Parameter	Disagreement	Major Disagreement
All	All	>5x difference when one result is < DL	>10x difference when one result is < DL
All	All	>3x difference when one result is < RL	>5x difference when one result is < RL
Water	All except TPH	>2x difference	> 3x difference
Soil	All except metals, VOCs, BTEX, and TPH	>4x difference	>5x difference
Soil	Metals	>2x difference	>3x difference
Water and Soil	TPH	Arbitrary (suggest >3x difference)	Arbitrary (suggest >5x difference)
Soil	VOCs and BTEX	Arbitrary (suggest >5x difference	Arbitrary (suggest >10x difference)

Reference: CRREL Special Report No. 96-9, "Comparison Criteria for Environmental Chemical Analyses of Split Samples Sent to Different Laboratories - Corps of Engineers Archived Data", Grant, C.G., Jenkins, T.F., and Mudambi, A.R., USACE Cold Regions & Environmental Research Laboratory, Hanover NH, May 1996.

The above criteria shall be applied when comparing field and QC sample pair data, as well as when comparing project and QA sample pair data. With the exceptions of volatile organic compounds (VOCs) in soil; and benzene, toluene, ethyl benzene, and xylenes (BTEX) in soil; and of total petroleum hydrocarbons (TPH) in either water or soil, the above criteria shall be used for all CQAR data comparisons. There is no definitive data for establishing comparison criteria for TPH (in water or soils) because of the wide variety of method modifications used by laboratories in the SW-846 8015M method ("M" is for "Modified"). The same is true for VOC and BTEX in soils because of the large error introduced during the conventional sample handling process. Result pairs are considered to disagree whether they are in the "Disagreement" or "Major Disagreement" category.

g. Review of Project Sample Data. This is the section the reader will refer to when seeking more details after reading the cover memorandum or the Executive Summary.

(1) Review of Primary Laboratory Quality Control Data. At a minimum, the laboratory QC data for the project and QC samples which correspond to the QA samples shall be reviewed. Some districts may arrange with the CMQAL to review the QC data for all of the project samples, although that is not required content for a CQAR. The laboratory QC data for project sample results should be examined in a manner similar to that used for the QA sample data (paragraph 4-4.e(1), above, and Table 3-1 in Chapter 3. Observed weaknesses in laboratory QC data may undermine the credibility of project sample data, even before comparison with the QA sample results. Missing QC data is always a deficiency, and will automatically injure data credibility by presenting the data in an unsupported manner. Samples prepared or analyzed outside of holding time may promote false negatives and give a negative bias to the associated data. Data sets without the required frequency of laboratory QC samples may have undefined data quality, although some explanation may be required. For example, sample results from a data set without a MB may be subject to false positives, but any samples in that same data set with undetectable levels of analyte would be unaffected (assuming LCS/LCSD recoveries were acceptable). Serious matrix effects may cause the data to fail project DQOs, making it unusable for project purposes. High RPDs in the project sample/matrix duplicate and MS/MSD pairs indicate inhomogeneity in the sample matrix, which would imply high variability (*i.e.*, low precision) in the project sample results. Some samples defy homogenization attempts; *i.e.*, sludges, clayey soils or sediments, multiphasic samples, and samples with macroscopic particles of analytes such as explosives and metals. High sample inhomogeneity can result in a determination that the samples were non-representative, making the associated analytical data unusable for project purposes. Determine if the primary laboratory possessed a current HTRW-CX validation when the analyses occurred, and if the project DQOs required that the project laboratories be validated. Data generated by an invalidated laboratory can adversely affect sensitivity, as well as all of the PARCCS parameters (precision, accuracy, representativeness, comparability, completeness, and sensitivity), making evaluation of its quality difficult. The above techniques also may be applied to QA sample data. Provide as much discussion as

necessary to fully explain the implications of out-of-control laboratory QC data upon the project sample results.

(2) Review of Field Quality Control Data. Any detectable analyte concentrations in the EB and/or TB should be commented on and their implications explained. There may be field notes provided separately or as part of the chains of custody which may yield clues concerning out-of-control QC data. Provide as much discussion as necessary to fully explain the implications of out-of-control field QC data upon the project sample results.

(3) Comparison with QA Sample Data. The availability of QA sample data provides more information for the data evaluator to further qualify the project sample data. QA sample data can reveal defective project sample data even when laboratory QC data are all in control. On the other hand, the confirming analysis of QA samples by an independent QA laboratory can provide evidence supporting the useability of project data that may otherwise have been questioned because of out-of-control laboratory QC data. QA sample data that does not agree with either the project sample or QC sample data should be discussed in detail in this section. When a data disagreement is observed, every attempt should be made to explain or to reconcile the disagreement. Verify at the outset that the data being compared all originated from splits (or co-located replicates in the case of volatiles) of the same sample. Do this by comparing sample descriptions, laboratory and field ID numbers, and the results from other analytes. Where feasible, both laboratories should be asked to check their results. Although there is the presumption that QA sample data in general is of higher quality, that may not always be the case. Where there is a disagreement involving the QA sample data, both data sets should be evaluated to ascertain if either has any weaknesses in its supporting laboratory QC data (*i.e.*, missing or out-of-control data). If the QA laboratory QC data is all present and in control, then the QA sample data is to be considered the "more correct", regardless of the status of the primary laboratory QC data. If the primary laboratory QC data is deficient, but the QA data agrees with the project sample results, then the QA data can be used to confirm the project data. These discussions all assume a single analyte perspective, *i.e.*, an out-of-control analyte will not affect the evaluation of another analyte that is in control, even if analyzed by the same laboratory. There is always the possibility that differences between the QA and project data could be due to sample inhomogeneity, and the temptation might exist to assign data discrepancies to this effect. The data evaluator is cautioned to use this explanation only as a last resort, or when supporting information is available, *i.e.*, when all three sample results (*i.e.*, project, QC, and QA) disagree, or when data from other parameters is also highly variable.

h. Sample Handling Documentation. This section should contain copies of all documentation related to sample handling and the QA inspection process, *i.e.*, chains of custody, cooler receipt forms, notices of deficiency, and documentation of any other communications (written or oral) with USACE or contractor POCs on correction of sample handling deficiencies.

i. Project Specific Concerns. This section should address all communications between the district, field offices, prime contractor, and the CMQAL. Examples of this may be a request from the district for lower detection limits, quick turnaround analysis, or other requests or comments of an unusual nature (*i.e.*, outside the boundaries of the pre-established project DQOs). This section should also address anything that may have improved the chemistry aspects of the project (*i.e.*, use of a USACE-validated laboratory, more appropriate methods, more QC and QA samples, faster turnaround of QA sample results, more field oversight, *etc.*).

Chapter 5
CHEMICAL DATA QUALITY ASSESSMENT REPORTS

5-1. Introduction. In this chapter, the requirements for CDQARs are defined. Each district is responsible for evaluation of chemical data quality, including determination of contract compliance, data useability and data quality objective attainment. The district's data evaluation is documented in the CDQAR. Districts with insufficient staff chemist resources to prepare CDQARs should rely upon the HTRW design district, the CMQAL, or the HTRW-CX for chemistry support. CDQARs should be prepared by the district project chemist for both contractor-executed and in-house projects.

5-2. Evaluation of Data Quality. The district project chemist has three general benchmarks for evaluation of project data: useability, DQOs, and contract compliance. The district project chemist must first determine if data are usable. Data useability is assessed using some form of data review followed by evaluation of other factors; general data review procedures are described in Chapter 3 of this EM. The district project chemist must also determine if project DQOs have been met. DQOs are summarized in the SAP; the chemist should review this summary and compare it to the project data to determine if DQOs were attained. Contract compliance should also be assessed by the district project chemist, to ensure that stated requirements for data quality have been met. The district project chemist should draw on all applicable sources of information to conduct the data evaluation. Good supporting documents might include the daily quality report, the contractor's assessment of data quality, results from PE samples, field oversight findings, and/or project-specific laboratory audits.

5-3. Documentation of Data Quality. The district project chemist documents chemical data quality determinations in a CDQAR.

a. Preparation of CDQAR. The CDQAR may be prepared in a variety of formats. The format for documentation of data quality shall be determined by the district project chemist on a project-specific basis. This allows the district project chemist flexibility to choose the most appropriate format for each HTRW project. Common formats include:

- a memorandum for record
- a separate report to the data users
- a memorandum to data user and/or PM and/or TM and/or customer
- an integral section of project report (prepared by or reviewed and approved by district project chemist)
- an appendix to the project report (prepared by or reviewed and approved by district project chemist)

b. Documentation. Documentation will typically include the following elements, as

applicable:

- description of project background and purpose
- summary of DQOs
- summary of sampling activities
- description of deficiencies in sampling, packaging, transportation, storage, or analysis
- restrictions on use of data
- statement of contract compliance or noncompliance
- data adequacy (including sensitivity requirements)
- lessons learned
- corrective actions taken

c. Documentation by Reference. If the above information is included in other documents, it may be incorporated by reference.

d. Assessment. The assessment of data useability and attainment of DQOs must be completed concurrent with or prior to completion of the draft project report.

Chapter 6
FIELD SAMPLING OVERSIGHT ON HAZARDOUS, TOXIC AND RADIOACTIVE WASTE PROJECTS

6-1. Introduction. QA of field sampling activities requires oversight of the various work elements involved. During implementation of sampling activities, field oversight assures that approved methods and procedures are used to perform the work. Data generated for all projects must be of known quality and should also be technically and legally defensible. The necessity for and frequency of field sampling oversight should be addressed during project planning when the scope and objectives of the proposed task are documented. Prior to the initiation of any field sampling activities, the USACE technical staff must approve all sampling and analytical protocols for technical adequacy to ensure field teams will collect samples properly during the field sampling activities. Oversight applies to both contract and in-house executed field sampling activities for any project phase.

6-2. Field Audit Checklists. Field audit checklists are useful tools for USACE technical personnel to conduct and document that approved protocols are being followed. Checklists for various field sampling activities are presented in Figures 6-1 through 6-8. The approved SAP, along with the field audit checklists, should be used as the basis for conducting field sampling oversight.

6-3. Sources of Error. Analytical procedures are often targeted as the main source of error in data analysis, but generally only represent a minimal contribution to the total error. Field errors are often the major source of error. Potential sources of field error are sample collection, sample handling, transport, preparation, preservation, and ID. The district project chemist should routinely communicate with the on-site QC personnel regarding these activities. The sampling portion of any data collection effort has historically been the most difficult in which to assess data quality. The chemist can provide QC for the bottles, reagents, and analyses, but it is difficult to provide QC measures for sample collection. Oversight provides a check on whether or not all the planning steps have been and project objectives are being implemented.

6-4. Frequency and Duration. The frequency and duration of oversight visits should be determined by the project technical team to ensure quality work and attainment of DQOs. The number of site visits and level of scrutiny will depend on the nature, length and complexity of the project, as well as past performance of the sampling team and the intended use of the data. Oversight of field sampling activities should be carried out on both an announced and unannounced basis. Although possibly predictable, oversight during the first stages of a field event and during sampling of critical locations or sample media should be a priority.

6-5. Feedback and Corrective Action. Feedback and corrective action, if appropriate, are the desired outcomes of the field sampling oversight. Feedback should be provided in written form

to the district representative or contracting officer's representative. For immediate correction of a problem, verbal feedback is acceptable followed by documentation for the file. Problems observed in the field should be identified and reported to the TM or contracting officer's representative for immediate resolution. The contractor should provide a written response of the completed corrective action to the TM or contracting officer's representative for the permanent project file. The checklists as well as the corrective actions should be placed in the project file. Unless empowered by the contracting officer's representative, or the district representative, or unless a condition is observed in the field which compromises personnel health and safety, all oversight findings requiring action should be routed through the district representative and not directly to the contractor by the field oversight personnel.

6-6. Documentation. Documentation of field sampling oversight is recommended for all projects. At a minimum, a report should be filed for any field sampling oversight conducted by USACE personnel. The report should include 1) all deficiencies or problems noted during the course of the oversight; 2) discussions held with the prime contractor and any corrective actions taken; 3) items that require follow-up action by the USACE or prime contractor; 4) unresolved questions from the prime contractor, the customer, and the USACE oversight personnel; 5) health and safety protocols and level of protection used; 6) general quality of the work observed; and 7) overall adherence to the approved work plans. Field sampling oversight is strongly recommended. The applicable manager should be encouraged to support this QA objective through funding and schedule coordination with the appropriate technical personnel.

Field Oversight Checklist - General Procedures

Project Name _____

Address _____

Facility Contact & Phone Number _____

Sampling Team Leader _____

Affiliation _____

Address & Phone Number _____

Sampling Personnel _____

Field Oversight Personnel _____

Affiliation _____

Date(s) of Oversight _____

Checklist section(s) completed for this overview:

1 __ 2 __ 3 __ 4 __ 5 __ 6 __ 7 __ 8 __

KEY:

1 General Procedures	2 Groundwater Sampling
3 Soil & Sediment Sampling	4 Surface Water Sampling
5 Waste Sampling	6 Storm Water Sampling
7 Air Sampling	8 Potable Water Sampling

****

1) Type of samples collected? _____

2) Were sampling locations properly selected? Yes __ No __

Comments _____

Figure 6-1

3) Were sampling locations adequately documented in a bound field log book using indelible ink? Yes __ No __

Comments _____

4) Were photos taken and photolog maintained? Yes __ No __

5) What field instruments were used during this study? _____

6) Were field instruments properly calibrated and calibrations recorded in a bound field log book? Yes __ No __

Comments _____

7) Was sampling equipment properly wrapped and protected from possible contamination prior to sample collection? Yes __ No __

Comments _____

8) Was sampling equipment constructed of Teflon®, polyethylene, glass, or stainless steel? Yes __ No __

Comments _____

9) Were samples collected in proper order? (least suspected contamination to most contaminated?) Yes __ No __

Comments _____

10) Were clean disposable latex or vinyl gloves worn during sampling? Yes __ No __

Comments _____

11) Were gloves changed before each sample? Yes __ No __

Comments _____

12) Was any equipment field cleaned? Yes __ No __

Comments _____

Figure 6-1 Continued

13) Type of equipment cleaned? _____

14) Were proper cleaning procedures used? Yes __ No __

Comments _____

15) Were equipment rinse blanks collected after field cleaning? Yes __ No __

Comments _____

16) Were proper sample containers used for samples? Yes __ No __

Comments _____

17) Were split samples offered to the regulatory agency representative? Yes __ No __

Comments _____

18) Was a receipt for samples form given to regulatory agency representative? Yes __ No __

Comments _____

19) Were any duplicate samples collected? Yes __ No __

Comments _____

20) Were samples properly field preserved? Yes __ No __

Comments _____

21) Were preservative blanks utilized? Yes __ No __

Comments _____

22) Were field and/or trip blanks utilized? Yes __ No __

Comments _____

23) Were samples adequately identified with labels or tags? Yes __ No __

Figure 6-1 Continued

Comments _____

24) Were coolers sealed with custody seals after collection? Yes __ No __

Comments _____

25) What security measures were taken to insure custody of the samples after collection? Yes __ No __

Comments _____

26) Were chain-of-custody and receipt for samples forms properly completed? Yes __ No __

Comments _____

27) Were any samples shipped to a laboratory? Yes __ No __

Comments _____

28) If yes to No. 27, were samples properly packed? Yes __ No __

Comments _____

29) What safety monitoring equipment, protection, and procedures were used prior to and during sampling? _____

30) Was safety monitoring equipment properly calibrated and were calibrations recorded in a bound field log book? Yes __ No __

Comments _____

Figure 6-1 Continued

Field Oversight Checklist - Groundwater Sampling

1) Type of wells sampled? (monitoring, potable, industrial, *etc.*)_____
_____

2) Were wells locked and protected? Yes __ No __

Comments _____

3) Were identification marks and measurement points affixed to the wells? Yes __ No __

Comments _____

4) What were the sizes and construction materials of the well casings?_____
_____

5) Were the boreholes sealed with a concrete pad to prevent surface infiltration?Yes __ No __

Comments _____

6) Was there a dedicated pump in the well? Yes __ No __

7) Was clean plastic sheeting placed around the wells to prevent contamination of sampling equipment and containers? Yes __ No __

8) Were total depth and depth to water determined before purging? Yes __ No __

9) What device was used to determine depth?_____

10) Were measurements made to the nearest 0.01 ft.? Yes __ No __

11) Was the measuring device properly cleaned between wells? Yes __ No __

Comments _____

12) Was the standing water volume in each well determined? Yes __ No __

13) How was the volume determined?_____

14) Was a sufficient volume purged prior to sampling? Yes __ No __

Figure 6-2

Comments _____

15) What was done with the purged water? Was it collected for proper disposal, containerized until characterized or sent to an approved treatment facility? Yes __ No __

Comments _____

16) How many volumes? _____

17) How was the purged volume measured? _____

18) What was the method of purging? _____

19) Were pH, conductivity, temperature, turbidity, and dissolved oxygen measurements taken and recorded during well-purging activities? Yes __ No __

Comments _____

20) Were pH, conductivity, temperature, turbidity, and dissolved oxygen readings stable prior to sampling? Yes __ No __

Comments _____

21) How many wells were sampled? _____

Up gradient? _____ Down gradient? _____

Comments _____

22) How were the samples collected?

Bailer ____Pump _____ Other _____

23) If pump was used, what type? _____

24) If a pump was used, was it properly cleaned before and/or between wells? Yes __ No __

Comments _____

25) What were the cleaning procedures? _____

Figure 6-2 Continued

26) Did bailers have polytetrafluoroethylene (PTFE)-coated wire leaders to prevent rope from coming into contact with water? Yes __ No __

27) Were bailers open or closed top? _____

28) Was a clean bailer and new leaders used at each well? Yes __ No __

Comments _____

29) Were samples properly transferred from the sampling device to the sample containers? (*i.e.*, purgeable sample first - not aerated, *etc.*) Yes __ No __

Comments _____

30) Was pH of preserved samples checked to insure proper preservation? Yes __ No __

Comments _____

31) Were samples iced immediately after collection? Yes __ No __

32) For what analyses were the samples collected?_____

-

33) If samples were split, what were the sample/station numbers for these? _____

34) Other comments or observations _____

_____

Figure 6-2 Continued

Field Oversight Checklist - Soil and Sediment Sampling

1) Type of samples collected? _____

2) General description of samples? _____

3) How many samples were collected? _____

4) Were background and/or control samples collected? Yes __ No __

Comments _____

5) Were representative samples collected? Yes __ No __

Comments _____

6) Were grab or composite samples collected? _____

7) Were composite samples areal or vertical? _____

8) How many aliquots were taken for the composite sample? ____

9) What procedures and equipment were used to collect samples?

_____ _____

10) Were samples thoroughly mixed prior to putting them into the sample containers? Yes __ No __

Comments _____

11) Were samples properly placed into sample containers? Yes __ No __

Comments _____

12) Were samples chilled with water iced immediately after collection? Yes __ No __

13) For what analyses were the samples collected?_____

14) If samples were split, what were the sample/station numbers for these? ___

Figure 6-3

15) Was a drilling rig, back hoe, *etc.*, used to collect soil samples? Yes __ No __

Comments _____

16) What was done with the soil cuttings from the drill rig or back hoe? Were the cuttings collected for proper disposal, or containerized until characterized? Yes __ No __

Comments _____

17) Were the drilling rig, backhoe, *etc.*, properly cleaned prior to arriving on site? Yes __ No __

Comments _____

18) What was the condition of the drilling and sampling equipment when it arrived on site? (cleanliness, leaking jacks, peeling paint) _____

19) Was a decontamination area located where the cleaning activities would not cross-contaminate clean and/or drying equipment? Yes __ No __

Comments _____

20) Was clean equipment properly wrapped and stored in a clean area? Yes __ No __

Comments _____

21) Was the drilling rig(s) properly cleaned between well borings? Yes __ No __

Comments _____

22) Were the cleaning and decontamination procedures conducted in accordance with the project plans? Yes __ No __

Comments _____

23) Other comments or observations._____
_____

Figure 6-3 Continued

Field Oversight Checklist - Surface Water Sampling

1) Type of samples collected? _____

2) General description of samples? _____

3) How many samples were collected? _____

4) Were background and/or control samples collected? Yes __ No __

Comments _____

5) Were grab or composite samples collected? _____

6) How many aliquots were taken for the composite sample? ___

7) What procedures and equipment were used to collect the samples? _____
_____

8) Were samples collected directly into sample containers? Yes __ No __

Comments _____

9) Did the sampler wade in the stream to collect the samples? Yes __ No __

Comments _____

10) Were the samples collected upstream from the sampler? Yes __ No __

Comments _____

11) Did the sampler insure that roiled sediments were not collected along with the water samples? Yes __ No __

Comments _____

12) Were representative samples collected? Yes __ No __

Comments _____

Figure 6-4

13) Was the pH of preserved samples checked to insure proper preservation? Yes __ No __

Comments _____

14) Were samples chilled with water iced immediately after collection? Yes __ No __

15) For what analyses were the samples collected? _____

_____

16) If samples were split, what were the sample/station numbers for these?

17) Other comments or observations _____

_____

Figure 6-4

Field Oversight Checklist - Waste Sampling

1) Type of samples collected? (oil, sludge, waste, wipe, chip, sweep)_____

_____

2) Description of containers or sources sampled? _____

_____

3) How many samples were collected? _____

4) What type of equipment was used to collect the samples?

_____ _____

5) What procedures were used to collect the samples? _____

_____

6) For what analyses were the samples collected? _____

7) If samples were split, what were the sample/station numbers for these? _____

_____

8) Were any special safety measures taken during collection of the samples? _____

_____

9) What level of safety protection was required for collection of the samples? _____

_____

10) Other comments or observations _____

_____

Figure 6-5

Field Oversight Checklist - Storm Water Sampling

1) Was outfall sampling point selection appropriate? Yes __ No __

2) Was visual monitoring conducted and recorded? Yes __ No __

3) Did the rainfall event produce a minimum of 0.1 inches of rain? Yes __ No __

4) Was the rainfall event preceded by a period of at least 72 hours during which no more than 0.1 inches of rain occurred? Yes __ No __

5) Was it a "normal" rainfall event (duration and total rainfall not more than 50% of the average storm event)? Yes __ No __

6) Was runoff produced? Yes __ No __

7) Types of samples collected? (grab, flow-weighted composite)

_____ _____

_____

8) Were grab samples collected within the first 30 minutes after the on-set of runoff? Yes __ No
9) If grab samples were not obtained during the first 30 minutes, were they at least collected within the first 60 minutes of discharge? Yes __ No __

10) What analytical procedures are going to be conducted on the grab samples? _____

_____

11) Were flow-weighted samples properly prepared (even time intervals)? Yes __ No __

12) What was the time duration over which the composite samples were obtained? _____

_____

13) Were composite samples composed of at least three discrete samples taken in each hour for the first three hours of discharge, or the entire storm if less than three hours in duration, with each sample being separated by minimum of 15 minutes? Yes __ No __

14) How was flow rate determined? _____

Figure 6-6

15) How was rainfall amount determined? _____

16) What analytical procedures will be conducted on the flow-weighted composited samples? ___
_____

17) What procedures and equipment were used to collect the samples? _____
_____

18) Were representative samples collected? Yes __ No __

Comments _____

19) Was adequate information recorded to document the sampling event? Yes __ No __

20) Was the pH of preserved samples checked to insure proper preservation? Yes __ No __

Comments _____

21) Were samples chilled with water iced immediately after collection? Yes __ No __

22) If samples were split, what were the sample/station numbers for these? _____
_____

23) Other comments or observations _____
_____

Figure 6-6 Continued

Field Oversight Checklist - Air Sampling

1) Is there a list of the air monitoring and meteorological stations? Yes __ No __

2) Is there a map(s) showing the location of air monitoring and meteorological stations? Yes __ No __

3) Is there a Contingency Plan addressing sampling failures caused by unpredicted meteorological delays? Yes __ No __

4) Does the sampling network agree with the project plan? Yes __ No __

Comments _____

5) Are there planned or required QC/QA samples scheduled? Yes __ No __

6) What are the contaminants of concern?_____
_____

7) Types of data collected? (particulate, gaseous, meteorological, *etc.*) _____
_____

8) Are there project-specific SOPs for sampling? Yes __ No __

9) Are the correct methods being performed? Yes __ No __

10) Type(s) of air monitoring equipment used? _____

11) Number of air monitoring stations? _____

12) Is there a data recording, reporting, and required data CoC plan? Yes __ No __

13) Are the air monitoring instruments locked and protected? Yes __ No __

14) Are there air monitoring calibration SOPs? Yes __ No __

15) Are the air monitoring instruments calibrated? Yes __ No __

Comments _____

Figure 6-7

16) Are calibration data and instrument serial numbers recorded in a log book? Yes __ No __

Comments _____

17) What meteorological data are being collected? _____

18) Number of meteorological stations? _____

l9) Are the wind speed and direction sensors located at the recommended height in meters? Yes __ No __

Comments _____

20) What is the duration for wind speed and direction readings? (2 hours, continuous) _____

_____

21) Are the meteorological instruments calibrated? Yes __ No __

Comments _____

22) Are calibration data and instrument serial numbers recorded in a log book? Yes __ No __

Comments _____

23) Are any air monitoring or meteorological stations located where the data collected could be biased? Yes __ No __

Comments _____

24) Did the sampling time and total sample volume collected provide sufficient sample for analysis which meets the required detection limits? Yes __ No __

Figure 6-7 Continued

Field Oversight Checklist - Potable Water Sampling

1) Did the sampling team verify that the sample tap was not located after a household purification and/or conditioning system? Yes __ No __

2) Were name(s) of the resident or water-supply owner/operator, mailing address, and phone number obtained by the field sampling team? Yes __ No __

3) Was clean plastic sheeting placed around the sampling point to prevent contamination of sampling equipment and containers? Yes __ No __

4) What were the preparatory purging procedures? _____
_____

5) Were aerator, strainer, and hose attachments removed from the tap prior to sampling? Yes __ No __

6) Were pH, specific conductance, and temperature readings stable prior to sampling? (pH ± 0.2 units, specific conductance ± 10%, temperature ± 0.5• C) Yes __ No __

Comments _____

7) Were the samples collected directly into the sample container? Yes __ No __

8) Were clean gloves used for each sampling location? Yes __ No __

9) How many taps were sampled? _____

10) If dissolved metals are a parameter of concern, were the samples filtered in the field prior to preservation? Yes __ No __

11) Was pH of preserved samples checked to insure proper preservation, and was this check completed without contaminating the sample? (*i.e.* do not put pH test strip into sample container) Yes __ No __

Comments _____

12) Were samples iced immediately after collection? Yes __ No __

13) For what analyses were the samples collected? _____

Figure 6-8

14) If samples were split, what were the sample/station numbers for these, making sure that they have been blind to the laboratory on the chain-of-custody form. _____

15) Other comments or observations _____

_____

Figure 6-7 Continued

Chapter 7
USACE CHEMIST TRAINING AND CERTIFICATION

7-1. Introduction. This document provides policies, procedures, responsibilities, and requirements for the administration and management of the USACE Environmental Chemists Career Program, as it relates to CDQM. The guidance outlined in this document is subordinate to policy established by either the supervisory chain of command or the responsible human resources office.

7-2. Objectives. The Environmental Chemist Career Program has four main objectives.

a. To raise the professional standards and improve the practices of environmental chemistry by giving special recognition to those USACE employees who, in fulfilling prescribed standards of performance and conduct, have demonstrated and maintained a high level of competence and ethical practices.

b. To identify for USACE, its customers, and the public, persons with broad knowledge of environmental chemistry and the capability to professionally apply that knowledge.

c. To establish a continuing career development program whose goal is the improvement of individual chemistry skills and professional development.

d. To enhance the body of knowledge and standards of conduct for the practice of environmental chemistry.

7-3. Eligibility. Any USACE employee meeting the minimum requirements may apply for certification.

7-4. Certification Program. Because a nationally or internationally recognized certification program is not available for the registration of environmental chemistry professionals, the USACE has developed this certification program. For the short term, the USACE will administer this certification process using the services of the American Institute of Chemists, (AIC) Inc. In the long term, Department of Defense (DoD) administration will be sought under the umbrella of the Tri-Service Agreements.

7-5. Certification Categories. Applicants may be certified as a Senior Chemist, Chemist, or Chemistry Technician (collectively referred to as environmental chemistry professionals) encompassing HTRW assignments to laboratories, districts, regions, centers, divisions, and HQ. For each category, applicants must fulfill a set of minimum requirements and pass a written examination.

a. Minimum Requirements.

(1) Certified Senior Chemist (CSC). Applicants must complete a minimum of a baccalaureate degree with a major in chemistry, chemical engineering, or a closely related field, and possess at least five years of directly relatable work experience.

(2) Certified Chemist (CC). Applicants must complete a minimum of a baccalaureate degree with a major in chemistry, chemical engineering, or a closely related field, and possess at least three years of directly relatable work experience.

(3) Certified Chemistry Technician (CCT). Applicants must complete a minimum of an associate degree with emphasis in chemistry, chemical engineering, or a closely related field, and possess at least five years of directly relatable work experience.

(4) Calculation of Work Experience. Work experience requirements are calculated based solely on environmental chemistry work experience. If a specific work assignment involved duties other than environmental chemistry, the relatable experience shall be calculated by multiplying the total time spent on the assignment by the percentage of time engaged in chemistry activities. Time intervals during which environmental chemistry activities accounted for less than fifty percent of total work assignments will not count towards certification work experience requirements. At least three years of practical chemistry experience must consist of continuous employment applying the principles and techniques of environmental chemistry. The experience must be verifiable by documentation submitted by the candidate.

b. Examination. Each applicant must submit to a written examination, to be conducted once each year at the USACE HTRW Chemist's Meeting and at each location where the USACE HTRW program employs chemistry professionals who have met the requirements for testing. Applicants prior to 15 October 1997 will be evaluated solely on the minimum requirements for certification. Those applicants meeting the criteria will be considered "grand fathered" and as such will not be required to take the examination.

c. Resources. Participation in the chemistry professional certification program is voluntary, and use of government resources for activities relating to certification or recertification must be approved by the individual's immediate supervisor.

7-6. Procedures for Certification and Recertification by Examination.

a. Application Forms. Application forms may be obtained from HQ, U.S. Army Corps of Engineers, CEMP-RT or the U.S. Army Corps of Engineers, HTRW-CX, CENWO-HX-C. The application form may be filed at any time with either the Administrative Officer or Chairperson of the Chemistry Certification Board. Roster of the Chemistry Certification Board members will

be printed in both the Corps of Engineers news letter and chemistry news letter.

b. Examination. After the application has been reviewed by the Chairperson, Chemistry Certification Board and all prerequisites verified, the applicant will be provided with references to suggested study material in order to prepare for the examination. The applicant will be formally advised of the exact place and date of the next examination. An applicant who does not take the examination at the scheduled time and place may reschedule the examination by submitting a written request to the Administrative Officer. If the applicant does not report for examination within two years after the originally scheduled examination date, said application will be considered void, and the applicant may not sit for examination unless he or she submits a new application.

c. Examination Scoring. The results of the written examination will be scored and recorded. The minimum passing grade will be stated on the examination. The score obtained in the written examination will determine whether or not the applicant meets the qualifications for certification. An applicant who fails the written examination must wait twelve months before retaking the examination. The certification application is not required to be resubmitted.

d. Certification. Upon meeting the minimum requirements and passing the examination, the Chemist Certification Board will promptly issue a certificate attesting to certification status. If an applicant is disapproved, the Chemistry Certification Board will so advise the applicant and make known the reasons thereof. An applicant who fails to receive certification has thirty days in which to appeal the decision in writing to the Director, Environmental Division, Directorate of Military Programs.

e. Confidentiality. All details pertaining to an applicant's request for certification will be kept confidential. The Chemist Certification Board will not disclose the names of applicants who fail. The official records of each applicant and a list of those currently certified will be maintained by the USACE Chemist Certification Board or its agents for its use in verifying certification. Once each year the list of those currently certified along with copies of the certification certificate will be provided to the executive office of each command for posting on their certification/registration board.

7-7. Certification Maintenance.

a. Certification Period. Certification is valid nominally for three years, after which recertification by the board will be required. For the purpose of establishing a uniform date for recertification, the thirtieth day of September nearest to three years from the initial date of certification shall be considered the termination date of the certification period. The certification and expiration dates will be placed on the certificate.

b. Recertification. Recertification may be accomplished by either examination or through the Professional Credit Plan. Under this plan, credits may be earned through activities that promote professional development. Twenty credits must be accumulated each three years to qualify for recertification as CSC, fifteen credits must be accumulated to qualify as a CC, and ten credits must be accumulated to qualify as a CCT.

c. Professional Credit Plan. The professional credits and the maximum that may be accrued each three years for recertification are as follows:

(1) Performed *(maximum six credits, two credits per year*). Employed as a practicing chemistry technician, chemist, supervisory chemist, or manager in an HTRW function. A statement of the work performed and the period claimed must be documented by the applicant. Maximum credit will be given for full time work in chemistry. Less than full-time work in environmental chemistry will receive credits in proportion to the percentage of full-time work actually spent in chemistry activities.

(2) Learned *(maximum six credits)*. Training courses used to meet the academic eligibility requirements for recertification must be taken within three years prior to submission of application. The Certification Board will determine the validity of each course. The credits in this category will be based on Continuing Education Units (CEUs). Each CEU will be equivalent to one professional credit.

(a) Attended chemistry training, seminars, conferences, clinics, workshops, or other symposia. Credits for attendance will be based on assigned CEUs. If CEUs are not assigned, the Chemist Certification Board will determine the amount of professional credit to be awarded.

(b) Completed a chemistry course sponsored by the government, a corporation, university, college, professional society or trade association.

(c) Completed a seminar sponsored by a university or college, or school of continuing education, which awards a certificate of participation. The seminar must be of a specialized subject relating to chemistry, pertaining to the latest technological advances and trends. The claimant must explain how the seminar relates to the HTRW Environmental Program. Credits for attendance will be based on assigned CEUs.

(d) Completed a recognized environmental certification program, such as, but not limited to: Hazardous Materials Management, International Organization for Standardization (ISO) 14000 Auditor, Environmental Assessment Association, *etc.*

(3) Taught *(maximum six credits)*.

(a) Participated as an instructor of chemistry courses conducted by federal agencies, a university, college, industry, state government, local community, or professional society. Maximum of one (1) credit per course taught.

(b) Submitted acceptable certification examination questions with answers to the Chemist Certification Board for use in examination. Each acceptable question and answer will receive a one-half (½) credit towards recertification. Maximum two (2) credits.

(4) Published/Presented *(maximum six credits)*.

(a) Published a professional paper on chemistry in a professional journal, a nationally or internationally distributed magazine. Five (5) credits per paper.

(b) Published an article in a USACE Newsletter. One (1) credit per article.

(c) Presented a paper on chemistry at a major technical society meeting. Two (2) credits per paper.

(d) Presented a paper on environmental chemistry to any professional, governmental, community, or select audience where such delivery is beneficial to the chemistry profession. One (1) credit per formal written paper; one-half (½) credit per oral presentation.

(e) Developed or updated chemistry, agency-wide, ERs, EMs, ETLs, or Construction Bulletins (CBs). Two (2) credits per document.

(f) Presented an acceptable thesis or dissertation on a chemistry subject in partial fulfillment of the requirements for an advanced degree from an accredited college or university. Six (6) credits per thesis or dissertation.

(5) Served *(maximum six credits)*.

(a) Elected as an officer or director of a national/international chemistry/environmental society. One (1) credit per year.

(b) Member of a chapter of a recognized chemistry, environmental, or QC society. One (1) credit per year.

(c) Served as a member of the Chemist Certification Board. Two (2) credits per year.

(d) Appointed as member or chairperson of a standing technical, or special ad hoc environmental committee as the USACE representative. One (1) credit per year.

(e) Participated in a voluntary professional society, state, county, municipal, or local community chemistry activity. One (1) credit per year.

d. Recertification Process. To receive credits claimed, sufficient supporting documentation must be provided with the submission. The recertification form must be mailed to the recertification board not less than three months prior to the expiration of the three year certification period. If a Certified Chemistry Professional (CCP) elects to recertify by taking the examination, he/she must notify the certification board not less than thirty days prior to the expiration of their certificate.

e. Failure to Recertify. It is the responsibility of the applicant to obtain a certification application and apply for renewal of his or her certificate no later than four months prior to expiration of the certification. Responsibility for applying for renewal in a timely manner rests solely with the certified individual. If a CCP fails to submit an application for recertification via the Professional Credit Plan prior to 15 September after the expiration year, the Chemist Certification Board will act as follows:

(1) If the recertification application is received after 1 March along with written documentation describing extenuating circumstances that made on-time submittal impossible, the Chemistry Certification Board, at its sole discretion, will decide whether or not to accept the application.

(2) In all other cases, the certification will expire and may be reacquired by application and examination only.

f. Appeal. If an applicant fails in recertification, he or she has thirty days to appeal the decision to the Director, Environmental Division, Directorate of Military Programs.

7-8. Implementation. Verification of entry level qualification, continuing education, training, and certification of chemistry professionals assigned to the USACE's HTRW Program is critical to successful implementation of the QA Program. The Chief Chemist assigned to the HTRW-Center of Expertise (CX) is responsible for maintaining documentation for all HTRW design district senior chemists, each CMQAL chief chemist and for all staff chemists and chemistry technicians assigned to the HTRW-CX and Ordnance and Explosives (OE) CX. The senior chemist assigned to each designated HTRW design district is responsible for maintaining similar documentation on each chemist assigned to the HTRW/OE function within that district's geographical boundaries of responsibility. Each CMQAL chief chemist is responsible for maintaining similar documentation on each chemist and chemistry technician assigned to HTRW/OE activities at the laboratory. Chemistry professional qualifications, continuing education, and certification files will be audited by HQUSACE during technical systems audits.

7-9. Administration.

a. Responsibility. Responsibility for planning, directing, and administering the program rests with the Chemist Certification Board. A majority of the members present at any meeting constitutes a quorum and will allow the board to conduct its affairs. The Chemist Certification Board is appointed by the Director, CENWO-HX (HTRW-CX).

b. Certification Board. The USACE Chemistry Certification Board or its agents is responsible for preparing the examinations, sample questions, and study guide.

c. Examination Administrator. An examination administrator will be appointed by the USACE Chemistry Certification Board to administer each examination. The identity of the examination administrator will not be made known to the general public until the day of the examination.

d. Examination Proctors. Examination proctors will conduct the examination. These persons will be selected by the USACE Chemistry Certification Board from the list of those currently certified.

e. Certification Board Function. The Certification Board shall not determine who shall engage in or practice chemistry, but rather shall certify applicants who are qualified and capable of being recognized as USACE CCPs.

7-10. Training. As chemistry professionals and supervisors outline their individual career development plans and Total Army Performance Evaluation System documents, they should consider the material presented in this document. The USACE standard is for each individual to participate, on average, in one week of formal training per fiscal year. During the initial years of service, it is recommended that chemistry professionals seek to attend the following training: (1)HTRW Overview; (2) Safety and Health for Hazardous Materials (as well as the eight-hour refresher course at required intervals); (3) Implementation of Hazardous and Toxic Waste Environmental Laws and Regulations on USACE Projects; (4) Risk Assessment for HTRW Sites; (5)HTRW New Chemist Orientation; and (6) HTRW and TPP Overview Workshop.

7-11. Professional Development. No matter what career goals an individual chemist may have, chemists should continue to grow professionally. The below listed characteristics are sought after in chemistry professionals assigned to the USACE; therefore, individual development plans (IDPs) should seek improvement in these areas:

(1) Ability to apply knowledge to solving problems;

(2) Ability to work on problems as a member of a team;

(3) Ability to make written and oral presentations;

(4) Knowledge of classical chemistry and its relationships with instrumental techniques;

(5) Ability to design experiments to produce meaningful results with minimal effort;

(6) Recognition of the importance of sampling;

(7) Ability to find information required for problem solving;

(8) Ability to interact with individuals from a variety of backgrounds;

(9) Familiarity with regulatory requirements;

(10) Understanding of basic principles of biology, geology, hydrology, and environmental chemistry in aquatic, atmospheric, and hydogeologic settings; and

(11) Ability to perform field studies and related modeling of environmental systems.

7-12. Use of the Certification Designations. A certified individual may use the CSC, CC, or CCT designation with his or her name on government business letters and business cards. Certification is for the individual only. The CSC, CC or CCT designations may not be used to imply that an organization's chemistry/environmental program is certified.

7-13. Expiration or Revocation of Certification. If a certified individual does not accumulate the required professional credits on time or be recertified by examination, his or her certification shall be terminated unless in the judgement of the Chemist Certification Board extenuating circumstances exist and the deficiency can be readily corrected. Certification may be revoked for causes such as violation of the "Principles of Ethical Conduct for Government Officers and Employees" (Executive Order 12674), falsification of information on the applications, malpractice, or unethical behavior. In addition the certification does not follow the individual to employment sites outside the USACE HTRW Program.