3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

3.0.0.1. The intent of this QAPP is to provide guidance to ensure that data of sufficient quality are collected to meet project-specific DQOs. The general types of projects included in this QAPP are:

- Preliminary Assessment/Site Investigation
- Remedial Investigation/Feasibility Study
- Predesign Data Collection
- Treatability Studies
- Technology Demonstrations
- Construction
- Precommissioning Monitoring
- Compliance Monitoring
- Performance Standard Verification
- Operations and Maintenance
- Underground Storage Tank Investigations
- RCRA Facility Investigations

3.0.0.2. The overall quality assurance (QA) objective for each of these project types is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and data reporting that provide results that meet Hill AFB project-specific DQOs and that are legally defensible. DQOs are qualitative and quantitative statements that specify the field and laboratory data quality necessary to support specific decisions or regulatory actions. The DQOs describe which data are needed, why the data are needed, and how the data are to be used to meet the needs of the project. DQOs also establish numeric limits for the data to allow the data user (or reviewers) to determine whether the data collected are of sufficient quality for their intended use. Project and site-specific data quality objectives shall be developed in accordance with the following guidance

(as appropriate): *Data Quality Objectives Process for Superfund, Interim Final Guidance* (U.S. EPA, 1993c), *Guidance for the Data Quality Objectives Process* (U.S. EPA, QA/G4, 1994), *Guidance for Data Quality Assessment Practical Methods for Data Analysis, EPA QA/G9, QA January 1998 Version,* U.S. EPA, January, 1998) and included in the accompanying field sampling plan (FSP), remedial design/remedial action work plan (RD/RA), or other project work plans. The use of the scientific method as described in the QA/G-5, calculation/estimation of the total study error, and data assessment (QA/G-9) shall be documented in the project specific work plans. An example of how DQOs may be presented is shown in Table 3-1. The remainder of this section defines data types and associated quality control requirements, and data type in relation to its end use.

3.1 DATA TYPES

3.1.0.1. The data type required for a project is based on the investigation type, the project-specific DQOs, the end use of the analytical data, and the level of documentation. Two primary data types are currently recognized by Hill AFB: 1) Screening data; data that are collected using non-standard sampling methodology or using rapid less precise methods of analysis with less rigorous sample preparation or quality control as compared to most standard methods of analysis and 2) Definitive data; data that are collected using standard sampling methodology and rigorous analytical methodology of known precision and accuracy. Whether data are considered screening or definitive is based on the method of sample collection and sample preparation and analysis. These data types are described in detail in Table 3-2.

3.1.0.2. The end use of the data defines the data type required for a given project. For example, if data are to be used for risk assessment they must be definitive. Screening data are generally only allowed for use in risk assessment if they are confirmed by definitive data. An example of how to present data types and uses is shown in Table 3-3. Examples of the type of data required to support its end use are presented in Appendix L.

These tables represent each project and media type included in the QAPP and are as follows:

- Table L-1 A through C Preliminary Assessment/Site Investigation
- Table L-2 A through C Remedial Investigation/Feasibility Study
- Table L-3 A through C Predesign Data Collection
- Table L-4 A through C Treatability Studies
- Table L-5 A through C Technology Demonstrations
- Table L-6 A through C Construction
- Table L-7 A through C Precommission Monitoring
- Table L-8 A through C Compliance Monitoring
- Table L-9 A through C Performance Standard Verification
- Table L-10 A through C Operations and Maintenance
- Table L-11 A through C Underground Storage Tank Investigations
- Table L-12 A through C RCRA Facility Investigations

3.1.0.3. These tables are not intended to be all inclusive or used as a direct reference, but to provide guidance for the Prime Contractor during DQO development determining the type of data appropriate for a specific task.

3.2 DATA QUALITY DEFINITION AND MEASUREMENT

3.2.1. Precision, Accuracy, Representativeness, Comparability, and Completeness

3.2.1.1. The effectiveness of a QA program is measured by the quality of data generated in the field and by the laboratory (September 1994). Data quality shall be assessed following the guidelines in QA/R-5 (October 1998), QA/G-4 (September 1994), QA/G-5 (February 1998) and QA/G-9 (January 1998). The criteria against which the data shall be evaluated for precision, accuracy, representativeness, completeness, and comparability (PARCC) are presented in Appendix A through H. In addition, the corrective action

procedures to be followed in the event of failure of the QC samples to meet acceptance criteria are also defined in Appendices A through H. The data evaluation criteria reflect current industry standards and represent the minimum requirements that shall be used for data evaluation. These terms are described in the following paragraphs.

3.2.1.2. Precision. Precision is the reproducibility of measurements under a given set of conditions. For large data sets, precision is expressed as the variability of a group of measurements compared to their average value (i.e., standard deviation). For duplicate measurements, precision is expressed as the relative percent difference (RPD) and is calculated using the following equation:

$$RPD = \frac{|A - B|}{\frac{(A + B)}{2}} \times 100$$

where A and B are the reported concentrations for duplicate sample analyses.

Precision assessment criteria for each analytical method included in this QAPP are listed in Appendices A through H.

3.2.1.3. Accuracy. Accuracy is the degree of agreement of a measurement or an average of measurements with an accepted reference or "true" value, and is a measure of bias in the system. The accuracy of a measurement system is affected by errors introduced through the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical techniques. Accuracy shall be evaluated using the percent recovery calculated using the following equation:

$$\text{Percent Recovery} = \frac{|A - B|}{C} \times 100$$

where: A is the target analyte concentration determined analytically from the spiked sample

B is the background level determined by a separate analysis of the unspiked sample

C is the concentration of spike added.

Accuracy assessment criteria for each analytical method included in this QAPP are listed in Appendices A through H.

3.2.1.4. Representativeness. Representativeness is a qualitative expression of the degree to which sample data accurately and precisely represent a characteristic of a population, a sampling point, or an environmental condition. Representativeness is maximized by ensuring that, for a given project, the number and location of sampling points and the sample collection and analysis techniques are appropriate for the specific investigation, and that the sampling and analysis program provides information that reflects "true" site conditions. The project-specific work plans shall define the strategy for ensuring that representative criteria are met.

3.2.1.5. Comparability. Comparability is a qualitative parameter that expresses the confidence with which one data set may be compared to another. Comparability is dependent on similar QA objectives and is achieved through the use of standardized methods for sample collection and analysis, the use of standardized units of measure normalizing results to standard conditions, and the use of standard and comprehensive reporting formats. The project-specific work plans shall define the methods of sample collection and analysis to ensure that comparability criteria are met.

3.2.1.6. Completeness. Completeness is defined as the percentage of valid data relative to the total number of measurements. Completeness shall be calculated using the following equation:

$$\text{Completeness} = \frac{\text{Number of valid data points}}{\text{Total number of measurements}} \times 100$$

Completeness shall be calculated and reported for each method, matrix, and analyte combination. Completeness shall be calculated using the completeness equation by dividing the total number of valid data points (does not include rejected data) by the total number of data points. Laboratory completeness specifications are project-specific and shall be included in the appropriate project-specific work plans, however, the minimum completeness goal for any given project shall be at least 95 percent.

3.2.2. Quality Control Samples

3.2.2.1. The quality control samples that shall be used to evaluate analytical data for the projects included in this QAPP are defined in Table 3-4 and their relation to PARCC parameters is described in Table 3-5**.** A general summary of the types of field and laboratory QC samples required for screening and definitive data are listed in Table 3-6. Method-specific quality control samples and frequency of QC sample analysis based on data type are listed in Table 3-7. The contract laboratories shall, at a minimum, analyze internal QC samples at the frequency specified by the analytical method and this QAPP.

3.3 ACQUISITION OF NON-DIRECT MEASUREMENT DATA

3.3.1. Non-direct measurement data are data that have been collected during other investigations but will be used for projects conducted under this QAPP. Before these data are used, it must be determined that the data are of sufficient quality to support the project-specific DQOs. Data quality objectives are qualitative and quantitative statements

that: clarify the intended use of the data, define the type of data needed to support the decision, identify the conditions under which the data should be collected, and specify tolerable limits on the probability of making a decision error due to uncertainty in the data. Acceptance criteria for non-direct data use in any project should be explicitly defined with respect to:

- Representativeness. Were the data collected from a population that is sufficiently similar to the population of interest and the population boundaries? How will potentially confounding effects (for example, season, time of day, and field meter type) be addressed so that these effects do not unduly alter the summary information?

- Bias. Are there characteristics of the data set that would shift the conclusions. For example, has bias in analysis results been documented? Is there sufficient information to estimate and correct bias?

- Precision. How is the spread in the results estimated? Does the estimate of variability indicate that it is sufficiently small to meet the objectives of the project-specific data quality objectives?

- Qualifiers. Are the data evaluated in a manner that permits logical decisions on whether or not the data are applicable to the current project? Is the system of qualifying and/or flagging data adequately documented to allow the combination of data sets?

- Summarization. Is the data summarization process clear and sufficiently consistent with the project specific data quality objectives? Ideally, observations and transformation equations should be used so that assumptions can be evaluated against the objectives of the current project. In addition, a

discussion on data limitations and use and the nature of the uncertainty of the data should be defined in the project-specific work plan.

3.3.2. There are several ways that existing data can be used including but not limited to:

- As stand alone or in combination with new data. This requires the use of sufficient documentation that verifies data quality. Determining where data can be appropriately combined with new data may not always be straight forward and may require statistical evaluation.

- Development of data collection design.

- Assessing site variability.

TABLE 3-1

EXAMPLE DATA QUALITY OBJECTIVES PRESENTATION

DQO Step	Statistical Data Evaluation Ground-Water Sampling	Surface Water Sampling New Seeps and Springs Off-Base Sampling	Annual Surface Water Sampling Canal Drains U1-410 and U1-411 Off-Base Sampling	Annual Surface Water Sampling Ponds U1-442, U1-423 and U1-424 Off-Base Sampling	Ground Water Sampling Wells U1-095 (annual), U1-211 (quarterly) Off-Base Sampling	Annual Ground Water Sampling Wells U1-075, U1-076R, U1-157, U1-158, U1-160, U1-161, and U1-163 On-Base Sampling	Quarterly Ground Water Sampling Wells U-120 through U1-207, U1-303, U1-304, and U1-307 On-Base Sampling	Annual Surface Water Sampling Pond 10 (U1-409), two ponds east of LF4 (U1-425, and U1-426) On-Base Sampling
State the problem								
Problem Statement	Determine the areal and vertical contamination distribution trends to the contaminants migrating from OU 1.	Determine if the five newly identified seeps and springs downgradient of OU 1 are hydraulically connected to OU 1.	Determine if the surface water from the canal drains are hydraulically connected to OU 1.	Determine if contaminants associated with OU 1 and seeps and springs upgradient of the ponds are present in surface water.	Monitor site conditions in the vicinity of South Weber Elementary School. Determine if contaminants associated with OU 1 are impacting drinking water source.	Monitor types and concentrations of contaminants migrating from OU 1.	Determine the mass of target VOCs and arsenic removed by existing OU 1 extraction system and collection galleries.	Determine if contaminants associated with OU 1 are impacting the surface water.
Planning Team Members	Robert Stites – U.S. EPA Muhammad Slam – UDEQ Hill AFB Project Coordinator – Kevin Bourne MW Project Manager MW Project Chemist MW Project Field Hydrogeologist MW Statistician	Planning team as indicated previously.	Planning team as indicated previously.	Planning team as indicated previously.	Planning team as indicated previously.	Planning team as indicated previously.	Planning team as indicated previously.	Planning team as indicated previously.
Primary Decision Maker	None – Decision will be made by consensus.	None – Decision will be made by consensus	None – Decision will be made by consensus	None – Decision will be made by consensus	None – Decision will be made by consensus	None – Decision will be made by consensus	None – Decision will be made by consensus	None – Decision will be made by consensus
Relevant Deadlines	Program to be completed prior to final ROD.	Program to be completed prior to 31 December 1997.	Program to be completed prior to 31 December 1997.	Program to be completed prior to 31 December 1997.	Program to be completed prior to 31 December 1997.	Program to be completed prior to 31 December 1997.	Program to be completed prior to 31 December 1997.	Program to be completed prior to 31 December 1997.
Identify the Decision								
Principle Study Question	Are there contaminant concentration trends in on-Base and off-Base groundwater?	Are there any current or potential risks not previously assessed?	Are there any current or potential risks not previously assessed?	Are there any current or potential risks not previously assessed?	Are the contaminants associated with OU 1 impacting drinking water or conditions at the elementary school?	Are contaminants migrating off base and if so at what concentration?	Are existing treatments removing contaminants?	Is there current or potential risk not previously assessed?
Alternative Actions	No Trends – Assess data for final ROD. Trends – Assess how trends may impact the selected remedial alternative for OU 1 and restoration or time frames	Current and/or future risk – Assess Data for final ROD. No current or future risk – Determine if continued monitoring necessary.	Current and/or future risk – Assess Data for final ROD. No current or future risk – Determine if continued monitoring necessary.	Current and/or future risk – Assess Data for final ROD. No current or future risk – Determine if continued monitoring necessary.	Conditions at school changed – Assess data for final ROD Drinking water impacted – Assess data for final ROD, and determine interim corrective action. Condition at school unchanged – Continue monitoring. No drinking water impact – Continue monitoring.	Contaminants present – Assess for final ROD. No contaminants present – Determine if continued monitoring is necessary.	Concentrations reduced – continue to monitor. Concentrations increase – Check systems. Assess data for final ROD.	New risk or potential risk – Assess data for final ROD. No new risk - Determine if continued monitoring is necessary.

Acronyms defined on last page of this table.

TABLE 3-1

DATA QUALITY OBJECTIVES, HILL AFB, UTAH
(Continued)

DQO Step	Statistical Data Evaluation Ground-Water Sampling	Surface Water Sampling New Seeps and Springs Off-Base Sampling	Annual Surface Water Sampling Canal Drains U1-410 and U1-411 Off-Base Sampling	Annual Surface Water Sampling Ponds U1-442, U1-423 and U1-424 Off-Base Sampling	Ground Water Sampling Wells U1-095 (annual), U1-211 (quarterly) Off-Base Sampling	Annual Ground Water Sampling Wells U1-075, U1-076R, U1-157, U1-158, U1-160, U1-161, and U1-163 On-Base Sampling	Quarterly Ground Water Sampling Wells U-120 through U1-207, U1-303, U1-304, and U1-307 On-Base Sampling	Annual Surface Water Sampling Pond 10 (U1-409), two ponds east of LF4 (U1-425, and U1-426) On-Base Sampling
Identify the Inputs to the Decision								
Physical Inputs	Groundwater elevation data.	Identify any new seeps and springs and surface water flow rate.	Surface water flow rate.	Surface water flow rate.	Ground-water elevation data.	Ground-water elevation data.	Ground-water elevation data.	Surface water depth.
Chemical Inputs [a]	Analytical Results from the following methods: • VOCs (SW Method 8260B) • Arsenic (SW method 7060) • Iron, Manganese (SW Method 6010B) • Sulfate (EPA 600/300.0) • Sulfide (EPA 600/376.2) • Nitrate/Nitrite (EPA 600/353.3) • TOC (EPA 600/415.1) • Field Analyses (Ground-water elevation, pH, temperature, specific conductance, turbidity, dissolved oxygen, and reduction/oxidation potential)	Analytical Results from the following methods: • VOCs (SW Method 8260B) • Arsenic (SW Method 7060) • Field Analyses (pH, temperature, specific conductance, turbidity, dissolved oxygen, and reduction/oxidation potential)	Analytical Results from the following methods: • VOCs (SW Method 8260B) • Arsenic (SW Method 7060) • Field Analyses (pH, temperature, specific conductance, turbidity, dissolved oxygen, and reduction/oxidation potential)	Analytical Results from the following methods: • VOCs (SW Method 8260B) • Arsenic (SW Method 7060) • Field Analyses (pH, temperature, specific conductance, turbidity, dissolved oxygen, and reduction/oxidation potential)	Analytical Results from the following methods: • VOCs (SW Method 8260B) • Arsenic (SW Method 7060) • Field Analyses (pH, temperature, specific conductance, turbidity, dissolved oxygen, and reduction/oxidation potential)	Analytical Results from the following methods: • VOCs (SW Method 8260B) • Arsenic (SW Method 7060) • Field Analyses (pH, temperature, specific conductance, turbidity, dissolved oxygen, and reduction/oxidation potential)	Analytical Results from the following methods: • VOCs (SW Method 8260B) • Arsenic (SW Method 7060) • Field Analyses (pH, temperature, specific conductance, turbidity, dissolved oxygen, and reduction/oxidation potential)	Analytical Results from the following methods: • VOCs (SW Method 8260B) • Arsenic (SW Method 7060) • Field Analyses (pH, temperature, specific conductance, turbidity, dissolved oxygen, and reduction/oxidation potential)
Action Levels	Maximum contamination level.	Maximum contamination level.	Maximum contamination level.	Maximum contamination level.	Drinking water standards, for water supply samples. Human health risk concentrations in vicinity of school.	Maximum contamination level.	Maximum contamination level.	None.
Define Study Boundaries								
Boundary	Off-Base and on-Base groundwater	Off-Base Surface water downgradient of OU 1	Off-Base Surface water downgradient of OU 1 that may impact the canal.	Off-Base surface water downgradient of OU 1 and upgradient of ponds U1-422, U1-423, and U1-424.	Potable water source downgradient of OU 1 and shallow groundwater in the vicinity of the school.	Groundwater northern perimeter of OU 1 downgradient of the CDP.	OU 1 groundwater extraction system.	Pond 10 and Ponds U1-425 and U1-426.
Develop Decision Rule								
Parameter of Interest	Trends in off-Base and on-Base groundwater contaminations.	Surface water contaminant concentrations.	Surface water contaminant concentrations.	Surface water contaminant concentrations.	Groundwater contaminant concentrations.	Groundwater contaminant concentrations.	Groundwater contaminant concentrations.	Surface water contaminant concentrations.

Acronyms defined on last page of this table.

TABLE 3-1

DATA QUALITY OBJECTIVES, HILL AFB, UTAH
(Continued)

DQO Step	Statistical Data Evaluation Ground-Water Sampling	Surface Water Sampling New Seeps and Springs Off-Base Sampling	Annual Surface Water Sampling Canal Drains U1-410 and U1-411 Off-Base Sampling	Annual Surface Water Sampling Ponds U1-442, U1-423 and U1-424 Off-Base Sampling	Ground Water Sampling Wells U1-095 (annual), U1-211 (quarterly) Off-Base Sampling	Annual Ground Water Sampling Wells U1-075, U1-076R, U1-157, U1-158, U1-160, U1-161, and U1-163 On-Base Sampling	Quarterly Ground Water Sampling Wells U-120 through U1-207, U1-303, U1-304, and U1-307 On-Base Sampling	Annual Surface Water Sampling Pond 10 (U1-409), two ponds east of LF4 (U1-425, and U1-426) On-Base Sampling
Develop Decision Rule (cont)								
Scale of Decision Making	On-Base – LF3, LF4, FTA1, CDPs, and off-Base groundwater downgradient of OU 1 within the DCE contaminant plume.	Hillside adajcent to OU 1 and within the current OU 1 boundary.	Hydraulically connected to OU 1.	Hydraulically connected to OU 1.	Individual sample concentrations exceeding drinking water standards in the water source. Individual standards exceeding human health risk levels in the vicinity of the school.	Individual contaminant concentrations and locations.	Reduction in contaminant concentrations by existing extraction system and collection galleries.	Contaminants, concentrations, and trends in concentrations for each sample locations.
Action Level	Not applicable.	None	None	None	None	None	None	None
Alternative Action	See previously defined alternative actions (previous page).	See previously defined alternative actions (previous page).	See previously defined alternative actions (previous page).	See previously defined alternative actions (previous page).	See previously defined alternative actions (previous page).	See previously defined alternative actions (previous page).	See previously defined alternative actions (previous page).	See previously defined alternative actions (previous page).
Specify Tolerance Limits on Decision Errors								
Historic Range of Parameter of Interest	Refer to Table K-2	None available.	Refer to Hill AFB Geographical Information system.	Refer to Hill AFB Geographical Information system.	Refer to Hill AFB Geographical Information system.	Refer to Hill AFB Geographical Information system.	Refer to Hill AFB Geographical Information system.	Refer to Hill AFB Geographical Information system.
Null Hypothesis	Contaminant concentrations exceed the ROD-listed Soil Performance Standards and RBCA Tier 1 standards.	Are concentrations greater than maximum contamination levels?	Are concentrations greater than maximum contamination levels?	Are concentrations greater than maximum contamination levels?	Are concentrations greater than maximum contamination levels?	Are concentrations greater than maximum contamination levels?	Are concentrations of discharge water greater than IWTP influent limits.	Are concentrations greater than maximum contamination levels?
Governing Error	Type II because it is more protective of human health and the environment.	Type II because it is more protective of human health and the environment. However, because statistical hypothesis analysis will not be conducted, identification of statistical error is not necessary.	Type II because it is more protective of human health and the environment. However, because statistical hypothesis analysis will not be conducted, identification of statistical error is not necessary.	Type II because it is more protective of human health and the environment. However, because statistical hypothesis analysis will not be conducted, identification of statistical error is not necessary.	Type II because it is more protective of human health and the environment. However, because statistical hypothesis analysis will not be conducted, identification of statistical error is not necessary.	Type II because it is more protective of human health and the environment. However, because statistical hypothesis analysis will not be conducted, identification of statistical error is not necessary.	Not applicable.	Type II because it is more protective of human health and the environment. However, because statistical hypothesis analysis will not be conducted, identification of statistical error is not necessary.
Gray Region	ROD-listed action level minus 10 percent. 10% is commonly used and regulatory accepted limit for defining the gray zone.	ROD-listed action level minus 10 percent. 10% is commonly used and regulatory accepted limit for defining the gray zone.	ROD-listed action level minus 10 percent. 10% is commonly used and regulatory accepted limit for defining the gray zone.	ROD-listed action level minus 10 percent. 10% is commonly used and regulatory accepted limit for defining the gray zone.	ROD-listed action level minus 10 percent. 10% is commonly used and regulatory accepted limit for defining the gray zone.	ROD-listed action level minus 10 percent. 10% is commonly used and regulatory accepted limit for defining the gray zone.	10% of IWTP influent limits.	Not applicable.
Optimize the Design for obtaining Data	The data collection design is described in the FSP.	The data collection design is described in the FSP.	The data collection design is described in the FSP.	The data collection design is described in the FSP.	The data collection design is described in the FSP.	The data collection design is described in the FSP.	The data collection design is described in the FSP.	The data collection design is described in the FSP.

Acronyms defined on last page of this table.

TABLE 3-1

DATA QUALITY OBJECTIVES, HILL AFB, UTAH
(Continued)

EPA	Environmental Protection Agency
CDPs	Chemical Disposal Pits
ROD	Record of Decision
MW	Montgomery Watson
FSP	Field Sampling Plan
DCE	Dichloroethene
LF3	Landfill 3 or 4
LNAPL	Light Nonaqueous Phase Liquid
OU	Operating Unit
TOC	Total organic carbon
RBCA	Risk-based corrective action
VOCs	Volatile Organic Compounds
NGVD	National Geodetic Vertical Datum
UDEQ	Utah Division of Environmental Quality
IWTP	Industrial Waste Treatment Plant

(a) EPA test methods for evaluating solid waste physical/chemical methods (SW-846); (U.S. EPA Third Edition, September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996).

TABLE 3-2

DATA TYPE DEFINITIONS

Data Type	Media Types	Data Type Definition	Parameters
Screening	Soil Sediment Ground Water Surface Water Non-Aqueous Phase Liquid Treatment System Influent Treatment System Effluent Air (Residential, Ambient) Treatment Off-Gas Soil Gas Landfill Gas	Data that are collected using non-standard sampling methodology(a) or collected using rapid, less precise methods of analysis with less rigorous sample preparation or quality control as compared to most standard methods of analysis(c). These data may be generated in the field or in the laboratory, and may not provide tangible raw data (e.g., direct-reading field meters). Screening data provide analyte identification and quantitation, however, confirmation of analyte identity and quantity may not be confirmed and the data may be less accurate or precise than definitive data. Physical test methods (e.g., dissolved oxygen, temperature, pH, reduction-oxidation potential, turbidity, conductance) have been designated as screening methods. Note that even though standard methods may be used for sample analysis, if non-standard methodology is used for sampling (e.g., Hydropunch™ for ground-water samples), the data are still considered screening level.	General water quality(d) General soil chemistry(e) Organic-Immunoassay Organic parameters - Field Meters or Instruments Inorganic metals - XRF Inorganic parameters - Field Meters, Instruments, or Test Kits Standard methods of analysis(c) for organic or inorganic compounds Geotechnical Data Biological data (biological oxygen demand, heterotrophic plate counts, chemical oxygen demand)
Definitive	Soil Sediment Ground Water Surface Water Non-Aqueous Phase Liquid Treatment System Influent Treatment System Effluent Air (Residential, Ambient) Treatment Off-Gas Soil Gas Landfill Gas	Data that are collected using standard sampling methodology(b) as defined in the available and applicable guidance and using rigorous analytical methodology of known precision and accuracy. The data are analyte specific, with confirmation of both the analyte identity and concentration. The analytical methodology provides tangible raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts (hard copies) or electronic files that can be stored and recovered. These data are generated on- or off-site and meet the method-specific quality control requirements.	Standard methods of analysis(c) for organic or inorganic compounds
Screening with Definitive Confirmation	Soil Sediment Ground Water Surface Water Non-Aqueous Phase Liquid Treatment System Influent Treatment System Effluent Air (Residential, Ambient) Treatment Off-Gas Soil Gas Landfill Gas	Screening data that are confirmed by definitive data. The percent definitive data required for screening data backup is a project-specific requirement and should be detailed in the project-specific work plans.	General water quality General soil chemistry Organic-Immunoassay Organic parameters - Field Meters or Instruments Inorganic parameters - Field Meters, Instruments, or Test Kits Standard methods of analysis(c) for organic or inorganic compounds

(a) Non-standard sampling methodology includes those methods not defined in applicable and available guidance as described below, and includes sampling techniques such as Hydropunch™ or Geoprobe™.

(b) Standard Sampling Methodology:

RCRA Ground-Water Monitoring Draft Technical Guidance (U.S. EPA, 1992)
RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (U.S. EPA, 1986a OSWER-9950)
American Society of Testing and Materials
Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells (EPA/600/4-89/034, March 1991)
Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (U.S. EPA, Office of Emergency and Remedial Response EPA 500/540/G-89/004)
Guidance for Conducting Treatability Studies under CERCLA, Final (U.S. EPA EPA/540/R-92/071A November 1992)
Soil Sampling Quality Assurance User's Guide (Environmental Monitoring Systems Laboratory. Las Vegas, NV EPA/600/8-89/046)
Representative Sampling Guidance Vol. 1, Soil. (U.S. EPA, 1991 OSWER Directive 9360.4-10)

TABLE 3-2

DATA TYPE DEFINITIONS
(CONTINUED)

(c) Standard Methods of Analysis:

EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third edition, September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996
EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993)
EPA 200 Series - Methods for the Determination of Metals in Environmental Samples, (EPA/600/4-91-010, June 1991; Supplement I, EPA/600/R-94/111, May 1994)
EPA 600 Series - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (U.S. EPA, CFR Title 40, Part 136, Appendix A, July 1996)
Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air (EPA/600/4-89/017, June 1988)
State of California Department of Health Services Determination of Perchlorate by Ion Chromatography (Rev. No. 0, June 1997).

(d) General water quality pH, specific conductivity, temperature, salinity, reduction-oxidation potential, dissolved oxygen, total dissolved solids, alkalinity, total organic carbon.

(e) General soil chemistry pH, specific conductivity, cation exchange capacity, total organic carbon.

TABLE 3-3

DATA TYPES AND USES

Program	Task	Task Description	Data (Method)	Data Type	Data Uses
Statistical Data Evaluation	Ground-Water Sampling	Collect four ground-water samples from each of 26 monitoring wells installed off-Base in the Weber River Valley and on-Base downgradient of the CDPs, LF3, FTA 1, and LF4 on a quarterly basis beginning in March 1997 and ending in December 1997. Ground-water samples will be collected from monitoring wells installed in both the shallow and deeper portions of the on- and off-Base shallow aquifers that represent the areal and vertical distribution of contaminants migrating from OU 1, that have both high and low concentrations of contaminants, and that are upgradient and downgradient of the area most likely to be included in future ground-water capture systems or remediation processes.	Ground-water elevation	Screening	ROD, PSV, RD
			pH	Screening	ROD, PSV, RD
			Temperature	Screening	ROD, PSV, RD
			Specific conductance	Screening	ROD, PSV, RD
			Turbidity	Screening	ROD, PSV, RD
			Dissolved oxygen	Screening	ROD, PSV, RD
			Reduction/oxidation potential (Eh)	Screening	ROD, PSV, RD
			Target Volatile Organic Compounds (SW-846 8260B)	Definitive	ROD, PSV, RD
			Arsenic (SW-846 7060)	Definitive	ROD, PSV, RD
			Iron, Manganese (SW-846 6010)	Definitive	ROD, PSV, RD
			Sulfate (EPA 600/300)	Definitive	ROD, PSV, RD
			Sulfide (EPA 600/376.2)	Definitive	ROD, PSV, RD
			Nitrate/Nitrite (EPA 600/353.3)	Definitive	ROD, PSV, RD
			TOC (EPA 600/415.1)	Screening	ROD, PSV, RD
Off-Base Sampling Program	Surface Water Sampling	Collect surface water samples from up to five newly identified seeps and springs downgradient of OU 1. These sites will be identified during a physical survey of the hillside adjoining OU 1 scheduled for the spring of 1997.	Surface water flow rate	Screening	RD, PSV
			pH	Screening	RD, PSV
			Temperature	Screening	RD, PSV
			Specific conductance	Screening	RD, PSV
			Turbidity	Screening	RD, PSV
			Dissolved oxygen	Screening	RD, PSV
			Reduction/oxidation potential (Eh)	Screening	ROD, PSV, RD
			Target Volatile Organic Compounds (SW-846 8260B)	Definitive	ROD, PSV, RD
			Arsenic (SW-846 7060)	Definitive	ROD, PSV, RD
		Collect surface water samples from canal drains U1-410 and U1-411 on an annual basis.	Surface water flow rate	Screening	RD, PSV
			pH	Screening	RD, PSV
			Temperature	Screening	RD, PSV
			Specific conductance	Screening	RD, PSV
			Turbidity	Screening	RD, PSV
			Dissolved oxygen	Screening	RD, PSV
			Reduction/oxidation potential (Eh)	Definitive	ROD, PSV, RD
			Target Volatile Organic Compounds (SW-846 8260B)	Definitive	ROD, PSV, RD
			Arsenic (SW-846 7060)	Definitive	ROD, PSV, RD
		Collect surface water samples from ponds U1-422, U1-423, and U1-424 located downgradient of off-Base seeps and springs on an annual basis.	Surface water flow rate	Screening	RD, PSV
			pH	Screening	RD, PSV
			Temperature	Screening	RD, PSV
			Specific conductance	Screening	RD, PSV
			Turbidity	Screening	RD, PSV
			Dissolved oxygen	Screening	RD, PSV
			Reduction/oxidation potential (Eh)	Definitive	ROD, PSV, RD
			Target Volatile Organic Compounds (SW-846 8260B)	Definitive	ROD, PSV, RD
			Arsenic (SW-846 7060)	Definitive	ROD, PSV, RD

Acronyms defined on the last page of this table.

TABLE 3-3

**DATA TYPES AND USES
(CONTINUED)**

Program	Task	Task Description	Data (Method)	Data Type	Data Uses
Off-Base Sampling Program, (continued)	Ground-Water Sampling	Collect ground-water samples from monitoring well U1-095 on an annual basis and collect ground-water samples from municipal well South Weber Number 2 (U1-211) on a quarterly basis.	Ground-water elevation	Screening	RD, PSV
			pH	Screening	RD, PSV
			Temperature	Screening	RD, PSV
			Specific conductance	Screening	RD, PSV
			Turbidity	Screening	RD, PSV
			Dissolved oxygen	Screening	RD, PSV
			Reduction/oxidation potential (Eh)	Definitive	ROD, PSV, RD
			Target Volatile Organic Compounds (SW-846 8260B)	Definitive	ROD, PSV, RD
			Arsenic (SW-846 7060)	Definitive	ROD, PSV, RD
On-Base Sampling Program	Ground-Water Sampling	Collect ground-water samples from northwestern area monitoring wells U1-075, U1-076R, U1-157, U1-158, U1-160, U1-161, and U1-163 on an annual basis.	Ground-water elevation	Screening	ROD, PSV, RD
			pH	Screening	ROD, PSV, RD
			Temperature	Screening	ROD, PSV, RD
			Specific conductance	Screening	ROD, PSV, RD
			Turbidity	Screening	ROD, PSV, RD
			Dissolved oxygen	Screening	ROD, PSV, RD
			Reduction/oxidation potential (Eh)	Definitive	ROD, PSV, RD
			Target Volatile Organic Compounds (SW-846 8260B)	Definitive	ROD, PSV, RD
			Arsenic (SW-846 7060)	Definitive	ROD, PSV, RD
	Ground-Water Sampling	Collect ground-water samples from extraction wells U1-201, U1-202, U1-203, U1-204, U1-205, U1-206, U1-207, U1-303, U1-304, and U1-307 on a quarterly basis.	pH	Screening	RD, PSV
			Temperature	Screening	RD, PSV
			Specific conductance	Screening	RD, PSV
			Turbidity	Screening	RD, PSV
			Dissolved oxygen	Screening	RD, PSV
			Reduction/oxidation potential (Eh)	Screening	RD, PSV
			Target Volatile Organic Compounds (SW-846 8260B)	Definitive	RD, PSV
			Arsenic (SW-846 7060)	Definitive	RD, PSV
	Surface Water	Collect surface water samples from Pond 10 (U1-409) and two ponds east of LF4 (U1-425 and U1-426) on an annual basis.	pH	Screening	RD, PSV
			Temperature	Screening	RD, PSV
			Specific conductance	Screening	RD, PSV
			Turbidity	Screening	RD, PSV
			Dissolved oxygen	Screening	RD, PSV
			Reduction/oxidation potential (Eh)	Screening	RD, PSV
			Target Volatile Organic Compounds (SW-846 8260B)	Definitive	RA, PSV, RD
			Arsenic (SW-846 7060)	Definitive	RA, PSV, RD
Ground-Water Elevation, LNAPL Thickness, and Seep and Spring Flow Rate Measurements	Ground-Water Elevation Measurements	Collect ground-water elevation measurements from 71 on-Base and off-Base monitoring wells on a monthly basis.	Ground-water elevation (feet above NGVD)	Screening	RD, PSV

Acronyms defined on the last page of this table.

TABLE 3-3

DATA TYPES AND USES
(CONTINUED)

Program	Task	Task Description	Data (Method)	Data Type	Data Uses
Ground-Water Elevation, LNAPL Thickness, and Seep and Spring Flow Rate Measurements (continued)	LNAPL Thickness Measurements	Collect LNAPL thickness measurements from 17 monitoring wells downgradient from and at the CDPs and at FTA 1.	LNAPL thickness (feet)	Screening	RD, PSV
Ground-Water Elevation, LNAPL Thickness, and Seep and Spring Flow Rate Measurements (continued)	Seep and Spring Flow Rate Measurements	Collect quarterly flow rate estimates from approximately 32 off-Base seeps and springs.	Flow rate (gallons per minute)	Screening	RD, PSV
Slope Stability Evaluation	Inclinometer Measurements	During the spring of 1997, the hillside adjoining OU 1 will be physically surveyed to identify any surficial indications of slope instability or the presence of seeps and springs not identified during other investigations. Slope stability measurements will be collected from inclinometers U1-762, U1-859, U1-860, and U1-861 during June 1997 and compared to their baseline measurements to assess whether there have been any changes in slope stability.	Cross-slope offset (B0/B180) Down-slope offset (A0/A180	Screening Screening	RD, PSV

EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition (EPA, 1996).
EPA 100-400 Series – Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993).

CDPs	Chemical Disposal Pits 1 and 2
LF3	Landfill 3
LF4	Landfill 4
FTA 1	Fire Training Area 1
ROD	Record of Decision
VOC	Volatile organic compound
RD	Remedial design
RA	Risk assessment
NGVD	National geodetic vertical datum
PSV	Performance standard verification

TABLE 3-4

FIELD AND LABORATORY QUALITY CONTROL SAMPLE DESCRIPTIONS

Field/Laboratory QC Samples	QC Sample Type	Rationale	Frequency	Description	QC Sample Data Assessment
Field QC Samples	Trip Blank	Identify target VOC analytes that may have been introduced into samples during sample handling, shipping, or storage at the laboratory. Applicable to all media, except air.	One per each cooler containing samples for VOC analysis[(c)].	Two 40-milliliter (ml) amber glass vials with Teflon septum caps containing reagent-grade water and preserved to a pH of $\leq$2. Prepared by the laboratory.	All target analyte detections are evaluated in accordance with the *National Functional Guidelines for Organic and Inorganic Data Validation* (U.S. EPA, 1994).
	Field Duplicates or Replicates	Assess sampling and analytical precision. Applicable to all media.	Ten percent of the total number of samples for each media and for each analytical method[(c)].	A field duplicate or replicate consists of a discrete sample split into two equal portions. One sample is labeled with the correct field identification, the other is submitted "blind" to the laboratory with a fictitious sample identification. Samples consisting of liquid or air are referred to as duplicates, solids samples are referred to as replicates.	The relative percent difference will be calculated for each analyte (reported above the project practical quantitation limit) between the sample and its duplicate or replicate and compared to the project-specific acceptance criteria.
	Ambient Air	Identify target analytes present in the ambient air to establish background concentrations. Applicable only to air media (e.g., landfill gas, treatment system off-gas, soil gas).	5 percent of the total number of samples for each analysis[(c)].	One Tedlar™ bag, PUF/XAD-2 Cartridge, or Summa canister containing ambient air.	All target analyte detections are evaluated in accordance with the *National Functional Guidelines for Organic and Inorganic Data Validation* (U.S. EPA, 1994).
	Source Water	Assess quality of water used for equipment decontamination.	One per batch of water type used for equipment decontamination[(c)].	The source water that is used for equipment decontamination is carried through the same sample collection, handling, and analytical procedures as the investigative samples.	All target analyte detections are evaluated in accordance with the *National Functional Guidelines for Organic and Inorganic Data Validation* (U.S. EPA, 1994).
	Equipment Blank	Assess the completeness of the decontamination process for non-dedicated sampling equipment used for solid or water samples.	Daily for each analysis type when non-dedicated equipment is used for sampling[(c)].	An equipment blank consists of rinsate from decontaminated equipment that is carried through the same sample collection, handling, and analytical procedures as the investigative samples. Equipment blank samples are only collected when non-dedicated or non-disposable equipment are used for sample collection.	All target analyte detections are evaluated in accordance with the *National Functional Guidelines for Organic and Inorganic Data Validation* (U.S. EPA, 1994).
	Temperature Blank [(e)]	Assess sample temperature criterion. Applicable to all samples that have specified temperature criteria.	Daily, one per each sample cooler.	A 40-ml amber glass bottle filled with reagent-grade water. The temperature of this sample is measured at the time samples are received by laboratory.	Assess whether the temperature criterion of 4°C $\pm$ 2°C has been met, and if not to assess whether corrective actions are necessary.
	Filter Blank	Assess the quality of the filters used for filtering ground-water samples for dissolved metals analysis. Applicable only for water media for dissolved metals analysis.	One per sampling round (water media only) or a lot of filters.	A filter blank consists of source water or reagent grade water that is passed through the same filter type that is used to filter water media samples for dissolved metals analysis. The filter blank is carried through the same sample collection, handling, and analytical procedures as the investigative samples.	Assess whether the filter is contributing metals to the ground-water samples and if corrective action is necessary.
	Field Blank [(f)]	Identify target analytes that may have been introduced into samples due to ambient conditions.	Project-specific.	A field blank consists of sample container filled with source water or reagent-grade water that is left open to the atmosphere during sampling. After sampling is complete, the sample container is sealed and carried through the same handling, shipping, and analytical procedures as the investigative samples.	All target analyte detections are evaluated in accordance with the *National Functional Guidelines for Organic and Inorganic Data Validation* (U.S. EPA, 1994).
Laboratory	Method Blank	Identify target analytes that may have been introduced into the sample during analysis. Applicable to all media.	Each sample or extraction batch ($\leq$20 samples) for each analytical method.	Reagent-grade water that is carried through the same analytical process as native samples.	All target analyte detections are evaluated in accordance with the *National Functional Guidelines for Organic and Inorganic Data Validation* (U.S. EPA, 1994).

TABLE 3-4

**FIELD AND LABORATORY QUALITY CONTROL SAMPLE DESCRIPTIONS
(CONTINUED)**

Field/Laboratory QC Samples	QC Sample Type	Rationale	Frequency	Description	QC Sample Data Assessment
Laboratory (continued)	Surrogate Spikes	Assess sample preparation/extraction efficiency and analytical accuracy. Applicable to all media.	Each sample for organic analysis including both investigative and QC samples for each method, except for SW-846 8280/8290.	Each sample will be spiked in the laboratory with surrogate spikes in accordance with the laboratories SOPs for the respective methods.	Percent recovery is calculated for each spiked analyte and compared to the acceptance criteria for surrogate accuracy specified in this QAPP (Appendices A through H) or the laboratory established criteria for the respective methods[(a)].
	Matrix Spike/Matrix Spike Duplicate[(d)]	Assess analytical accuracy and precision and identify media interference during analysis. Applicable to all media, except air.	Each sample or extraction batch (either ≤ 10 or ≤20 samples, method specific) for each analytical method for each media type.	The samples for matrix spike/matrix spike duplicate analysis are prepared in the laboratory by adding a standard of known concentration to the samples in accordance with the laboratory's SOPs for the respective methods.	Percent recovery and the relative percent difference (RPD) for each spiked analyte is calculated and compared to the acceptance criteria for accuracy and precision specified in this QAPP (Appendices A through H) or the laboratory established criteria for the respective methods[(a)].
	Matrix Spike/Matrix Duplicate[(d)]	Assess analytical accuracy and precision and identify media interference during analysis. Applicable to all media, except air.	Each sample or extraction batch (either ≤ 10 or ≤20 samples, method specific) for each analytical method.	The samples for matrix spike analysis are prepared in the laboratory by adding a standard of known concentration to the samples in accordance with the laboratory's SOPs for the respective methods. The matrix duplicate consists of one discrete sample split into two fractions and analyzed as two samples in accordance with the laboratory SOPs for the respective methods.	The percent recovery for each spiked analyte in the MS is calculated and compared to the acceptance criteria for accuracy specified in this QAPP (Appendices A through H) or the laboratory established criteria for the respective methods[(a)]. The RPD is calculated between the MD and its parent sample and is compared to the acceptance criteria for precision specified in this QAPP (Appendices A through H) or the laboratory established criteria for the respective methods[(a)].
	Laboratory Control Sample	Assess analytical accuracy. Applicable to all media.	Each sample or extraction batch (≤20 samples) for each analytical method.	The laboratory control sample is prepared by the laboratory and consists of reagent-grade water or sand spiked with a standard (either from a source other than, or the same source used for the initial calibration standard) in accordance with analytical method and the laboratories SOPs for each respective method.	Percent recovery for each spiked analyte is calculated and compared to the acceptance criteria for accuracy specified in this QAPP (Appendices A through H) or the laboratory established criteria for the respective methods[(a)].
	Laboratory Control Sample Duplicate[(b)]	Assess analytical accuracy and precision. Applicable to all media.	Same as the laboratory control sample.	Same as the laboratory control sample.	Percent recovery for each spiked analyte is calculated and compared to the acceptance criteria for accuracy specified in this QAPP (Appendices A through H) or the laboratory established criteria for the respective methods[(a)]. The RPD is calculated between the LCS and its duplicate and compared to the laboratory established criteria for the respective methods[(a)].

(a) If the laboratory acceptance criteria are within the limits included in Appendices A through H, the laboratory's acceptance criteria should be used for data assessment. If the laboratories acceptance criteria are outside the acceptance criteria specified in this QAPP, the QAPP values should be used as the default values for data assessment.

(b) Laboratory control sample duplicates are not method-specific requirements, but are commonly analyzed by laboratories to assess precision. The inclusion of laboratory control sample duplicates in an analytical program will be dependent upon the Contract Laboratory.

(c) The field QC sample frequency listed in this table is based on the method-specific suggested guidance. The frequency of field QC samples is project specific and should be determined during the project scoping process.

(d) Either matrix spike/matrix spike duplicate or matrix spike/matrix duplicate sample pairs may be analyzed to meet method requirements.

(e) An IR gun maybe used in place of a temperature blank to measure sample temperature.

(f) Not required unless ambient site conditions are suspected of being a source of contamination to samples.

EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, (EPA Third edition, September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996).
EPA 100-400 Series Methods for the Determination of Inorganic Substances in Environmental Samples, (EPA/600R-93/100. August 1993).
EPA 200 Series Methods for the Determination Metals in Environmental Samples, (EPA/600/4-91-010, June 1991; Supplement I, EPA/600R/94-111. May 1994).
EPA 600 Series (40CFR, Part 136, July, 1988).
Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air, April 1994.
State of California Department of Health Services Determination of Perchlorate by Ion Chromatography (Rev., No. 0, June 1997).

TABLE 3-5

QUALITY CONTROL SAMPLE EVALUATION IN TERMS OF PRECISION, ACCURACY, REPRESENTATIVENESS, COMPARABILITY, AND COMPLETENESS

PARCC	Quality Control Samples	Evaluation Criteria
Precision	Field Duplicate or Replicate Sample Pairs	Relative Percent Difference
	Matrix Spike/Matrix Spike Duplicate	Relative Percent Difference
	Investigative Sample/Matrix Duplicate	Relative Percent Difference
	Laboratory Control Sample/ Laboratory Control Sample Duplicate	Relative Percent Difference
Accuracy	Laboratory Control Sample	Percent Recovery
	Laboratory Control Sample Duplicate	Percent Recovery
	Matrix Spike	Percent Recovery
	Matrix Spike Duplicate	Percent Recovery
	Surrogate Spikes	Percent Recovery
	Response Factors	Percent Recovery
	Trip Blanks	Target Analyte Detections
	Holding Time	Quantitative/Qualitative, Degree of Confidence
Representativeness	Method Blanks	Qualitative, Degree of Confidence
	Trip Blanks	Qualitative, Degree of Confidence
	Field Duplicates or Replicates	Qualitative, Degree of Confidence
	Holding Time	Quantitative/Qualitative, Degree of Confidence
	Equipment Blank (if collected)	Quantitative/Qualitative, Degree of Confidence
	Source Water (if collected)	Quantitative/Qualitative, Degree of Confidence
Completeness	Valid Data	Percent Valid Data (a)
Comparability	Standard Analytical Methods	Qualitative, Degree of Confidence
	Standard Units of Measure	Qualitative, Degree of Confidence
	Standard Sampling Methods	Qualitative, Degree of Confidence
	Normalizing Results to Standard Conditions	Qualitative, Degree of Confidence
	Standard and Comprehensive Data Reports	Qualitative, Degree of Confidence

(a) Percent Valid Data = $\frac{\text{number of valid data points}}{\text{total number of measurements}} \times 100$

TABLE 3-6

QUALITY CONTROL SAMPLE SUMMARY

Data Type	Sampling Methodology	Data Description	Analysis	Laboratory QC Sample*	Field QC Sample
Screening Data: Soil or Sediment.	Standard or Non-Standard	Soil data collected in the field using portable meters.	pH Conductivity Temperature	None required None required None required	None required None required None required
Screening Data: Soil or Sediment.	Standard or Non-Standard	General soil data generated by a laboratory.	Total Organic Carbon	Method blank Matrix spike/matrix spike duplicate[(a)] Matrix spike/matrix duplicate[(a)] Laboratory control sample Laboratory control sample duplicate[(b)]	None required
Screening Data: Ground-Water, Surface Water, Influent, or Effluent.	Standard or Non-Standard	General water quality data collected in the field using portable meters.	pH	None required	None required
			Specific Conductivity	None required	None required
			Temperature	None required	None required
			Salinity	None required	None required
			Reduction-Oxidation Potential	None required	None required
			Dissolved Oxygen	None required	None required
			Tturbidity	None required	None required
Screening Data: Ground-Water, Surface Water, Influent, or Effluent.	Standard or Non-Standard	General water quality data generated by a laboratory.	Total Dissolved Solids	Method blank Matrix spike/matrix spike duplicate[(a)] Matrix spike/matrix duplicate[(a)] Laboratory control sample Laboratory control sample duplicate[(b)]	None required
			Total Organic Carbon	Method blank Matrix spike/matrix spike duplicate[(a)] Matrix spike/matrix duplicate[(a)] Laboratory control sample Laboratory control sample duplicate[(b)]	None required
			Total Suspended Solids	Method blank Matrix spike/matrix spike duplicate[(a)] Matrix spike/matrix duplicate[(a)] Laboratory control sample Laboratory control sample duplicate[(b)]	None required

TABLE 3-6

**QUALITY CONTROL SAMPLE SUMMARY
(CONTINUED)**

Data Type	Sampling Methodology	Data Description	Analysis	Laboratory QC Sample*	Field QC Sample
Screening Data: All media types except air and gas (Refer to Table 3-6).	Standard or Non-Standard	Headspace analysis for volatile hydrocarbons using field meters (organic vapor meter or field gas chromatograph [GC]).	Total volatile hydrocarbons (organic vapor meter)	None required	None required
			Target volatile hydrocarbons (field GC)	None required	Method blank Duplicate/replicate sample analysis
Screening Data: All media types, except air and gas (Refer to Table 3-6).	Standard or Non-Standard	Inorganic or organic data collected in the field using test kits (e.g., Hach or immunoassay kits), or instruments (XRF).	Cations (Hach Kit), Anions (Hach Kit), or Metals (XRF or Hach Kit)	None required	Method blanks Duplicate/replicate sample analysis
			Immunoassay (PCBs, Pesticides, BTEX, Polyaromatic hydrocarbons, Trinitrotoluene, Pentachlorophenol, etc.)	None required	Method blanks Duplicate/replicate sample analysis
Screening Data: All media types, except air and gas.	Standard or Non-Standard	Biological data generated by a laboratory.	Biological oxygen demand, heterotrophic plate count, and chemical oxygen demand	Method blank Matrix duplicate	Field duplicate
Screening Data: All media types except air and gas.	Non-Standard	Inorganic or organic data generated by a laboratory.	Standard methods of analysis [(d)] for organic and inorganic compounds	Method blank Surrogate spikes (organic analysis only) Matrix spike/matrix spike duplicate[(a)] Matrix spike/matrix duplicate[(a)] Matrix duplicate Laboratory control sample Laboratory control sample duplicate[(b)]	None required
Screening Data: Air, Treatment Off-Gas, Soil Gas, Landfill Gas.	Standard or Non-Standard	Data collected in the field using portable meters (CO_2 and O_2 meters or organic vapor meters).	Carbon dioxide	None required	None required
			Oxygen	None required	None required
			Volatile hydrocarbons	None required	None required
Screening Data: Air Treatment Off-Gas, Soil Gas, Landfill Gas.	Standard or Non-Standard	Volatile hydrocarbon data collected using field meters (organic vapor meter or field GC).	Total volatile hydrocarbons (organic vapor meter)	None required	None required
			Target volatile hydrocarbons (field GC)	None required	Method blank

TABLE 3-6

**QUALITY CONTROL SAMPLE SUMMARY
(CONTINUED)**

Data Type	Sampling Methodology	Data Description	Analysis	Laboratory QC Sample*	Field QC Sample
Definitive Data: All media types (Refer to Table 3-6).	Standard	Inorganic or organic data generated by a laboratory.	Standard methods of analysis [(d)] for organic and inorganic compounds	Method bank Surrogate spikes (organic analysis only) Matrix spike/matrix spike duplicate[(a)] Matrix spike/matrix duplicate[(a)] Matrix duplicate Laboratory control sample Laboratory control sample duplicate	Trip blank (VOCs only)[(c)] Field duplicate[(c)] Source water[(c)] Equipment blank[(c)] Filter blank

(a) Either matrix spike/matrix spike duplicates or matrix spike/matrix duplicate sample pairs must be analyzed for all methods except air methods. Air methods do not specify MS/MSD or MS/MD analysis.

(b) Laboratory control sample duplicate analyses are optional and whether they are analyzed on a routine basis is laboratory specific.

(c) The requirement for the listed field quality control sample is project-specific and may not always be required.

(d) Standard Methods of Analysis:

EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third edition, September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996
EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993)
EPA 200 Series - Methods for the Determination of Metals in Environmental Samples, (EPA/600/4-91-010, June 1991; Supplement I, EPA/600/R-94/111, May 1994)
EPA 600 Series - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (U.S. EPA, CFR Title 40, Part 136, Appendix A, July 1996)
Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air (EPA/600/4-89/017, June 1988)
State of California Department of Health Services Determination of Perchlorate by Ion Chromatography (Rev. No. 0, June 1997).

* Although the data are considered screening, the laboratory still must include the minimum QC criteria specified by the analytical method during sampling analysis.

TABLE 3-7

FIELD AND LABORATORY QUALITY CONTROL SAMPLE REQUIREMENTS FOR STANDARD METHODS OF ANALYSIS

Data Type/ Sample Media	Field/ Laboratory QC Samples	QC Sample Type	Frequency[a]
Screening SW-846 Methods for Organic and Inorganic Compound Analysis:			
VOCs (SW-846 8260B and 8021B), SVOCs (8270C), Pesticides (8081A), PCBs (8082), Explosives (8330), Polynuclear Aromatic Hydrocarbons (8310), Herbicides (8151A), Total Petroleum Hydrocarbons (8015B, Modified), Dioxin Furans (8280A and 8290), Metals (6010A, 6010B, 6020, and 7000 series), and Hexavalent-Chromium (7196A)			
All Media Types, Except Air and Gas	Field	None Required[b]	None
	Laboratory	Method Blank	Each preparation batch (≤20 samples) for each analytical method.
		Surrogate Spikes	Each sample for organic analysis, except for SW-846 8280/8290.
		Matrix Spike (MS)/Matrix Spike Duplicate (MSD)[c]	Each preparation batch (≤20 samples) for each analytical method for each media type. Samples analyzed for MS/MSD may be either site or non-site specific.
		Matrix Spike/Matrix Duplicate (MD)[c]	Each preparation batch (≤20 samples) for each analytical method for each media type. Samples analyzed for MS/MD may be either site or non-site specific.
		Laboratory Control Sample (LCS)	Each preparation batch (≤20 samples) for each analytical method.
		Laboratory Control Sample Duplicate (LCSD)[d]	Each preparation batch (≤20 samples) for each analytical method.
Definitive SW-846 Method for Organic and Inorganic Compound Analysis:			
VOCs (SW-846 8260B and 8021B), SVOCs (8270C), Pesticides (8081A), PCBs (8082), Explosives (8330), Polynuclear Aromatic Hydrocarbons (8310), Herbicides (8151A), Total Petroleum Hydrocarbons (8015B, Modified), Dioxin Furans (8280A and 8290), Metals (6010A, 6010B, 6020, and 7000 series), Hexavalent-Chromium (7196A)			
All Media Types, Except Air and Gas	Field	Trip Blank	One per each cooler containing samples for VOC analysis.
		Field Duplicate/ Replicate	Ten percent of the total number of samples for each media and for each analytical method.
		Source Water	One per batch of water type used for equipment decontamination.

TABLE 3-7

FIELD AND LABORATORY QUALITY CONTROL SAMPLE REQUIREMENTS FOR STANDARD METHODS OF ANALYSIS (CONTINUED)

Data Type/ Sample Media	Field/ Laboratory QC Samples	QC Sample Type	Frequency[a]
Definitive SW-846 Methods for Organic and Inorganic Compound Analysis, (con't):			
SW-846 Methods for Organic and Inorganic Compound Analysis; VOCs (SW-846 8260B and 8021B), SVOCs (8270B), Pesticides (8081A), PCBs (8082), Explosives (8330), Polynuclear Aromatic Hydrocarbons (8310), (Herbicides (8151A), Total Petroleum Hydrocarbons (8015B, Modified), Dioxin Furans (8280A and 8290), Metals (6010A, 6010B, 6020, and 7000 series), and Hexavalent-Chromium (7196A)			
		Equipment Blank	Ten percent of total number of samples for each analysis type when non-dedicated equipment is used for sampling.
		Temperature Blank	Each sample cooler
		Filter Blank	One per sampling round (required only when water media is collected for dissolved metals).
	Laboratory	Method Blank	Each preparation batch (≤20 samples) for each analytical method.
		Surrogate Spikes	Each sample for organic analysis, except for SW-846 8280/8290.
		Matrix Spike/Matrix Spike Duplicate[c]	Each preparation batch (≤20 samples) for each analytical method for each media type. Samples for MS/MSD analysis must be site specific.
		Matrix Spike/Matrix Duplicate[c]	Each preparation batch (≤20 samples) for each analytical method for each media type. Samples for MS/MSD analysis must be site specific.
		Laboratory Control Sample	Each preparation batch (≤20 samples) for each analytical method.
		Laboratory Control Sample Duplicate[d]	Each preparation batch (≤20 samples) for each analytical method

TABLE 3-7

FIELD AND LABORATORY QUALITY CONTROL SAMPLE REQUIREMENTS FOR STANDARD METHODS OF ANALYSIS (CONTINUED)

Data Type/ Sample Media	Field/ Laboratory QC Samples	QC Sample Type	Frequency[a]
Screening EPA 600 Series for Organic Compounds:			
Halogenated/Aromatic VOCs (601/602), Pesticides/PCBs (608), VOCs (624), SVOCs (625)			
Ground Water, Surface Water, Influent, Effluent	Field	None Required[b]	None
Screening EPA 600 Series for Organic Compounds, (con't):			
Halogenated/Aromatic VOCs (601/602), Pesticides/PCBs (608), VOCs (624), SVOCs (625)			
	Laboratory	Method Blank	Each preparation batch (≤20 samples) for each analytical method.
		Surrogate Spikes	Each sample for each method of analysis.
		Matrix Spike	One per each preparation batch (≤10 samples) for each GC method and one per each preparation batch (≤20 samples) for each GC/MS method. Sample for MS analysis may be site or non-site specific.
		Laboratory Control Sample	One per each MS failure. Sample must be spiked with a standard from a source other than that used for the initial calibration standard.
		Laboratory Control Sample Duplicate[d]	Each preparation batch (≤20 samples) for each analytical method.
Definitive EPA 600 Series for Organic Compounds:			
Halogenated/Aromatic VOCs (601/602), Pesticides/PCBs (608), VOCs (624), SVOCs (625)			
Ground Water, Surface Water, Influent, Effluent	Field QC Samples	Trip Blank	One per each cooler containing samples for VOC analysis.
		Field Duplicate/ Replicate	Ten percent of the total number of samples for each media and for each analytical method.

TABLE 3-7

FIELD AND LABORATORY QUALITY CONTROL SAMPLE REQUIREMENTS FOR STANDARD METHODS OF ANALYSIS (CONTINUED)

Data Type/ Sample Media	Field/ Laboratory QC Samples	QC Sample Type	Frequency[a]
Definitive EPA 600 Series for Organic Compounds (cont):			
Halogenated/Aromatic VOCs (601/602), Pesticides/PCBs (608), VOCs (624), SVOCs (625)			
		Source Water	One per batch of water type used for equipment decontamination.
		Equipment Blank	Ten percent of total number of samples for each analysis type when non-dedicated equipment is used for sampling.
		Temperature Blank	Each sample cooler
	Laboratory	Method Blank	Each preparation batch (≤20 samples) for each analytical method.
		Surrogate Spikes	Each sample for each method of analysis.
		Matrix Spike	One per each preparation batch (≤10 samples) for each GC method and one per each preparation batch (≤20 samples) for each GC/MS method. Sample for MS analysis must be site specific.
		Laboratory Control Sample	One per each MS failure. Sample must be spiked with a standard from a source other than that used for the initial calibration standard.
		Laboratory Control Sample Duplicate[d]	Each preparation batch (≤20 samples) for each analytical method.
Screening EPA/600/4-89/017 Toxic Organic Compounds in Air:			
Ethane and Methane (TO-3), Semi-Volatile Organic Compounds (TO-13), and Volatile Organic Compounds (TO-14)			
Air and Gas	Field	None Required	None
	Laboratory	Method Blank	Each preparation batch (≤20 samples) for each analytical method.
		Surrogate Spikes	Each sample for method TO-13 analysis.
Screening EPA/600/4-89/017 Toxic Organic Compounds in Air (cont):			

TABLE 3-7

FIELD AND LABORATORY QUALITY CONTROL SAMPLE REQUIREMENTS FOR STANDARD METHODS OF ANALYSIS (CONTINUED)

Data Type/ Sample Media	Field/ Laboratory QC Samples	QC Sample Type	Frequency[a]
Ethane and Methane (TO-3), Semi-Volatile Organic Compounds (TO-13), and Volatile Organic Compounds (TO-14)			
		Laboratory Control Sample	Each preparation batch (≤20 samples) for each analytical method.
		Laboratory Control Sample Duplicate[d]	Each preparation batch (≤20 samples) for each analytical method.
Air and Gas	Field	Field Duplicate	One per 10 samples for each analytical method.
		Ambient Air	Five percent of the total number of samples for each analysis.
	Laboratory	Method Blank	Each preparation batch (≤20 samples) for each analytical method.
	Laboratory	Method Blank	Each preparation batch (≤20 samples) for each analytical method.
		Surrogate Spikes	Each sample for method TO-13 analysis.
		Laboratory Control Sample	Each preparation batch (≤20 samples) for each analytical method.
		Laboratory Control Sample Duplicate[d]	Each preparation batch (≤20 samples) for each analytical method.
Screening EPA Drinking Water Metals:			
Atomic Absorption, 200.7 Metals (ICP), 200.8 Metals (ICP/MS), Atomic Absorption 200.9			
All Media Types, Except Air and Gas	Field	None Required[b]	None
	Laboratory	Method Blank	Each preparation batch (≤20 samples) for each analytical method.

Screening EPA Drinking Water Metals (cont):

TABLE 3-7

FIELD AND LABORATORY QUALITY CONTROL SAMPLE REQUIREMENTS FOR STANDARD METHODS OF ANALYSIS (CONTINUED)

Data Type/ Sample Media	Field/ Laboratory QC Samples	QC Sample Type	Frequency[a]
Atomic Absorption, 200.7 Metals (ICP), 200.8 Metals (ICP/MS), Atomic Absorption 200.9			
		Matrix Spike/Matrix Duplicate	Each preparation batch (≤10 samples) for each media type for each method. Samples for MS/MD analysis may be site or non-site specific.
		Laboratory Control Sample	Each preparation batch (≤20 samples) for each analytical method.
		Laboratory Control Sample Duplicate[d]	Each preparation batch (≤20 samples) for each analytical method.
All Media Types, Except Air and Gas	Field QC Samples	Field Duplicate	Ten percent of the total number of samples for each analytical method.
		Source Water	One per batch of water type used for equipment decontamination.
		Equipment Blank	Ten percent of total number of samples for each analysis type when non-dedicated equipment is used for sampling.
		Temperature Blank	Each sample cooler.
Definitive EPA Drinking Water Metals:			
Atomic Absorption, 200.7 Metals (ICP), 200.8 Metals (ICP/MS), Atomic Absorption 200.9			
		Filter Blank	One per sampling round (required only when water media is collected for dissolved metals).
	Laboratory	Method Blank	Each preparation batch (≤20 samples) for each analytical method.
		Matrix Spike/Matrix Duplicate	Each preparation batch (≤10 samples) for each media type for each method. Samples for MS/MD analysis must be site specific.
Definitive EPA Drinking Water Metals (cont):			

TABLE 3-7

FIELD AND LABORATORY QUALITY CONTROL SAMPLE REQUIREMENTS FOR STANDARD METHODS OF ANALYSIS (CONTINUED)

Data Type/ Sample Media	Field/ Laboratory QC Samples	QC Sample Type	Frequency[a]
Atomic Absorption, 200.7 Metals (ICP), 200.8 Metals (ICP/MS), Atomic Absorption 200.9			
		Laboratory Control Sample	Each preparation batch (≤20 samples) for each analytical method.
Screening EPA 100-400 Series Methods for Inorganic Compounds:			
Perchlorate (300.0, Modified), TDS (160.1), TSS (160.2), Cl, Fl, Sulfate, Nitrate/Nitrite (300.0), Alkalinity (310.1), Fluoride (340.2), Nitrate/Nitrite (353.2), Sulfide (376.2), Total Organic Carbon 415.1/2 and SW-846 9060 TOC			
Ground Water, Surface Water, Influent, Effluent	Field	None Required[b]	None
	Laboratory	Method Blank	Each preparation batch (≤20 samples) for each analytical method.
		Matrix Spike/Matrix Spike Duplicate[c]	Each preparation batch (≤20 samples) for each analytical method, except TDS. Samples for MS/MD analysis may be non-site or site specific.
		Matrix Spike/Matrix Duplicate[c]	Each preparation batch (≤20 samples) for each analytical method, except TDS. Samples for MS/MD analysis may be non-site or site specific.
		Matrix Duplicate	Each preparation batch (≤20 samples) for TDS. Samples for MD may be non-site or site specific.
		Laboratory Control Sample	Each preparation batch (≤20 samples) for each analytical method.
		Laboratory Control Sample Duplicate[d]	Each preparation batch (≤20 samples) for each analytical method.

TABLE 3-7

FIELD AND LABORATORY QUALITY CONTROL SAMPLE REQUIREMENTS FOR STANDARD METHODS OF ANALYSIS (CONTINUED)

Data Type/ Sample Media	Field/ Laboratory QC Samples	QC Sample Type	Frequency[a]
Definitive EPA 100-400 Series Methods for Inorganic Compounds:			
Perchlorate (300.0, Modified), Cl, Fl, Sulfate, Nitrate/Nitrite (300.0), Alkalinity (310.1), Fluoride (340.2), Nitrate/Nitrite (353.2), Sulfide (376.2)			
Ground Water, Surface Water, Influent, Effluent	Field QC Samples	Field Duplicate	Ten percent of the total number of samples for each media and for each analytical method.
		Source Water	One per batch of water type used for equipment decontamination.
		Equipment Blank	Ten percent of total number of samples for each analysis type when non-dedicated equipment is used for sampling.
		Temperature Blank	Each sample cooler.
	Laboratory	Method Blank	Each preparation batch (≤20 samples) for each analytical method.
		Matrix Spike/Matrix Spike Duplicate[c]	Each preparation batch (≤20 samples) for each analytical method except TDS. Samples for MS/MSD analysis must be-site specific.
		Matrix Spike/Matrix Duplicate[c]	Each preparation batch (≤20 samples) for each analytical method, except TDS. Samples for MS/MD analysis must be-site specific.
		Matrix Duplicate	Each preparation batch (≤20 samples) for TDS. Samples for MD analysis must be-site specific.
		Laboratory Control Sample	Each preparation batch (≤20 samples) for each analytical method.
		Laboratory Control Sample Duplicate[d]	Each preparation batch (≤20 samples) for each analytical method.

(a) The field QC sample frequency listed in this table represent default criteria. The frequency of field QC sample analysis is project specific (based on the project data quality objectives) and should be determined during the project scoping process.

TABLE 3-7

FIELD AND LABORATORY QUALITY CONTROL SAMPLE REQUIREMENTS FOR STANDARD METHODS OF ANALYSIS (CONTINUED)

(b) It is recommended that, at a minimum, a temperature blank is included with the samples if a commercial carrier is used to transport samples to the laboratory.

(c) Either matrix spike/matrix spike duplicate or matrix spike/matrix duplicate sample pairs may be analyzed to meet the method requirements.

(d) Laboratory control sample duplicates are not method specific requirements, but are commonly analyzed by laboratories to assess precision. The inclusion of laboratory control sample duplicates in an analytical program will be dependent upon the contract laboratory.

EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, (EPA Third edition, September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996)

EPA 100-400 Series Methods for the Determination of Inorganic Substances in Environmental Samples, (EPA/600R-93/100. August 1993).

EPA 200 Series Methods for the Determination Metals in Environmental Samples, (EPA/600/4-91-010, June 1991; Supplement I, EPA/600R/94-111. May 1994).

EPA 600 Series (CFR, Title 40 Appendix A Part 136, July, 1996).

State of California Department of Health Services Determination of Perchlorate by Ion Chromatography (Rev. No. 0, June 1997).

Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air, April 1994.