ENERGY*SOLUTIONS*

WATER MONITORING
QUALITY ASSURANCE PLAN

GWQDP UGW450005
APPENDIX B

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Water Monitoring Quality Assurance Plan – GWQDP UGW450005 Appendix B

Revision	Date	Comments
7	4/1/2013	Section B.6 – Modification of calibration procedure for specific conductance.
8	2/18/2014	Section B.4 – Modification of VOC sampling procedure. Section B.4 – Modification of QC sample requirements for dioxin/furan analysis. Table B.4-2 – Modification of radiological (C-14, I-129, Tc-99, tritium) preservation.

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B.1 PROJECT AND QUALITY ASSURANCE PROJECT PLAN DESCRIPTION

PROJECT DESCRIPTION

The purpose of this Water Monitoring Quality Assurance Plan (WMQAP) is to present the field collection and analytical methodology to be used during groundwater monitoring at the Energy*Solutions* radioactive and mixed waste disposal facility in Tooele County, Utah. This WMQAP is prepared as required by Energy*Solutions'* permits and licenses including:

- State of Utah, Department of Environmental Quality (DEQ), Division of Water Quality (DWQ), Groundwater Quality Discharge Permit (GWQDP)
- State of Utah, DEQ, Division of Radiation Control (DRC) radioactive material license

This WMQAP is prepared following the guidance in the RCRA Groundwater Monitoring Technical Enforcement Guidance Document (TEGD) (EPA, 1986 and EPA, 1992).

BACKGROUND

Energy*Solutions* operates a radioactive waste and mixed waste disposal facility in Tooele County, Utah. The goal of the Energy*Solutions* facility is to efficiently and economically dispose of low level radioactive waste and mixed waste in a manner that is protective of human health and the environment. The Energy*Solutions* facility occupies Section 32 of T1S, R11W Salt Lake Base and Meridian (SLBM), and is divided into five main disposal areas: the low-activity radioactive waste (LARW) Cell (closed in 2005), the Class A Cell, the Class A North Cell, the 11e.(2) Cell, and the RCRA Mixed Waste Cell. Each of these disposal areas is accountable to various regulatory agencies. This WMQAP, however, is applicable to the DRC and the

DWQ. Any significant changes to, or significant deviations from, this approved WMQAP should not be made without the approval of the DRC.

B.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section describes Energy*Solutions*' and the contracted laboratories' various responsibilities.

ENERGY*SOLUTIONS*, PROJECT STAFF

All groundwater monitoring is conducted under the direction of Energy*Solutions*' Director of Compliance and Permitting (DCP). The DCP will assure that all quality control (QC) requirements are established at the beginning of the project and maintained throughout the project. The Groundwater Manager, Staff Hydrogeologist, Groundwater Sampling Technicians, Health Physics Specialists and Technicians, Environmental Manager, Environmental Technicians, and other qualified personnel may assist the DCP. Specific responsibilities of the DCP or associates include:

- Acquiring and applying technical and corporate resources as needed to ensure the projects are completed on schedule.
- Developing and meeting ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task.
- Reviewing and analyzing overall task performance with respect to planned requirements.
- Approving all deliverables, including interim and final reports.
- Representing the project team at meetings and public hearings.
- Establishing and maintaining communication between technical staff, QC coordinator, health and safety coordinator, and regulatory agencies.
- Ensure compliance with all applicable regulations.

Energy*Solutions*' Groundwater Manager, Staff Hydrogeologist or designee will perform data management and validation. These responsibilities include:

- Ensuring that the laboratory implements the requirements of the WMQAP.
- Coordinating with the laboratory on all quality assurance (QA)/QC matters.
- Coordinating data validation.
- Providing updates to the DCP regarding the QA/QC data.

The Energy*Solutions* field team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently complete their respective tasks. All field team members will review and thoroughly understand all aspects of the procedures germane to their responsibilities presented in the WMQAP prior to initiating any field activity.

AMERICAN WEST ANALYTICAL LABORATORIES, PROJECT STAFF

American West Analytical Laboratories (AWAL) will be the contract laboratory for organic and inorganic non-radiological analyses.

The AWAL QA Manager is responsible for the following:

- Development and implementation of the AWAL analytical portion of this WMQAP.
- Preparation of written documents that define QA/QC procedures and review and approval of laboratory QC procedures
- Supervision of sample control operations, and oversight of inter-laboratory testing programs and laboratory certifications.
- Spot-checking data sets to ensure that the appropriate QC measures have been taken and performing audits to evaluate the effectiveness of the laboratory QA/QC program.

The AWAL QA Manager will report unacceptable findings to the Laboratory Director for corrective action.

The AWAL Project Manager will serve as the primary AWAL contact person for Energy*Solutions* and will ensure that the laboratory meets project requirements. The AWAL Project Manager is also responsible for the following:

- Scheduling sample analyses and ensuring that results adhere to the WMQAP requirements.
- Monitoring the progress and timeliness of the work, reviewing work orders and laboratory reports, and processing any changes in the scope of work.
- Ensuring that project-specific corrective action is taken when necessary to address problems identified by the QC results or QA audit findings and ensuring that all corrective action is documented.

TEST AMERICA, PROJECT STAFF

Test America located in Richland, Washington (TAR) will be the contract laboratory for radiological analyses. Test America located in Denver, Colorado (TAD) will analyze Energy*Solutions*' potentially contaminated conventional chemistry water samples. Potentially contaminated samples would include pond samples, Mixed Waste Leachate samples, and collection lysimeter samples.

The TAR and TAD QA Managers are responsible for the following:

- Development and administration of the laboratory's standard operating procedures (SOPs) and for development and implementation of the Test America analytical portions of this WMQAP.
- Preparation of written documents that define QA/QC procedures and review and approval of laboratory QC procedures.
- Supervision of sample control operations, and oversight of inter-laboratory testing programs and laboratory certifications.

- Spot-checking data sets to ensure that the appropriate QC measures have been taken and performing audits to evaluate the effectiveness of the laboratory QA/QC program through audits.

The QA Manager will report unacceptable findings to the Laboratory Director for corrective action.

The TAR and TAD Project Managers are the primary Test America contacts for Energy*Solutions* and will ensure that both Test America laboratories meet project requirements. The TAR and TAD Project Managers are also responsible for the following:

- Scheduling sample analyses and ensuring that results adhere to the WMQAP requirements.
- Monitoring the progress and timeliness of the work, reviewing work orders and laboratory reports, and processing any changes in the scope of work.
- Ensuring that project-specific corrective action is taken when necessary to address problems identified by the QC results or QA audit findings and ensuring that all corrective action is documented.

B.3 QUALITY ASSURANCE OBJECTIVES

DATA QUALITY OBJECTIVES

The overall quality assurance objective for this monitoring program is to develop and implement sampling, sample handling, and analytical procedures that will provide data that can be used to fulfill the Data Quality Objectives (DQOs). 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 will be used to meet the needs of the project. DQOs also establish numeric limits for the data collected by the Energy*Solutions*' groundwater monitoring program to allow the data user (or reviewers) to determine whether the data are of sufficient quality for their intended use. A summary of the individual tasks and their frequency are included in Table B.3-1.

ANALYTICAL QUALITY CONTROL LEVELS

Currently two levels are used to define data quality that are based on the type of site, the project DQOs, the end use of the analytical data, and the level of documentation:

- **Screening.** Screening-level data are qualitative or semi-qualitative data obtained by use of approved field equipment such as groundwater quality parameter meters.

- **Definitive.** Definitive data are quantitative, have known precision and accuracy, and are produced under controlled conditions using laboratory-grade instrumentation. EPA-accepted methods, such as SW-846 and the Contract Laboratory Program (CLP), are used for definitive data. Both screening and definitive data will be collected for this project

Practical Quantitation Limits (PQLs) are based on the extent to which the equipment, laboratory or field, or analytical process can provide accurate measurements of a reliable

quality for specific constituents in field samples. The PQL for a given analysis will vary depending on instrument sensitivity and matrix effects. PQLs are discussed in Section B.7.

DATA QUALITY DEFINITION AND MEASUREMENT

The effectiveness of a QA program is measured by the quality of the data generated in the field and by the laboratory. For Energy*Solutions* compliance monitoring, data quality will be assessed in terms of its precision, accuracy, representativeness, comparability, and completeness (the PARCC parameters). These terms are described below:

Precision. Precision is the reproducibility of measurements under a given set of conditions. For large data sets for conventional chemistry analyses, 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) of a data pair and will be calculated using the following equation:

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

where: A and B are the reported concentrations for field duplicate sample analyses or the percent recoveries for matrix spike and matrix spike duplicate samples.

Data precision acceptance criterion is defined as using a control limit of $\pm$ 25% for the RPD for a sample value greater than 5 times the laboratory detection limit (LDL). If the sample data are less than 5 times the LDL, a control limit of $\pm$ the LDL is used.

Although precision for field duplicate samples will be assessed and reported, field duplicates will not be used to qualify data because there is no guidance for qualifying data based on duplicate RPDs.

For radiological analysis two types of data precision are used, corresponding with the two types of data. These are activity data and concentration data. Concentration data precision is determined by calculating the RPD as in the conventional chemistry analysis discussed in the section above. Activity data precision is determined by calculating the relative error ratio (RER) using the following formula:

$$\text{RER} = \left| \frac{(x - y)}{\sqrt{s^2 + t^2}} \right|$$

Where:

x = Sample result
y = Duplicate result
s = error term of sample
t = error term of duplicate

Activity data precision acceptance criterion is defined as using a control limit of less than 3 for the RER for data greater than 5 times the LDL. If sample values are less than 5 times the LDL, a control limit of $\pm$ LDL is used.

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 impacted by errors introduced through the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical techniques.

Accuracy will be evaluated by the following equation:

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

where: A is the concentration of analyte in a spiked sample

B is the concentration of analyte in an unspiked sample

C is the concentration of spike added.

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 will provide information that reflects "true" site conditions.

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 objectives and is achieved through the use of standardized methods for sample collection and analysis, and the use of standardized units of measure.

Completeness. Completeness is defined as the percentage of valid data relative to the total number of measurements. Completeness for this project will be calculated using the following equation:

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

Where the number of valid data points is the total number of valid analytical measurements based on the precision, accuracy, and holding time evaluation.

Project completeness is determined at the conclusion of the data validation and is calculated by dividing the number of valid sample results by the total number of sample analyses listed in the WMQAP. The completeness objective for this project is 95 percent for all data. However, DRC approval will be required for any completeness objective less than 100 percent.

A summary of the evaluation of QC samples in relation to the PARCC parameters is presented in Table B.3-2. Method specific quality control procedures, frequency of QC sample analysis, acceptance criteria (control limits), and corrective actions are included in Attachment A.

TABLE B.3-1

Field Program Descriptions, Rationale, and DQOs for Groundwater Compliance Monitoring Energy*Solutions* , Clive, Utah

Field Program	Field Program Description	Data Quality Objective	Data Types	Analytical Level [(a)]	Data Uses
Lysimeter Water Monitoring	Monitoring requirements listed in Appendix C of GWQDP	To evaluate the bottom liners of the LARW, Class A, and Class A North cells.	presence of volume of water	Screening	Assess volume of water moving through liner.
Lysimeter Sampling	Collect water from lysimeter when water is present.	Compliance Monitoring	Water quality parameter	Definitive	Assess water quality of water moving through liner.
Groundwater Elevation Measurements	Collect groundwater elevation measurements on a monthly basis from 86 monitoring wells	To provide data to assess groundwater paths, calculate hydraulic gradients for modeling purposes, calculate pre-sampling purge volumes, and to evaluate groundwater evolution.	Groundwater elevation (feet above NGVD)	Screening	Assess groundwater flow direction
Groundwater Sampling	Collect groundwater samples from: 14 monitoring wells (RCRA) (annually), 14 monitoring wells (11e.(2)) (annually), 13 monitoring wells (LARW) (annually), 18 monitoring wells (Class A) (annually) 13 monitoring wells (Class A North) (annually), and 6 monitoring wells (Ponds) (annually).	To provide data to assess the background concentrations of specific analytes; to assess hydrogeologic conditions at the facility; to determine if releases have occurred from the facility.	Groundwater Quality Parameters [(b)]	Screening	To assess stability of groundwater parameters prior to sampling and assess groundwater characteristics over time.
			Background water quality concentrations Compliance monitoring	Definitive	Develop background concentrations of compliance monitoring parameters. Monitor for compliance with established background concentrations with regulatory licenses

(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).
(b) pH, temperature, specific conductivity, and Eh

TABLE B.3-2

CHEMICAL DATA QUALITY CONTROL EVALUATION IN TERMS OF PARCC PARAMETERS

PARCC	Quality Control Program	Evaluation Criteria
Precision	Field Replicate or Duplicate Sample Pairs	Relative Percent Difference
	Matrix Spike/Matrix Spike Duplicate Sample Pairs	Relative Percent Difference
	Investigative/Matrix Duplicate Sample Pairs	Relative Percent Difference
Accuracy	Surrogate Spikes	Percent Recovery
	Matrix Spike	Percent Recovery
	Matrix Spike Duplicate	Percent Recovery
	Laboratory Control Sample	Percent Recovery
	Calibration Standards	Percent Recovery
	Internal Standards	Percent Recovery
Representativeness	Holding Time	Qualitative, Degree of Confidence
	Method Blanks	Qualitative, Degree of Confidence
	Trip Blanks	Qualitative, Degree of Confidence
	Field Blanks	Qualitative, Degree of Confidence
	Refrigerator Blanks	Qualitative, Degree of Confidence
	Field Replicates/Duplicates	Quantitative/Qualitative, Degree of Confidence
Comparability	Standard Field Procedures	Qualitative, Degree of Confidence
	Standard Analytical Methods	Qualitative, Degree of Confidence
	Standard Units of Measure	Qualitative, Degree of Confidence
Completeness	Valid Data	Percent Acceptable Data

PARCC Precision, Accuracy, Representativeness, Completeness, and Comparability

B.4 SAMPLING PROCEDURES

As required by Energy*Solutions*' various regulatory permits and licenses, surface water and groundwater elevation measurement programs and surface water and groundwater sampling and analysis programs will be conducted. Specifically, groundwater will be monitored at the LARW, Class A, and Class A North collection lysimeters; the Mixed Waste, Northwest Corner, and three LARW evaporation ponds; the Mixed Waste leachate collection sumps; and compliance monitoring wells (See Plate 1 for locations). This section describes the field procedures for monitoring these locations.

COLLECTION LYSIMETER FIELD PROCEDURES

Water Elevation Measurements. The collection lysimeters will be monitored by removing the manhole cover, implementing confined space entry procedures, and then removing the end plug from the top of the standpipe. The standpipe will then be probed for the presence of liquids using an electric well probe. Should free liquids exist, the depth to the free liquids will be recorded.

If and when free liquids initially appear in the standpipe, the DRC will be notified in accordance with Part I.H.8 of the GWQDP. Immediately after free liquids are initially detected, the monitoring frequency will be increased to daily in order to assess the flow rate into the collection lysimeter. Daily monitoring will continue until the flow rate has stabilized or can be estimated to schedule periodic purging and sampling of the lysimeter standpipe. Free liquid monitoring frequency will then be decreased as approved by the Executive Secretary to an appropriate monitoring interval.

Free liquids will not be allowed to build up in the standpipe to a level less than 12 inches below the invert of the transfer pipe. The standpipe will be purged of free liquids when they are detected unless a sampling event is planned and the volume is being accumulated

to provide adequate sample volume for analysis. Purging will be performed using either a dedicated bailer or a peristaltic pump.

Sampling Procedures. Part I.F.6 of the GWQDP requires that water quality samples be collected within 24 hours after discovery. Because of the limited amount of water expected to be in the collection lysimeters, the number of radiological and chemical analyses will also be limited. Therefore, analytical samples will be collected using the following priority list.

Priority	Parameter	Sample Volume (ml)
1	Field Parameters- Temperature, pH, Specific Conductivity	100
2	Radiologics – LARW Suite	3,500
3	Metals/Inorganics – LARW Suite	500
4	TDS/TSS	500
5	Major Cations and Anions	500
6	Volatile Organic Compounds (VOCs)	3 X 40

Samples will be collected using either a dedicated bailer or a peristaltic pump.

WASTEWATER POND FIELD PROCEDURES

Water Elevation Measurements. Part I.F.13 of the GWQDP requires that the permitted Evaporation Ponds be monitored for freeboard. All inspection records shall comply with Part II.G. of the GWQDP, and a minimum of 24-inches of vertical freeboard shall be kept in the ponds.

Sampling Procedures. Part I.F.13 of the GWQPD requires that water quality samples be collected on an annual basis in all five ponds (Mixed Waste, Northwest Corner, 1995 LARW, 1997 LARW, and 2000 pond). Samples shall be collected at each pond during

the normal annual groundwater sampling effort. Samples will be collected using a peristaltic pump and 1-inch PVC pipe. The PVC pipe will be lowered into the ponds, and the peristaltic tubing will be inserted inside the pipe. This will keep the peristaltic tubing from floating on the water surface. Samples will be analyzed in accordance with Parts I.F.5 and I.F.13 of the GWQDP.

MIXED WASTE LEACHATE MONITORING FIELD PROCEDURES

Sampling Procedures. Part I.F.15 of the GWQDP requires that water quality samples be collected on an annual basis from the Mixed Waste leachate collection system (upper leachate collection access pipe. Samples shall be collected at each sump during the normal annual groundwater sampling event. If no leachate is present during the sampling event, no sample is required. This will be documented in the annual report. Samples will be collected using a peristaltic pump. Dedicated ¼" polyethylene tubing stored in each sump will be attached to the leachate withdrawal hose. Mixed Waste leachate will be sampled for VOCs, polychlorinated biphenyls (PCBs), and the radiologic constituents listed in tables IE and IF of the Ground Water Quality Discharge Permit, including complete gamma spectroscopic analysis.

MONITORING WELL FIELD PROCEDURES

Groundwater Elevation Measurements. Groundwater elevation measurements will be collected on a monthly basis at GW-37, GW-38R, PZ-1, PZ-2, I-1-100, I-3-30, I-3-100, GW-27D, GW-19B, and all compliance monitoring wells. These sites are shown on Plate 1, and are listed in the Groundwater Elevation Measurement Form shown in Figure B.4-1.

In addition, the specific gravity (SG) of groundwater from all locations listed above will be measured on-site on an annual basis. Samples for SG measurement will be obtained during groundwater sampling. For the wells without dedicated pumps (deep wells and

piezometers), a disposable bailer will be used to collect samples for SG measurement. A hydrometer will be used to measure the SG.

Procedures. Depth to groundwater will be measured using an electric water level indicator. The groundwater elevation measurements will be made from a surveyed reference location at the top of the protective casing. Prior to insertion into the well casing, the electric water level probe will be triple rinsed with distilled or deionized water and inspected for foreign matter to ensure proper decontamination. A straight edge will be placed across the open protective casing and measurements will be determined at the bottom of the straight edge.

After decontamination, the probe is then lowered until the signal is activated. The probe is then gently lifted and lowered as needed so that the probe is positioned at the surface of the water. The depth to groundwater value is determined by observing the place on the water level indictor's line at the bottom of the straight edge when the probe indicates it is at the surface of the water. Depth to water measurements are recorded to the nearest 0.01' in the Groundwater Field Notebook and on the Groundwater Elevation Measurement Form (Figure B.4-1). The measurements are repeated until at least two successive values are observed. The observed value is recorded. The probe is then removed from the well and rinsed thoroughly with distilled or deionized water and inspected for foreign matter.

Total Well Depth Measurements. Total well depth measurements will be collected on an annual basis at all wells currently in the monitoring well network. These measurements will be made during the annual sampling event. The measured water column will be compared to the theoretical water column (based on monitoring well completion diagrams) to evaluate the amount of silt that has accumulated in the bottom of the monitoring wells using the following equation:

$$\text{Percent Actual Water column} = \frac{(TD_m - DTW)}{(TD_t - DTW)} \times 100$$

where:

TD_m is the measured well depth

TD_t is the theoretical well depth

DTW is the measured depth to water

If the measured water column is less than 90 percent of the theoretical water column, the monitoring well will be redeveloped prior to sampling.

Procedures. Total well depth will be measured using an electric water level indicator. Prior to measuring the total depth of each well, the dedicated pumps will be extracted from the wells. The condition of each pump will be checked, and any maintenance will be performed to ensure proper operating conditions of the pumps. The total monitoring well depth measurement will be made from a surveyed reference location at the top of the protective casing. A straight edge will be placed across the open protective casing and measurements will be determined from the bottom of the straight edge. Prior to insertion into the well casing, the electric water level probe will be triple rinsed with distilled or deionized water and inspected for foreign matter to ensure proper decontamination.

After decontamination, the electric water level indicator is turned off. The probe is then lowered slowly into the well until it hits the bottom of the well. The depth to the bottom of the well is determined by observing the place on the water level indictor's line at the bottom of the straight edge when the probe indicates it is at the bottom of the well. Depth to the bottom of the well measurements are recorded to the nearest 0.01' in the Groundwater Field Notebook. The measurements are repeated until at least two successive values are observed. The observed value is recorded. The probe is then removed from the well and rinsed thoroughly with distilled or deionized water and inspected for foreign matter.

After all depth measurements are recorded, a correction factor is added to each measurement. The correction factor represents the distance from the depth to water sensor (where the measuring tape is referenced) to the end of the steel probe (which contacts the bottom of the well).

Documentation. All data collected during this program will be recorded on the Groundwater Elevation Measurement Form (Figure B.4-1). The field personnel will also maintain a field logbook consisting of a weather resistant, bound, survey-type book, with non-removable, numbered pages. The logbook will be updated on a daily basis (during fieldwork) and will include the following information:

Name of individual making entry	Name and location of job
Personnel on site	Name and address of field contact person
Date and time groundwater elevations were started and completed	Equipment used for groundwater elevation measurements
Weather conditions	Any deviations from QAPP
Groundwater well number	Problems with monitoring wells

All entries will be made in ink and any errors will be corrected by drawing a single line through the appropriate text and then adding the correct test. All changes will be dated and initialed.

GROUNDWATER SAMPLING

Groundwater Sampling Locations and Frequency. This WMQAP applies to groundwater monitoring at five disposal areas at Energy*Solutions'* Clive facility. These disposal areas include the LARW cell, the Class A cell, the Class A North cell, the 11e.(2) cell, and the Mixed Waste cell. Because these disposal areas fall under different regulatory agencies, wells monitored for these areas have different analyte suites. However, all radiological analyses are regulated by the DRC. The groundwater sampling programs for the Energy*Solutions* facility are indicated and described in Tables B.4-1a and B.4-1b. Figure B.4-1 lists the monitoring wells for which depth to water measurements are determined on a monthly basis and provides areas for recording:

- Measurement dates
- Depth to water measurements
- Specific gravity and groundwater elevation (if applicable)

Quality Assurance/Quality Control Samples. To ensure the comparability of data to previous sampling programs, quality control (QC) for the groundwater sampling programs will include the following samples:

QC Samples	Requirement
Trip Blank	One trip blank will be included in each cooler containing samples for Volatile Organic Compounds (VOC) analysis
Field Blank	For RCRA sampling, one field blank (pour blank) will be collected per sampling event when the event includes VOC samples

Blind Duplicate	One blind duplicate will be collected for each scheduled analysis for each round of sampling (5 percent)
Matrix Spike	One sample for matrix spike analysis will be collected for each scheduled analysis for each round of sampling (5 percent)
Matrix Spike Duplicate	One sample for matrix spike duplicate analysis will be collected for each scheduled analysis for each round of sampling (5 percent) [a]

[a] Except for dioxin/furan analysis by Method 8290 or equivalent, where isotopic dilution is used to assess the effects of matrix on method performance.

Sample Designation. All environmental groundwater samples will be designated using their current Energy*Solutions* location identification. The QA/QC samples will be designated based on type. Trip blanks will be designated by "TB", which indicates the sample is a trip blank, and the date it was submitted for analysis (e.g., TB-7/24/97). Field blank samples will be designated with "FB", which indicates the sample is a field blank, and the date the sample was collected (e.g., FB-7/24/97). Blind duplicates will be designated with a fictitious sample identification (e.g., the blind duplicate for GW-29 may be labeled GW-301). Samples collected for matrix spike (MS) and matrix spike duplicate (MSD) analyses will have the same designation as their associated environmental sample, except that an MS or MSD will follow the sample designation, e.g., GW-29 MS or GW-29 MSD.

GROUNDWATER SAMPLING EQUIPMENT AND PROCEDURES

Pre-Sampling Procedures. Prior to sampling, each monitoring well will be checked for proper identification, and the well head will be examined for signs of tampering or damage. All indications of tampering or damage will be recorded and reported to the DCP.

The sampler will prepare a Groundwater Sampling Sheet (Figure B.4-2) and a complete set of sample containers prior to sampling each well. All of the samples will be collected in new, and certified clean (by manufacturer), sample containers provided by the analytical laboratory. The analytical methods, and the container types and preservatives for each analysis type are listed in Table B.4-2.

A label will be placed on each sample container submitted for analysis and will include the following information:

- Project name and location
- Field sample identification
- Date and time the sample was collected
- Preservative (if applicable)
- Sampler's initials
- Analysis type

Equipment. All compliance groundwater monitoring wells at the Energy*Solutions* facility have dedicated PVC and Teflon® bladder pumps with Teflon® lined, polyethylene tubing. Should additional monitoring wells be required for future monitoring, these new monitoring wells also will be equipped with dedicated bladder pumps and tubing.

Depth to groundwater will be measured and recorded as previously discussed.

Pre-Sampling Purging. To ensure the groundwater samples are representative of the aquifer, a minimum of three casing volumes of groundwater will be purged using the dedicated bladder pump. The following procedures will be used to calculate the volume of water to be purged from each monitoring well:

- The height of the water column in the well will be determined by measuring the static water level and the total well depth according to the methods previously described.

- The volume of water to be purged from the monitoring well will be calculated using the height of the water column in the well casing as follows:

Total Purge Volume: $V_t = 3(V_c) \times 7.48 \text{ gal / ft}^3$

where: V_t = Total Purge Volume (gallons)
V_c = Volume of water in well casing (ft^3)

Casing Volume: $V_c = \pi r_1^2 h_1$

where: V_c = Casing Volume (ft^3)
r_1 = Inside radius of monitoring well casing (ft)
h_1 = Height of water column (i.e., total well depth minus static water level depth) (ft)

If there is insufficient groundwater recharge to evacuate three casing volumes from the well, it will be evacuated to dryness, then sampled after the well has recovered to 80 percent of the static water level. If the well becomes dry before all sample containers are filled, then the remaining sample containers will be filled after the well recharges

sufficiently. Purge volume calculations and the actual purge volume removed from each well will be recorded on the Groundwater Sampling Sheet.

Water Quality Parameter Measurements. To ensure the groundwater samples are representative of the aquifer, specific conductivity (SC), pH, temperature, dissolved oxygen (DO), and reduction/oxidation (redox) potential (Eh) will be monitored using a flow-through cell during pre-sampling purging. In addition, SG will be measured on an annual basis after purging is complete in each well. SG measurements will be made in the field using a hydrometer. Before sampling is initiated, a minimum of three casing volumes will be purged from the well and three consecutive water quality measurements will meet the following criteria:

- Specific conductivity = ± 3 percent
- pH = ± 0.1 units
- Temperature = ± 1°C

If the criteria listed above are not met after three casing volumes have been removed from the well, the Groundwater Manager will be contacted to determine what corrective actions, if any, should be taken prior to sampling, or purging can continue until water quality measurements stabilize. All of the water quality measurements will be recorded on the appropriate Groundwater Sampling Sheet. The appearance of the discharge water will also be recorded on this sheet.

Purge Water Disposal. Purge water evacuated from all wells is to be discharged into the Mixed Waste Wash Pad sump or into one of the Mixed Waste Evaporation Tanks.

ENVIRONMENTAL AND QA/QC SAMPLE COLLECTION

Environmental Samples. Groundwater samples will be collected directly into the appropriate sample container from the discharge line of the dedicated bladder pump. For all samples, the sample bottles will be filled in the order of compound volatility or stability as follows:

1. Volatile Organic Compounds (VOC)
2. Semi-Volatile Organic Compounds (SVOCs)
3. Inorganics/Anions
4. Total Dissolved Solids (TDS), Total Suspended Solids (TSS)
5. Sulfides/Cyanide
6. Metals/Cations
7. Radiological Parameters

The analytical methods for this program, and the associated sample containers and preservatives are listed on Table B.4-2.

For groundwater samples collected for VOCs from the bladder pumps, the discharge rate of the pump will be reduced to the extent possible to allow gentle filling of the sample bottles without aeration. The VOC sampling flow rate will be measured and documented on the sampling field sheet immediately prior to sample collection for VOCs, at least once daily, on all days when VOC samples are collected. Immediately after VOC sample collection, sample containers will be placed in a cooler containing ice in order to meet the VOC preservation requirements.

Quality assurance/quality control samples for these sampling programs include trip blank, field blank (for RCRA sampling), blind duplicate, matrix spike, and matrix spike duplicate samples. These samples will be collected as described below.

Trip Blanks. Trip blanks will be prepared by the laboratory prior to sampling and will consist of three 40 ml glass bottles filled with preserved reagent grade (High Pressure Liquid Chromatography [HPLC]) water. The bottles will be filled so that there is no

headspace and will be capped with a Teflon® septum. Trip blanks will be included in each cooler containing samples scheduled for VOC analysis.

Field Blanks. Field blanks (Pour Blanks) are collected during RCRA sampling and consist of laboratory provided reagent grade water. During the sampling process, water supplied by the laboratory in a certified clean, new bottle is poured into at least three, 40 ml VOC bottles. The VOC bottles should then be capped so that no air is present. Field blanks are stored in the same sample cooler as other VOC samples.

Blind Duplicates. A blind duplicate sample is a single grab sample that is split into two samples during collection. For samples collected for VOC analysis, the environmental sample will be collected from one pump cycle of water, and then the additional vials will be collected from the next two pump cycles. For all other samples, the environmental sample will be collected by alternately filling the environmental sample and the duplicate sample. Typically, the environmental bottle will be filled to one-third the total volume, and then the duplicate bottle will be filled to one-third of the total volume. The bottles will be alternated in this fashion until both bottles are filled. The frequency of collection of blind duplicates will be 1 per 20 samples, or 5 percent.

Matrix Spike and Matrix Spike Duplicate Samples. Samples for MS/MSD analysis will be collected for five percent of the total number of samples for each analytical method. The same procedures used to collect blind duplicate samples will be used to collect samples for MS/MSD analysis.

CHAIN OF CUSTODY

A project-specific Chain-of-Custody (COC) form will be completed and accompany each sample cooler. The COC includes:

- Project identification

- Project location
- Sample location identification
- Sample designation and analysis type
- Sample collection date and time
- Sample collection technique
- Sample matrix

All entries will be made in ink and unused portions of the COC form will be crossed out and initialed. Any errors will be corrected by drawing a single line through the appropriate text and then adding the correct text. Any changes will be dated and initialed. An example of the COC that will be used for this project is provided as Figure B.4-3.

The original copy of the COC will be signed, placed in a plastic bag, and placed inside of the shipping container used for sample transport. When the laboratory receives the samples, the appropriate laboratory personnel will sign the COC. After the laboratory logs in the samples, the COC will be completed and a copy of the completed COC will be faxed or e-mailed to the DCP or designee within 48 hours.

SAMPLE PACKAGING PROCEDURES

All groundwater samples will be packaged in coolers containing ice and transported or shipped for next-day delivery to the appropriate laboratory on the same day of collection. In the event that the samples require shipping, the following procedures will be used for packing samples:

- The samples will be placed upright in a waterproof metal (or equivalent strength plastic) ice chest or cooler provided by the laboratory.

- Ice will be placed in double Ziploc™ bags (to prevent leakage) and arranged around, among, and on top of the sample bottles. Sufficient ice will be used so that the samples will be chilled and maintained at approximately 4°C.

- To prevent the sample containers from sliding around the cooler, the cooler will be filled with inert cushioning material, such as shipping peanuts, additional bubble pack, or cardboard dividers.

- The completed COC form will be placed in a waterproof plastic bag and taped to the inside of the cooler lid.

- The lid will be secured with strapping tape by wrapping it completely around the cooler.

- Signed and dated custody seals will be placed on the cooler in two locations across the opening of the cooler lid.

SAMPLE SHIPPING

Samples will be hand delivered to AWAL laboratories and shipped to Test America laboratories. The delivery address for AWAL is:

American West Analytical Laboratories
(ATTN: AWAL Project Manager)
463 West 3600 South
Salt Lake City, UT 84115

Samples will be shipped to TAR and TAD via overnight delivery service. The delivery address for radiological samples is:

Test America Richland
(ATTN: STL Project Manager)
2800 George Washington Way
Richland, WA 99352
(509) 375-3131

The delivery address for potentially contaminated conventional chemistry samples is:

Test America Denver
(ATTN: STL Project Manager)
4955 Yarrow Street
Arvada, CO 80002
(303) 736-0100

FIELD EQUIPMENT CALIBRATION PROCEDURES

Field Parameter Meters. All meters will be calibrated on a daily basis prior to their use, in accordance with the manufacturer's directions. The meters will also be recalibrated any time drift in the meter is suspected, and the calibration will be checked in the middle of the day (mid-day calibration check) and at the end of each day of use. All calibration information will be recorded on the Groundwater Monitoring Field Instrument Calibration Sheet (Figure B.4-4).

Water-Level Sounder. The electric water-level sounder will be checked daily before the beginning of field activities to ensure that it is in good working order. The sounder will be checked for overall appearance (cleanliness, cuts in the tape) and the sounder probe will be placed in water to check for operation. This information will be recorded on the Calibration Sheet.

DOCUMENTATION PROCEDURES

As discussed in the above paragraphs, all data collected during groundwater sampling will be recorded on the Groundwater Sampling Sheet (Figure B.4-2). The sampling personnel will also maintain a field logbook consisting of a weather resistant, bound, numbered, survey-type book, with non-removable pages. The log book will be updated on a daily basis (during field work) and will include the following information:

- The name and location of the job
- Personnel onsite
- Name and address of the field contact person
- The date(s) groundwater sampling was started and completed
- Weather conditions
- Sampling methodology
- Photograph numbers and descriptions (if applicable)
- Any deviations from the WMQAP
- Observations that may be relevant to the field program.

All entries will be made in ink and any errors will be corrected by drawing a single line through the appropriate text and then adding the correct text. Any changes will be dated and initialed.

FIGURE B.4-1

Groundwater Elevation Measurement Form
Energy*Solutions*

Well ID	Area	STATE PLANE COORDINATES Easting (feet)	Northing (feet)	Top of Pro. Casing w/o Lid[1] (feet)	Date (dd-mmm-yr)	Specific Gravity	Depth to Water (feet)	Groundwater Elevation (feet)
I-1-30	RCRA	1,194,195.8	7,420,900.9	4,279.45				
I-3-30	RCRA	1,194,589.6	7,422,922.8	4,281.33				
GW-16R	LARW	1,193,928.8	7,422,886.6	4,281.12				
GW-19A	11e.(2)/Pond	1,189,864.7	7,421,007.7	4,270.79				
GW-20	11e.(2) LARW	1,192,617.2	7,421,988.4	4,276.60				
GW-22	LARW	1,193,462.9	7,422,929.9	4,277.25				
GW-23	LARW	1,193,052.8	7,422,934.6	4,276.63				
GW-24	11e.(2) LARW	1,192,636.4	7,422,837.9	4,276.69				
GW-25	11e.(2) LARW	1,191,653.8	7,423,063.1	4,276.24				
GW-26	11e.(2)	1,190,914.9	7,423,076.1	4,274.67				
GW-27	11e.(2)	1,190,080.1	7,423,096.0	4,272.43				
GW-28	11e.(2)	1,190,065.0	7,422,152.4	4,271.26				
GW-29	11e.(2) LARW	1,192,602.0	7,421,099.4	4,276.32				
GW-36	11e.(2)/Pond	1,190,699.5	7,421,642.8	4,272.09				
GW-37	11e.(2)	1,191,256.3	7,422,025.7	4,270.88				
GW-38R	11e.(2)	1,191,202.0	7,422,392.3	4,275.70				
GW-56R	LARW	1,193,952.3	7,422,491.1	4,279.19				
GW-57	11e.(2)	1,190,072.5	7,422,629.2	4,271.88				
GW-58	11e.(2)/Pond	1,190,084.7	7,421,679.4	4,271.38				
GW-60	11e.(2)	1,191,831.9	7,420,943.4	4,274.79				
GW-63	11e.(2)	1,190,937.2	7,420,971.1	4,272.04				
GW-64	LARW	1,193,904.2	7,421,623.1	4,278.96				
GW-66R	RCRA/Pond	1,194,183.8	7,421,240.1	4,281.77				
GW-77	LARW	1,193,897.5	7,421,068.4	4,282.96				
GW-103	LARW	1,192,748.0	7,420,884.8	4,278.30				
GW-104	LARW	1,193,240.5	7,420,877.9	4,278.74				
GW-105	LARW	1,193,731.0	7,420,869.9	4,279.22				
I-1-100	Deep Well	1,194,193.9	7,420,896.6	4,279.33				
I-3-100	Deep Well	1,194,590.0	7,422,927.9	4,281.56				
GW-19B	Deep Well	1,189,864.3	7,420,999.9	4,270.69				
GW-27D	Deep Well	1,190,079.3	7,423,071.4	4,273.67				
GW-139D	Deep Well	1,192,431.7	7,425,700.4	4,283.14				
P3-95 NECR	Pond Well	1,194,361.0	7,423,973.8	4,285.20				
P3-95 SWC	Pond Well	1,194,114.1	7,423,717.1	4,280.25				
P3-97 NECR	Pond Well	1,194,343.2	7,424,298.4	4,282.02				
PZ-1	Piezometer	1,189,765.5	7,420,893.2	4,269.18				
PZ-2	Piezometer	1,193,809.7	7,427,011.9	4,281.79				
GW-81	Class A	1,190,443.9	7,424,663.5	4,276.78				
GW-82	Class A	1,190,775.1	7,424,656.4	4,276.81				
GW-83	Class A	1,191,104.5	7,424,649.8	4,276.90				
GW-84	Class A	1,191,437.3	7,424,643.6	4,277.29				
GW-85	Class A	1,191,760.6	7,424,637.2	4,277.88				
GW-86	Class A	1,192,156.8	7,424,629.7	4,278.15				
GW-88	Class A	1,192,544.6	7,424,621.6	4,279.58				
GW-89	Class A	1,192,538.6	7,424,228.2	4,279.35				
GW-90	Class A	1,192,532.9	7,423,836.7	4,278.76				
GW-91	Class A	1,192,526.7	7,423,442.1	4,278.48				
GW-92	Class A	1,192,519.9	7,423,043.2	4,279.05				
GW-93	Class A	1,192,132.2	7,423,053.1	4,277.86				
GW-94	Class A	1,191,333.3	7,423,069.2	4,276.55				
GW-95	Class A	1,190,503.5	7,423,084.6	4,274.63				
GW-99	Class A	1,190,086.6	7,423,490.1	4,273.71				
GW-100	Class A	1,190,095.3	7,423,883.1	4,274.37				
GW-101	Class A	1,190,103.7	7,424,276.5	4,275.03				

FIGURE B.4-1

Groundwater Elevation Measurement Form
Energy*Solutions*

Well ID	Area	STATE PLANE COORDINATES Easting (feet)	Northing (feet)	Top of Pro. Casing w/o Lid[1] (feet)	Date (dd-mmm-yr)	Specific Gravity	Depth to Water (feet)	Groundwater Elevation (feet)
GW-102	Class A	1,190,112.5	7,424,670.5	4,275.47				
GW-106	Class A North	1,190,128.0	7,424,985.7	4,276.18				
GW-107	Class A North	1,190,138.4	7,425,378.5	4,276.26				
GW-108	Class A North	1,190,148.1	7,425,724.7	4,275.96				
GW-109	Class A North	1,190,431.3	7,425,719.1	4,276.46				
GW-110	Class A North	1,190,759.6	7,425,712.9	4,276.72				
GW-111	Class A North	1,191,086.4	7,425,706.8	4,277.07				
GW-112	Class A North	1,191,421.8	7,425,701.5	4,277.40				
GW-126	11e.(2) LARW	1,192,625.7	7,422,412.9	4,279.08				
GW-127	11e.(2) LARW	1,192,607.5	7,421,543.2	4,278.36				
GW-128	LARW	1,193,916.2	7,422,056.0	4,282.62				
GW-129	Pond Well	1,190,375.2	7,426,189.8	4,283.55				
GW-130	RCRA	1,194,288.6	7,422,901.3	4,281.15				
GW-131	RCRA	1,194,613.8	7,422,907.6	4,281.74				
GW-132	RCRA	1,194,937.0	7,422,912.3	4,282.95				
GW-133	RCRA	1,194,943.0	7,422,569.8	4,283.54				
GW-134	RCRA	1,194,938.8	7,422,238.2	4,285.28				
GW-135	RCRA	1,194,936.1	7,421,904.9	4,284.26				
GW-136	RCRA	1,194,930.0	7,421,583.2	4,283.79				
GW-137	Class A North	1,191,789.8	7,425,698.9	4,278.43				
GW-138	Class A North	1,192,096.3	7,425,695.2	4,279.42				
GW-139	Class A North	1,192,429.7	7,425,689.5	4,282.92				
GW-140	Class A North	1,192,424.3	7,425,362.2	4,280.88				
GW-141	Class A North	1,192,420.8	7,425,032.9	4,280.19				

Measured By: _____ Date: _____

[1] - Surveyed location where depth to water measurements are referenced.

Instrument: _____

TABLE B.4-1a

Groundwater Sampling Program
Energy*Solutions*

Well ID	Area	Screened Interval [1] (feet)	Sampling Frequency	Analyte List [3]
I-1-30	RCRA	25-35	Annual	RCRA List
GW-16R	LARW	23-38	Annual	LARW List
GW-19A	11e.(2)/Pond	18-28	Annual	LARW List [2]
GW-20	11e.(2)/LARW	25-35	Annual	LARW List [2]
GW-22	LARW	22-32	Annual	LARW List
GW-23	LARW	22-32	Annual	LARW List
GW-24	11e.(2)/LARW	22-32	Annual	LARW List [2]
GW-25	11e.(2)	24-34	Annual	11e.(2) List
GW-26	11e.(2)	20-30	Annual	11e.(2) List
GW-27	11e.(2)	20-30	Annual	11e.(2) List
GW-28	11e.(2)	20-30	Annual	11e.(2) List
GW-29	11e.(2)/LARW	22-32	Annual	LARW List [2]
GW-36	11e.(2)/Pond	20-30	Annual	LARW List [2]
GW-56R	LARW	25-35	Annual	LARW List
GW-57	11e.(2)	20-30	Annual	11e.(2) List
GW-58	11e.(2)/Pond	20-30	Annual	LARW List [2]
GW-60	11e.(2)	22-27	Annual	11e.(2) List
GW-63	11e.(2)	20-30	Annual	11e.(2) List
GW-64	LARW	25-35	Annual	LARW List
GW-66R	RCRA/Pond	25-40	Annual	RCRA List [4]
GW-77	LARW	29-39	Annual	LARW List
GW-81	Class A	19-34	Annual	LARW List
GW-82	Class A	19-34	Annual	LARW List
GW-83	Class A	19-34	Annual	LARW List
GW-84	Class A	19-34	Annual	LARW List
GW-85	Class A	19-34	Annual	LARW List
GW-86	Class A	25-40	Annual	LARW List
GW-88	Class A	19-34	Annual	LARW List
GW-89	Class A	19-34	Annual	LARW List
GW-90	Class A	19-34	Annual	LARW List
GW-91	Class A	19-34	Annual	LARW List
GW-92	Class A	19-34	Annual	LARW List
GW-93	Class A	19-34	Annual	LARW List
GW-94	Class A	19-34	Annual	LARW List
GW-95	Class A	14-29	Annual	LARW List
GW-99	Class A	19-34	Annual	LARW List
GW-100	Class A	14-29	Annual	LARW List
GW-101	Class A	19-34	Annual	LARW List
GW-102	Class A	19-34	Annual	LARW List
GW-103	LARW	29-39	Annual	LARW List

TABLE B.4-1a

Groundwater Sampling Program
Energy*Solutions*

Well ID	Area	Screened Interval [1] (feet)	Sampling Frequency	Analyte List [3]
GW-104	LARW	29-39	Annual	LARW List
GW-105	LARW	29-39	Annual	LARW List
GW-106	Class A North	23.5-38.5	Annual	LARW List
GW-107	Class A North	23.75-38.75	Annual	LARW List
GW-108	Class A North	24-39	Annual	LARW List
GW-109	Class A North	23.5-38.5	Annual	LARW List
GW-110	Class A North	23.5-38.5	Annual	LARW List
GW-111	Class A North	23.5-38.5	Annual	LARW List
GW-112	Class A North	23.5-38.5	Annual	LARW List
GW-126	11e.(2)	20.5-35.5	Annual	11e.(2) List
GW-127	11e.(2)	20.5-35.5	Annual	11e.(2) List
GW-128	LARW	25-40	Annual	LARW List
GW-129	Pond	29-44	Annual	LARW List
GW-130	RCRA	24.1-39.1	Annual	RCRA List
GW-131	RCRA	24.4-39.4	Annual	RCRA List
GW-132	RCRA	24.5-39.5	Annual	RCRA List
GW-133	RCRA	24.5-39.5	Annual	RCRA List
GW-134	RCRA	26.7-41.7	Annual	RCRA List
GW-135	RCRA	26.5-41.5	Annual	RCRA List
GW-136	RCRA	26.5-41.5	Annual	RCRA List
GW-137	Class A North	20.5-35.5	Annual	LARW List
GW-138	Class A North	24.0-39.0	Annual	LARW List
GW-139	Class A North	23.7-38.7	Annual	LARW List
GW-140	Class A North	24.4-39.4	Annual	LARW List
GW-141	Class A North	20.5-35.5	Annual	LARW List
P3-95 NECR	Pond	25-40	Annual	LARW List
P3-95 SWC	Pond	21-36	Annual	LARW List
P3-97 NECR	Pond	19-34	Annual	LARW List

[1] - Depth below ground surface

[2] - The LARW list is more comprehensive and will therefore be collected. 11E.(2) semi-volatiles will also be collected.

[3] - The analyte lists are provided in Table B.4-1b

[4] - Also an Evaporation Pond Monitoring Well, RCRA List plus GWQDP requirements

TABLE B.4-1b

Summary of Analyte Lists
Energy*Solutions*

RCRA Analyte List[1]

Groundwater Monitoring Parameters (including pH, SC, TDS, TSS, and Sulfide)

Anions (including F, Cl, NO_3-NO_2, SO_4, HCO_3, CO_3, and OH)

Cations (including Ca, Fe, Mg, K, and Na)

Anion/Cation Balance

Metals (including Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Ni, Se, Ag, Tl, V, and Zn)

Volatiles (full Appendix IX RCRA Groundwater Monitoring List Scan)

Semi-Volatiles (full Appendix IX RCRA Groundwater Monitoring List Scan)

Organochlorine Pesticides (full Appendix IX RCRA Groundwater Monitoring List Scan)

Polychlorinated Biphenyls (PCBs)

Radiologics (including Gross β, Ra-226 and 228, Np-237, Th-230 and 232, U-233, 234, 235, 236, and 238, K-40, C-14, I-129, Tc-99, Sr-90, Total U, and Tritium)

LARW, Class A, Class A North, and Evaporative Pond Analyte List

Groundwater Monitoring Parameters (including pH, SC, cyanide, and TDS)

Anions (including Br, F, Cl, NO_3-NO_2, SO_4, HCO_3, CO_3, and OH)

Cations (including Ca, Fe, Mg, K, and Na)

Anion/Cation Balance

Metals (including Sb, Ba, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, and Zn)[2]

Volatiles (including 1,2-Dichloroethane, MEK, Acetone, Carbon Disulfide, Chloroform, Methylene Chloride, 1,1,2-Trichloroethane, and Vinyl Chloride)

Radiologics (including Gross-β, Ra-226 and 228, Np-237, Th-230 and 232, U-233, 234, 235, 236, and 238, K-40, C-14, I-129, Tc-99, Sr-90, Total U, and Tritium)

11e.(2) Analyte List

Groundwater Monitoring Parameters (including pH, SC, cyanide, and TDS)

Anions (including Br, F, Cl, NO_3-NO_2, SO_4, HCO_3, CO_3, and OH)

Cations (including Ca, Fe, Mg, K, and Na)

Anion/Cation Balance

Metals (including Sb, Ba, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, and Zn)[2]

Volatiles (including 1,2-Dichloroethane, MEK, Acetone, Carbon Disulfide, Chloroform, Methylene Chloride, 1,1,2-Trichloroethane, and Vinyl Chloride)

Semi-Volatiles (including Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, Diethyl Phthalate, 2-Methylnaphthalene, Naphthalene)

Pesticides (including Chlordane)

Radiologics (including Gross β, K-40, Ra-226 and 228, Th-230 and 232, and Total U)

[1] Non-radiological analyte list from MW Storage, Treatment, and Disposal Permit Table VI-1

[2] Include As and Mo at Permit and License renewal

TABLE B.4-2
Standard Units of Measurement, Sample Containers, and Holding Times
Energy*Solutions*
(Page 1 of 2)

Analysis (Method)	Sample Container	Preservative	Filtered	Unit of Measure	Holding Time
Volatile Organic Compounds (VOCs) EPA Method 8260	3 40-ml glass bottles with a Teflon septum cap; No head space	Chill to 4°C Hydrochloric Acid	No	µg/L	14 days from sample collection to analysis
Semi-Volatile Organic Compounds (SVOCs) EPA Method 8270 Organochlorine Pesticides EPA Method 8081 Polychlorinated Biphenyls (PCBs) EPA Method 8082	2 1-l amber glass bottles with a Teflon lined cap	Chill to 4°C	No	µg/L	7 days from sample collection to extraction 40 days from extraction to analysis
Metals - Various methods (see Attachment A)	1 1-l plastic bottle with a Teflon lined cap	Chill to 4°C Nitric Acid pH < 2	Yes (No for RCRA)	µg/L	28 days for Hg 6 months for all other metals
Anions - Various Methods (see Attachment A)	1 250-ml plastic bottle with a Teflon lined cap	Chill to 4°C	No	mg/L	28 days from sample collection to analysis
Nitrate/Nitrite (EPA 353.2)	1 250-ml plastic bottle with a Teflon lined cap	Chill to 4°C Sulfuric Acid to pH <2	No	mg/L	28 days from sample collection to analysis
Total Dissolved Solids (SM 2540 C)	1 250-ml plastic bottle with a Teflon lined cap	Chill to 4°C	Yes	mg/L	7 days for sample collection to analysis
Total Suspended Solids (SM 2540 D)	1 1liter plastic bottle with a Teflon lined cap	Chill to 4°C	No	mg/L	7 days for sample collection to analysis
Alkalinity (SM 2320 B)	1 250-ml plastic bottle with a Teflon lined cap	Chill to 4°C	No	mg/L	7 days for sample collection to analysis

TABLE B.4-2
Standard Units of Measurement, Sample Containers, and Holding Times
Energy*Solutions*
(Page 2 of 2)

Analysis (Method)	Sample Container	Preservative	Filtered	Unit of Measure	Holding Time
Cyanide (EPA 335.4) and sulfide (EPA 376.1 and 376.2)	1 500-ml plastic bottle with a Teflon lined cap	Chill to 4°C NaOH to pH > 12 add Zinc Acetate for sulfide	No	mg/L	14 days from sample collection to analysis
Radiologics - Gross β, Ra-226 and 228, Iso-Th, K-40, Sr-90, Np-237, Iso-U, Tot-U, and Tc-99 (see Attachment A for methods)	1 4-l plastic bottle	Nitric acid pH < 2	Yes	pCi/L (Tot-U mg/L)	6 months from sample collection to analysis
Radiologics - C-14, I-129,Tc-99, Tritium (see Attachment A for methods)	1 1- plastic bottle	None	Yes	pCi/L	6 months from sample collection to analysis

FIGURE B.4-2

Groundwater Sampling Sheet
Energy*Solutions*
CL-EV-PR-004-F3

Groundwater Well No. or Sampling Point _____ Date _____ Arrival Time _____

Sampling Team Members: Name and Initials Team Leader (TL) _____ Assistant _____

Description of Well Condition. (Note the condition of the well at the time of arrival, whether the well is secure (locked), general condition, note presence of cracks or any evidence of tampering.)

Y N In good condition?
Y N Is the well fully operational?
Y N Was the lock secure on arrival?
Y N Evidence of tampering or vandalism?
Y N Are sandy or silty materials in the well?
Y N Standing water in or around the well?
Y N Cracks or breaks in the concrete or casings?
Y N Has the annual TD been determined?
Y N Is the well in need of repairs?
Y N Is there a marked change in pumping rate?

Weather Conditions

Wind Direction _____
Speed (est.) _____
Cloud Cover _____
Temperature _____ degrees F
Precip: Present Recent Rain Snow Other _____
General Comments/Problems: _____

Specific Gravity: _____

Pre- and Post-Sampling Groundwater Field Analysis Results. Temperature: F C Specific Conductivity: µmhos/cm

#	Pre-pH	Pre-Temp	Pre-SC	Pre-Eh	Pre-Diss O	Appearance of Groundwater
1						
2						
3						

Well Information: for 2-inch well Purge Volume Formula: V_p (gal) = 0.5 gal/ft x ($Depth_{TD}$ - $Depth_{H2O}$)

Depth to well bottom (D_{TD}): _____
Survey factor for DTW probe: _____
Calculated purge volume: _____
Total purge volume: _____

Depth to groundwater (D_{H2O}): _____
Adjusted D_{H2O}: _____
Time pump on: _____ Time pump off: _____
1st flow rate of purge: _____ gallons/minute
2nd flow rate of purge: _____ gallons/minute

Analytical laboratories and delivery information:
Rad Lab _____ Delivery Time/Date: _____
Chem Lab _____ Delivery Time/Date: _____

Collection Order	Minimum Vol/ Container	Collection Order	Minimum Vol/ Container
1 _____ a. Volatile Organics	3x40ml/glass	5 _____ e. Cations	500 ml plastic
2 _____ b. Semi-VOCs	2x500ml/amber glass	6 _____ f. Anions	500 ml plastic
3 _____ c. Metals/Inorgs	500 ml plastic	7 _____ g. Radiologics	3.5 gallons plastic
4 _____ d. TDS, TSS	500 ml plastic	8 _____ h. Others (describe)	_____

Sampling Team Leader's Initials: _____ Others: _____

FIGURE B.4-3

ENERGY*SOLUTIONS* CHAIN OF CUSTODY RECORD/LAB WORK REQUEST

CL-EV-PR-004-F1

Chain of Custody Number _____
Cooler Number _____
Page _____ of _____
Air Bill No. _____

Laboratory _____

Energy*Solutions*
Phone (801) 649-2000 Fax (801) 321-0453

Contact: Jeff Low

Project LARW 11e.(2) Mixed Waste (circle one)

Samplers Signatures _____

Lab ID No. (Lab Only)	Location ID	Sample ID	Depth Interval (ft)	Date Collected	Time Collected	Matrix[a]	Sampling Technique[b]	Volatile Organic Compounds	Semi-Volatile Organic Compounds, Pesticides, Herbicides	Total PCBs	Dissolved Metals or Total Metals (circle) (includes Sb, As, Ba, Be, Cd, Ch, Co, Cu, Pb, Hg, Mo, Ni, Se, Ag, Tl, V, and Zn	Major Cation and Anions (includes Br, Ca, Mg, K, Na, HCO_3, CO_3, Cl, F, NO_3, NO_3-NO_2, and SO_4	pH, SC, TDS, and TSS	Cyanide, Sulfide	Carbon-14, Iodine-129, Technetium-99, and Tritium	Gross β, Total U, Be-7, Cd-109, Co-60, Mg-54, K-40, Ra-226 & 228, Sr-90, Np-237, Th-230 & 232	Iso Uranium	Total Uranium	Fluorine	

Analyses Requested

Laboratory Use Only

SAMPLES WERE:

1 Shipped or hand delivered
Notes:

2 Ambient or Chilled
Notes:

3 Temperature _____

4 Received Broken/Leaking (Improperly Sealed)
Y **N**
Notes:

5 Properly Preserved
Y **N**
Notes:

6 Received Within Holding Times
Y **N**
Notes:

COC Tape Was:

1 Present on Outer Package
Y **N** **NA**

2 Unbroken on Outer Package
Y **N** **NA**

3 Present on Sample
Y **N** **NA**

4 Unbroken on Sample
Y **N** **NA**
Notes:

Discrepancies Between Sample Labels and COC Record?
Y **N**
Notes:

a Matrix:
SO-Soil
SE-Sediment
WS-Surface Water
WG-Groundwater
LF-Product
AA-Air
SW-Wipe
EP/TCLP-Leachate
EQ-Trip Blank
Equipment Blanks
WW-Wastewater

b Sampling Technique
C-Composite
G-Grab
HA-Hand Auger
CN-Cone Penetrometer
BP-Bladder Pump
SP-Submersible Pump
B-Bailer

SPECIAL INSTRUCTIONS:
11e.(2) S-VOCs/Pest: naphthalene, diethyl phthalate, 2-methylnaphthalene, benzo(a)anthracene, chlordane, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, benzo(a)pyrene, dibenz(a,h)anthracene

Relinquished by	Received by	Date	Time

Relinquished by	Received by	Date	Time

FIGURE B.4-4

Groundwater Monitoring Field Instrument Calibration Sheet
Energy*Solutions*
CL-EV-PR-004-F2
1 of 2

Sampling Event: _____ Date: _____

Pre-Event Calibration of pH Meter Operator: _____

Meter: _____
(Manufacturer, serial number, model number, etc.)

Probe: _____
(Manufacturer, serial number, model number, etc.)

Calibration Solutions: _____
(Manufacturer, serial number, lot number, etc.)

_____

_____ Inspection of meter, probe, calibration solutions, cords, parts, battery.

Initial Reading:	(4)	_____	Initial:	(7)	_____	Initial:	(10)	_____
Temperature:	(T)	_____	Temp:	(T)	_____	Temp:	(T)	_____
Calibrate:	(4)	_____	Calibrate:	(10)	_____	Check:	(7)	_____
	(T)	_____		(T)	_____		(T)	_____

Time: _____

Pre-Event Calibration of SC Meter Operator: _____

Meter: _____
(Manufacturer, serial number, model number, etc.)

Probe: _____
(Manufacturer, serial number, model number, etc.)

Calibration Solutions: _____
(Manufacturer, serial number, lot number, etc.)

_____ Time: _____

_____ Inspection of meter, probe, calibration solutions, cords, parts, battery.

Init. Reading:	(_____) _____	Init. Reading:	(_____) _____
Init. Reading:	(_____) _____	Init. Reading:	(_____) _____
Calibration:	(_____) _____	Calibration:	(_____) _____
Calibration:	(_____) _____	Calibration:	(_____) _____

Eh Meter Information Operator: _____

Meter: _____
(Manufacturer, serial number, model number, etc.)

Probe: _____
(Manufacturer, serial number, model number, etc.)

_____ Time: _____

_____ Inspection of meter, probe, calibration solutions, cords, parts, battery.

FIGURE B.4-4

Groundwater Monitoring Field Instrument Calibration Sheet
Energy*Solutions*
CL-EV-PR-004-F2
2 of 2

Pre-Event Check of Water Level Indicator Operator: _____

Meter: _____
(Manufacturer, serial number, model number, etc.)

Probe: _____
(Manufacturer, serial number, model number, etc.)

_____ Inspection of meter, probe, calibration solutions, cords, parts, battery.

Result of Check: OK Other: _____ Battery: OK Replace Time: _____

Mid-Day Check of pH Meter Operator: _____ Time: _____

Meter, Probe, Solutions: Same Other: _____

_____ Inspection of meter, probe, calibration solutions, cords, parts, battery.

_____ Check with pH (7) Reading (7): _____ Temperature (7): _____

Mid-Day Check of SC Meter Operator: _____ Time: _____

Meter, Probe, Solutions: Same Other: _____

_____ Inspection of meter, probe, calibration solutions, cords, parts, battery.

_____ Check Reading (_____) _____

Mid-Day Check of Water Level Indicator Operator: _____ Time: _____

Meter, Probe: Same Other: _____

_____ Inspection of meter, probe, calibration solutions, cords, parts, battery.

Result of Check: OK Other: _____ Battery: OK Replace

End-Of-Day Check of pH Meter Operator: _____ Time: _____

Meter, Probe, Solutions: Same Other: _____

_____ Inspection of meter, probe, calibration solutions, cords, parts, battery.

_____ Check with pH (7) Reading (7): _____ Temperature (7): _____

End-Of-Day Check of SC Meter Operator: _____ Time: _____

Meter, Probe, Solutions: Same Other: _____

_____ Inspection of meter, probe, calibration solutions, cords, parts, battery.

_____ Check Reading (_____) _____

End-Of-Day Check of Water Level Indicator Operator: _____ Time: _____

Meter, Probe: Same Other: _____

_____ Inspection of meter, probe, calibration solutions, cords, parts, battery.

Result of Check: OK Other: _____ Battery: OK Replace

B.5 SAMPLE CUSTODY, HANDLING, AND SHIPPING PROCEDURES

SAMPLE CUSTODY

To ensure that samples are identified correctly and remain representative of the environment, the documentation and sample custody procedures specified in this section will be followed during sample collection and analysis. Standard sample documentation and custody procedures, as outlined below, will be used during the sampling program to maintain and document sample integrity during collection, transportation, storage, and analysis. The field sampling personnel will be responsible for ensuring proper documentation and that custody procedures are initiated at the time of sample collection until samples are relinquished to the laboratory. The laboratory will be responsible for maintaining sample custody and documentation from the time samples are relinquished to the lab until final sample disposition.

CHAIN OF CUSTODY

Chain-of-custody (COC) procedures provide an accurate written record of the possession of each sample from the time of collection in the field through laboratory analysis. A sample is considered in custody if one of the following applies:

- It is in an authorized person's immediate possession,
- It is in view of an authorized person after being in physical possession,
- It is an a secure area after having been in physical possession of an authorized field person, or
- It is in a designated secure area, restricted to authorized laboratory personnel only.

Field Procedures. The sample custody and documentation procedures will be initiated at the time of sample collection. Sample collection details will be documented on the

Groundwater Sampling Sheet (Section B.4). Samples will be labeled and the appropriate information will be recorded on the COC as described in Section B.4. All entries will be made in indelible ink. Any errors will be corrected by drawing a single line through the incorrect entry, entering the correct information, and then initialing and dating the change.

Sample Labels. Sample labels will be completed and attached to sample containers as described in Section B.4.

Chain of Custody Record. Properly completed COC records will ensure that sample custody is documented, appropriate sample fractions have been collected, and scheduled analyses are properly assigned. The type of COC and the information required for completion of the COC are described in Section B.4.

Custody Seals. Custody seals will be placed in two locations across the cooler closure to ensure that any tampering is detected. The date and initials of the sampler will be written on the custody seal.

Sample Packaging, Handling, and Transporting. All groundwater samples will be packaged, handled, and transported as described in Section B.4.

Laboratory Custody Procedures. Upon receipt in the laboratory, the integrity of the shipping container will be checked by verifying that the custody seal is not broken. The cooler will be opened and examined for evidence of proper cooling. The sample containers will then be checked for breakage, leakage, damage, and the contents and analytical requirements of the shipment will be verified against the COC. Custody seal integrity, the temperature, and sample preservation will be checked. If a problem is found, it will be documented on the sample custody form(s) and the Groundwater Manager or Staff Hydrogeologist will be notified at the time of receipt. Any shipping receipts will be stapled on the COC records and stored in the project file.

A permanent logbook will be maintained in the Sample Control area to document the following:

- Date of sample receipt
- Sample accession number
- Number of samples
- Source of samples

All insufficiencies and/or discrepancies will be immediately reported to the Laboratory Project Manager and an Anomaly Form will be completed. The Laboratory Project Manager will either resolve the problem internally or contact the Groundwater Manager or Staff Hydrogeologist for resolution. If the samples and documentation are acceptable, each sample container will be assigned a unique laboratory identification number from AWAL's, or Test America's Laboratory Information Management Systems (LIMS) database. Sample tracking will be documented on the LIMS (one of the functions of the LIMS is to assist in tracking samples while they are in the custody of the laboratory). Other information that will be recorded includes date and time of sampling, sample description, due dates, and required analytical tests. After the samples are entered into the LIMS, a copy of the proposed work order will be e-mailed or faxed to the Groundwater Manager or Staff Hydrogeologist within 24 hours of sample receipt. The Groundwater Manager or Staff Hydrogeologist will review the proposed work order and will contact the laboratory immediately should any errors or omissions be observed.

When the LIMS log-in has been completed, the samples will be transferred to the appropriate refrigerators in the Sample Control area. Separate refrigerators will be used for samples suspected to contain high levels of organic compounds and for samples for volatile analyses. The sample refrigerators will be kept at 0-6 degrees centigrade (^{o}C) and their temperatures will be recorded daily with thermometers calibrated against National Institute of Standards and Technology (NIST) thermometers. The cleanliness of

refrigerators storing samples for volatile analyses will be monitored using refrigerator blanks.

The Department Managers or their designee will be notified that the samples have arrived through the LIMS and will maintain custody of the samples during processing. The LIMS will maintain records of the sample custody. A sample location list is entered into the LIMS and printed on each sample label. Access to samples will be limited to authorized personnel, and Sample Check In/Out is tracked with the LIMS. Either a sample custodian or laboratory chemist will distribute samples for analysis from Sample Control.

Sample custody will be maintained within the laboratory's secure facility until sample disposal. Any marks or notes made on the chain-of-custody document by the Sample Custodian will be clearly distinguishable from original field notation.

Sample Disposal. Thirty days after a laboratory report has been generated and submitted to the Groundwater Manager or Staff Hydrogeologist, the samples are transferred to the sample disposal area. This transfer will be documented on the Sample Control Form. Samples will be disposed according to the laboratory's SOP, which is based on both State and Federal guidelines.

B.6 CALIBRATION PROCEDURES

This section discusses general requirements for field equipment and laboratory instrument calibration and standards preparation. Instrument calibration is necessary for accurate sample quantitation, and it establishes the dynamic range of an instrument. Criteria for calibration are specific to each method and instrument manufacturer. The following paragraphs outline the calibration procedures for the field equipment and laboratory instrumentation

FIELD EQUIPMENT

The field equipment to be used during the groundwater sampling program includes a water-level sounder; an Eh meter; a hydrometer, and a specific conductance, pH, and temperature meter. The meters will be calibrated according to the procedures outlined below.

Water-Level Sounder. The electric water-level sounder will be checked before the beginning of field activities to ensure that it is in good working order. The sounder will be checked for overall appearance (cleanliness, cuts in the tape) and the sounder probe will be submerged in water to check for operation. This information will be recorded on the Groundwater Monitoring Field Instrument Calibration Sheet provided in Section B.4.

In addition, the water-level sounder will also be calibrated against a steel surveyor's tape on an annual basis, typically at the first of the calendar year. This calibration will be made at room temperature, and any adjustments will be made based off of the certificate of calibration.

Water Quality Parameter Meters. Any meter used for water quality parameter measurements will be calibrated using reliable commercial reference standards or solutions in accordance with the manufacturer's instructions. Three buffer standards (4, 7, and 10) will be used for pH meter calibration. One standard (approximately 100,000 μmhos/cm) will be used for calibrating the specific conductance meter for a meter requiring a single-point calibration. Two standards (approximately 10.000 and 100,000 μmhos/cm) will be used for calibrating the specific conductance meter for a meter requiring a two-point calibration. These instruments will be calibrated prior to use or any time meter drift is suspected. In addition, calibration checks will be performed during the middle of the day and at the end of the day.

LABORATORY INSTRUMENTS

AWAL and Test America will provide analytical services for all definitive data. Attachment B contains AWAL and Test America Standard Operating Procedures (SOPs) including instrument calibration and corrective action procedures.

B.7 ANALYTICAL PROCEDURES AND DETECTION LIMITS

All groundwater samples collected for definitive data will be analyzed by AWAL and Test America Laboratories. The methods and Practical Quantitation Limits (PQLs) are listed in Attachment A. The PQLs are laboratory-specific target reporting limits that can be met in the absence of matrix interferences or high contaminant concentrations and are at least as stringent as the reporting limits specified for the individual analytical methods.

For radiological analysis, if the sum of the measured concentration plus the associated counting error term is equal to or greater than the Ground Water Protection Level (GWPL), the sample will be recounted for a period sufficient to provide a concentration with a counting error of ≤10 percent at the 95 percent confidence level.

All samples with concentrations of target analytes that exceed the linear range of the instrument will be diluted and reanalyzed. Every effort will be made to dilute the samples such that the sample concentration falls within the linear calibration range of the instrument.

Estimated data will be used in any trends analysis or compliance reporting, but the results will be qualified.

B.8 DATA REDUCTION, VALIDATION, AND REPORTING

FIELD MEASUREMENTS

Raw data from field measurements and sample collection activities will be documented in the field logbook and on the appropriate field forms. All field data generated during this program will be evaluated under the direction of Energy*Solutions* DCP or designee.

LABORATORY MEASUREMENTS

Data Reduction Calculations. Data will be reduced as specified by the analytical methods. These calculations are specific to the analytical instruments that are used for the analysis, the level of automation, and the type of software used to reduce the data. The procedures used for data reduction for each analytical method are described in the laboratory's SOPs, which are included as Attachment B of this WMQAP.

LABORATORY DATA VALIDATION

The laboratory will perform in-house analytical data reduction and review under the direction of the Laboratory Project Manager and the Laboratory QA Officer before data are released to Energy*Solutions*. The Laboratory Project Manager and Laboratory QA Officer also are responsible for assessing the data quality and qualifying any data that may be unreliable. The laboratory will prepare and retain full analytical and QC documentation. The data reduction and review will be conducted as follows:

- The bench analyst will convert the raw data and conduct the initial data review. The analyst will review preliminary data entries, calculations, holding times and precision, accuracy, and calibration check standards. The analyst will also provide explanation and/or corrective action summaries for any method control parameters that are outside control

criteria. The analyst will sign the analytical batch control form when the review is complete.

- The Laboratory Director (or designee) will review the analytical control documentation associated with each batch, as well as any corrective action explanations provided by the analyst. If the Laboratory Director (or designee) is not satisfied with all corrective action explanations and analytical control results, additional explanation will be required for the batch. The Laboratory Director is responsible for determining if the analytical data meet quality control criteria established by the analytical methods and by this WMQAP. The Laboratory Director will sign the analytical batch control form when satisfied with the data quality.

- The Laboratory Project Manager or Laboratory Supervisor will review analytical data batches that have been approved by the analyst, and will sign the batch control form when satisfied with the data. The Laboratory Project Manager also is responsible for reviewing all final data reports for proper format and reporting consistency prior to releasing the reports to Energy*Solutions*.

- The Laboratory QC Officer is responsible for performing annual audits to ensure that required QC procedures are followed. In the case of QC problems, the Laboratory QC Officer will initiate and follow up on corrective actions taken to rectify the problem. The laboratory maintains a permanent record of these in-house audits.

The laboratory review of the data includes assessing compliance with the control limits in this WMQAP. Accuracy and precision are the primary data parameters that can be used to calculate control limits. Data to evaluate accuracy are obtained primarily from separately prepared laboratory QC samples. Data used to evaluate

precision are QC sample analyses or the replicate analysis of field samples. The calculations that are used to evaluate precision and accuracy are defined in the laboratory's SOP. Precision and accuracy quality control limits are generated from the statistical analysis of QC sample results.

DATA REPORTING

All the correspondence, sample custody forms, raw data, reports, etc. will be kept in a specific project folder. The analytical data will be reported in a format organized to facilitate data evaluation. All of the data, including QC data, will be reported in the chronological order in which they were produced. The following information will be included in each data package:

- A case narrative that identifies samples not meeting QC criteria (i.e., poor spike recoveries) and any other analytical irregularities. The narrative shall describe the corrective action taken. If matrix effects are invoked as a case for out-of-control recoveries, a subsection of the narrative shall present a detailed justification for this assertion and include a summary of all relevant quality control data.

- A copy of the original chain-of-custody and copy of the project receipt checklist.

- The date the sample was collected in the field and the date the sample was received by the laboratory.

- Results for all environmental and QC sample analysis.

- Sample extraction/preparation and analysis dates.

- Method of analysis (name and method number).

- Quality control sample identification (for project specific quality control samples).
- Dilution factors for all applicable samples.
- Reporting limits or practical quantitation limits and units of measure for all analyses.
- Field sample identification and laboratory sample identification number.
- Quality control batch identifications
- The initial concentration and percent recovery of the surrogate spikes, matrix spikes, and laboratory control sample spikes and their associated quality control limits.
- Laboratory Control Sample (LCS) accuracy results with associated control limits – all samples will be clearly associated with each LCS analysis.
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) (as applicable) precision and accuracy results with associated control limits – all samples will be clearly associated with each MS/MSD sample pair analyses.
- Matrix Duplicate (MD) precision results with associated control limits.
- Method blank analytical results will be reported for all analytes for all required analyses – all samples will be clearly associated with each method blank sample analyses.
- Completed tuning and calibration data are stored in the data package with the raw data.

- Completed internal standard result summary results are stored in the data package with the raw data.

- Completed sample injection time and standard injection time summary forms are stored in the data package with the raw data.

The laboratories will archive the Energy*Solutions* project files, including raw data and bench work sheets for five years. These data will be available upon request. After five years, the DCP or designee will be notified for disposition of data.

B.9 INTERNAL QUALITY CONTROL

FIELD PROGRAM

Internal quality control evaluates whether a method is performing within acceptable limits of precision and accuracy. On the sampling level, the quality control samples used to assess field sampling techniques and environmental conditions during sample collection and transportation include trip blanks and field blanks, and blind duplicates.

Trip blanks and field blanks will be used to evaluate representativeness. Trip blanks will be used to assess whether volatile organic compounds (VOCs) were introduced into samples during handling, shipping, or storage at the laboratory. Field blanks will be used to assess whether the target analytes were introduced into the environmental sample during sample collection and handling.

Blind duplicate samples will be used to assess variability in the sample media and to assess sampling and analytical precision. Blind duplicate samples will be collected for five percent of the total number of samples collected for all analyses.

LABORATORY ANALYSIS

The general objectives of the laboratory QC program are to:

- Ensure that all procedures are documented, including any changes in administrative and/or technical procedures.
- Ensure that all analytical procedures are validated and conducted according to method guidelines.
- Monitor the performance of the laboratory using a systematic inspection program.

- Ensure that all data are properly archived.

All contract laboratories will conduct internal quality control for analytical services in accordance to their standard operating procedures, the individual method requirements, and this WMQAP. Before making changes to the WMQAP or analytical methodology, the laboratory will notify the DCP in writing. Energy*Solutions* will then notify the DRC, DWQ, and DSHW Project Managers.

Laboratory quality control consists of two distinct components: a laboratory component and media component. The laboratory component measures the performance of the laboratory analytical processes during the sample analyses (i.e., holding time, refrigerator blanks, method blanks, and laboratory control samples), while the media component (i.e., MS/MSD and surrogate spikes) measures the effects of a specific medium on the method performance. The following paragraphs discuss the QC samples that the laboratories will use to assess the data quality prior to submission to Energy*Solutions*.

Holding Time. Holding time reflects the length of time that a sample or sample extract remains representative of the environmental conditions. Depending on the analysis, either one or two holding times will be evaluated. For those analyses that do not include sample extraction, one holding time will be evaluated: the amount of time between sample collection and sample analysis. For analyses that have an extraction prior to analysis (e.g., SW-846 Method 8270), two holding times will be evaluated: 1) the length of time from sample collection until sample extraction, and 2) the length of time from sample extraction to sample analysis. Holding times for each analytical method are listed in Table B.4-2 of this WMQAP. Analytical data for those samples whose holding times were exceeded will be considered quantitatively questionable (possibly biased low) and will be qualified in accordance with EPA guidance to

indicate the data are estimated. In addition, an explanation detailing any holding time violation will be provided in the case narrative.

Method Blanks and Refrigerator Blanks. Both method and refrigerator blanks will be used to evaluate representativeness by identifying any contaminants that have been introduced into the environmental sample during sample storage or analysis. Method blanks are generated in the laboratory and consist of reagent grade water. Refrigerator blanks are prepared in the laboratory and consist of a 40-ml glass bottle with a Teflon® septum containing reagent grade water. The refrigerator blank is placed with the environmental samples in the storage refrigerator when the samples are first received for a given sampling event and remains in the refrigerator until all samples for the sampling event are received. The refrigerator blank is then analyzed with the last analytical batch of samples for the sampling event. Both the refrigerator and method blanks are carried through each processing step necessary for a given analytical procedure. These blanks measure contamination originating from the laboratory (i.e., storage, water, air, reagents, equipment, and instruments used for analysis), and are used to distinguish low-level field contamination from laboratory contamination. If analytes of interest are found in the blanks and in associated environmental samples, the data from the associated environmental samples may be considered questionable depending on the relative concentrations of contaminants in the blanks and the environmental sample. All data for environmental samples with associated blank contamination will be qualified according to EPA guidance. In addition, an explanation detailing any blank contamination problems will be provided in the case narrative.

Laboratory Control Samples. Laboratory Control Samples (LCS) will be used to evaluate accuracy. These samples are carried through the same analytical procedures as the environmental samples and are used to evaluate method and analytical procedure performance in the absence of matrix interference. LCSs are prepared in

the laboratory and consist of ultra-pure water that is spiked with specific compounds as outlined in the analytical methods. An LCS sample will be prepared and analyzed at a frequency of one per 20 samples, or daily, whichever is more frequent. Accuracy will be evaluated by calculating percent recovery for each spiked compound and comparing it to the QC limits established by the individual methods (Attachments A and B). Values within the established QC limits indicate acceptable analytical accuracy. Values outside the QC limits indicate that the data may be inaccurate.

Matrix Spike and Matrix Spike Duplicate Samples. MS/MSD/MD samples will be analyzed at a frequency of 5 percent on site-specific media to access accuracy and precision. MS/MSD analyses will not be performed for radiological constituents, with the exception of technetium-99 and total uranium. Unlike LCSs, MS/MSD samples will be used to assess the influence of the sample media (media interference) on the analysis. Each MS/MSD sample will be spiked with the compounds specified by the analytical method. To evaluate accuracy, the percent recovery for each spiked compound will be calculated and compared to the QC limits listed in Attachment A. Precision will be evaluated by calculating the RPD between the MS and MSD samples for each spiked analyte. These RPDs will be compared to the QC limits established by laboratory performance (Attachment A). Percent recovery and RPD values within the QC limits indicate acceptable precision and accuracy. Values outside the QC limits indicate that there may have been media interference during analysis.

Matrix Duplicates. Precision may also be measured by preparing and analyzing the same sample twice. Precision will be evaluated by calculating the RPD between the parent sample and the matrix duplicate (MD) for inorganic analyses, or by calculating the RER for the radiological analyses. The RPDs or RERs will be compared to the QC limit established by laboratory performance (Attachment A).

Surrogate Spikes. Surrogate spikes will be used to evaluate the accuracy of the method and analytical instrument performance for methods for organic analysis. Surrogate spikes will be added to each sample, including QC samples, prior to extraction or analysis as specified in SW-846 Test Methods for Evaluating Solid Waste (USEPA, 1996). After the analysis has been completed, the percent recovery of each surrogate spike will be calculated and compared to the QC limits established by the method of analysis (Attachment A). Percent recoveries within the QC limits indicate acceptable accuracy during analysis. Percent recoveries outside the QC limits indicate that there may have been a problem during analysis (media or non-media) and that the data may be inaccurate. Any surrogate failures will be summarized in the case narrative.

B.10 PERFORMANCE SYSTEMS AUDITS

FIELD PROGRAMS

Oversight of the field procedures will be the direct responsibility of the DCP, who will review all elements of this WMQAP to ensure that the objectives of the monitoring are met. In addition to an initial review, the sampling procedures will be reviewed regularly so that any necessary modifications can be made.

The Energy*Solutions* Quality Assurance Manager (or designee) will conduct internal audits of field activities (sampling and measurements). The audits will include examining field measurement records, field equipment calibration records, field sampling records, field instrument operation records, sample collection procedures, sample handling and shipping procedures, and COC procedures. Field activities will be audited immediately after the approval of this WMQAP to verify that all the procedures in the WMQAP are being followed. Follow-up audits will be conducted on an annual basis to correct deficiencies, and to verify that QA procedures are maintained throughout the project.

The DRC, DSHW, and DWQ may conduct external field audits. Field audits may be conducted at any time during the field operations and will be based upon the requirements in this WMQAP. These audits may or may not be announced at the discretion of the regulatory agencies.

LABORATORY AUDITS

In-house and regulatory agency audits of laboratory systems and performance are a regular part of a laboratory QC program and are outlined in the laboratory's QA/QC plans. The audits consist of a review of the entire laboratory system and at a minimum include examination of sample receiving, log-in, storage, and chain-of-

custody documentation procedures; sample preparation and analysis; and instrumentation procedures.

To verify proper implementation of laboratory procedures and adherence to this WMQAP, external audits may be performed by regulatory or Energy*Solutions* personnel prior to or during field activities. These audits may or may not be announced and are conducted at the discretion of the auditing agency. External audits will include (but are not limited to) review of laboratory analytical procedures, laboratory on-site audits, and/or submission of Performance Evaluation (PE) samples to the laboratory for analysis.

B.11 PREVENTATIVE MAINTENANCE

FIELD EQUIPMENT

The field equipment used for this sampling program includes an electronic water-level sounder; and Eh, DO, pH, specific conductivity, and temperature meters or multiprobe. All meters and instruments will be maintained and used according to the manufacturers' directions. Each piece of equipment will be inspected on a regular basis to ensure that the equipment is operational. The results of any equipment inspection will remain on-site. Any preventative maintenance or repair conducted in the field will be recorded on the calibration sheets (Figure B.4-4).

LABORATORY EQUIPMENT

Documentation. All maintenance performed on an instrument is documented in its maintenance logbook, which is kept with the instrument. The date, initials of the analyst performing the maintenance and the type of maintenance are recorded in this logbook. Receipts from routine maintenance performed by the manufacturer's representative are filed with the maintenance logbook.

Contingency Plan. In the event of instrument failure, every effort will be made to analyze samples by an equivalent alternate means within holding times. If the redundancy in equivalent instrumentation is insufficient to handle the affected samples, the DCP (or designee) will be notified immediately and the corrective action to be taken will be determined by the laboratory and the DCP (or designee). These actions include, but are not limited to re-collecting the groundwater samples after repairs are complete or sending the environmental samples to a secondary laboratory for analysis.

B.12 DATA ASSESSMENT PROCEDURES

As described in Section B.3, the quality of the field and analytical data will be evaluated using the PARCC parameters, which are quantitative and qualitative statements that describe data quality. The PARCC parameters will be used to determine whether the data quality objectives of this program have been met by comparing QC sample results and standard procedures with acceptance criteria established for this project. The PARCC parameters that will be used for data evaluation are defined in Section B.3.

FIELD DATA

The Groundwater Manager or Staff Hydrogeologist will assess field measurement data. The data quality evaluation, in terms of the PARCC parameters, will focus primarily on the laboratory data. However, the field data will be evaluated qualitatively in terms of the PARCC parameters. The following sections discuss how the PARCC parameters will be used to evaluate the field data and field sampling procedures.

Precision. Sampling precision is affected by the procedures used for sample collection, handling, and transportation. To reduce the variability that may be introduced during sampling, Section B.4 of the WMQAP outlines the standard sampling, handling, and shipping procedures that will be used for the sampling program. The use of these procedures should minimize variability in the sampling process.

In addition, the results of blind duplicate and blind replicate sample analyses will be used to evaluate sampling precision. The RPD will be calculated for each blind duplicate sample pair. Although the results of blind duplicate sample analyses also

reflect the variability associated with analytical procedures, low RPD values are an indication that consistent sampling techniques were used for sample collection.

Accuracy. Although there is no way to quantitatively measure the accuracy of the field program using percent recovery, some aspects of accuracy can be assessed, such as comparing the length of the water-level probe to a steel, engineers tape of known length and proper calibration of the field instruments.

Representativeness. The representativeness of the field data is determined by the implementation of the data collection procedures. The sampling and field measurement procedures to be used are based on existing analytical data, hydrogeology, and the physical setting of the Energy*Solutions* facility. Representativeness of the field sampling procedures and the field measurements will be evaluated by comparing the sampling and measurement procedures used in the field to the procedures outlined in this WMQAP. In addition, the results of field blank samples will be used to evaluate the representativeness of field sampling procedures. Contaminants detected in field blanks are indications that the sampling procedures are not being followed appropriately or there is another environmental factor that should be considered.

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, and the use of standardized units of measure. Comparability of the field measurements will be assessed by evaluating compliance with the specific field measurement procedures presented in this WMQAP.

Completeness. Completeness of the field program will be evaluated to ensure that the appropriate number of samples was collected for analysis, and that field data of the type and quantity outlined in the WMQAP were collected. Completeness of the field investigations will be evaluated by comparing the actual number of samples and the actual quantity of data that were collected to the requirements outlined in this WMQAP.

LABORATORY DATA

The laboratory data will be validated by the Groundwater Manager or Staff Hydrogeologist, based on the assumption that the sample was collected, handled, and analyzed according to this WMQAP. The data reviewer will conduct a systematic review of the data for compliance with the QC criteria established in the WMQAP and will identify any data omissions or data that do not meet the quality control criteria. The reviewer also will interact with the contract laboratories to correct any data deficiencies. Decisions to repeat sample collection or analyses will be made by the DCP based on the extent of the data deficiencies and their importance in the overall context of the project.

Laboratory Data Assessment Procedures. All definitive data will be validated and qualified based on the results of QC sample analysis and the basic principles for data validation outlined in the *USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review* (EPA, 1994). To assess the quality of the analytical data, the results of QC sample analyses will be evaluated using quality control limits established by the analytical methods or by past laboratory performance (Attachment A). The QC samples that will be used for data validation for each data type are listed in Table B.3-2. The forms shown in Figures B.12-1 and B.12-2 will be used during the data validation process and will be completed for each data package. Results of the QC sample evaluation will be expressed in terms of the PARCC parameters and will be used to assess the quality of the analytical data.

The QC samples that will be used to evaluate the analytical data for this program include (as applicable) trip, field, refrigerator, and method blanks; surrogate spikes; MS/MSD; LCS; and blind duplicate samples. The specific types and descriptions of the QC samples that will be collected in the field are discussed in Section B.4. The QC samples that are prepared in the laboratory and the rate at which these samples are analyzed are method-specific. A summary of the QC sample evaluation of laboratory data in terms of the PARCC parameters is presented in Table B.3-2. Data qualifiers that will be used during this program are listed in Table B.12-1. The following sections describe the criteria that will be used to evaluate the laboratory data.

Precision. Analytical precision will be assessed by comparing the percent recovery of the spiked analytes in the MS/MSD samples, or by comparing the MD concentration to the concentration of the parent sample. Relative percent difference will be calculated between the MS/MSD sample pairs using the recovery values of the spiked analytes, or by calculating the RPD between the concentrations of the MD and the parent sample for inorganic analyses. The RER will be calculated between the parent sample and the MD using the sample concentrations for the activity-based radiological analyses. The RPDs and RERs will then be compared to the QC acceptance criteria. The data quality objectives for precision during this program are based on laboratory established control limits, which are specific to each analyte (Attachment A).

Both analytical and field sampling precision will be evaluated by comparing the analytical results of field duplicate sample pairs. The RPDs will be calculated only for those analytes detected above the PQL in both the environmental and field duplicate sample. Because there is no guidance available for establishing QC limits for field duplicate RPDs, the QC criterion of ±25 percent will be adopted for this project. Relative percent difference values within the QC guidelines indicate that

good sampling and analytical procedures were followed. Relative percent difference values outside the QC limit indicate that there may have been a problem during sampling or analysis. Although precision for field duplicate samples will be assessed and reported, because there is no guidance for qualifying data based on field duplicate RPDs, field duplicate results will not be used to qualify data.

Accuracy. Laboratory accuracy will be evaluated using the results for surrogate spike, MS/MSD, and LCS sample analyses. As with precision, the accuracy objectives for the data are based on laboratory-established limits and vary with the specific analyte (Attachment A).

Representativeness. Representativeness is a qualitative parameter that evaluates whether or not the data represent the actual environmental conditions. Representativeness will be evaluated by analysis of method, refrigerator, trip, and field blanks and blind duplicate samples. Method, refrigerator, trip, and field blanks will be used to identify sources of contamination not associated with the environmental sample. Low RPDs for blind duplicate sample pairs indicate that the sampling technique was consistent and the resulting samples are representative of the environment.

Representativeness also is evaluated using holding-time criteria, which reflect the length of time that a sample or extract remains representative of the environmental conditions after sample collection. Holding times are compared to standard method-specific holding times accepted by the EPA. All holding times within the acceptance criteria are considered representative. Those holding times outside of EPA acceptance criteria are qualitatively evaluated to determine the effect on sample representativeness.

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, and the use of standardized units of measure.

As discussed in Section B.3, laboratory data comparability is dependent on the use of similar sampling and analytical methodology for different projects at a specific site. Comparability of laboratory data will be maximized for this project by specifying methodologies in this WMQAP, which are similar to those used previously. Laboratory data comparability will be assessed by comparing data collected under this WMQAP to historical Energy*Solutions* data (as available) and assessing whether the analytical methodologies presented in this WMQAP were followed.

During the validation process, the Groundwater Manager or Staff Hydrogeologist may determine that a laboratory result is anomalous by comparison with historical results. The Groundwater Manager or Staff Hydrogeologist may request re-analysis (within holding times) or resampling to confirm the anomalous result. However, the re-analysis or resampling will not delay the determination and notification of compliance status. In other words, anomalous data will be included in the evaluation of compliance status, and the compliance status will be reported in accordance with the requirements of the GWQDP. The reason(s) for considering the result anomalous and follow-up actions to be taken (e.g., reanalysis) should be discussed in the compliance status notification.

Completeness. Completeness also will be used to assess data quality and is expressed as the percentage of valid data relative to the total number of measurements. Completeness for this project will be calculated using the following equation:

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

Where: the number of valid data points is the total number of valid analytical measurements based on the precision, accuracy, and holding time evaluation. Acceptance criteria for completeness are defined in Section B.3.

TABLE B.12-1

Data Qualifiers
Energy*Solutions*

B	Analyte is detected above method detection limit, but below the practical quantitation limit.
R	Result is unusable.
UB	Analyte is not detected at or above the indicated concentration due to blank contamination.
UK	Analyte is not detected at or above the indicated concentration based on data evaluation.
UJ	Possible false negative result due to related QC problems.
J	Result is estimated based on MS/MSD or surrogate recoveries.

FIGURE B.12-1
ORGANIC ANALYSIS DATA VALIDATION WORKSHEET

Analytical Method/Analytes:_____ Sample Collection Date(s): _____

Laboratory _____ MW Job Number: _____

Batch Identification: _____ Matrix: _____

QC Identification[a]: _____ Page: 1 of 2

Validation Complete: _____

(Date/Signature)

Sample No.	Sample ID	Lab. ID	Hits (Y/N)	Quals.	Comments

DATA VALIDATION WORKSHEET

Analytical Method: _____ **QC Identification[a]:** _____

Laboratory: _____ **Batch Identification:** _____

Validation Criteria	Sample Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hardcopy vs. Chain-of-Custody														
Holding Time														
Analyte List														
Reporting Limits														
Tuning Standard (GC/MS)														
Initial Calibration (all methods)														
Continuing Calibration (all methods)														
Injection Time(s) (all methods)														
Internal Standard EICP Area (GC/MS methods)														
Internal Standard Retention Time Window (GC/MS methods)														
Retention Time Windows (GC methods)														
Method Blank (all methods)														
Surrogate Spike Recovery (organic methods)														
Laboratory Control Sample (all methods)														
Laboratory Control Sample Duplicate (lab specific)														
Matrix Spike/Matrix Spike Duplicate (all organic methods)														
Trip Blanks														
Field Duplicate/Replicate														
Equipment Rinsate Blanks														
Electronic Deliverable vs. Hardcopy														
Electronic Deliverable vs. Chain of Custody														

(a) List QC batch identification if different than Batch ID
A indicates validation criteria were met
A/L indicates validation criteria met based upon Laboratory's QC Summary Form
X indicates validation criteria were not met
N indicates data review were not a project specific requirement
N/A indicates criteria are not applicable for the specified analytical method
N/R indicates data not available for review

NOTES

FIGURE B.12-2
INORGANIC ANALYSIS DATA VALIDATION WORKSHEET

Analytical Method/Analytes:_____ Sample Collection Date(s): _____

Laboratory:_____ MW Job Number: _____

Batch Identification:_____ Matrix:_____

QC Identification[a]: _____ Page: 1 of 2

Validation Complete: _____

(Date/Signature)

Sample No.	Sample ID	Lab. ID	Hits (Y/N)	Quals.	Comments

DATA VALIDATION WORKSHEET

Analytical Method: _____ **QC Identification[a]:** _____

Laboratory: _____ **Batch Identification:** _____

Validation Criteria	Sample Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hardcopy vs. Chain-of-Custody														
Holding Time														
Analyte List														
Reporting Limits														
Initial Calibration (all methods)														
Initial Check Blank (ICP & AA methods)														
Continuing Calibration (ICP & AA methods)														
Injection Time(s) (all methods)														
Interference Check Standard (ICP Method														
Method Blank (all methods)														
Laboratory Control Sample (all methods)														
Laboratory Control Sample Duplicate (lab specific)														
Matrix Spike/Matrix Spike Duplicate (all organic methods)														
Matrix Duplicate (Lab Specific)														
Field Duplicate/Replicate														
Equipment Rinsate Blanks														
Electronic Deliverable vs. Hardcopy														
Electronic Deliverable vs. Chain of Custody														

(a) List QC batch identification if different than Batch ID
A indicates validation criteria were met
A/L indicates validation criteria met based upon Laboratory's QC Summary Form
X indicates validation criteria were not met
N indicates data review were not a project specific requirement
N/A indicates criteria are not applicable for the specified analytical method
N/R indicates data not available for review

NOTES:

B.13 CORRECTIVE ACTIONS

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out of quality control performance that may affect data quality. All proposed and implemented corrective action will be documented in the regular quality assurance reports to the appropriate project management. Corrective actions will be implemented only after approval by the DCP. If immediate corrective action is required, approvals secured by telephone from the DCP will be documented in an additional memorandum.

For each non-compliance, a formal corrective action program will be established and implemented at the time the problem is identified. The person who identifies the problem will be responsible for notifying the DCP, who in turn will notify the appropriate regulatory Project Manager. Implementation of the corrective action will be confirmed in writing as described previously.

Any non-conformance with the established QC procedures specified in the WMQAP will be identified and corrected in accordance with the WMQAP. Corrective actions will be implemented and documented. No staff member will initiate a corrective action without prior communication of findings through proper channels. If corrective actions are insufficient, the appropriate personnel may issue a stop work order.

FIELD CORRECTIVE ACTION

During any field activity, the field staff will be responsible for documenting and reporting all suspected technical and QA non-conformances, and suspected deficiencies. The non-conformances and/or deficiencies will be documented in the field logbook and reported to the DCP. If the problem is associated with field measurements or sampling equipment, the field staff will take the appropriate steps to

correct the problem. Typical field procedures to correct problems include the following:

- Repeating the measurement to check for error.
- Making sure the meters or instruments are adjusted properly for the ambient conditions, such as temperature.
- Checking or replacing batteries.
- Recharging batteries.
- Re-calibrating the instruments.
- Replacing the meters or instruments used to measure field parameters.
- Stopping the work until the problem is corrected (if necessary).

If a deficiency is noted during review of the Groundwater Monitoring Field Instrument Calibration Sheet, corrective action will be taken. If calibration information is incomplete or if it is determined that a meter was not properly calibrated, the Groundwater Manager or Staff Hydrogeologist will determine and document corrective actions. If information is missing, the Sampling Technician will be contacted and applicable field logbooks will be reviewed to determine if the information was recorded in the logbook.

Although groundwater field parameter data are screening-level data, if a meter calibration deficiency is found, associated field parameter data will be qualified as estimated. The affected field data will depend on the timing of the deficiency (i.e., pre-event, mid-day, or end-of-day). Alternatively, rather than qualifying data, the deficiency may be corrected by obtaining another field measurement.

Stabilization of specific conductivity, pH, and temperature readings is used to document completion of purging prior to groundwater sample collection. If calibration associated with the measurement of all three of these parameters is found to be deficient, the Groundwater Manager or Staff Hydrogeologist will notify the DCP. The DCP will determine if the well(s) should be resampled. The deficiency and its resolution will be documented.

As stated in Sections B.4 and B.5, the analytical laboratory will provide copies of COC forms to the Groundwater Manager or Staff Hydrogeologist within 48 hours of sample receipt (Section B.4) or, if a deficiency is noted at sample login, at the time of receipt (Section B.5). The Groundwater Manager or Staff Hydrogeologist will promptly review the COC forms for completeness, proper custody, and accuracy of information (sample numbers, collection dates, and requested analyses). If a problem or deficiency is noted, the Groundwater Manager or Staff Hydrogeologist will provide the laboratory with a corrected COC. Timing will consider analytical method holding times. If the custody deficiency potentially requires resampling, the DCP will be notified. The DCP will determine if the well(s) should be resampled. The deficiency and its resolution will be documented.

Field corrective action may consist of additional Sampling Technician training in groundwater sampling, water elevation measurement, field meter calibration, COC, sampling packaging and shipping, documentation, or completion of field forms. All field training will be documented.

If a non-conformance or problem requires a major adjustment to the field procedures as outlined in this WMQAP (e.g., changing sampling methodology), the DCP, in conjunction with the appropriate regulatory Project Manager, will be responsible for initiating corrective actions. The DCP will be responsible for:

- Evaluating the reported non-conformance.
- Controlling additional work on non-conforming items.
- Determining the appropriate corrective actions in conjunction with the appropriate regulatory Project Manager.
- Approving all changes in writing or verbally prior to field implementation, if feasible. If deemed unacceptable, the action taken during the period of deviation will be evaluated to determine the significance of any departure from established program practices and action taken.
- Ensuring that explanations of non-conformances and corrective actions are included in the report scheduled for this program.
- Ensuring that no additional work that is dependent on the non-conforming activity is performed until the appropriate corrective actions are completed.
- Reporting all changes to all affected parties.

LABORATORY CORRECTIVE ACTION

Corrective actions are required whenever unreliable analytical results prevent the quality control as specified by the method or the laboratory WMQAP from being met. The corrective action that is taken depends on the analysis and the non-conformance. Attachment A provides a summary of the corrective actions that will be undertaken for problems associated with specific laboratory analyses.

Corrective actions are handled primarily at the bench level by the analyst who reviews the sample preparation or extraction procedures, and performs the instrument

calibration and analysis. If the problem persists or its cause cannot be identified, the matter will be referred to the department supervisor or QA department for further investigation. Once resolved, full documentation of the corrective action procedure will be filed with the QA department. A summary of the corrective actions will be included in the data package submitted to Energy*Solutions*.

Corrective action may be undertaken if one of the following occurs:

- Loss or spillage of sample during transit to the laboratory.
- Violation of the maximum holding time before laboratory analysis.
- QC data are outside the acceptance criteria for precision and accuracy.
- Blanks contain contaminants above acceptance levels.
- A trip blank analytical result is more than 10 percent of the corresponding parameter result, and the original parameter is above its corresponding GWPL.
- Gamma-spectroscopy yields a lower limit of detection (LLD) that is not at or below 10 percent of the corresponding GWPL.
- A counting error term is reported that is greater than the corresponding approved acceptance limit.
- Undesirable trends are detected in spike recoveries (or spike recoveries are outside the QC limits), or RPDs between duplicate analyses are consistently outside QC limits.
- There are unusual changes in detection limits.

- Deficiencies are detected during QA audits.

Whether or not corrective action is taken will be dependent upon how severe the problem is, and how critical the data are to the project DQOs and the completeness goal.

DATA VALIDATION CORRECTIVE ACTION

Corrective action may be initiated during data validation or data assessment. Potential corrective actions may include requesting re-sampling by the field team or reinjection/reanalysis of samples by the laboratory.

These actions are dependent upon the ability to mobilize the field team, how critical the data are to the project DQOs, or whether the samples are still within holding time criteria. When the data validator identifies a corrective action situation, the DCP will be notified and will have final responsibility for contacting the appropriate State agencies and for authorizing the implementation of the corrective action, including re-sampling. All corrective actions of this type will be documented by the DCP.

Field duplicate precision is evaluated as part of data validation. As stated in Section B.3, evaluation of field duplicate precision will not result in data qualification. However, if assessment of field duplicate data indicates a pattern of field duplicate precision results exceeding acceptance criteria, corrective actions will be implemented and documented as described above for field corrective action.

B.14 QUALITY ASSURANCE REPORTS

All of the analytical data collected during this program will be presented in annual reports, as required by the individual permit or license. The reports will be submitted to the DCP and to DRC, DWQ, and DSHW project managers as appropriate. The following information will be included in the report:

- Sampling procedures (planned and implemented, problems, and corrective actions).
- Groundwater sampling sheets
- Analytical procedures and detection limits.
- Analytical data (environmental and QC sample results).
- Results of the data quality evaluation.
- Findings regarding any field programs, data validation, and/or laboratory corrective action needed.
- Conclusions and recommendations.

REFERENCES

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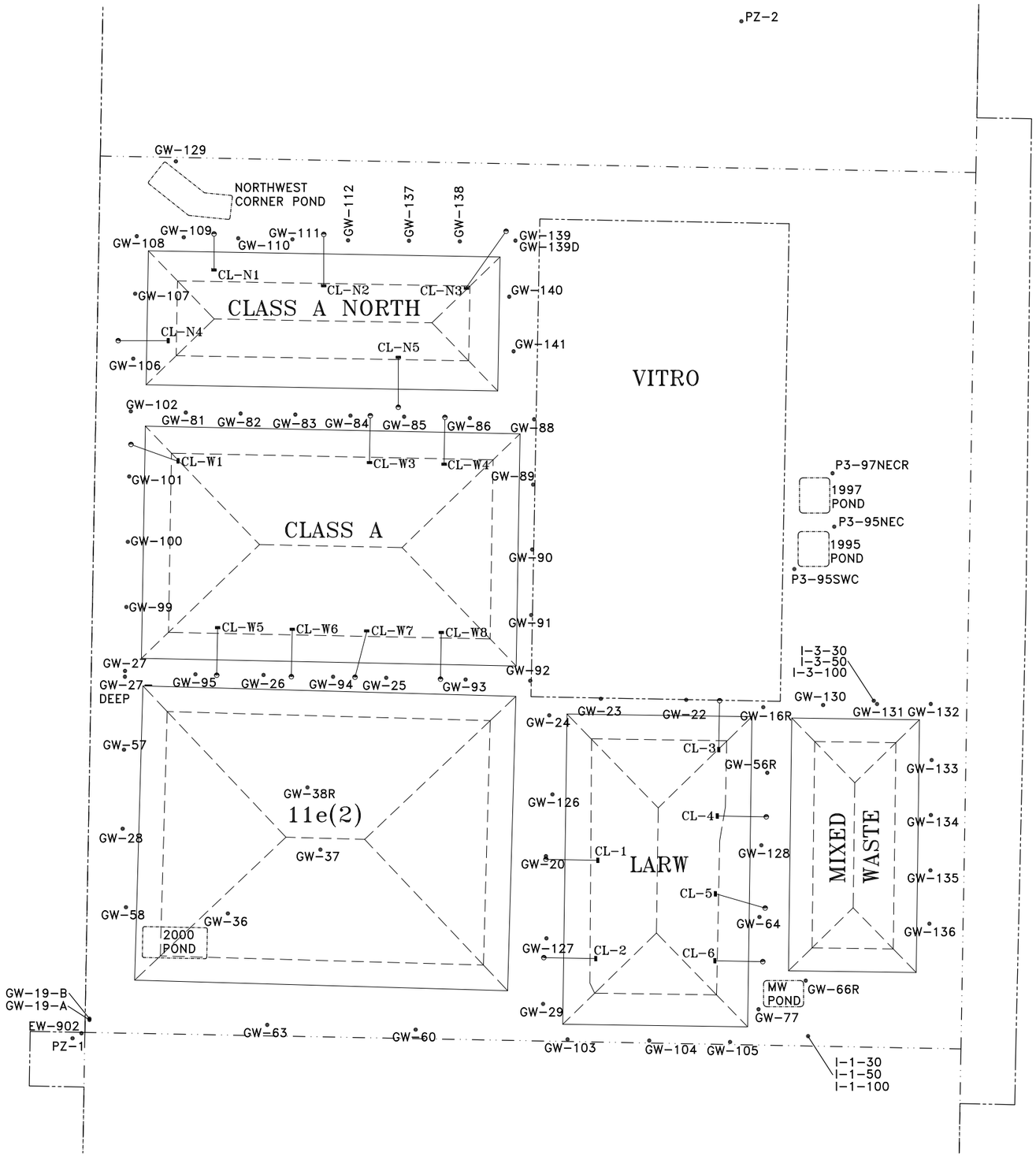

LEGEND

- SECTION LINE
- PROPERTY LINE
- PERMITTED EMBANKMENT LIMITS
- EMBANKMENT EARTHWORK BREAK LINES
- EVAPORATION POND
- GROUND WATER MONITORING WELL
- LYSIMETER PAN
- LYSIMETER COLLECTION MANHOLE

360 0 360 720

NOTE:
CL-N1, N2, N3 AND N4 HAVE NOT BEEN CONSTRUCTED YET, AS OF 6/29/11.

DATE	BY	DESCRIPTION OF CHANGE
6/29/11	DFB	2011 UPDATE – FOR INFORMATION

ENERGYSOLUTIONS

PLATE 1

SURFACE AND GROUNDWATER SAMPLING LOCATIONS
CLIVE, UTAH

FOR INFORMATION ONLY

DRAFTED BY D.BOOTH
REVIEWED BY B.SOBOCINSKI
APPROVED BY D.BOOTH
SCALE AS SHOWN | DATE 06/27/11 | REV.
DRAWING NO. 2011 PLATE 1