aquilogic, Inc.
environment ● water ● strategy

1503 South Coast Drive, Suite 203
Costa Mesa, CA 92626
Tel. +1.714.770.8040
Web: www.aquilogic.com

APPENDIX B
QUALITY ASSURANCE PROJECT PLAN
SOUTH BASIN GROUNDWATER PROTECTION PROJECT (SBGPP)
Orange County, California

Prepared for:
Orange County Water District
18700 Ward Street
Fountain Valley, CA 92708

Project No.: 002-01

May 2012

TABLE OF CONTENTS

1.0 PROJECT SUMMARY 1
1.1 PROJECT TASKS 2
1.2 PROJECT OBJECTIVES 2
2.0 PROJECT/TASK ORGANIZATION 3
2.1 PROJECT MANAGER (PM) 3
2.2 PROJECT QUALITY ASSURANCE MANAGER (PQAM) 3
2.3 PROJECT CONSISTENCY REVIEWER (PCR) 3
2.4 PROJECT FIELD SUPERVISOR (PFS) 4
2.5 PROJECT HEALTH AND SAFETY OFFICER (PHSO) 4
2.5.1 HEALTH AND SAFETY PLAN (HASP) 4
2.5.2 HEALTH AND SAFETY TRAINING 5
2.6 PROJECT FIELD TEAM (PFT) MEMBERS 5
2.7 PROJECT DATABASE MANAGER (PDM) 5
2.8 PROJECT ORGANIZATION CHART 6
3.0 DATA QUALITY OBJECTIVES AND CRITERIA 7
3.1 PRECISION 8
3.2 ACCURACY 8
3.3 REPRESENTATIVENESS 8
3.4 COMPLETENESS 8
3.5 COMPARABILITY 8
3.6 DATA QUALITY INDICATOR SUMMARY 9
4.0 DOCUMENTS AND RECORDS 10
4.1 FIELD OPERATION RECORDS 10
4.2 FIELD SAMPLING FORM 10
4.3 CHAIN OF CUSTODY RECORDS 10
4.4 SAMPLE LABELS 11
4.5 QUALITY CONTROL SAMPLE RECORDS 11
4.6 CORRECTIVE ACTION REPORTS (CARs) 12
4.7 LABORATORY RECORDS 12
4.7.1 SAMPLE SUMMARY RESULTS 12
4.7.2 SAMPLE MANAGEMENT RECORDS 12
4.7.3 ANALYTICAL METHODS 12
4.7.4 QA/QC REPORTS 13

4.8 DATA HANDLING RECORDS 13
5.0 SAMPLING METHODS REQUIREMENTS 14
6.0 SAMPLE HANDLING AND CUSTODY REQUIREMENTS 16
6.1 SAMPLE PACKAGING 16
6.2 FIELD SAMPLE CUSTODY PROCEDURES 16
6.3 SAMPLE LABELING 17
6.4 LABORATORY CUSTODY PROCEDURES 17
7.0 QUALITY CONTROL REQUIREMENTS 18
7.1 BLANK SAMPLES 18
7.1.1 EQUIPMENT BLANKS (FIELD) 18
7.1.2 FIELD BLANKS (FIELD) 18
7.1.3 TRIP BLANKS (FIELD) 19
7.1.4 METHOD BLANKS (LABORATORY) 19
7.2 DUPLICATE SAMPLES 19
7.2.1 FIELD DUPLICATES (FIELD) 19
7.2.2 LABORATORY DUPLICATES (LABORATORY) 19
7.3 SPIKED SAMPLES 20
7.3.1 LABORATORY CONTROL SAMPLES (LCS) 20
7.3.2 MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES (MS/MSD) 20
7.4 QC SAMPLING FREQUENCY 21
7.5 STANDARDS 21
8.0 INSTRUMENT CALIBRATION AND FREQUENCY 22
9.0 DATA MANAGEMENT 23
9.1 DATA REDUCTION 23
9.2 DATA VALIDATION 23
9.3 DATA REPORTING 24
9.4 DATA RETENTION 24
10.0 PERFORMANCE AUDITS 25
11.0 CORRECTIVE ACTION 26
12.0 QA/QC REPORTING 27
13.0 DATA VALIDATION AND USABILITY 28
13.1 DATA REVIEW, VALIDATION, AND VERIFICATION 28
13.1.1 ACCURACY ASSESSMENTS 28

13.1.2 PRECISION ASSESSMENTS 28
13.2 VALIDATION AND VERIFICATION 29
13.2.1 FIELD DATA VALIDATION 29
13.2.2 LABORATORY DATA VALIDATION 30
14.0 CLOSURE 31
15.0 REFERENCES 32

LIST OF APPENDICES

A Sample Forms:

Daily Field Report

Well Sampling Form

QA/QC Sample Record

Corrective Action Reports

Chain of Custody Record

Data Quality Checklist and Corrective Action Form

ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
Cal/EPA	California Environmental Protection Agency
Cal-OSHA	California Occupational Safety and Health Administration
CalTrans	California Department of Transportation
CARs	Corrective Action Reports
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CHSP	Corporate Health and Safety Plan
CoC	chain-of-custody
COCs	chemicals of concern
$Conc_{sample}$	concentration of sample
$Conc_{duplicate}$	concentration of duplicate
CPT	cone penetrometer test
Cr(VI)	hexavalent chromium
1,1-DCA	1,1-dichloroethane
1,2-DCA	1,2-dichloroethane
1,1-DCE	1,1-dichlorothene
Cis-1,2-DCE	cis-1,2-dichlorothene
DQIs	Data Quality Indicators
DQO	data quality objectives
DTSC	Cal/EPA Department of Toxic Substances Control
DWR	California Department of Water Resources
EDD	electronic data deliverables
FID	flame ionization detector
FSP	Field Sampling Plan
GC/MS	Gas chromatography–mass spectrometry
GPR	ground penetrating radar
GWBZ	groundwater bearing zone
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCl	hydrogen chloride
HCS	Hazard Communication Standard
HNO_3	Nitric Acid
IDW	investigation derived wastes
KCl	Potassium chloride
LCS	laboratory control sample
MCL	maximum contaminant level
MS/MSD	Matrix spike/matrix spike duplicate
MSR	Matrix spike result
MSDR	Matrix spike duplicate result
NIST	National Institute of Standards and Technology
OCHCA	Orange County Health Care Agency
OCSD	Orange County Sanitation District

OCWD	Orange County Water District
OSHA	Occupational Safety and Health Administration
OVA	organic vapor analyzer
PCE	tetrachloroethene
PCR	Project Consistency Reviewer
PDM	Project Database Manager
PFS	Project Field Supervisor
%	percent
PFT	Project Field Team
PHSO	Project Health and Safety Officer
PID	photoionization detector
PM	Project Manager
ppm	parts per million
ppmv	parts per million by volume
PQAM	Project Quality Assurance Manager
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RPD	relative percent difference
RWQCB	California Regional Water Quality Control Board
SA	Spiked analyte added
SAP	Sampling and Analysis Plan
SBGPP	South Basin Groundwater Protection Project
SIM	single ion monitoring
SOPs	standard operating procedures
SR	Sample result
SRM	standard reference material
SSR	Spiked sample result
SWRCB	State Water Resources Control Board
TCA	trichloroethane
TCE	trichloroethene
TSCA	Toxic Substances Control Act
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
VOA	volatile organic analysis
VOCs	volatile organic compounds
WQCA	California Porter-Cologne Water Quality Control Act

1.0 PROJECT SUMMARY

Since 2008, the Orange County Water District (OCWD) has conducted groundwater investigations within the area defined as the South Basin Groundwater Protection Project (SBGPP). The SBGPP is located within the South Basin area of the Orange County groundwater basin and includes an approximate four square mile area in the cities of Santa Ana, Irvine, and Tustin, California (Figure 1 of the work plan). Contaminants have been detected at concentrations exceeding maximum contaminant levels (MCLs) in the groundwater in the shallow aquifers above a depth of approximately 100 feet below ground surface (bgs). Detections of contaminants have also been reported in water supply wells that withdraw groundwater from deeper aquifer units, notably supply well IRWD-3 which is screened in both the Principal Aquifer and Deep Aquifer systems. The principal chemicals of concern (COCs) within the SBGPP, and to be addressed as part of this assessment, include trichloroethene (TCE), tetrachloroethene (PCE, also known as perchloroethylene), 1,1-dichloroethene (1,1-DCE), 1,4-dioxane, perchlorate, and hexavalent chromium (Cr(VI)). Other constituents have also been detected above MCLs less frequently, including, but not limited to: 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA), cis-1,2-dichlorothene (cis-1,2-DCE), and vinyl chloride.

The depth and number of aquifer zones that contain COCs in the vicinity of the drinking water supply wells within the SBGPP are unknown. The pathways for contaminants to migrate from the Shallow Aquifer System into deeper aquifers have not been fully characterized. The distribution of TCE, PCE, 1,1-DCE, 1,4-dioxane, Cr(VI), and perchlorate detections in wells indicate that COCs have been released at more than one source site within the SBGPP.

The OCWD has several regional groundwater monitoring wells within the SBGPP, and more than 500 monitoring wells have been installed as part of contaminant investigation programs at "source sites" located with the SBGPP. Of the more than 500 monitoring wells, only a few are completed within the lower sands of the Shallow Aquifer System, and none of these monitoring wells appear to be completed within the Principal Aquifer System.

This phase of investigation has been developed to complement the initial phase of investigation previously completed within the SBGPP by the OCWD. The initial phase of investigation included the construction of six permanent groundwater monitoring wells (each constructed with three discrete-depth screened intervals) and approximately 50 temporary groundwater monitoring points completed using cone penetrometer (CPT) methods. The locations of the groundwater monitoring wells and CPTs completed during this initial phase of investigation by the OCWD with the SBGPP are shown in Figures 3 through 7 of the work plan.

This Quality Assurance Project Plan (QAPP) has been prepared for the Phase 2 CPT investigation in the SBGPP.

1.1 PROJECT TASKS

Tasks included in this assessment include the following:

- Completion of approximately 200 CPT boreholes;
- Completion of multiple hydropunch sampling locations for the collection of discrete-depth groundwater samples adjacent to each CPT borehole; and,
- Tasks associated with the completion of the CPT and discrete groundwater sample locations, including utility clearance, traffic control, sample collection, chain of custody management, and coordinating the disposal of any investigation derived wastes (IDW).

1.2 PROJECT OBJECTIVES

The objectives of this phase of investigation are as follows:

- Further characterize the hydrogeology of the Shallow Aquifer System within the SBGPP;
- Further delineate the nature, magnitude, and extent of contamination in the vicinity of the "source sites" and drinking water supply well IRWD-3;
- Characterize possible pathways for contaminants to migrate from the Shallow Aquifer System to deeper aquifers; and,
- Support the development of an appropriate remedial response for the protection of drinking water within the SBGPP.

2.0 PROJECT/TASK ORGANIZATION

This section describes the roles and responsibilities of project team members that will be involved in the implementation of the Quality Assurance/Quality Control (QA/QC) program. Procedures and practices, as described within this QAPP, were prepared in general accordance with the United States Environmental Protection Agencies (USEPA) guidance for quality assurance project plans (USEPA, 1998a).

2.1 PROJECT MANAGER (PM)

The Project Manager (PM) has overall responsibility for the implementation of QA/QC measures presented in this QAPP. The PM is responsible for the overall design and implementation of the project including development of the work plan. The PM is also responsible for assuring the specific field methods and analytical methods included in the Sampling and Analysis Plan (SAP) are appropriate to provide data for the intended use.

2.2 PROJECT QUALITY ASSURANCE MANAGER (PQAM)

The Project Quality Assurance Manager (PQAM) is responsible for project QA. The PQAM will review all aspects of the work plan and SAP prior to implementation of the field program. The PQAM will ensure that adequate QA procedures are incorporated into the work plan and SAP to allow for the collection of data of acceptable quality for the intended use. The PQAM will update the QAPP, as required. The PQAM is responsible for evaluating the impact on data quality of any significant deviations from the work plan or SAP reported by the Project Field Supervisor (PFS). The result of any such evaluation will be reported in writing to the PM. The PQAM will conduct QC evaluations of the laboratory methods being used for the analytical work. If necessary, the PQAM will prepare Corrective Action Reports (CARs) (Appendix A). The PQAM will work closely with the laboratory representatives and the project team to ensure measurement performance criteria are met. Any significant laboratory deviation from the criteria will be reported to the PM. The PQAM has the authority to suspend project tasks if the project quality objectives are not being met and will notify the PM in writing upon taking such action.

2.3 PROJECT CONSISTENCY REVIEWER (PCR)

The Project Consistency Reviewer (PCR) assists the PQAM with chemistry validation by verifying that associated sample data information reported by the laboratories is consistent with data collected in the field. This person also verifies that electronic data and hard copy reports provided by the laboratories are consistent.

2.4 PROJECT FIELD SUPERVISOR (PFS)

The PFS is responsible for overseeing the implementation of the field activities in accordance with the work plan, SAP and the QAPP. The PFS's specific responsibilities will include:

- Communicating task objectives to task managers and task members;
- Distributing the work plan, including SAP and QAPP, to members of the team; and
- Answering any questions regarding the sampling program.

In addition, the PFS is also responsible for documenting and notifying, in writing, the PM and PQAM of any deviations from the work plan or SAP that occur during field sampling.

2.5 PROJECT HEALTH AND SAFETY OFFICER (PHSO)

The Project Health and Safety Officer (PHSO) is responsible for preparation, implementation and updating of the project specific Health and Safety Plan (HASP). Further details regarding health and safety personnel are provided in the accompanying HASP.

2.5.1 HEALTH AND SAFETY PLAN (HASP)

A project specific HASP, based upon the **aquilogic** Corporate Health and Safety Plan (CHSP), has been prepared (Appendix A to the work plan). This HASP conforms to applicable regulatory requirements including, but not limited to, Section 29 of the Code of Federal Regulations (CFR) 1910.120 and 1926.59 as administered by the Federal Occupational Health and Safety Administration (OSHA). The following sections are included in the HASP:

- Project background and scope-of-work;
- Project Safety Personnel;
- Planned Site Activities;
- Health and Safety Hazard Assessment;
- Community Hazards Analysis;
- Protective Actions;
- Injury Illness Prevention Program;
- Site Control and Decontamination Program;
- Emergency Response Plan;

Field work will be performed in accordance with the HASP. **Aquilogic** will conduct its operations in such a way as to avoid risk or bodily harm to persons or damage to property.

Aquilogic will designate a PHSO. The PHSO, or their designated representative, will be present at the site during field activities. Both persons will be familiar with hazardous waste laws and regulations in California and with OSHA requirements.

2.5.2 HEALTH AND SAFETY TRAINING

Aquilogic and subcontractor personnel working at a site will have received OSHA 40-hour health and safety training in accordance with the requirements of the USEPA, State of California, the OSHA requirements for Hazardous Waste Operations and Emergency Response (HAZWOPER) as found in 29 CFR 1910.120, and Hazard Communication Standard (HCS) as found in 29 CFR 1910.120. In addition, field personnel will have received the required 8-hour refresher training courses to remain current. The PHSO is responsible for maintaining copies of the certificates for the 40-hour and 8-hour HAZWOPER courses for field personnel working at a given facility.

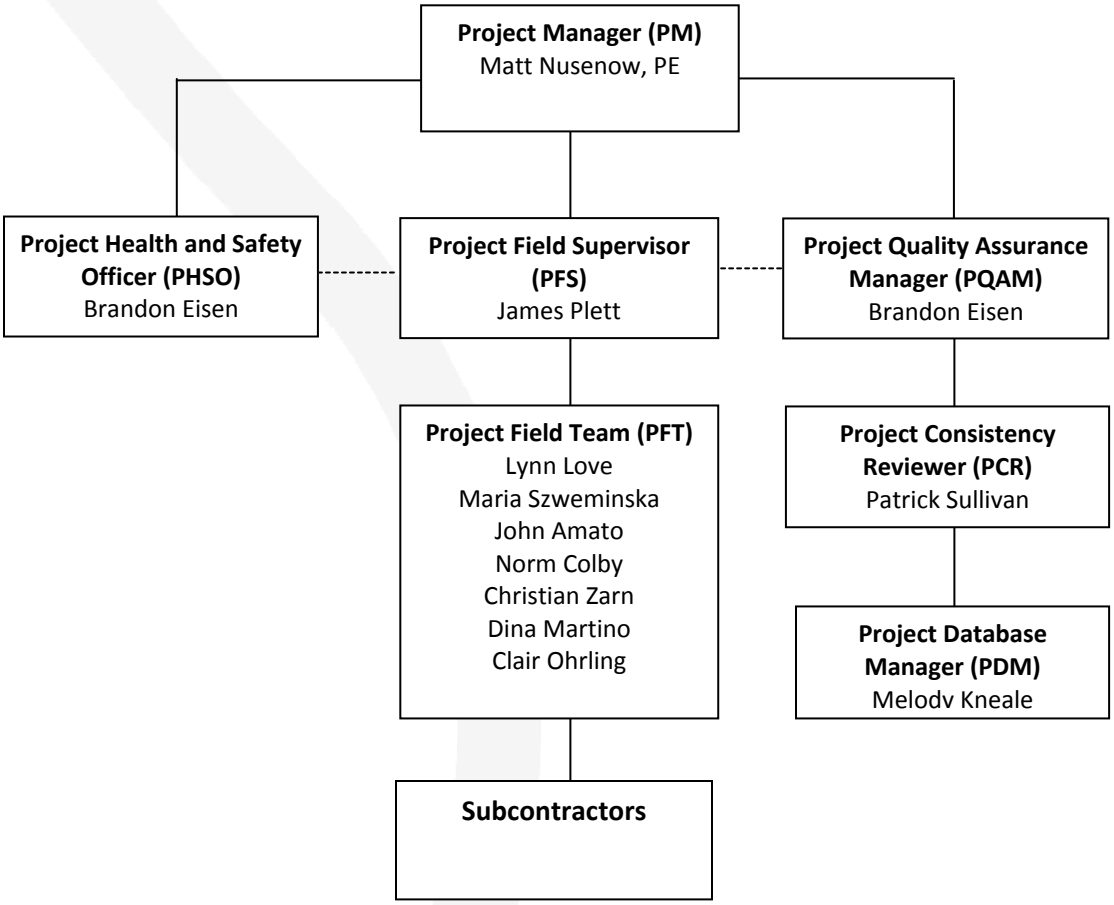
2.6 PROJECT FIELD TEAM (PFT) MEMBERS

The Project Field Team (PFT) members are responsible for reviewing and understanding the work plan, SAP, QAPP, HASP, any amendments to these documents, and particularly the field sampling procedures described in the work plan and SAP. PFT members are responsible for directing any questions about the field procedures to the PFS.

2.7 PROJECT DATABASE MANAGER (PDM)

The Project Database Manager (PDM) is responsible for tracking data collected for the project, including: Daily Field Reports, Well Sampling Forms, Quality Control Sample Records, Chain-of-Custody (CoC) record, and analytical results received from laboratories. Sample forms are included in Appendix A. In addition, the PDM verifies documentation of action performed on the data. The data are sent to the database only after the PDM approves the transfer.

2.8 PROJECT ORGANIZATION CHART



3.0 DATA QUALITY OBJECTIVES AND CRITERIA

Project data quality objectives (DQOs) have been designed with the primary purpose of successfully meeting the objectives of the project outlined in Section 1.2. The overlying DQO is to collect data that will assist in resolving, with a minimum degree of uncertainty, whether COCs are currently present in groundwater. Within this guiding DQO, the following are specific DQO's that relate to specific data:

- Groundwater measurements;
- Groundwater sampling, including collection of appropriate QA/QC samples;
- Groundwater and QA/QC sample analysis;
- Data compilation and reduction; and
- Data analysis.

Adhering to the guidelines of the DQOs insures that the chemical concentrations reported in groundwater samples are representative of conditions within the appropriate groundwater bearing zone (GWBZ). This in turn requires that QA/QC and SAP procedures for both field and laboratory work are adhered to in a satisfactory manner and that QA objectives are met. The QA objectives are to collect representative samples and measurements that can be analyzed in an accurate and precise manner providing results in a standard, comparable format.

Groundwater samples will be analyzed using the appropriate USEPA methods as outlined in the SAP. This document describes the protocols in place to ensure the quality of the data. The goals for assessing precision and accuracy in laboratory measurements are consistent with those put forth in the USEPA Test Methods For Evaluating Solid Waste (1986) and USEPA Methods for Chemical Analysis of Water and Wastes (1979). If USEPA methods other than those contained in USEPA (1986) and USEPA (1979) are used, laboratory goals for precision and accuracy will be consistent with those put forth by USEPA (1986).

Representative field and laboratory data will be obtained through the use of consistent methods for field installations and testing, and sample collection, preservation, transportation, and analysis. These methods are provided in the accompanying SAP for this investigation.

Performance and acceptance criteria are often expressed in terms of Data Quality Indicators (DQIs). The principal indicators of data quality are precision, accuracy, representativeness, comparability, completeness, and sensitivity.

3.1 PRECISION

Precision is defined as the degree of agreement between repeated measurements of the same property under identical or substantially similar conditions; calculated either as the range or as the standard deviation. Precision is usually expressed as relative percent difference (RPD).

3.2 ACCURACY

Accuracy is defined as the degree of overall agreement of a measurement to a known value; and includes a combination of random error (precision) and systematic error (bias) components of both sampling and analytical operations. Accuracy is usually expressed as percent recovery or as a percent bias.

3.3 REPRESENTATIVENESS

Representativeness is defined as an expression of the degree to which the data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that is most controlled by the proper design of the sampling program. The sampling protocol provided in the work plan or SAP should be designed to collect a statistically valid number and distribution of samples. The PFT members are responsible for collecting samples representative of the media being sampled following field procedures described in the work plan or SAP. Representativeness can be assessed by the use of field duplicate samples. Duplicate samples are collected so that they are equally representative of a given point in time and space. Therefore, they measure both precision and representativeness.

3.4 COMPLETENESS

Completeness is defined as a measure of the amount of valid data obtained from a system as compared with the amount that was expected to be obtained. Completeness for techniques performed in the laboratory will be defined as 90%, but may be modified in amendments to this QAPP.

3.5 COMPARABILITY

Comparability is defined as an expression of the confidence with which one data set can be compared to another. Sample data collected during this investigation should be comparable with other data for similar samples, sample conditions, and to data collected during previous investigations.

Comparability of data throughout the project will be attained by recording field and laboratory data in consistent units, as well as following the protocols outlined in the Work Plan and SAP for collecting and analyzing samples. Parameters commonly measured for this type of project and their associated units are listed below:

Parameter	Units
Length	Inches (in), feet (ft), miles, millimeters (mm), centimeters (cm), meters (m) and kilometers (km)
Volume	Length^3 or gallons (g), milliliters (ml) and liters (L)
Area	Length^2 or acre hectare and square meters
Time	Seconds (s), minutes (min), hours (hr), days (d), years (yr)
Weight	Micrograms (µg), milligrams (mg), grams (gm), kilograms (kg), pounds (lbs), tons (t)
Depth	feet (ft) and meters (m) below ground surface (bgs)
pH	pH units
Temperature	degrees Fahrenheit (°F) and Celsius (°C)
Specific Conductance	micro-Siemens per centimeter @ 25 °C (µS/cm)
Concentration, Water	micrograms per liter (µg/L)
Concentration, Soil	milligrams per kilogram (mg/kg)

3.6 DATA QUALITY INDICATOR SUMMARY

Indicator	Means of Assessment	Acceptance Criteria
Precision	RPD	Field Duplicates: +/- 30% to 50%
Accuracy	Percent Recovery	Matrix Spike Duplicates: +/- 50% Lab Spike Duplicates: +/- 50%
Representativeness	Statistical Ranking	To be determined
Completeness	Percent of Complete Samples	>90%

4.0 DOCUMENTS AND RECORDS

4.1 FIELD OPERATION RECORDS

Field operation records will document the overall field operations and any unusual conditions which may occur during this investigation. Each field team member will complete a daily field activity report (Appendix A), which summarizes the activities completed during the day. Information presented in the daily field logs will include, at a minimum, the following:

- Date;
- Identify responsibilities/duties;
- Time of arrival;
- General weather conditions;
- Any significant problems or unusual situations encountered while sampling; and
- Time of departure from site.

4.2 FIELD SAMPLING FORM

Depending of the activity performed, field personnel will complete task specific forms, a boring log (for soil sampling) or well sampling form (for groundwater sampling), which summarizes the location and details the activities performed for that task. Information which will be noted for each sample includes the following:

- Sample identification number;
- Date;
- Time of collection;
- Type of sample (e.g., waste characterization, soil boring, or monitoring well);
- Sample location; and
- Any unusual problems or observations while collecting samples.

4.3 CHAIN OF CUSTODY RECORDS

Upon collection of environmental samples, field personnel will be responsible for completing a CoC (usually supplied by Laboratory) for which includes the following information:

- Matrix;
- Sample identification number;
- Date;
- Project name and number;

- Sampler's initials;
- Time of collection (military time);
- Type of sample (grab or composite);
- Number of samples;
- Volume of containers;
- Analysis request;
- Preservation methods; and
- Remarks.

4.4 SAMPLE LABELS

Each sample sent to the laboratory will have a sample label (usually supplied by Laboratory) securely attached to the sample container (usually supplied by Laboratory). The sample labels will include the following information:

- Project number;
- A sample identification number;
- Date collected;
- Sampler's initials; and
- Remarks.

4.5 QUALITY CONTROL SAMPLE RECORDS

Field personnel will be responsible for completing a QC sample record (Appendix A) in the daily field log or in the well sampling form that includes the following information:

- Matrix;
- Sample identification number;
- Date;
- Project name and number;
- Sampler's initials;
- Type of QC sample (field, trip, equipment rinsate, or duplicate sample);
- Time of collection (military time);
- Number of samples;
- Volume of containers;
- Analysis request; and
- Preservation methods.

4.6 CORRECTIVE ACTION REPORTS (CARs)

The PQAM will be responsible for reviewing all of the forms described above and generating a CAR (Appendix A) for any irregularities. The CAR will include the following:

- A definition of the problem;
- Assignment of responsibility for investigating the problem;
- Definition of the cause of the problem;
- An outline of the appropriate corrective action to be taken;
- Assignment and acceptance of responsibility for implementing the corrective action;
- Establishment of measures to assess the effectiveness of the corrective action; and
- Verification of the effectiveness of the implanted corrective action.

4.7 LABORATORY RECORDS

Information to be included in the data report packages provided by the analytical laboratory will include sample summary results, sample management records, analytical methods, and QA/QC reports. A description of each item within the analytical laboratory report is summarized in the following sections. A Data Quality Checklist and CAR (Appendix A) may be used to record that the laboratory performed the requested analyses to the appropriate specifications.

4.7.1 SAMPLE SUMMARY RESULTS

The sample summary results will include verification that the sample met the holding times prescribed in the analytical methods; the overall number of samples; sample location; any deviation from the standard operating procedures (SOPs): and time of day, and date. Corrective action procedures to replace samples violating the protocol also will be noted.

4.7.2 SAMPLE MANAGEMENT RECORDS

This will include records of sample receipt, handling and storage, and scheduling of analyses.

4.7.3 ANALYTICAL METHODS

If analyses are performed as prescribed in the SOPs, this document will not be provided. Otherwise, the report will provide a description of how the analyses were performed in the laboratory including: sample preparation and analysis, instrument standardization, detection and reporting limits, and analysis-specific QC criteria.

4.7.4 QA/QC REPORTS

Laboratory QA/QC reports will include instrument calibration; routine monitoring of analytical performance; calibration verification; and checks for blanks, spikes, calibration check samples, replicates, and splits.

Copies of all results and records will remain within **aquilogic**'s project files for a minimum period of three (3) years.

4.8 DATA HANDLING RECORDS

The PDM will be responsible for reviewing all of the data handling records and verifying the accuracy of data transcription and calculations.

5.0 SAMPLING METHODS REQUIREMENTS

Laboratory calibration and analytical procedures will be conducted using the guidelines presented in USEPA publication Test Methods for Evaluating Solid Waste (1986).

The analytical methods to meet the objectives of this assessment include, but may not be limited to, the following:

Parameter	Test Method	Sample Containers	Preservation	Holding Time	Filling Instructions
Volatile Organic Compounds (VOCs)	U.S. EPA 524.2	Three 40-ml glass VOA vials	4 ^{o}C, hydrogen chloride (HCL)	14 days	Sample must be full and free of headspace
VOCs	GC/MS (EPA 8260B)	Three 40-ml glass VOA vials	4 ^{o}C, HCL	14 days	Sample must be full and free of headspace
1,4-Dioxane by Gas chromatography–mass spectrometry (GC/MS) – single ion monitoring (SIM) in Water	EPA 8260B-SIM	Three 40-ml glass VOA vials	4 ^{o}C, HCL	14 days	
Semi-VOCs by GC/MS 1,4 Dioxane	EPA 8270C MOD	Two 1 L Amber	4 ^{o}C, Cool	7 days	
Metals in Water	EPA 6010B	500 mL Poly	4 ^{o}C, Nitric Acid (HNO_3)	180 days	
Dissolved Metals in Water	EPA 6010B-Diss	1 Liter Poly	Filtration + HNO_3	180 days	
Dissolved Inorganics in Water Chromium VI-218.6	EPA 218.6	500 mL Poly	4 ^{o}C, Cool	1 day	
Dissolved Inorganics in Water Chromium VI-7199	EPA 7199	500 mL Poly	4 ^{o}C, Cool	1 day	
Inorganics in Water Chromium VI-7196A	Chromium VI-7196A EPA 7196A	500 mL Poly	4 ^{o}C, Cool	1 day	
Inorganics in Water Perchlorate 314.0	EPA 314.0	500 mL Poly	None	28 days	
Inorganics in Water Perchlorate 332.0	EPA 332.0	125 mL Poly (sterile)	Sterile filtration + ⅓ headspace, 4 ^{o}C	28 days	

Sampling containers for use in collection of water samples will be provided by the analytical laboratory. Sample containers will be as noted above and in the SAP. Water samples will be preserved by storing samples in a chilled cooler prior to analysis. All samples will be analyzed within the appropriate holding times.

6.0 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Custody procedures are used to document the identification of each field sample from the time of sample collection through its final disposition. Field CoC forms document the collection of the sample (e.g., date and time of collection, field location, sample labeling, analyses required) and track it from the field through transfer to the laboratory. Laboratory internal custody procedures document the tracking of samples throughout the preparation, analysis, storage or disposal of samples and sample extracts.

6.1 SAMPLE PACKAGING

Groundwater samples collected during this investigation will be sealed, labeled, and packed on ice in a portable cooler immediately after collection. A trip blank will accompany each cooler containing the samples to be tested for VOCs. Sample containers will be packed in resealable plastic bags in order to minimize contact between ice and container, thereby reducing the likelihood of cross contamination. Inert, soft packaging (e.g., bubble wrap) will be used to minimize the likelihood of impact damage during transit. Once packed, a custody seal will be placed across the lid of the sample cooler. The cooler will be delivered to the laboratory within appropriate holding times whereupon the integrity of the custody seal will be checked.

6.2 FIELD SAMPLE CUSTODY PROCEDURES

The PFS is responsible for the implementation and maintenance of sample custody procedures in the field. The CoC will be initiated by the sampling personnel as a result of the completion and attachment of sample labels to the sample containers and by the transcription of supporting information into the field notebooks or field forms (i.e., daily field log). CoC documentation will be completed after the samples have been collected. The PFS will control the samples in a manner that minimizes the likelihood of sample tampering and degradation, contamination, or loss due to chemical or physical actions (e.g., photodegradation, breakage, volatilization). Physical control over collected samples may be maintained by one or more of the following:

- Storing samples and sample containers within the PFS's or designate's immediate possession;
- Storing the samples and sample containers in a locked and restricted room; and
- Sealing and storing the samples and sample containers in a way that guarantees the evidence of entry is obvious once the containers are opened (e.g., custody seals).

Transfer of sample custody from the PFS, or designate, to the laboratory will be accomplished using the field CoC. One CoC must accompany each container in which the samples are packed. Each form will be completed with information describing samples contained in the packing container, including: sample code, sampling date and time, preservation methodology, analyses requested and shipping company/airbill number. Once the accuracy of the information on the form has been confirmed, the form will be signed by the PFS or designee and the original will be placed in a plastic bag inside the packing container. A copy of the CoC will be retained by the field team and placed in the project file.

6.3 SAMPLE LABELING

Sample labels are necessary to ensure proper sample identification. The labels should also be sufficiently durable to remain fixed to the sample container and legible even when wet. The following information will be specified on each label:

- Project name and number;
- Sample identification number (which include sample matrix, date, and a location related identifier);
- Date and time of collection;
- Preservatives used (if applicable);
- Laboratory analyses requested (if known); and
- Initials of collector.

6.4 LABORATORY CUSTODY PROCEDURES

The sample custodian at the designated laboratory will sign the field CoC and will indicate on each form the date of arrival, the number of samples received, and condition of samples upon receipt. The samples will be entered into the laboratory's sample custody system, which will continue tracking the sample until a data package is generated and delivered to the PDM.

7.0 QUALITY CONTROL REQUIREMENTS

Quality control samples related to both field and laboratory operations are used as measures to assess accuracy, precision, and representativeness. The internal QC samples to be used during this project include blank samples, duplicate samples, and spiked samples. Each type of QC sample is described below.

7.1 BLANK SAMPLES

The results from the analysis of blank samples are used to assess possible levels of CoCs introduced into the samples during container manufacture, container handling in the field, during shipment, or in the laboratory.

7.1.1 EQUIPMENT BLANKS (FIELD)

Equipment blanks are prepared by exposing sampling materials (e.g., bottles, collection devices) to the sampling environment without allowing them to actively mix with the matrix of interest. Equipment blanks will be collected after standard decontamination of the field equipment by fully rinsing the equipment which would normally contact the sample with deionized or distilled water. Equipment used in the homogenization of field duplicates (e.g., stainless steel bowl, trowel) should also be rinsed with deionized or distilled water. Equipment blanks will be submitted for analyses similar to samples collected during the investigation. Results obtained from analysis of equipment blanks are used to assess the potential contamination from sampling equipment used to collect and transfer samples and ambient site conditions. Potential sources of contamination also include: laboratory reagents, sample container and laboratory glassware cleaning procedures, or contact with analytical glassware/hardware during laboratory sample preparation and analysis. Equipment blanks will be collected at a minimum rate of one for every 20 primary samples.

7.1.2 FIELD BLANKS (FIELD)

Field blanks are aliquots of the water used to collect the equipment blanks but are not exposed to the equipment. If the equipment blank shows contamination, the results of the field blank analysis are used to isolate the cause of the contamination. This is critical for organics analysis, because some sources of “clean” water actually contain trace levels of contamination. Ideally, a field blank should be collected each time the equipment blank is collected. At a minimum, a field blank will be taken when the first equipment blank is collected or when a new source of water is used. Field blanks will be collected at a minimum rate of one per 20 samples.

7.1.3 TRIP BLANKS (FIELD)

The trip blank accompanies unused sample bottles to the field and is then returned to the laboratory. Trip blanks are handled, transported, and analyzed in the same manner as the field samples, except that trip blank sample bottles are not opened in the field. The results obtained from analysis of trip blanks are used to assess potential sources of contamination in the laboratory and during transport. Potential sources of contamination include: laboratory reagents, sample container and laboratory glassware cleaning procedures, cross contamination during shipment, ambient air, or contact with analytical glassware/hardware during laboratory sample preparation and analysis.

7.1.4 METHOD BLANKS (LABORATORY)

Method blanks are prepared in the laboratory on each day that samples are extracted or one per 20 field samples, if more than 20 samples are extracted in one day. Method blanks are indicative of contamination that is solely laboratory related.

7.2 DUPLICATE SAMPLES

Duplicate samples are defined as separate samples taken from the same location at the same point in time. The analytical results obtained from these samples are used to assess and document the precision of sampling and analysis. Several types of duplicate samples are described below.

7.2.1 FIELD DUPLICATES (FIELD)

Field duplicate samples will be collected at a minimum frequency of one per 10 samples per matrix. Field duplicates are handled, transported, and analyzed in the same manner as the other samples collected on the same day. The results obtained from analyzing field duplicates are used to assess and document the reproducibility of overall sampling, handling, and analytical procedures. Duplicate samples taken in the field represent the heterogeneity of field conditions. Therefore, it is expected that precision estimates obtained from the analysis of field duplicate samples will have substantial associated variability, more so than replicate samples prepared in the laboratory.

7.2.2 LABORATORY DUPLICATES (LABORATORY)

Laboratory duplicate samples are defined as two sample aliquots taken from the same sample container and analyzed independently. Samples will be prepared and analyzed for each type of organic analysis at a minimum frequency of one per 20 samples. The analysis of samples will show laboratory precision for the spiked analytes and other unspiked positive results.

7.3 SPIKED SAMPLES

Spiked samples are prepared in the laboratory to define the accuracy of the analytical procedure. Laboratory control samples are prepared to demonstrate that the method is in control; whereas, matrix spike samples show the effect of the individual sample matrix on analyte recovery. In addition, surrogate analytes are spiked into all field samples to demonstrate analytical accuracy on a sample-specific basis.

7.3.1 LABORATORY CONTROL SAMPLES (LCS)

A laboratory control sample (LCS) and a duplicate LCS are prepared by spiking two aliquots of a blank matrix with the target analytes for each method. Alternatively, a certified standard reference material (SRM) is extracted and analyzed as a control sample. A LCS and a duplicate LCS are prepared on every day of sample preparation or for every batch of 20 field samples prepared (whichever is more frequent). The percent recovery and the percent difference are calculated by dividing the concentration found by the concentration spiked and multiplying by 100. QC criteria are specified in each method.

7.3.2 MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES (MS/MSD)

Matrix spike/matrix spike duplicate (MS/MSD) samples are prepared in the laboratory by spiking two aliquots of a field sample with target analytes (or a subset of target analytes). The frequency of MS/MSD sample preparation is one per 20 (5%). Percent recovery is calculated in the same manner described above for laboratory control samples. MS/MSD samples provide information on the accuracy of the method for the specific sample matrix. They also provide precision data for both the spike analytes and unspiked positive results.

7.4 QC SAMPLING FREQUENCY

Rate of QC samples collection is summarized below:

	QC Samples	Frequency
Field QC	Field Blank	1 in 20 samples
	Field Duplicate	1 in 10 samples
	Equipment Blank	1 in 20 samples (groundwater only)
	Trip Blank	1 per cooler transporting samples to be tested for fuel hydrocarbons and oxygenates, VOCs
Laboratory QC	Method Blank	1 in 20 samples
	Laboratory Duplicate	1 in 20 samples
	LCS/LCS Duplicates	1 in 20 samples
	MS/MSD	1 in 20 samples

7.5 STANDARDS

Field instrument standards will be calibrated using the appropriate standards for the instrument. The standards used may include the following:

- pH-buffers traceable to National Institute of Standards and Technology (NIST);
- Conductivity - Potassium chloride (KCl) solutions; and
- Temperature - NIST certified thermometer.

Primary reference materials and purchased standards must be certified and/or have a certificate of analysis. The laboratories will follow the procedure specifications for preparation of solutions and document their preparation. This information must be available to the PQAM, should the need arise.

8.0 INSTRUMENT CALIBRATION AND FREQUENCY

To assure that data are representative of the actual field conditions, field equipment will be routinely calibrated. Instrument calibration will be performed in accordance with requirements provided by the manufacturer. For each calibration, the time and date of the procedure, equipment identification number, calibration procedure used and type of standards used will be recorded on field forms (daily field log) and/or notebooks attached to the equipment.

A photo-ionization detector (PID) will be used for the VOC headspace analysis and ambient air monitoring. The PID will be calibrated at the beginning of each day using standard gases and following the manufacturer's instructions. The standard gas is generally 100 parts per million (ppm) isobutylene for the PID.

9.0 DATA MANAGEMENT

9.1 DATA REDUCTION

The calculation of final results from raw data varies according to parameter and calibration approach. Laboratory data are generated following equations specified in each analytical method. In general, the ratio of instrument response for each analyte of interest to analyte concentration is defined for one or more calibration standards. If the calibration is linear, the average of the ratios is used as an average response factor to calculate sample response. If calibration is not linear, a calibration curve is made by plotting the concentration at a minimum of three concentration levels versus the instrument response, and sample concentration is calculated using a linear regression equation. Raw data are manipulated to account for the original sample size, dilutions, and wet or dry weight (for soil samples only) to produce a comparable concentration. These data and associated quality control data (e.g., blanks, spikes, duplicates) are provided by the laboratory in a data package. Also included in the data package will be copies of pertinent notebook pages, sample preparation information, raw data and signed CoCs.

9.2 DATA VALIDATION

Each data package will be reviewed to confirm that data quality objectives have been met. It is not anticipated that raw data will be assessed in the review of the data packages. The areas listed below will be reviewed (where applicable) to verify the usability of the data:

- Holding Time;
- Blank Data;
- Data Package Completeness;
- Laboratory Control Samples;
- Field Duplicates;
- Surrogate Recoveries; and
- MS/MSD Data.

For accuracy, the surrogate recoveries will be examined, where applicable, and the MS/MSD spike recoveries will also be checked against the specified QC criteria as described in Section 3 for their respective methods. In addition to the aforementioned recovery information, a check for contaminants will be performed for the following QC samples:

- Field Blanks;
- Equipment Blanks;

- Trip Blanks; and
- Method Blanks.

For precision, an analysis of the following QC samples will be performed:

- MS/MSD;
- Field Duplicates; and
- Laboratory Duplicates.

9.3 DATA REPORTING

Chemical data will be generated by the laboratories and submitted to **aquilogic** in electronic data deliverables (EDD) format and as hard copy data packages. As necessary, data will be qualified as a result of data validation. QA procedures will be implemented to ensure that electronic formatted data are matching those in the hard copy printouts. The PDM or PFS will check the data printouts against the original laboratory sheets.

9.4 DATA RETENTION

A daily field record will be kept for each day of fieldwork, and the original will be placed in the project files. All site specific information collected electronically by computerized or automated measurement devices will be kept on file at **aquilogic**. Copies of results and records will remain within **aquilogic**'s project files for a minimum period of three years. **Aquilogic** will provide our client with a 90-day notice thereafter prior to destroying project records.

10.0 PERFORMANCE AUDITS

Informal performance audits of the field operations will be conducted by the PM, PFS, or PQAM to assess the field sampling performance by reviewing the field logbooks and CoC forms on a periodic basis. Laboratory performance will be monitored by the PDM as part of the data quality review process. Frequent communication by PDM and the subcontracted laboratory will be maintained throughout the program. It is not anticipated that a physical audit of the laboratory will be conducted.

11.0 CORRECTIVE ACTION

A system for reporting, evaluating, and resolving nonconformance with established quality standards is a significant component of any QA plan. Need for corrective action is triggered by an identified or potential deficiency in an activity, data set, or document that may adversely affect program objectives. Corrective actions, either short-term or long-term, are instituted to eliminate the cause of nonconformance. Where corrective actions are needed, the following closed loop corrective action system is used:

- The problem is defined;
- Responsibility for investigating the problem is assigned;
- The cause of the problem is defined;
- The appropriate corrective action is outlined;
- Responsibility for implementing the corrective action is assigned and accepted;
- Measures to assess the effectiveness of the corrective action are established;
- The corrective action is implemented; and
- The effectiveness of the corrective action is verified.

Corrective action needs are defined on a continual basis through vigilance on the part of the entire project team, and on a periodic basis through **aquilogic**'s and the projects system of QA audits and reviews. Equipment and instrument malfunctions can frequently be repaired immediately on site. Corrective actions such as these should be recorded in the field notebook or daily field log and further documentation is not necessary. If the problem cannot be remedied in this manner, the project team member is expected to identify the concern and notify the PM and PQAM in writing and initiate the preparation of a CAR. The PM or PQAM then initiates the involvement of responsible staff to resolve the issue. A sample CAR is included in Appendix A.

The time required for appropriate corrective action may be as short as an on-the-spot remedy, or as long as several weeks. In the latter case, **aquilogic**'s PM consults with the client to evaluate whether sampling and/or analysis should continue or be put on hold pending accomplishment of the corrective action.

The PQAM reviews CARs, evaluates corrective actions, and completes and files each CAR into the projects QA files. The PM and PQAM are responsible for reviewing the results of major corrective actions to evaluate and document the effectiveness of the actions in the corrective action forms and follow-up memoranda. These memoranda are maintained in the filing system established for all of the projects QA records.

12.0 QA/QC REPORTING

The PQAM or PFS is responsible for providing the PM with QA/QC reports. These reports will be generated after reviewing the data from the laboratory or as prescribed by the PM. They will contain a periodic assessment of data accuracy, precision, and completeness, and any contamination problems in blank samples. If there are any significant QA problems, they will be documented in the QA/QC reports along with recommended solutions. A summary of the status of analytical data will also be given.

13.0 DATA VALIDATION AND USABILITY

13.1 DATA REVIEW, VALIDATION, AND VERIFICATION

The accuracy, precision, and completeness of the environmental data collected as part of this project will be routinely assessed for each measurement parameter. The following section describes the procedures to make data accuracy, precision, and completeness assessments, and the methods used to obtain the information for the precision and accuracy calculations. Performance and acceptance criteria of accuracy, precision, and completeness are listed in Section 3.

13.1.1 ACCURACY ASSESSMENTS

Accuracy, or bias, of the data will be assessed through the use of the MS/MSDs, laboratory control samples, and spike surrogate recoveries as defined in Section 7.

MS/MSD spike percent recoveries are calculated as follows:

$$\text{Matrix Spike \% Recovery} = \frac{SSR-SR}{SA} \times 100$$

Where:

SSR = Spiked sample result;
SR = Sample result; and
SA = Spiked analyte added.

Spike surrogate recoveries and performance evaluation sample recoveries are calculated using the following equation:

$$\text{\% Recovery} = \frac{\text{Concentration (or amount) found}}{\text{Concentration (or amount) spiked}} \times 100$$

The percent bias is calculated by subtracting 100 percent from the percent recovery.

13.1.2 PRECISION ASSESSMENTS

Data precision estimates can be defined via field duplicate and laboratory duplicate samples as described in Section 7. Field duplicate samples provide a precision estimate for the overall measurement system, which includes the following elements: sample acquisition, homogeneity,

handling, shipping, storage, preparation, and analysis. Laboratory duplicates provide a means to assess the analytical precision based only on sample preparation and analysis.

Precision is usually expressed as RPD. For MS/MSDs, RPD is calculated as follows:

$$RPD = \frac{MSR - MSDR}{(0.5)(MSR + MSDR)} \times 100$$

Where:

MSR = Matrix spike result;
MSDR = Matrix spike duplicate result.

Similarly, laboratory duplicate and field duplicate RPDs can be calculated by substituting the sample concentration and its corresponding duplicate concentration for MS and MSD, respectively, into the previous equation:

$$RPD = \frac{(Conc_{sample} + Conc_{duplicate})}{(0.5)(Conc_{sample} + Conc_{duplicate})} \times 100$$

Where:

$Conc_{sample}$ = concentration of sample;
$Conc_{duplicate}$ = concentration of duplicate.

13.2 VALIDATION AND VERIFICATION

13.2.1 FIELD DATA VALIDATION

Field data calculation, transfers, and interpretations will be performed by the field personnel and reviewed for accuracy by the PQAM and PM. All logs and documents will be checked for the following:

- General completeness;
- Readability;
- Usage of appropriate procedures;
- Appropriate instrument calibration and maintenance;
- Reasonableness of data collected;
- Correct sample location; and
- Correct calculations and interpretations.

13.2.2 LABORATORY DATA VALIDATION

Quality control reports from laboratories that document measurement system performance, including data from blank samples, spiked samples, laboratory control samples, or any other internal QC measures will be evaluated. Data validation procedures will be consistent with those described in USEPA's Guidance for Data Quality Assessment (1998b).

14.0 CLOSURE

This QAPP has been prepared for the exclusive use of the OCWD as it pertains to the investigation of contamination within the SBGPP. Our services have been performed using that degree of care and skill ordinarily exercised under similar circumstances by reputable, qualified environmental consultants practicing in this or similar locations. No other warranty, either expressed or implied, is made as to the professional advice included in this document.

15.0 REFERENCES

United States Environmental Protection Agency (U.S. EPA). (1979). "Methods for Chemical Analysis of Water and Wastes. U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Cincinnati (EMSL-CI). EPA-600/4-79-020." April. Updated March 1983 and March 1993.

United States Environmental Protection Agency (U.S. EPA). (1986). "Test Methods for Evaluating Solid Waste, Volume 1A: Laboratory Manual, Physical/Chemical Methods (SW-846)." November, 1986.

United States Environmental Protection Agency (U.S. EPA). (1998a.) "Guidance For Quality Assurance Project Plans: EPA QA/G-5." February.

United States Environmental Protection Agency (U.S. EPA). (1998b.) "Guidance for Data Quality Assessment: Practical Methods for Data Analysis (QA/G-9), EPA/600/R-96/084, Office of Research and Development."

APPENDICES

aquilogic, Inc.
environment - water - strategy

1503 SOUTH COAST DRIVE, SUITE 203

COSTA MESA, CA 92626, USA

www.aquilogic.com

TEL.: (714) 770-8040

DAILY FIELD REPORT

PROJECT NAME:	
PROJECT NO.:	TASK NO.:
RECORDED BY:	
DATE:	PAGE OF

AQUILOGIC PERSONNEL ON-SITE:

CONTRACTOR(S) ON-SITE:

GENERAL WORK DESCRIPTION:

TIME	ACTIVITY - WORK PROGRESS	
		Signed:

Arrive Site:	Travel Time:	Reviewed By:
Depart Site:	Prep. Time:	Review Notes:
TIME ON SITE:	Misc. Time:	Date:

ANY NECESSARY FOLLOW UP:

PROJECT N0.:	TASK NO.:	RECORDED BY:	DATE:	PAGE OF

TIME	ACTIVITY - WORK PROGRESS

Signed:

aquilogic, Inc.

environment - water - strategy

1503 SOUTH COAST DRIVE, SUITE 203

COSTA MESA, CA 92626, USA

www.aquilogic.com

TEL.: (714) 770-8040

WELL SAMPLING FORM

PROJECT NAME:	
PROJECT NO.:	TASK NO.:
RECORDED BY:	
DATE:	PAGE OF

WELL CONSTRUCTION DETAILS	**Well No.:**	
DATES	Casing Type:	Screen Type:
Constructed:	Diameter:	Diamter:
Developed:	Length:	Length:
Last Sampled:	T.D.:	Slot Size:

LOCATION SKETCH:

WELL CONDITION	**Water Depth:**	
G.S. Elev.:	Water Depth:	F.P. Thickness:
T.C. Elev.:	Water Column:	Water Odor:
W.L. Elev:	Casing Volume:	Turbidity:
Note: 2" = 0.16 g/ft; 4" = 0.65 g/ft; and 6" = 1.5 g/ft		

Well Purging Method:	Purge Vol.:

WELL PURGING AND RECOVERY ANALYSIS

Time	W.L.	Purge Rate	Vol.	Temp.	pH	Conduct.	Turbid.	D.O.	ORP	Sample No.	REMARKS

SAMPLING INFORMATION:

Sample No.	Time	Sampling Method	Container	Analysis Required

ADDITIONAL INFORMATION:

aquilogic, Inc.
environment - water - strategy

1503 SOUTH COAST DRIVE, SUITE 203, COSTA MESA, CA 92626, USA

www.aquilogic.com TEL.: (714) 770-8040

QA/QC SAMPLE RECORD

PROJECT NAME:	DATE:	PAGE OF
PROJECT NO.:	TASK NO.:	NO. SAMPLES

SAMPLE I.D.	DEPTH	MATRIX	DATE SAMPLED	TIME SAMPLED	CONTAINER (VOL)	NO. CONTAINERS	PRESERVATION (Yes/No)	TEMPERATURE (F)	TYPE OF QA/QC SAMPLE				ANALYSIS REQUIRED												
									FIELD	TRIP	EQUIPMENT	DUPLICATE	TPH gasoline (8015m)	BTEX (8020)	VOCs (524.2/8260B)	SVOCs (8270)	Title 22 Metals STLC/TTLC	Hexavalent chromium (7199)					Low-level analysis	Turnaround Time	Hold for Instructions

REMARKS:

RECORDED BY:

aquilogic, Inc.

environment - water - strategy

1503 SOUTH COAST DRIVE, SUITE 203

COSTA MESA, CA 92626, USA

www.aquilogic.com

TEL.: (714) 770-8040

CORRECTIVE ACTION REPORT

PROJECT NAME:	
PROJECT NO.:	TASK NO.:
RECORDED BY:	
DATE:	PAGE OF

PROBLEM TO BE RESOLVED:	

RESPONSIBLE PARTY FOR INVESTIGATION:

CAUSE OF PROBLEM:	

CORRECTIVE ACTION TO BE TAKEN:	DEADLINE:
1	
2	
3	
4	

RESPONSIBLE PARTY FOR IMPLEMENTING ACTION:

SIGNED:	DATE:

MEASURES TO ASSESS EFFECTIVENESS OF CORRECTIVE ACTION:	DEADLINE:
1	
2	
3	
4	

VERIFICATION OF THE EFFECTIVENESS OF THE IMPLEMENTED CORRECTIVE ACTION:

RECOMMENDED FOLLOW-UP ACTION:

DISTRIBUTION (upon completion):

PM:

PROJECT QA MANAGER:

PROJECT H&S OFFICER:

CORP QA MANAGER:

CORP H&S OFFICER:

CORP EXECUTIVES:

OTHER:

NA	DATE:

aquilogic, Inc.

environment - water - strategy

1503 SOUTH COAST DRIVE, SUITE 203

COSTA MESA, CA 92626, USA

www.aquilogic.com

TEL.: (714) 770-8040

CHAIN OF CUSTODY RECORD

DELIVER TO:

PROJECT NAME:	
PROJECT NO.:	TASK NO.:
RECORDED BY:	
DATE: PAGE OF	No. Samples:

BORING/WELL	SAMPLE I.D.	DEPTH	MATRIX	DATE SAMPLED	TIME SAMPLED	SAMPLE METHOD	CONTAINER	PRESERVATION (Yes/No)	TEMPERATURE (F)	ANALYSIS REQUIRED																	
										TPH gasoline (8015m)	TPH diesel (8015m)	TPH crude (8015m)	BTEX (8020)	Oil & Grease (413.2)	TRPH (418.1)	VOCs (524.2/8260B)	SVOCs (8270)	Title 22 Metals STLC/TTLC	Hexavalent chromium (7199)					Low-level analysis	Turnaround Time	Hold for Instructions

Special Analysis or Handling Requirements:

Relinquished By:	Signed:	Date:	Time:	No. Samples:
Received By:	Signed:	Date:	Time:	No. Samples:
Relinquished By:	Signed:	Date:	Time:	No. Samples:
Received By:	Signed:	Date:	Time:	No. Samples:

aquilogic, Inc.

environment - water - strategy

1503 SOUTH COAST DRIVE, SUITE 203

COSTA MESA, CA 92626, USA

www.aquilogic.com

TEL.: (714) 770-8040

DATA QUALITY CHECKLIST

PROJECT NAME:	
PROJECT NO.:	TASK NO.:
RECORDED BY:	
DATE:	PAGE OF

Laboratory:	
Contact:	
Report ID:	
Sampling Date:	

Sample Inventory

Analysis	Method	Matrix	Total # of Samples	# of Trip Blanks	Date(s) Collected	Total # of Samples Analyzed	# Trip Blanks Analyzed

Notes:

Report Content

	Yes	No	N/A

Report Content	Yes	No	N/A
1. Is there a signature and title of the person accepting responsibility for the report?	☐	☐	
2. Has the laboratory submitted an electronic copy of the data?	☐	☐	
3. Was the entire report received (based on total number of pages or indication of last report page)?	☐	☐	
4. Is there a legend or list explaining data qualifiers?	☐	☐	☐
5. Is the original chain-of-custody form included in the report?	☐	☐	
6. Was a laboratory sample receiving/integrity report included in the report? Any noted problems? *Any noted problems?*	☐	☐	
7. Do receipt dates match the chain-of-custody form?	☐	☐	
8. Have all requested analyses on the chain-of-custody form been conducted?	☐	☐	
9. Have all analyses been conducted by this laboratory? If No, which analyses? *If No, which analyses?*	☐	☐	
10. Are all dates (i.e., collection date(s), receipt date(s), extraction date(s) analysis date(s), reporting dates, etc.), listed for all samples and are they consistent throughout the report? Identify omissions and inconsistencies on page(s) *Identify omissions and inconsistencies on page(s)*	☐	☐	
11. Were all specified sample holding times met? If no, identify? *If no, identify?* _____	☐	☐	
12. Do sample IDs in the report match the chain-of-custody form and are they consistent throughout the report? *Circle inconsistencies and identify pages*	☐	☐	
13. If test methods were specified on the chain-of-custody form, were samples analyzed for the test methods requested?	☐	☐	☐
14. If test methods were specified on the chain-of-custody form, are the test methods listed appropriate for the requested analysis?	☐	☐	☐
15. Is the report complete and all laboratory quality control data included for each analysis?	☐	☐	

Report Content	Yes	No	N/A
16. Are results reported with a consistent and appropriate number of significant figures?	☐	☐	
17. Are results reported using appropriate and consistent concentration units?	☐	☐	
18. Have data below the method detection limit (MDL) or practical quanititation limit (PQL) been correctly qualified? *If not, Identify data with a check mark (✓)*	☐	☐	☐
19. Have data above the MDL or PQL been correctly left unqualified? *Identify data with asterisks (*)*	☐	☐	☐
20. Indicate if the following field QC samples were collected and if so were they collected at the required frequency listed in the sampling plan:			
a. Trip blank sample	☐	☐	☐
b. Field blank sample	☐	☐	☐
c. Field replicate or duplicate sample	☐	☐	☐
d. Equipment (rinsate) blank sample	☐	☐	☐
21. Did the laboratory perform the following QC analysis, where appropriate:			
a. One laboratory method blank sample per 20 samples or batch, whichever is more frequent?	☐	☐	☐
b. One matrix spike/matrix spike duplicate (MS/MSD) sample per 20 samples or batch, whichever is more frequent?	☐	☐	☐
c. One blank spike sample or laboratory control sample (LCS) per 20 samples or batch, whichever is more frequent if MS analyses were not performed?	☐	☐	☐
d. One laboratory duplicate per 20 samples or batch, whichever is more frequent?	☐	☐	☐
e. Other (Define)	☐		
22. Were any analytes detected in the following:			
a. Method blank samples	☐	☐	☐
b. Field blank samples	☐	☐	☐
c. Trip blank samples	☐	☐	☐
d. Equipment (rinsate) blank samples	☐	☐	☐
23. Do surrogate recoveries meet acceptance criteria (accuracy)? *If no, note exceptions and qualify appropriately*	☐	☐	☐
24. Do percent recoveries for MS/MSD meet control limits (accuracy) for the test method/sample matrix?	☐	☐	☐

Report Content	Yes	No	N/A
25. Do the relative percent differences (RPDs) for MS/MSD meet control limits (precision) for the test method/sample matrix?	☐	☐	☐
26. Do percent recoveries for LCS meet control limits (accuracy) for the test method/sample matrix?	☐	☐	☐
27. Do the RPDs for laboratory duplicate analyses meet control limits (precision) for the test method/sample matrix?	☐	☐	☐
28. Do the RPDs for field (blind) duplicate pairs meet acceptance criteria (precision) for the test method/sample matrix?	☐	☐	☐
29. If sample reference materials or laboratory check standards were included in the data set, were recoveries within the control limits for the test method/sample matrix? Circle exceptions	☐	☐	☐
30. Is the discussion of any report variance consistent with the data reported?	☐	☐	☐
31. Have all qualified data been completely/correctly identified? *If not, data on which page*	☐	☐	☐
32. Is the quality of the data package acceptable without revisions by the laboratory? *If no, attach corrective action summary*	☐	☐	☐

Qualifiers Assigned by Data Reviewers

U: Data qualified with an U indicates that the value reported for the sample is less than 5 times the amount of that analyte detected in the blank. The U qualifier is applied to the data according to U.S. EPA Functional Guidelines for Review of Inorganic and Organic Data as follows:

1. If the level of an analyte reported in the sample is greater than the MDL for that analyte in that sample, a U is placed next to the sample result if it is less than 5 times the level in the blank.
2. If the level reported in the sample is less than the MDL (qualified by the laboratory with a J) and less than 5 times the level in the blank, the sample result and J qualifier are crossed out and replaced with the MDL for that analyte in that sample followed by U.

Sample results that exceed the MDL and are greater than 5 times the level in the blank are not qualified.

J: Data qualified with a J indicates that the analyte was positively identified, but the associated numerical value is an approximate concentration. The J qualifier is applied to results by both the laboratory and data validator.

B: Data qualified with a B indicates that the analyte was detected in the laboratory method blank.

R: Data qualified with a R indicates that the result is rejected. The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

aquilogic, Inc.

COREECTIVE ACTION REPORT

Describe data corrective actions or report revisions required from laboratory:

Corrective action initiated? ☐ Yes ☐ No By _____ Date: _____

Summary of Resolution:

Verified? ☐ Yes ☐ No By _____ Date: _____