

Quality Assurance Project Plan

**Former Gloucester
Manufactured Gas Plant
Harbor Loop
Gloucester, Massachusetts**

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Prepared For:

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1. INTRODUCTION

1.1 Purpose

This Quality Assurance Project Plan (QAPP) has been prepared to specify recommended procedures to be followed during the Phase II - Comprehensive Site Assessment (Phase II CSA) to be conducted at the former Gloucester Manufactured Gas Plant (MGP) site in order to provide data of known, documented quality. The Phase II CSA Scope of Work (SOW), which this QAPP addresses, includes a sampling program for soil gas, sediment, surface water, surface soil, subsurface soil, and groundwater at the site. A complete project description and other relevant background information are included in the main section of the Phase II SOW and are not repeated in this QAPP.

Site conditions encountered during the course of the investigation may necessitate variations from procedures presented in this QAPP. In addition, field observations may lead to modification of the scope of activities. Therefore, the procedures outlined in this document can be changed as site conditions dictate. However, before changes are made to the SOW and QAPP procedures, the changes will be discussed with the appropriate EECS, Inc. and Arcadis U.S., Inc. project managers and Massachusetts Electric Company d/b/a National Grid (National Grid). Modifications to the procedures set forth in this QAPP will be documented and noted in the Phase II report.

1.2 Project Organization

This report has been prepared by EECS, Inc. (EECS) of Milford, Massachusetts and Arcadis U.S., Inc. (Arcadis) of Beverly, Massachusetts on behalf of National Grid. National Grid is undertaking the actions required by the Massachusetts Department of Environmental Protection (MADEP) under Massachusetts General Law (MGL) Chapter 21E and the Massachusetts Contingency Plan (MCP), with respect to MGP waste at this site.

EECS and Arcadis are fully committed to implementing an effective QAPP program. The success of this program is based on the concept that implementation of this program is the responsibility of all project participants. Specific responsibilities have also been assigned to key project personnel for the implementation of this QAPP program.

Kenneth E. Lento, P.E. is the Licensed Site Professional (LSP) of Record for this site (License Number 5877). Mr. Lento will also serve as the EECS project manager and the overall Project Quality Assurance Manager (PQAM). As the project manager, Mr. Lento will be responsible for the overall technical direction and management of the project including allocation of technical and human resources and schedule

management. As the PQAM, Mr. Lento will be responsible for the oversight of data validation activities, as well as preparation of quality assurance (QA) documentation for the Phase II report. He will work with the Laboratory Project Manager to resolve quality control (QC) issues as they affect the viability of the project data and with the assigned data validators to ensure that all analytical data is in conformance with the requirements of this QAPP and applicable MADEP guidance documents, specifically the MADEP Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data.

Mr. Mark Mahoney will serve as the Arcadis project manager. Mr. Mahoney will be responsible for the technical direction and management of the portion of the project conducted within Gloucester Harbor (i.e., the sediment and surface water sampling related activities).

The test pit excavation activities will be conducted by T. Ford, Inc. of Georgetown, Massachusetts under the direction of EECS. Laboratory and drilling subcontractors have not yet been identified for this project.

2. QA/QC OBJECTIVES FOR MEASUREMENT OF DATA

2.1 Introduction

The QA objective for the project is to develop and implement procedures which will provide data of known, documented quality. Field and laboratory quality QA/QC requirements defined by MADEP and other applicable guidelines ensure acceptable levels of data quality will be maintained throughout the sampling and analysis program. The criteria commonly used to specify QA goals include precision, accuracy, representativeness, completeness, and comparability. These criteria are described in more detail in the following sections of this report.

2.2 Precision

Precision is an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Specifically, it is a quantitative measurement of the variability of a group of measurements compared to their average value (USEPA, 1987). Precision is usually stated in terms of standard deviation, but other estimates such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum value), and relative range are common. For this project, precision will be evaluated by recording duplicate measurements of the same parameter on similar sample aliquots under the same conditions and calculating the relative percent difference (RPD) between the values. The formula for calculating RPD is presented in subsequent sections of this report.

RPDs can only be calculated when the duplicate samples both contain detectable concentrations of an analyte. If an analyte is considered not detected at the detection limit, then the RPD cannot be calculated. Instead, the results of the analysis of matrix spiked duplicate laboratory samples will be used to determine precision.

Measurement data for this project will include field data as well as laboratory analytical data. Laboratory precision will be performed according to the requirements described in the associated analytical methods. The field measurement data may include surface water conductivity, temperature, turbidity, salinity, dissolved oxygen, organic vapor readings, and water elevation measurements. The objective for precision of field data collection methods is to take replicate (minimum of two for every 20 samples) measurements for field parameters to determine the reproducibility of the measurements.

For water quality meters, precision will be tested by multiple readings in the medium of concern. Consecutive readings should agree reasonably after the instrument has been field calibrated in accordance with the manufacturer recommendations. Equipment will be visually inspected prior to each use to ensure its condition is satisfactory.

The organic vapors will be measured using a Photovac Microtip (or equivalent) photoionization detector (PID). Daily background and upwind readings of sediment coring and other sampling activities will be measured prior to commencing work and at periodic intervals throughout each day's activities. The natural variation/fluctuation in measurements at background or upwind locations will be used for baseline background values, and the variability will be noted. Surface water elevation measurements at a tide gauge installed within a stilling basin will be precise within 0.1 feet for duplicate measurements or additional water level measurements will be collected to evaluate reasons for the observed difference. Turbidity measurements will be calibrated to a precision of $\pm 2\%$ nephelometric turbidity units (NTUs).

2.3 Accuracy

Accuracy is a measure of the difference between a measured value and the "true" or accepted reference value. The accuracy of an analytical procedure is best determined by the analysis of a sample containing a known quantity of material and is expressed as the percent of the known quantity, which is recovered, or measured. The recovery of a given analyte is dependent upon the sample matrix, method of analysis, and the specific compound or element being determined. The concentration of the analyte relative to the detection limit of the analytical method is also a major factor in determining the accuracy of the measurement. Concentrations of analytes that are close to the detection limits are less accurate because they are affected by such factors as instrument "noise". Higher concentrations will not be as affected by instrument or other variables and thus will be more accurate.

The accuracy of laboratory measured data will be evaluated by determining the percent recovery of both matrix and blank spike samples as described in subsequent sections of this report. For the measurement of organics by gas chromatography (GC) or GC/mass spectroscopy (MS), the recovery of a surrogate spiked into each sample, blank, and standard will also be used to assess accuracy.

The objective for accuracy of the other field measurements is to achieve and maintain factory equipment specifications for the field equipment. Field measurements cannot be assessed for accuracy by spiking the medium with the analytical parameter and measuring the increase in response; therefore, these instruments can only be assessed for accuracy by the response to a known sample (such as a calibration standard) used to standardize them. The surface water and groundwater quality meters are calibrated with solutions traceable to the National Institute of Standards and Technology (NIST, formerly the National Bureau of Standards) or other manufacturer provided standards.

All volatile organic detectors (such as the PID) will be calibrated to an appropriate standard daily prior to use.

2.4 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. Samples must be representative of the environmental media being sampled. Selection of sample locations and sampling procedures will incorporate consideration of obtaining the most representative sample possible.

Field and laboratory procedures will be performed in such a manner as to ensure, to the degree that is technically possible, that the data derived represents the in-place quality of the material sampled. Every effort will be made to ensure chemical compounds will not be introduced into the sample via sample containers, handling, or analysis. Decontamination of sampling devices and other investigation equipment will be performed between samples as outlined in subsequent sections of this report. Laboratory sample containers will be thoroughly cleaned in accordance with procedures outlined in subsequent sections of this report. Analysis of field blanks, trip blanks, and method blanks will also be performed to monitor for potential sample contamination from field and laboratory procedures.

The assessment of representativeness also must consider the degree of heterogeneity in the material from which the samples are collected. Sampling heterogeneity will be evaluated through the analysis of field duplicate samples, coded to ensure the samples are treated and analyzed as separate samples. The field personnel and analytical laboratory will make every reasonable effort to assure the samples, except for the portion of the sample submitted for analyses of volatile organic compounds, are adequately homogenized prior to taking aliquots for analysis, so the reported results are representative of the sample received. Chain-of-custody (CoC) procedures will be followed to document that contamination of samples has not occurred during container preparation, shipment, and sampling. This plan sets forth procedures for ensuring that sampling methods maximize representativeness of the samples.

2.5 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid. The QA/QC objective for completeness is generation of valid data for a minimum of 85 percent of the analysis requested. Any data deficiencies and their impact on project goals will be evaluated during data validation and discussed in the Data Usability Statement included in the Phase II Report.

3.3.4 *Sampling Equipment*

The following is a general list of equipment, which may be necessary for sample collection:

- Stainless steel spoons and bowls for mixing sediment samples;
- Appropriate sample bottles (kept closed and in the laboratory-shipped coolers until the samples are collected) provided by the laboratory;
- Reagent-grade preservatives and pH meter (or pre-preserved sample containers) for aqueous samples;
- Chain-of-Custody labels, tags, seals, and record forms;
- Logbook, field sampling records, and indelible ink markers;
- Laboratory grade decontamination detergents (such as Alconox, Liquinox, etc.), reagent-grade solvents, and deionized, organic-free water to be used for decontaminating equipment between sampling stations;
- Squirt Bottles;
- Ruler and measuring tape;
- Garbage bags;
- Paper towels and/or wipes;
- Buckets, wash basins, and scrub brushes to be used for decontaminating equipment;
- GPS unit;
- Digital camera or camera and film to document sampling procedures and sample locations;
- White board to include in photographs to label samples/photos;
- Shipping labels and forms;
- Knife;
- Packing/shipping material to prevent damage to sample bottles during shipping;
- Strapping, clear plastic, and duct tape;
- Aluminum Foil;
- Re-closable plastic bags;
- Ice;
- Portable field instruments, which may include but not be limited to a pH meter, conductivity meter, turbidity meter, dissolved oxygen (DO) meter or multi-parameter flow through cell, PID, and water level indicator;
- Combustible gas indicator (CGI);
- Poly-sheeting;
- Driller's jars (for archiving samples);
- Polypropylene or stainless steel bailers;
- Poly propylene rope and/or Teflon line; and
- Submersible, peristaltic and/or centrifugal pump and associated tubing.

2.6 Comparability

Comparability is an expression of the confidence with which one data set can be compared with another. Comparability between sets of field data will be dependent upon the similarity of properly designed field sampling programs, and similarity of field sampling techniques. Planned laboratory analytical data will be comparable when similar sampling and analytical methods are used and documented by QAPP. Comparability is also dependent upon similar QA/QC objectives.

Data comparability will be ensured through control of sample collection methodology, analytical protocols, and documentation of results. The selection of United States Environmental Protection Agency (EPA), MADEP, and industry-recognized sampling and analytical methods satisfies technical and regulatory requirements for data comparability.

3. INVESTIGATION AND SAMPLING PROCEDURES

3.1 Introduction

A series of field activities have been designed to gather additional data required to complete a Phase II under the guidelines of the MCP. Activities include: collection of soil gas samples, advancement of sediment cores and collection of sediment samples from the cores, collection of surface water samples, surface soil sampling, excavation of test pits and collection of subsurface soil samples from the test pits, drilling of borings and collection of subsurface soil samples from the borings, and installation of monitoring wells and collection of groundwater samples from the monitoring wells. Field activities will be conducted in accordance with the health and safety plan (HASP) included in Appendix C of the SOW.

All off-site laboratory samples will be analyzed according to the methods provided in the MADEP QA/QC Guidelines for the Acquisition and Reporting of Analytical Data. Regardless of the method used, all analytical and extraction holding times must meet the MADEP requirements for that analytical group. Holding times will be calculated from verified time of sample receipt at the laboratory. The analytical laboratory chosen for the project will be certified by MADEP, and must maintain MADEP certification. The breakdown of investigative samples is detailed in this section of the report. Laboratory analytical methods and quantitation limits are discussed in the MADEP QA/QC Guidelines for the Acquisition and Reporting of Analytical Data and the MADEP Compendium of Analytical Methods (including Combined Target Analyte List for MCP Analytical Methods). The method detection limits (MDLs) for the analytes will be specified by the laboratory selected for the project based on its most recent MDL studies, and subject to approval by the LSP.

3.2 Soil Gas Sampling Program

Three soil gas samples will be collected during this Phase II investigation. The soil gas samples will be collected from probes installed beneath the slab of the building situated on the National Grid property to assess whether soil gas may be a potential pathway for compounds of concern detected in site soil and groundwater to migrate into indoor air. Three semi-permanent soil gas monitoring points will be installed within the National Grid owned building in order to facilitate the collection of the soil gas samples. The monitoring points will be semi-permanent in order to collect additional soil gas samples at a later date if warranted. The soil gas monitoring points will be identified as SG-201, SG-202, and SG-203.

Each soil gas monitoring point will be installed by first coring through the existing concrete slab, which is the building's floor. The coring will be performed using a 4-inch diameter concrete coring bit and a portable concrete corer. Once the concrete slab has been penetrated with the bit, the cored portion of the slab will be removed

from the hole. Then, a soil gas probe will be advanced so that the screened portion of the probe is approximately two inches below the bottom of the concrete slab. The probe will then be removed leaving a dedicated point attached to Teflon tubing in the probe hole. The tubing will be sealed with a Swagelok fitting. The probe hole will then be sealed with activated bentonite. A 4 inch diameter roadbox will be placed over the tubing and into the bentonite effectively sealing the hole. The roadbox will then be cemented into place flush with the concrete slab surface. The three soil gas sampling points will be installed before soil gas samples are obtained from any of the points.

Once the monitoring points are installed, a soil gas sample will be collected from each location. Prior to the samples be obtained, at least two probe volumes will be removed from the probe using a PID while recording volatile organic compound (VOC) measurements. The VOC measurements will be obtained for use as a general check on the laboratory data results. While the probe is being evacuated, the seal around the probe will be assessed with the use of smoke. If smoke is observed entering the probe, the tubing and probe hole will be resealed with bentonite as necessary. The preliminary sampling procedure will then be repeated until no smoke is observed entering the soil gas sampling tubing.

Once the tubing seal has been checked, the samples will be collected using six liter capacity Summa canisters in order to provide enough sample to the laboratory to re-run the requested analysis as necessary. The Summa canisters will be connected to the tubing in the soil gas monitoring points using Teflon tubing and Swagelok fittings. In the sampling train, a flow meter provided by the laboratory will be connected so that the soil gas sample is collected over a two hour period. During the collection period, the pressure gage will be monitored to ensure that the sample is not collected at a faster rate. At the completion of the two hour period, the pressure gage will be observed and the reading recorded. The samples will be analyzed for Air-Phase Petroleum Hydrocarbons (APH) using the draft MADEP Method by a MADEP-certified laboratory.

For QA/QC purposes, the canisters will each be certified clean by the laboratory. Since the number of samples is minimal, no duplicate samples will be collected. In addition, no field blanks will be collected since the sampling equipment (i.e., tubing) will be dedicated to the individual samples.

3.3 Sediment and Surface Water Sampling Program

3.3.1 Positioning Protocol

The field investigations will be performed primarily in the marine environment. Locating and mapping the locations of field investigations in the field is not amenable to standard land-based survey techniques. Procedures for data acquisition,

analysis and quality assurance for survey/positioning for field investigation locations shall include:

- Coordinates for proposed field investigation locations are based on state plane coordinate system in existing AutoCad files and are tabulated in Tables 1 through 3 of the SOW.
- Proposed location coordinates will be verified in the field using Global Positioning System (GPS) equipment accurate to ± 10 feet. GPS equipment accuracy will be checked daily in the field by checking and recording coordinates for a known benchmark. Observations regarding horizontal position will be recorded in the field notebook (e.g., distance from mapped landmark).
- For elevation measurements - each time a measurement of elevation (e.g., water depth at sediment core location) is recorded that is related to water depth, the time of the measurement will be recorded to the nearest minute. The surface water elevation will be approximated in the field, and the actual surface water elevation at the time of measurement shall be retrieved from the time-series of water level data for Gloucester Harbor recorded and maintained by the National Oceanic and Atmospheric Administration (NOAA). The bathymetric elevation shall be cross-checked at each sample location by mapping the horizontal location of the sample location on NOAA Chart 13281, Gloucester Harbor and Annisquam River and estimating the bathymetric elevation based on mapped bathymetry.

3.3.2 Underground Utilities

All underground utilities, including electric, telephone, cable TV, sewers, water, natural gas, etc., will be identified prior to any coring, drilling, and subsurface sampling. DigSafe and the Gloucester Harbormaster will be contacted at least 72 hours prior to field activities to aid in identifying and locating underground utilities. Other potential on-site hazards such as shoreside utility markers, submerged obstacles, known subsurface structures, overhead power lines, and navigation hazards will be identified during a site reconnaissance visit.

3.3.3 Sample Identification

Each sample will be given a unique identification as shown in Tables 1 through 3 of the SOW. With this type of identification, no two samples will have the same label. Labels or tags that include the sample number will be attached to each sample container. Labels or tags will be rendered waterproof by either covering the label with clear plastic wrapping tape or utilizing waterproof material for the tag or label.

Other sampling materials and equipment may be utilized as warranted by field conditions encountered at time of sampling. Appropriate health and safety equipment and personal protective equipment (PPE), per the HASP included in Appendix C of the SOW will be used.

3.3.5 *Field Records*

The project manager will control all field logbooks. Each field logbook will receive a serialized number and be issued to field staff. Field logbooks will be maintained by field staff to provide a daily record of significant events, observations, and measurements during the field investigation. All entries will be signed and dated at the bottom of each page.

Information pertinent to the field investigation and/or sampling activities will be recorded in the logbooks. The logbooks will be bound with consecutively numbered pages. Entries in the logbook will include, at a minimum, the following information:

- Name and title of author, date and time of entry, and physical/environmental/weather conditions during field activity;
- Purpose of sampling activity;
- Location of sampling activity;
- Name and address of field contact;
- Name and title of field crew members;
- Name and title of any site visitors;
- Sample media (sediment, surface water, etc.);
- Sample collection method;
- Number and volume of sample(s) collected;
- Description of sampling point(s);
- Volume of groundwater removed before sampling;
- Preservatives used;
- Date and time of sample collection;
- Sample identification number(s);
- Sample distribution (e.g., laboratory);
- Field observations;
- Any field measurements made, such as pH, temperature, turbidity, salinity, DO, water level elevation, horizontal position, etc.;
- References for all maps and photographs of the sampling site(s); and
- Information pertaining to sample documentation such as: dates and method of sample shipments, CoC Record Numbers, and Overnight Shipping Air Bill Number.

All original data recorded in Field Logbooks, Sample Tags, and CoC records will be written with waterproof ink. None of these accountable, serialized documents will be destroyed.

If an error is made on an accountable document assigned to one individual, that individual will make all corrections simply by crossing a single line through the error, placing the initials of the individual making the correction and date next to the crossed out information and entering the correct information. The erroneous information will not be erased. All field personnel will be instructed as to the proper field logging techniques for maintaining the integrity of the documentation.

3.3.6 Sediment Probing & Coring Procedures

Sediment probes will be conducted using a gravity corer. The gravity corer will be pushed directly into the sediment approximately 24 inches to 36 inches. Sediment cores will be conducted using aluminum or lexan core barrels. The core barrels will be vibrated into the sediment until the depth listed in Table 2 of the SOW for each core location is reached. Record penetration distance and general penetration resistance (very stiff, stiff, loose, very loose) for each probe and core location. Upon retrieving the probe or core barrel, extrude sediment, split core longitudinally (use mechanical shears if necessary to split probe or core barrel) with a wire pulled through the sediment and log probe or core in accordance with ASTM D2487. At a minimum, record the following in the field logbook:

- Site;
- Station ID;
- Date and time;
- Initials of sampling personnel;
- Coring Company's Name;
- Sediment type;
- Color;
- Inches of recovery;
- Estimated moisture content;
- Texture;
- Grain size and shape;
- Relative density;
- Consistency;
- Presence of visible oil/tar (VOT), defined as the presence of oil/tar within the pore space of the sediment (estimate % of pore space occupied by the oil/tar); and
- Miscellaneous observations (including organic vapor readings and presence of sheen on water during probing).

If no recovery, or limited recovery, is observed in the probe or core, then a description regarding the lack of sample recovery should be provided on the log and field book and if evidence of an obstruction or equivalent can be identified.

Each probe and core will be photographed. A white board marked with the station location, date, and time will be included in the photograph. A measuring tape with the inch and feet divisions marked on the tape will be located next to the probe or core in the photograph, with the '0' end of the tape located at the top of the probe or core.

Sediment cores will be sampled at the depth intervals shown in Table 2 of the SOW. Additional samples may be collected from the sediment cores based on field observations (e.g., VOT, organic odors, and discoloration). Sediment samples will be submitted for laboratory chemical analyses as presented in Table 2 of the SOW.

3.3.7 Surface Water Sampling Procedures

Surface water samples will be collected at three stations. At each station two surface water samples will be collected. One sample will be collected near the time of low tide, and the second sample will be collected near the time of high tide. A total of six surface water samples will be collected. Samples will be tested in the field for temperature, salinity, pH, turbidity, and DO. Samples will be submitted for laboratory chemical analyses for polycyclic aromatic hydrocarbons (PAHs) using EPA Method 8270 with selected ion monitoring (SIM) to achieve low detection limits and free cyanide using EPA Method OIA-1677.

A Niskin bottle will be used to collect the surface water for these samples. At no time will a sample jar, which contains preservative, be submerged in the sampling media. The sample should be collected from mid-depth by submersing the Niskin bottle to a mid-depth position and opening the bottle and allowing it to fill. The Niskin will be decontaminated following the procedures outlined below. Surface water samples will be collected prior to collecting sediment samples.

The surface water sampling procedure is summarized as follows:

- Prepare Niskin Bottle, cable and messenger for deployment;
- Prepare and calibrate temperature, salinity, pH, turbidity, and DO sensors for deployment;
- Collect sample and decant immediately into glassware provided by laboratory;
- Lower temperature, salinity, pH, turbidity, and DO sensors to sample depth and record measurements using electronic datalogger function and field book; and
- Decontaminate bottle for next sample location.

All field data will be recorded in the logbook. At a minimum, the following should be recorded in the field book:

- Site;
- Station ID;
- Date and time;
- Initials of sampling personnel;
- Work Boat Company's Name; and
- Miscellaneous observations (including organic vapor readings and presence of sheen on water during probing).

3.3.8 QA/QC Samples

A trip blank will accompany each sample delivery group (SDG) of samples to the laboratory that will be analyzed for VOCs or volatile petroleum hydrocarbons (VPH). Trip blanks are used in conjunction with VPH and VOC analyses to assist in the assessment of field accuracy and representativeness and are a measure of “false positive” contamination during sample acquisition and/or storage. For water samples submitted for VPH and VOC analyses, trip blanks consist of VOC-free water in VOA vials preserved in the same manner as the samples. For solid samples submitted for VPH analysis, trip blanks consist of a vial-containing methanol. For solid samples submitted for VOC analysis, trip blanks may consist of (a) VOC-free water or sodium bisulfate preservative solution for low level analysis, and/or (b) methanol for high-level analysis. Trip blanks accompany the empty sample containers from the laboratory to the field and return with the collected samples from the field to the laboratory. The presence of measurable concentrations of contaminants in a trip blank indicates the potential for cross contamination with a potential for the reported concentrations of VOCs to be higher than the actual concentrations in the samples (false positives). The sources of the cross contamination may be associated with the transportation of containers to and from a site, ambient conditions present at a site, and/or other samples shipped with the trip blank. It should be noted that an assessment of accuracy can not be made by evaluating trip blank data unsupported by other data quality indicators (e.g., matrix spikes, etc.). The trip blanks will be numbered sequentially. Note that for this project no sediment or surface water samples are expected to be analyzed for VOCs or VPH. Therefore, no trip blanks will be submitted with these samples.

Equipment blanks will be taken at a minimum frequency of one per 20 field samples per sample matrix that use non-dedicated sampling equipment. An equipment blank is a way to measure “false positive” contamination during sample acquisition and/or storage. Contaminant-free water is poured over sampling equipment and then collected for analysis. The presence of measurable concentrations of contaminants in an equipment blank indicates the potential for cross-contamination. For this project, two equipment blanks will be taken during the sediment sampling program if non-dedicated equipment is used and one equipment blank will be taken during the

surface water sampling program. The equipment blanks will be numbered sequentially.

To determine the reproducibility and homogeneity of samples, coded field duplicates will be collected. The samples are termed "coded" because they will be labeled in such a manner that the laboratory will not be able to determine that they are a duplicate sample. This will eliminate any possible bias that could arise. The frequency of collection of these samples is one per 20 field samples. Duplicate samples will be assigned a unique sample number that correlates with the source sample number. The duplicate sample number and sample number for the source sample will be recorded in the field book. For this project, two duplicate sediment samples and one duplicate surface water sample will be collected.

Matrix Spike/Matrix Spike Duplicate/Matrix Duplicate (MS/MSD/MD) samples (MSD for organics; MD for inorganics) will be collected at a frequency of one pair per 20 field samples per seven day SDG. The reproducibility and homogeneity of the samples can be assessed by determining the RPD for both spike and non-spike compounds.

3.3.9 Equipment Decontamination

Prior to sampling, all non-dedicated/non-disposable equipment (i.e., bowls, trowels, water samplers, and field measurement equipment that contacts sediment and/or surface water) will be washed with potable water and a laboratory grade detergent (such as Alconox). Decontamination may take place at the sampling location as long as all liquids are contained in pails, buckets, 55-gallon drums, etc. The sampling equipment will then be rinsed with potable water followed by a reagent-grade isopropanol or methanol rinse and finally a de-ionized water rinse. Additionally, all equipment used to collect samples for metals analysis will receive a nitric acid rinse followed by a de-ionized water rinse. Between rinses, equipment will be placed on polyethylene sheeting. At no time will decontaminated equipment be placed directly on the vessel deck or ground. Equipment will be wrapped in polyethylene plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location, where appropriate.

3.4 Surface Soil Sampling Program

Four surface soil samples will be collected during the Phase II CSA. The samples will be analyzed and the analytical results will be used to confirm if compounds detected in site surface soils are indeed at background conditions (SS-201 and SS-202) and to assess the potential risk to USCG workers posed by exposure to compounds potentially present in the surface soil samples (SS-203 and SS-204).

Each surface soil sample will be a composite of soil collected from one location between the ground surface and 0.5 feet below the ground surface. Soil at each location will be obtained using a stainless steel spoon. The soil will then be placed in a stainless steel mixing bowl and composited. The composited soil will then be placed in the appropriately labeled glassware and analyzed for extractable petroleum hydrocarbons (EPH) using the MADEP Method that includes the target PAHs, the 14 listed metals in the MCP (MCP 14 Metals) using various EPA methods, and physiologically available cyanide (PAC) using EPA Method 9014 modified by MADEP protocols.

One field equipment blank and one duplicate soil sample will also be collected and submitted to the laboratory for QA/QC purposes. The field blank will be analyzed for EPH and PAC while the duplicate sample will be analyzed for the same parameters as the surface soil samples. The equipment blank will be obtained by pouring distilled water over the stainless steel spoon into the stainless steel mixing bowl after the sampling equipment has been decontaminated in accordance with the decontamination procedures identified below. A sample will then be obtained from this water and labeled SSFB-1. The duplicate surface soil sample will be identified as SS-205.

The samples will be stored on ice or refrigerated prior to delivery to the selected laboratory. Proper control of the CoC will be maintained for each sample. Samples will be delivered to the laboratory within approximately 48 hours after sample collection.

The stainless steel mixing bowl and stainless steel spoon will be decontaminated with successive rinses of an Alconox solution, dilute methanol, and distilled water between sampling locations.

Upon collection of each soil sample, a wooden stake identifying the sampling location will be driven into the hole created during collection of the sample in order to survey the surface soil sample location. The time of collection and the approximate location of each of the surface soil samples in addition to any other soil characteristics will be recorded in the field logbook. Locations will be surveyed to a vertical accuracy of 0.05 ± 0.05 feet and a horizontal accuracy of 0.25 ± 0.10 feet at the same time the other sampling/explorations locations are surveyed.

3.5 Test Pit Excavation Program

EECS, Inc. will subcontract T. Ford, Inc. of Georgetown, Massachusetts to excavate three test pits on the Americold property. Test pits will be identified as TP-201 through TP-203. Care will be taken during excavation operations to prevent damage to underground utility lines.

Test pits will be excavated using a backhoe with a minimum reach of 14 feet operated by an OSHA-trained operator and supervised by EECS, Inc. personnel. The test pits will be excavated to the maximum depth that can be reached with the backhoe or until groundwater or refusal is encountered. The length of the test pits will be dictated by the field conditions and property boundaries but should not exceed 30 feet. If refusal is encountered and that refusal is the bottom of a foundation or if non-aqueous phase liquid (NAPL) is encountered within a former structure above any refusal or confining layer, the test pitting operation will stop. In the event any test pit excavation is affecting Americold operations, the test pit excavation will be discontinued and backfilled. Borings will then be advanced in locations where test pits could not be excavated.

Test pits located within paved areas will be initiated by first cutting the pavement to the proposed dimensions of the test pit using a pavement cutting saw or a pavement cutting attachment and the backhoe. The cut portion of the pavement will be removed and temporarily stockpiled in an area of the site approved by National Grid and Americold. Upon completion of the test pit program, the stockpiled asphalt will be transported to an asphalt recycling facility or other appropriate disposal facility.

Soils excavated during the test pit operations will be temporarily placed adjacent to the test pit on polyethylene sheeting to minimize potential contamination of pavement surfaces. Each test pit excavation will be logged on a test pit log form and photo-documented. Upon completion of each test pit, excavated soils will be replaced in the excavation and tamped down using the backhoe bucket. The backhoe bucket will then be decontaminated over the test pit location using a high-pressure steam cleaner. The plastic sheeting will be disposed in an appropriate manner. Test pits excavated in unpaved areas of the site will be re-graded to match the existing grade and re-seeded as necessary. Test pits excavated in paved areas of the site will be re-paved. Test pit locations will be surveyed after completion of all other exploration locations. Similar to the surface soil sampling locations, the test pit locations will be surveyed to a vertical accuracy of 0.05 ± 0.05 feet and a horizontal accuracy of 0.25 ± 0.10 feet.

During excavation of the test pits, soil samples will be collected from the excavation walls when the excavation is less than four feet in depth and from the backhoe bucket when the excavation is greater than four feet. The soil samples will be screened for VOCs using a PID and in accordance with the MADEP Jar Headspace Analytical Screening Procedure outlined below:

- Half-fill a clean glass jar with the sample to be analyzed. Quickly cover the open top with one sheet of clean aluminum foil and subsequently apply the screw cap to tightly seal the jar. Sixteen ounce (16 oz.) (approx. 500 ml) soil or “mason” type jars are preferred; jars less than 8 oz. (approx. 250 ml) total capacity may also be used.

- Allow headspace development for at least 10 minutes. Vigorously shake jar for 15 seconds both at the beginning and end of the headspace development period. Where ambient temperatures are below 32° F (0°C), headspace development should be placed within a heated vehicle or building.
- Subsequent to headspace development, remove screw lid/expose foil seal. Quickly puncture foil seal with instrument sampling probe, to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particulates.
- Following probe insertion through foil seal, record highest meter response as the jar headspace concentration. Using foil seal/probe insertion method, maximum response should occur between 2 and 5 seconds. Erratic meter response may occur if there is elevated headspace moisture, in which case headspace data should be discounted.

Soil screening results will be recorded in field books and on the test pit log. Documentation of instrument calibration will also be recorded in the field book.

In addition to the soil screening, a total of up to three soil samples will be collected and submitted to MADEP-certified laboratory for analysis during the test pit program. The soil samples will be analyzed for EPH, VPH, MCP 14 Metals, and PAC. Additional samples may be collected if soil conditions within the test pits are significantly different within the former MGP structure compared to outside the structure. Test pit soil samples will be labeled with the test pit number followed by the soil sample number and the depth at which the sample was obtained (ex. TP-101-S1-D4). Samples that are sent to the laboratory will be stored on ice or refrigerated until delivery to the laboratory. Proper control of the chain-of-custody will be maintained for each sample. Samples will be delivered to the laboratory within 48 hours after sample collection.

QA/QC samples for the test pit program include one trip blank. The trip blank will be numbered sequentially as with the previously mentioned trip blanks. A duplicate sample will not be obtained as the one in 20 frequency for soil samples has not been reached when the test pit samples are included with the surface soil samples for which a duplicate sample will be obtained. In addition, an equipment blank will not be obtained as the samples will be collected using disposable sampling spatulas or spoons and the soil will be placed directly into the appropriate glassware using that disposable equipment.

3.6 Boring/Monitoring Well Program

EECS, Inc. will subcontract a drilling company to advance seven borings during the Phase II CSA. All of the seven borings will be completed as monitoring wells. Five

of the proposed boring/monitoring wells will be identified as MW-201 through MW-205. Since the two wells to be installed next to each other on the United States Coast Guard (USCG) property will be a well couplet (i.e., one installed in overburden and one within bedrock), these two wells will be identified as MW-206A (for the overburden well) and MW-206B (for the bedrock well). In addition, if the well identified as MW-3 that is present on the Americold property is not viable, an additional well (identified as MW-207) will be installed on the Americold property to replace MW-3.

The boring/monitoring well locations were selected to avoid existing and abandoned utility lines, to the extent possible. If utilities are suspected to be present near a boring location, the top 5 feet of soil will be hand-dug or removed with a vacuum truck. If subsurface utilities are encountered at a boring location, the boring will be moved to a new location at least 10 feet from the utility line.

The four shallow soil borings (MW-201, MW-202, MW-205, and MW-206A) will be advanced through the overburden to the top of bedrock, which is anticipated to be between 10 and 20 feet below the ground surface, to evaluate overburden conditions. If bedrock or refusal is not encountered by a depth of 20 feet and the boring has already been advanced 10 feet deeper than the groundwater table, then the boring will be terminated at the 20-foot depth. It is anticipated that borings will be advanced using standard hollow stem auger techniques. The four borings will then be completed as shallow monitoring wells that will be screened across the surface of the groundwater table. The ten-foot well screens will be installed with approximately seven feet of screen below the observed level of the water table and three feet above.

The remaining three borings will be advanced using casing to an approximate National Geodetic Vertical Datum (NGVD) elevation of -47.5, which is the apparent elevation at which “creosote oil” was encountered in the boring performed during some dock work on the USCG property. This NGVD elevation correlates to an approximate depth of 55 to 65 feet below the ground surface depending upon the boring/monitoring well location. If VOT is observed in bedrock before reaching this elevation, then the boring will be terminated at the elevation at which VOT was encountered. These three borings will be completed as bedrock monitoring wells with a screened interval of five feet. The casing for each of the bedrock wells will be advanced to at least one foot into the competent bedrock. The bedrock wells will be sealed during the well construction to prevent the vertical migration of potential overburden contamination. If contamination is encountered during the advancement of these borings, telescoping drilling procedures will be utilized through the zone of contamination to minimize the potential contamination of lower confining layers during drilling activities. Drilling procedures will be conducted in accordance with MADEP Standard References.

The groundwater monitoring wells will be constructed of two-inch diameter, schedule 40 polyvinyl chloride (PVC) pipe, approved for potable water applications by the National Sanitation Foundation (NSF). Well materials will include PVC well screen (machine slotted with 0.010-inch width slots) and flush-threaded well riser.

The borehole annulus around the PVC well materials will be backfilled to approximately one foot above the screen with washed, uniform grade, silica sand. In the shallow wells, a two foot thick bentonite seal will be placed around the well riser above the silica sand to prevent local surface water run-off and infiltration from entering directly into the well. In the deep wells, the annulus above the silica sand will be grouted to within five feet of the ground surface with a thick bentonite slurry using a tremie pipe. Remaining annular space in each of the wells will be backfilled to the ground surface with native soils. A locking iron or steel guard pipe or protective well riser pipe will be installed at the ground surface and surrounded by a concrete surface seal to provide additional protection to the well head.

Decontamination of down-hole equipment (e.g., split spoon sampler) will be performed throughout the drilling program. A portable, high pressure steam cleaner will be used to clean down-hole drilling equipment both at the start and at the completion of the drilling program, as well as between borings.

Any borings not completed as monitoring wells will be abandoned using a bentonite-cement grout. The grout will be installed from the bottom of the boring up to within one foot of ground surface. The borehole will then be capped with native soils. Borings over-drilled for exploratory purposes will be backfilled with bentonite pellets to within three feet of the bottom of the screened interval. A silica sand pack will then be placed between the bentonite seal and the screened interval.

Geological information for each boring/monitoring well and construction specifications for each monitoring well will be recorded on boring logs and on groundwater monitoring well reports.

During the advancement of the shallow borings, soil samples will be collected continuously (every two feet) through the overburden material in accordance with ASTM procedures of the Standard Penetration Test (ASTM D1586-67). No soil samples will be obtained during the advancement of the deep borings since they will be advanced adjacent to new or old shallow borings and the soil would already have been characterized in the vicinity of these explorations with the exception of MW-204. One split-spoon sample will be collected in MW-204 at the depth indicated in Table 4 of the SOW in order to confirm previous sampling data. Soil samples will be field screened for VOCs using a PID following the jar headspace analysis procedure outlined in Section 3.5 of this QAPP.

Up to five soil samples will be collected and submitted to MADEP-certified laboratory for analysis. See Table 4 of the SOW for sampling depths. The soil samples will be analyzed for EPH, VPH, MCP 14 Metals, and PAC. Additional samples may be collected if visual observations indicate the presence of MGP-impacted soils within the borings.

One equipment blank will be obtained during the drilling program between sampling locations after the sampling equipment has been decontaminated. The equipment blank will be obtained by pouring distilled water through the split-spoon sampler and over any spatula used. A sample will then be obtained from this water and labeled DPFB-1. A duplicate sample will not be obtained as the one in 20 frequency for soil samples has not been reached when the boring samples are included with the surface soil samples for which a duplicate sample will be obtained. A trip blank will accompany each day's shipment of samples to the laboratory. The trip blank will be numbered sequentially as with the previously mentioned trip blanks.

Samples will be placed in the appropriate glassware and stored on ice. Proper control of the CoC will be maintained for each sample. Samples will be delivered to the laboratory within approximately 48 hours after sample collection.

Subsequent to well installation, each newly installed monitoring well will be developed by bailing or pumping methods to adequately develop the annular sand pack around the well screen and to remove fine-grained material (i.e., silt). During the drilling program all soil cuttings and well development water will be placed in drums for future characterization and disposal.

At the completion of the drilling program, we will survey in the newly installed monitoring wells for incorporation into the existing site base plan. Locations will be surveyed to a vertical accuracy of 0.05 ± 0.05 feet, and a horizontal accuracy of 0.25 ± 0.10 feet. Elevations of the ground surface, top of inner casing, and a clearly-marked permanent reference point on the outer protective casing/road box will be surveyed for each well.

3.7 Groundwater Sampling Program

Groundwater samples will be collected from the three wells installed during the Phase I Initial Site Investigation (ISI) (MW-101, MW-102, and MW-103), the previously mentioned MW-3 located on the Americold property, and the seven wells to be installed during this Phase II CSA. Sampling will be conducted during four sampling rounds that will be performed in summer, fall, and winter of 2007 and spring of 2008.

Prior to any groundwater sampling, a complete set of groundwater elevation measurements will be collected. Sampling personnel will measure water levels in the

monitoring wells using an electronic water level indicator or oil/water interface probe. Groundwater elevations will be measured relative to the highest point on the PVC well pipe. Measurements will be repeated within each monitoring well until agreement between two consecutive measurements is within 0.02 feet. The measuring device will be decontaminated before use and between well measurements to minimize the potential for cross-contamination.

During the monitoring well gauging, each monitoring well will also be checked for the presence of NAPL. If light non-aqueous phase liquid (LNAPL) is detected in any of the wells during gauging, groundwater elevation measurements will be corrected for the presence of LNAPL in those monitoring wells. The groundwater elevation measurements will be used to construct groundwater elevation contour maps that will be included in the Phase II report.

Monitoring wells where NAPL is detected during gauging will not be sampled. If NAPL is detected in the monitoring wells and verified with clear bailers, the wells will be purged using dedicated PVC bailers or a peristaltic pump with dedicated tubing and the bailed contents of the wells drummed for future characterization and disposal.

The groundwater samples will be collected using the low flow sampling procedure approved by the EPA. The following procedure will be used for sampling groundwater monitoring wells with a positive displacement pump. First, the depth to groundwater will be measured using an electronic water level indicator and recorded on a groundwater sampling log form. The pump, safety cable, tubing, and electrical lines will then be lowered slowly into the well to a depth corresponding to the center of the saturated screen section of the well but at least two feet above the bottom of the well, to prevent mobilization of sediment that may be present in the bottom of the well.

The water level will be measured again with the pump in the well before starting the pump. The initial pumping rate will be 0.2 to 0.5 liters per minute. Ideally, the pump rate should cause little or no water level drawdown in the well (less than 0.3 feet and the water level should stabilize). The water level will be monitored every three to five minutes during pumping. Care should be taken not to cause pump suction to be broken, or air to be entrained in the sample. Pumping rate adjustments and depths to water will be recorded in the field log book. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If the recharge rate of the well is very low and the well is purged dry, then sampling shall commence as soon as the well has recharged to a sufficient level to collect the appropriate volume of samples with the pump. For those wells that are purged dry, the wells will be purged dry only once before sampling.

During purging of the well, pH, conductivity, and temperature will be measured in the purged water every three to five minutes. Stabilization is considered as the condition when the pH, conductivity, and temperature are within ten percent for three consecutive readings. If the parameters have stabilized, but the turbidity is not in the range of the 5 NTU goal, the pump flow rate will be decreased, and measurement of the parameters will continue every three to five minutes. Measurements will be obtained in a clean glass beaker or sample jar or continuously in a flow cell.

If a peristaltic pump can be use, then the only change in the procedure will be that a pump will not be inserted down the well. Instead, a Teflon-lined tubing will be placed into the well and dedicated for future sampling rounds. The same procedure described above will be followed.

The groundwater samples will be submitted to a MADEP-certified laboratory and analyzed for EPH/VPH, MCP 14 Metals, and PAC. The VPH sample will be collected first followed by the remaining sample parameters. The samples will be collected directly into the preserved sample containers using the low flow pump. The sample containers will be filled by allowing the pump discharge to flow gently down the inside of the container with minimal disturbance.

For QA/QC purposes, one duplicate groundwater sample will be submitted to the laboratory for analysis during each sampling round. The duplicate sample will be analyzed for the same parameters as the other groundwater samples and identified as the highest well identification plus one (i.e., if MW-207 is the last well installed, then the duplicate sample shall be labeled as MW-208). One equipment blank will also be obtained during each groundwater sampling round between sampling locations after the sampling equipment is decontaminated. The equipment blanks will be obtained by pouring distilled water through the pump and any non-dedicated tubing. Samples will then be obtained from this water and labeled GWFB-1 and sequentially thereafter.

Samples will be stored on ice or refrigerated for delivery to the laboratory. Proper control of the CoC will be maintained for each sample. Samples will be delivered to the laboratory within approximately 48 hours after sample collection.

Sampling equipment will be decontaminated prior to use and following sampling of each well. Pumps will not be removed between purging and sampling operations. The pump and tubing including the support cable and electrical wires that are in contact with the sample will be decontaminated by the following procedure.

The equipment, including the pump, will be flushed with potable water either by pumping the water from buckets through the pump or by disassembling the pump and flushing the parts directly. Then, the equipment will be flushed with at least five gallons of Alconox solution. The detergent solution will be removed by flushing the

equipment with tap water and then with a diluted methanol solution to drive off remaining volatiles. Finally, the equipment will be flushed one last time with distilled or potable water. Decontamination fluids will be drummed for future characterization and disposal, if necessary.

4. SAMPLE HANDLING PROCEDURES/SAMPLE CUSTODY

4.1 Sample Handling

Sample custody procedures will be followed to ensure that samples are always in the custody of a responsible person, and to provide a record of those responsible for the samples. CoC begins at the time of preparation for the field activity and the procedures apply to field sampling activities, sample shipping, laboratory analysis activities, and data reporting.

Sample custody means that a person has physical possession of and responsibility for a given set of samples. This will be accomplished by maintaining a CoC form for each sample and providing training for sampling personnel in custody procedures prior to beginning sampling.

4.2 Field Activity Chain-of-Custody Procedures

Field activities, observations, and data will be recorded in a bound log book. Log book entries will contain sufficient details so that the activities recorded can be reconstructed at a later date without reliance on memory.

Bound log books will be assigned to individual field personnel for use, and stored with the project files when not in use. Each log book will be identified by project name and number, log book number and dates of use.

Information recorded in the field log book may include:

- The date and time of the activity recorded;
- Weather conditions;
- Names of individuals present;
- Level of personal protection used; and
- Identification of visitors (and the purpose of the visit) to the work area.

A record of sampling and/or data collection activities will include:

- The location of the sampling/measurement station;
- A record of photographs taken;
- A listing of equipment used in the collection activity, including pertinent calibration and decontamination details; and,
- A brief description of the sample.

A sample is physical evidence collected from the environment. Because of the potential evidentiary nature of sample-collecting investigations, the possession of samples must be traceable from the time the samples are collected until they are received and analyzed by the laboratory. CoC procedures are used to maintain and

document sample possession. The principal forms used to identify samples and to document possession are sample labels and Chain-of-Custody Records.

Sample labels will include the following information:

- Site name;
- Sample number;
- Date;
- Time - indicating the time of sample collection;
- Samplers - sampler's name or initials; and,
- Remarks - indicating the type(s) of analysis to be performed and the preservative used.

The following chain-of-custody procedures will be followed:

- To the extent possible, the quantity and types of samples and sample locations are determined prior to actual field work. As few people as possible should handle samples.
- The team member performing the sampling is responsible for the care and custody of the collected samples until they are transferred or dispatched properly.
- The project manager or his designated assistant must review field activities to determine whether proper custody procedures were followed during the field work and decide if additional samples are required.

The following procedures will be followed for transfer of sample custody and sample shipment.

- Samples are accompanied by a Chain-of-Custody Record. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date and note the time of the record. This record documents sample custody transfer from the sampler, often through another person, to the analyst.
- Samples will be packaged in coolers with sufficient packing material to ensure safe shipment of glass containers. Ice (or "blue ice") will be included to keep the samples cool (target sample temperature is approximately 4 °C).
- Properly packaged samples are shipped to the laboratory for analysis, with custody records accompanying each shipment. Shipping containers will be locked or secured with a custody seal for shipment to the laboratory. Custody seals will be covered with clear tape. The method of shipment, courier name(s) and other pertinent information is entered in the "Remarks" section.

- The original Chain-of-Custody Records accompany the samples in shipment. The Project Manager retains copies of each Chain-of-Custody record and each shipping receipt.

Unless prohibited by weather conditions, original data are recorded in log books, field data sheets, sample tags, and chain-of-custody records. None of the accountable documents listed above are to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

Internal laboratory chain-of-custody will be maintained during sample handling and analysis.

5. CALIBRATION PROCEDURES AND FREQUENCY

5.1 Field Instrumentation Calibration

The field personnel will be responsible for ensuring that instrumentation are of the proper range, type and accuracy for the test being performed, and that all of the equipment are calibrated at their required frequencies, according to their specific calibration protocols/procedures.

All field measurement instruments must be calibrated according to the manufacturer's instructions prior to the commencement of the day's activities. Exceptions to this requirement shall be permitted only for instruments that have fixed calibrations pre-set by the equipment manufacturer. Calibration information shall be documented on instrument calibration and maintenance log sheets or in a designated field logbook. The calibration information (log sheet or logbook) shall be maintained at the site during the on-site investigation and, once the field work is completed, shall be placed in the project files. Information to be recorded includes the date, the operator, and the calibration standards (concentration, manufacturer, lot number, expiration date, etc.). All project personnel using measuring equipment or instruments in the field shall be trained in the calibration and usage of the equipment, and are personally responsible for ensuring that the equipment has been properly calibrated prior to its use.

In addition, all field instruments must undergo response verification checks at the end of the day's activities and at any other time that the user suspects or detects anomalies in the data being generated. Verification checks may also be performed at the request of National Grid or the LSP. The checks consist of exposing the instrument to a known source of analyte (e.g., the calibration solution), and verifying a response. If an unacceptable instrument response is obtained during the check (i.e., not within specifications), the data shall be labeled suspect, the problem documented in the site logbook, and appropriate corrective action taken.

Any equipment found to be out of calibration shall be re-calibrated. When instrumentation is found to be out of calibration or damaged, an evaluation shall be made to ascertain the validity of previous test results since the last calibration check. If it is necessary to ensure the acceptability of suspect items, the originally required tests shall be repeated (if possible), using properly calibrated equipment, to acquire replacement data for the measurement in question.

Any instrument consistently found to be out of calibration shall be repaired or replaced within 24 hours or field work will be terminated until the malfunctioning equipment is repaired/replaced.

5.2 Laboratory Instrumentation Calibration

Personnel at the laboratory will be responsible for ensuring that analytical instrumentation are of the proper range, type and accuracy for the test being performed, and that all of the equipment are calibrated at their required frequencies, according to specific protocols/procedures. Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory analyst. These records will be filed at the location where the work is performed and will be subject to QA audit. For laboratory instruments, the laboratory will maintain in-house spare parts and/or service contracts with vendors.

Off-site laboratory equipment shall be calibrated using certified/nationally recognized standards and according to the applicable methodologies and the laboratory Standard Operating Procedures (SOPs). In addition, these methods/procedures specify the appropriate operations to follow during calibration or when any instrument is found to be out of calibration.

6. DATA REDUCTION, VALIDATION, AND REPORTING

The criteria used to identify and quantify the analytes will be those specified for the applicable methods by MADEP. The data package provided by the laboratory will contain all items required by MADEP, as appropriate to the analyses performed.

6.1 Chain-of-Custody Records

Completed copies of the CoC records accompanying each sample from time of initial bottle preparation to completion of analysis shall be attached to the report of analytical testing.

6.2 Data Handling

One complete copy and one additional copy of the analytical data summary report will be provided by the laboratory. One set of the analytical data will be forwarded directly to the data validator by the laboratory. The project manager will immediately arrange for filing of the complete package, after the QA/QC reviewer checks the package to ensure all deliverables have been provided. The second data summary report will be used to generate summary tables. These tables will form the foundation of a working database for assessment of the site contamination condition.

The project manager will maintain close contact with the QA/QC reviewer to ensure all non-conformance issues are acted upon prior to data manipulation and assessment routines. Once the QA/QC review has been completed, the project manager may direct the team leaders or others to initiate and finalize the analytical data assessment.

6.3 Data Validation Process

6.3.1 Data Validation

Data validation is a basic step in the control and processing of the project data generated by the laboratory. The data validation process will consist of a systematic review of the analytical results and QC documentation, and will be performed in accordance with the guidelines identified in this section of the QAPP. All off-site laboratory data will undergo validation unless otherwise authorized by the LSP. On the basis of this review, the data validator will make judgments and express concerns and comments on the quality and limitations of specific data, as well as on the validity of the overall data package. The data validator will prepare documentation of his or her review and conclusions in a Data Usability Assessment (DUA; see Section 6.3.2).

The data validator will inform the LSP and project manager of data quality and limitations, and assist the LSP and project manager in interacting with the laboratory to correct data omissions and deficiencies. The laboratory may be required to rerun

or resubmit data depending on the extent of the deficiencies, and their importance in meeting the data quality objectives within the overall context of the project. The validated laboratory data will be reduced into a computerized tabulation which will be suitable for inclusion in the Phase II - CSA Report and will be designed to facilitate comparison and evaluation of the data. The data tabulations will be sorted by classes of constituents and by sample matrix. Each individual table will present the following information:

- Sample matrix, designations, and locations;
- Sample dates;
- Constituents for which positive results were obtained;
- Reported constituent concentrations in the field and/or trip blanks associated with the samples;
- Constituent concentration units;
- Name and location of laboratory which performed the analyses;
- Data qualifiers provided by the laboratory; and
- Data qualifiers and comments provided by the data validator, if any.

6.3.2 Data Usability Assessment

A DUA will be prepared after reviewing and evaluating the analytical data. The parameters to be evaluated in reference to compliance with the analytical method protocols includes all sample CoC forms, holding times, raw data (instrument print out data and chromatograms), calibrations, blanks, spikes, controls, surrogate recoveries, duplicates and sample data. If available, the field sampling notes should also be reviewed and any quality control problems should be evaluated as to their effect on the usability of the sample data.

The DUA will describe the samples and analysis parameters reviewed. Data deficiencies, analytical method protocol deviations and quality control problems will be described and their effect on the data will be discussed in the DUA.

Re-sampling/re-analysis recommendations, if applicable, will be made. Data qualifications are documented for each sample analyte following the MADEP guidelines.

This work will be performed by trained and experienced data validators. The results of the data validation screening (i.e., missed holding times or data rejected due to blank contamination) will be incorporated into the data summary tables used in the final investigative report. The DUA identifies data gaps caused by non-compliant or rejected data, and will indicate what steps have been or will be taken to fill these gaps.

7. INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

7.1 Quality Assurance Batching

Each set of samples will be analyzed concurrently with calibration standards, method blanks, MS, MSD or MD, and QC check samples (if required by the protocol). The MS/MSD/MD samples will be designated by the field personnel. If no MS/MSD/MD samples have been designated, then the laboratory must contact the PQAM or project manager for corrective action.

7.2 Organic Standards and Surrogates

All standard and surrogate compounds are checked by the method of mass spectrometry for correct identification and gas chromatography for degree of purity and concentration. When the compounds pass the identity and purity tests, they are certified for use in standard and surrogate solutions. Concentrations of the solutions are checked for accuracy before release for laboratory use. Standard solutions are replaced monthly or earlier based upon data indicating deterioration.

7.3 Laboratory Quality Control Samples

The quality control samples included are detailed below:

- **Method Blanks/Preparation Blanks:** Analyses for organic compounds (method blank) and inorganics (preparation blank) include a blank analysis of the laboratory reagent water. The blank is analyzed with each set of samples or more often as required to verify that contamination has not occurred during the analytical process. The concentration of target compounds in the blanks must be less than or equal to the method detection limits specified by MADEP for the selected method of analysis.
- **Matrix Spike/Matrix Spike Duplicate Analysis:** This analysis is used to determine the effects of matrix interference on analytical results. Spikes of analytes are added to aliquots of sample matrix in the manner specified by MADEP. Selected samples are spiked to determine accuracy as a percentage recovery of the analyte from the sample matrix and precision as RPD between the MS and MSD samples. A matrix duplicate is prepared in the same manner as the matrix spike sample.
- **Analytical Duplicate Samples:** Replicate samples are aliquots of a single sample that are split on arrival at the laboratory, or upon analysis. Significant differences between two replicates, split in a controlled laboratory environment, will result in flagging the affected analytical results.
- **Surrogate Spike Analyses:** Surrogate spike analyses are used to determine the efficiency of recovery of organic analytes in the sample preparations and analyses. Calculated percentage recovery of the spike is used as a measure of the accuracy of the total analytical method.

- **Laboratory Control Sample/ (Spike Blank):** For each method which requires a laboratory control sample (LCS) or spike blank, a LCS spike blank will be prepared with each quality control batch and analyzed according to criteria specified by MADEP. These samples support an assessment of the ability of the analytical procedure to generate a correct result without matrix effects or interference affecting the analysis.

8.0 QA PERFORMANCE AND SYSTEM AUDITS

Quality assurance audits may be performed by the PQAM or personnel designated by the PQAM. The PQAM and his or her designees function as an independent body and report directly to quality assurance management. The PQAM may plan, schedule, and approve system and performance audits based upon the procedure customized to the project requirements. These audits may be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). At times, the PQAM may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits.

Formal audits encompass documented activities performed by qualified lead auditors to a written procedure or checklists to objectively verify that quality assurance requirements have been developed, documented, and instituted in accordance with contractual and project criteria. Formal audits may be performed on project and subcontractor work at various locations.

Audit reports will be written by lead auditors after gathering and evaluating all resultant data. Items, activities, and documents determined by lead auditors to be in noncompliance will be identified at exit interviews conducted with the involved management. Noncompliances will be logged, documented, and controlled through audit findings which are attached to and are a part of the integral audit report. These audit finding forms will then be directed to management to satisfactorily resolve the noncompliance in a specified and timely manner. All audit checklists, audit reports, audit findings, and acceptable resolutions must be approved by the PQAM prior to issue. QA verification of acceptable resolutions will be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the PQAM will close out the audit report and findings.

It is the project manager's overall responsibility to verify that all corrective actions necessary to resolve audit findings are acted upon promptly and satisfactorily. Audit reports must be submitted to the project manager within 15 days of completion of the audit. Serious deficiencies must be reported to the project manager within 24 hours.

Serious deficiencies identified during an audit will be reported to the LSP and National Grid as part of the DUA.

8.1 System Audits

System audits, performed by the PQAM or designated auditors, may encompass evaluation of measurement system components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation may be audited. These audits may be performed once

during the performance of the project. However, if conditions adverse to quality are detected or if the project manager requests the PQAM to perform unscheduled audits, these activities will be instituted.

8.2 Performance Audits

In accordance with the requirements for MADEP certification, the laboratory will participate in all performance evaluation testing.

Also, one field audit may be performed by the PQAM or designated auditor during collection of the field samples to verify that field samplers are following established sampling procedures. Performance of a field audit will be based on the type of investigation activities being performed, the length of the field project, and any available information concerning prior inspections of the project or sampling team.

9.0 PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES

9.1 Preventive Maintenance Procedures

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedure developed by the operators. Analytical instruments will be serviced at intervals recommended by the manufacturer. An instrument repair/maintenance log book will be kept for each instrument, and this log will be available on-site during field activities and, at the completion of the investigation, be placed in the project files. Entries include the date of service, type of problem encountered, corrective action taken, and initials and affiliation of the person providing the service.

The instrument use log book will be monitored by the analysts to detect any degradation of instrument performance. Changes in response factors or sensitivity are used as indications of potential problems. These are brought to the attention of the laboratory supervisor and preventive maintenance or service is scheduled to minimize down time. Back-up instrumentation and an inventory of critical spare parts are maintained to minimize delays in completion of analyses.

Use of equipment in need of repair will not be allowed, and field work will be terminated until the malfunction is repaired or the instrument replaced.

9.2 Schedules

Written procedures, where applicable, will identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the operator to adhere to this maintenance schedule and to arrange any necessary and prompt service as required. Service to the equipment, instruments, tools, gauges, etc. shall be performed by qualified personnel.

9.3 Records

Logs shall be established to record and control maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges. Records produced shall be reviewed, maintained, and filed by the operators at the laboratories and by the data and sample control personnel when and if equipment, instruments, tools, and gauges are used at the sites. The project manager or the PQAM may audit these records to verify complete adherence to these procedures.

9.4 Spare Parts

Where appropriate, a list of critical spare parts will be identified by the operator in consultation with the equipment manufacturer. These spare parts will be stored for availability and use in order to reduce the downtime. In lieu of maintaining an inventory of spare parts, a service contract for rapid instrument repair or backup instruments will be available.

10.0 PROCEDURES TO ASSESS DATA QUALITY

This section discusses the equations and calculations used to calculate data quality parameters. Data quality goals and objectives are discussed in Section 2 of this QAPP.

10.1 Accuracy

Accuracy is a determination of how close a measurement is to the true value. Accuracy can be assessed by using environmental samples spiked with reference analytes of known or established concentration. Analytical accuracy is expressed as the percent recovery of an analyte/parameter that has been added to an environmental sample at a known concentration before preparation and analysis. Percent recovery is calculated as follows:

$$\text{Percent Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Amount of Spike Added}} \times 100$$

10.2 Precision

Matrix spike duplicates and duplicates are used to assess precision. Analytical precision is expressed as a percentage (Relative Percent Difference) of the difference between the results of two samples for a given analyte divided by the mean of the results as follows:

$$\text{RPD} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Mean of the Two Results}} \times 100$$

10.3 Completeness

Data completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount expected under normal conditions. For completeness, the data set must contain all analyses verifying precision and accuracy. Completeness is calculated as:

$$\text{Completeness} = \frac{\text{valid data obtained}}{\text{total data obtained}} \times 100$$

11.0 CORRECTIVE ACTION

11.1 Corrective Action

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or out-of-quality-control performance which can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation and data assessment. Corrective action proposed and implemented should be documented in QA reports to management. Corrective action should be implemented only after the approval of the LSP or his designee. If immediate corrective action is required, approvals secured by telephone from the LSP should be documented.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the LSP. Implementation of corrective action will be confirmed in writing through the same channels.

Non-conformance with the established QC procedures in the QAPP will be identified and corrected in accordance with the QAPP. The LSP, or his designee, will issue a non-conformance report describing non-conformance action.

11.2 Field Corrective Action

Corrective action in the field may be required when the sample network is changed (e.g., more or fewer samples, or sampling locations other than those identified in the QAPP), or when sampling procedures and/or field analytical procedures require modification due to unexpected conditions. The need for corrective action and recommendations will be communicated to the LSP, who will approve the corrective action and insure that the corrective action has been implemented. Corrective actions will be implemented and documented in a bound field logbook. No EECS or Arcadis personnel will initiate corrective action without prior communication of findings through proper channels.

If corrective action taken will result in fewer samples collected, fewer parameters analyzed for, alternate sampling locations, or other changes which might result in non-attainment of QA objectives, then the project manager must be advised of the proposed corrective action and must concur with its implementation.

11.3 Corrective Action During Data Quality Review and Data Assessment

The need for corrective action may be identified during data quality review or data assessment. Potential types of corrective action may include re-sampling by the field team, or re-injection and reanalysis of samples by the laboratory. These actions are

dependent upon the ability to mobilize the field team, and whether the data to be collected are necessary to meet the required data quality objectives. If a corrective action situation is identified, the project manager will recommend the implementation of corrective action. The project manager will implement and document the approved corrective action.

12.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

QA reports to management will be required only if corrective action has been initiated during any phase of this project. The content of the QA report will include a summary of the issue requiring corrective action, the action performed, and the results of the follow-up inspection. The impact on any data will also be summarized. QA results will be reported in the Phase II report.